IJPH

International Journal of Public Health

An independent society journal of the non-profit Swiss School of Public Health (SSPH+)

February 2025

Ageing and Health in Sub-Sahara Africa

Issue Editors

Stephen Ojiambo Wandera
Makerere University, Uganda

Elke Loichinger
Federal Institute for Population Research, Germany

Alyson Van Raalte
Max Planck Institute for Demographic Research, Germany

Tobias Vogt
University of Groningen, Netherlands

SSPH+ SWISS SCHOOL OF PUBLIC HEALTH

frontiers | Publishing Partnerships

IJPH

Ageing and Health in Sub-Sahara Africa

ISSN 1661-8564
ISBN 978-2-8325-5974-1
DOI 10.3389/978-2-8325-5974-1

IJPH

Table of contents

International Journal of Public Health
SPECIAL ISSUE EDITORIAL
published: 03 January 2025
doi: 10.3389/ijph.2024.1608177

Ageing and Health in Sub-Sahara Africa

Tobias Vogt[1,2]*, *Elke Loichinger*[3], *Alyson van Raalte*[4,5,6] and *Stephen Ojiambo Wandera*[7]

[1]Population Research Centre, Faculty of Spatial Sciences, University of Groningen, Groningen, Netherlands, [2]Prasanna School of Public Health, Manipal Academy for Higher Education, Manipal, India, [3]Global and Regional Population Dynamics Research Group, Federal Institute for Population Research (BIB), Wiesbaden, Germany, [4]Lifespan Inequalities Independent Research Group, Max Planck Institute for Demographic Research, Rostock, Germany, [5]Max Planck – University of Helsinki Center for Social Inequalities in Population Health (MaxHel Center), Rostock, Germany, [6]Max Planck – University of Helsinki Center for Social Inequalities in Population Health (MaxHel Center), Helsinki, Finland, [7]Department of Population Studies, Makerere University, Kampala, Uganda

Keywords: ageing, Africa, sub-Saharan Africa, multimorbidity, health

Editorial on the Special Issue

Ageing and Health in Sub-Sahara Africa

Sub-Saharan African societies have experienced substantial gains in life expectancy at birth in recent decades, with mortality reductions at all ages. These added years of life have led to an increasing number of older persons. Today, 4.8% percent of the population is older than 60 years and this share is expected to rise to 7.4% by 2050. This seemingly low share masks large absolute numbers. By 2050 158 million persons aged 60 years and older are projected to live in the region.

Despite past mortality improvements, the chances of surviving from infancy to older ages are very unevenly distributed and depend on a range of contextual factors. Girls in Botswana live 71.9 years on average, under the conditions of the 2024 life table death rates. This is a full 17 years longer than girls in Nigeria, and 5 years longer than Botswanan boys. In countries with comparatively high and increasing life expectancy such as Botswana, Rwanda, Kenya or South Africa, the number of older adults will increase steeply during the next years. These countries are also those experiencing among the lowest fertility rates in the region, a combination that makes them the forerunners of population ageing in Sub-Saharan Africa. Already today, around 5%–8% of the population in these countries is older than 60 years and this share is expected to double to 10%–16% within the next 3 decades [1].

The twelve articles in the Special Issue "*Ageing and health in Sub-Sahara Africa*" cover a wide range of topics in Cameroon, Ghana, Kenya, Nigeria, South Africa, Tanzania, Zambia, and sub-Saharan African countries overall. The described increase in the number of older adults creates challenges for policymakers and societies. Of particular concern is the vulnerability of older persons with regard to ill-health and access to health services [2]. With increasing life expectancies, older Africans are experiencing longer phases of dependency on public or private support, in combination with a rise of non-communicable diseases and disabilities [3]. Chronic conditions like obesity, diabetes or depressive symptoms are widespread. Multimorbidity is common already from middle adult ages. For example, in their study from Tanzania, Kohler et al. report that 73% of peri-urban dwellers above age 40 suffer from more than one chronic condition with women being more likely to suffer from multimorbidity than men. Mwangala et al. report that the share of frail older adults was around 13% in a Kenyan costal population and is especially high among older adults with HIV. The

OPEN ACCESS

Edited by:
Nino Kuenzli,
Swiss Tropical and Public Health Institute (Swiss TPH), Switzerland

***Correspondence**
Tobias Vogt,
t.c.vogt@rug.nl

This Special Issue Editorial is part of the IJPH Special Issue "Ageing and Health in Sub-Sahara Africa"

Received: *19 November 2024*
Accepted: *03 December 2024*
Published: *03 January 2025*

Citation:
Vogt T, Loichinger E, van Raalte A and Wandera SO (2025) Ageing and Health in Sub-Sahara Africa. Int J Public Health 69:1608177. doi: 10.3389/ijph.2024.1608177

ageing of HIV prevalence into older age groups in combination with increasing other chronic health conditions confronts policymakers, individuals, and their families with the challenges of managing a double disease burden [3].

Increasing disease burdens and disabilities are only one dimension of older adults' vulnerability. They are also exposed to various forms of deprivation which increases their dependency in times of need. Mobolaji shows that 75% of older Nigerians, especially older women, are multidimensionally deprived which includes lack of assets, low education and poor living standards. The importance of these individual dimensions is confirmed by a study from Zambia that emphasizes the high relevance of housing conditions and additional community level factors such as access to tap water and availability of cooking or heating fuel Banda et al.

In the absence of larger public support programs, major shares of the older Sub-Saharan African population are relying exclusively on their families to support them in times of need. This seems especially true once older adults suffer from chronic conditions and disability. However, a study from Ghana suggests that the receipt of family support is more impacted by an older adult's ability to work rather than the prevalence of a chronic condition Hooley et al. Also family wealth as such seems to be less relevant for the risk of suffering from disability Makofane et al.

Overall, the articles in this Special Issue highlight a region coming to grips with larger populations in need of care. The articles are also informative by what they do not contain, and that is rich cross-country comparative perspectives supported by quality data. Datasets from the region remain questionably representative, and longitudinal data is scarce. Not only is this a problem for studying the determinants of healthy ageing, but it creates major limitations for monitoring the progress of Sub-Saharan countries in providing supportive environments for older populations. The challenges of individual and population ageing have been addressed in the Madrid International Plan of Action on Ageing (MIPAA). It represents a policy resource to help governments and societal stakeholder to meet these challenges. In her commentary, Schmidt discusses the emergence of MIPAA and the urgency of Sub-Saharan African countries to focus on different priority areas to prepare for population ageing which is already a reality in many of them.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

CONFLICT OF INTEREST

The authors declare that they do not have any conflicts of interest.

GENERATIVE AI STATEMENT

The author(s) declare that no Generative AI was used in the creation of this manuscript.

REFERENCES

1. United Nations. *World Population Prospects 2024 - Population Division*. (Accessed November 5, 2024). Available from: https://population.un.org/wpp/
2. Aboderin I. Understanding and Advancing the Health of Older Populations in Sub-saharan Africa: Policy Perspectives and Evidence Needs. *Public Health Rev* (2010) 32(2):357–76. doi:10.1007/BF03391607
3. Gouda HN, Charlson F, Sorsdahl K, Ahmadzada S, Ferrari AJ, Erskine H, et al. Burden of Non-communicable Diseases in Sub-saharan Africa, 1990–2017: Results From the Global Burden of Disease Study 2017. *Lancet Glob Health* (2019) 7(10):e1375–87. doi:10.1016/S2214-109X(19)30374-2

International Journal of Public Health
ORIGINAL ARTICLE
published: 15 June 2023
doi: 10.3389/ijph.2023.1605916

Navigating Life With HIV as an Older Adult on the Kenyan Coast: Perceived Health Challenges Seen Through the Biopsychosocial Model

Patrick N. Mwangala[1,2,3]*, *Ryan G. Wagner*[4], *Charles R. Newton*[1,3,5,6] and *Amina Abubakar*[1,3,5,6]

[1]Centre for Geographic Medicine Research Coast, Kenya Medical Research Institute (KEMRI), Kilifi, Kenya, [2]School of Public Health, University of the Witwatersrand, Johannesburg, South Africa, [3]Institute for Human Development, Aga Khan University, Nairobi, Kenya, [4]MRC/Wits Rural Public Health and Health Transitions Research Unit (Agincourt), Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa, [5]Department of Psychiatry, Warneford Hospital, University of Oxford, Oxford, United Kingdom, [6]Department of Public Health, Pwani University, Kilifi, Kenya

Objectives: This study explores the perceptions of adults living with HIV aged ≥50 years (recognized as older adults living with HIV—OALWH), primary caregivers and healthcare providers on the health challenges of ageing with HIV at Kilifi, a low literacy setting on the coast of Kenya.

Methods: We utilized the biopsychosocial model to explore views from 34 OALWH and 22 stakeholders on the physical, mental, and psychosocial health challenges of ageing with HIV in Kilifi in 2019. Data were drawn from semi-structured in-depth interviews, which were audio-recorded and transcribed. A framework approach was used to synthesize the data.

Results: Symptoms of common mental disorders, comorbidities, somatic symptoms, financial difficulties, stigma, and discrimination were viewed as common. There was also an overlap of perceived risk factors across the physical, mental, and psychosocial health domains, including family conflicts and poverty.

Conclusion: OALWH at the Kenyan coast are perceived to be at risk of multiple physical, mental, and psychosocial challenges. Future research should quantify the burden of these challenges and examine the resources available to these adults.

Keywords: older adults, sub-Saharan Africa, HIV, Kenya, biopsychosocial challenges

OPEN ACCESS

Edited by:
Alyson Van Raalte, Max Planck Institute for Demographic Research, Germany

Reviewed by:
Zahra Reynolds, Massachusetts General Hospital and Harvard Medical School, United States

***Correspondence:**
Patrick N. Mwangala
pmwangala27@gmail.com
patrick.nzivo@aku.edu

This Original Article is part of the IJPH Special Issue "Ageing and Health in Sub-Sahara Africa"

Received: *21 February 2023*
Accepted: *02 June 2023*
Published: *15 June 2023*

Citation:
Mwangala PN, Wagner RG, Newton CR and Abubakar A (2023) Navigating Life With HIV as an Older Adult on the Kenyan Coast: Perceived Health Challenges Seen Through the Biopsychosocial Model. Int J Public Health 68:1605916. doi: 10.3389/ijph.2023.1605916

INTRODUCTION

The last decade has witnessed a dramatic shift in the demographic profile of people living with human immunodeficiency virus (HIV) globally. Presently, many HIV clinics are caring for a growing number of adults aged ≥50 years (categorized as older adults) due to increased survival in people living with HIV (PLWH) and a steady rise in HIV diagnoses in this age cohort [1]. More than 30% of the PLWH in High-Income Countries (HICs) are now aged ≥50 years [1] compared to 15% in sub-Saharan Africa (SSA) [2]. These statistics herald a new era in the HIV epidemic response, where the needs and demands of the OALWH can no longer be ignored, especially in Eastern and Southern Africa, home to more than half the number of OALWH globally [1].

Research findings, mainly from HICs, indicate that OALWH present with an average of three comorbid conditions in addition to HIV, including medical diseases (e.g., diabetes, hypertension), mental health problems (e.g., depression, anxiety, substance use, cognitive problems) and social challenges (e.g., stigma, loneliness, and lack of social support) [3–6]. The observed mental health challenges reduce the quality of life of these adults and have important health implications, e.g., poor HIV treatment [7]. The physical health problems faced by OALWH may also be complicated by environmental and psychosocial challenges such as poverty, food insecurity and lack of support [7].

Despite the evidence of complex health challenges related to ageing and HIV, little research has qualitatively examined how OALWH understand their health and care needs. To date, most studies of ageing and HIV in SSA are cross-sectional studies focusing on biomedical processes and outcomes and rarely provide local insight into the health and wellbeing of these adults [8]. Qualitative studies are needed to better understand the experiences and needs of this diverse population, especially among low-literacy populations. This is especially important as many cohorts of OALWH are emerging for the first time across the SSA region, and the apparent variability in findings among previous studies, e.g., in the prevalence and determinants of chronic comorbidities [8]. Apart from complementing quantitative studies in accurately documenting the burden and determinants of the health challenges in these adults, qualitative studies will shed light on the contextual factors to guide the development or adaptation and subsequent implementation of culturally appropriate interventions in this population. Overall, the few qualitative studies among OALWH in SSA are mainly concentrated in Uganda [9–13] and South Africa [14–18]. Others are from Kenya, Eswatini and Malawi [19–22]. In Uganda, ageing with HIV is seen as a daily challenge financially and socially [9–13]. The key barriers to successful ageing with HIV in this setting include stigma, food insecurity, and unmet healthcare needs, particularly for associated comorbidities such as common mental disorders. In South Africa, the crucial barriers to living with HIV in old age include food insecurity, unemployment, stigma, and access to transportation and healthcare [14–18].

Emerging data suggest that OALWH in Kenya face complex challenges when seeking care, including visits to multiple providers to manage HIV and comorbidities, ageist discrimination, and inadequate social support [20, 21]. However, these data come from the Western region of Kenya. As such, the health and wellbeing experiences of OALWH from other parts of the country is not known. To bridge this research gap, we conducted in-depth interviews to explore the health challenges faced by OALWH at Kilifi, a low literacy setting at the coast of Kenya. Using the biopsychosocial framework, we explore the perceptions of 34 OALWH, 11 healthcare providers and 11 primary caregivers on the physical, mental, and psychosocial challenges of ageing with HIV in this setting.

Theoretical Framework

We utilized Engel's biopsychosocial model of health [23], which provides a logical account of the chronic, complex, and dynamic nature of HIV. This model recognizes healthy ageing as the ability to thrive in an evolving environment influenced by physical/biological, mental/psychological, and social factors (**Figure 1**). The model provides a holistic approach to understanding the health needs of older adults and is supported by calls for research that positively impact the physical, mental, and social aspects of ageing with HIV [24–26]. According to this model, the cause, manifestation and outcome of wellness and disease are determined by a dynamic interaction between physical, psychological, and social factors [23]. Each model component includes systems that reciprocally influence other dynamics in the model and also affect health.

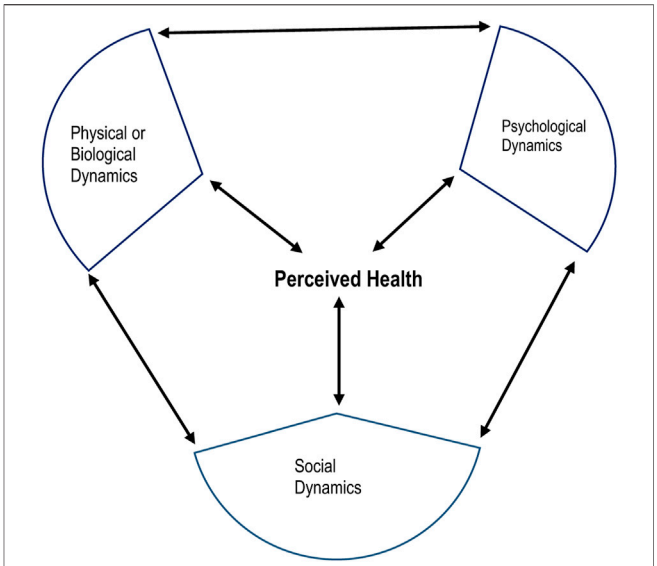


FIGURE 1 | Components of the biopsychosocial model of health (HIV-Associated Neurobehavioral Disorders Study, Kilifi County, Kenya 2019).

METHODS

Study Context and Participants

This study was conducted in 2019 at the Kenya Medical Research Institute (KEMRI) located within Kilifi County on the coast of Kenya. By the end of 2019, there were roughly 1.5 million residents in Kilifi County, the majority of whom were rural dwellers (~60%), and 11% were aged ≥50 years [27]. Kilifi has an HIV prevalence of 38 per 1,000 people [28] in the general population and is currently unknown in those aged ≥50 years. People living with HIV usually receive care in specialized HIV clinics within primary care facilities.

This study involved the following three groups of participants.

a) OALWH aged ≥50 years receiving HIV care and treatment at the HIV Comprehensive Care Clinic of the Kilifi County Hospital (KCH).
b) Healthcare providers attending to OALWH.
c) Primary caregivers of OALWH.

Recruitment and Eligibility

Study participants were selected purposively to represent diversity in the participants' characteristics, including age,

sex, and the cadre of service (for healthcare providers). Initial contact was made via a community health volunteer stationed at the KCH. Recruitment was conducted by a trained research assistant in liaison with the community health volunteer during their routine clinic visits. OALWH had to be ≥50 years old and on HIV treatment to be eligible. Primary caregivers were identified through the OALWH, usually during their scheduled clinic visits. These caregivers had to be directly involved in providing care and support, e.g., medical care to an OALWH. HIV providers were approached at their place of work and invited to participate. We specifically targeted providers who provided direct care to OALWH. Participants who agreed to participate were invited to a face-to-face interview at a convenient place, usually at KEMRI Kilifi.

Data Collection and Tools

The lead author (PM) conducted in-depth interviews lasting, on average 45–60 min with each participant. All the interviews were guided by a pre-tested semi-structured interview schedule developed with guidance from prior work on HIV and ageing. All interviews were conducted in Swahili, English or Giryama. We also sought permission from the participants to take notes and audio record the interviews.

Among OALWH, topic guide themes included: patient illness experiences following diagnoses. These issues were explored using general open-ended questions, followed by additional probing to highlight further the issue raised. For healthcare providers, participants were invited to share their experiences providing care to OALWH. Among caregivers, we explored different issues, including their experiences taking care of OALWH and the challenges these adults faced in their environment. We also collected respondents' demographic information such as age, sex, educational status, and employment status. For OALWH, we also collected HIV-related information. All participants were given Ksh 350 (about US$3) as compensation for time spent in the research, with transport expenses also reimbursed.

Data Analysis

All the audio-recorded interviews were transcribed verbatim by a team of four trained research assistants. Subsequent data management was done using NVivo software (version 11). We applied the framework approach to analyze our qualitative data [29]. Initially, two authors (PM and AA) developed a preliminary coding framework inductively through in-depth reading of transcripts and deductively by considering themes from the interview schedules. These codes were discussed, and consensus reached on how they should be brought together into themes with guidance from the biopsychosocial model. The initial coding framework was progressively expanded to capture emergent themes as coding continued. When the coding was complete in NVivo, the lead author grouped all themes related to a specific concept to form categories and exported this to a word-text processor to produce charts. The generated charts were used to summarize data, look for similarities or differences and explore patterns among the three groups of participants in the analyzed data.

TABLE 1 | Sociodemographic and clinical characteristics of older adults living with HIV (HIV-Associated Neurobehavioral Disorders Study, Kilifi County, Kenya 2019).

Characteristic	*n* (%) or median (IQR)
Median age	57 (54–63)
Female	18 (53%)
Educational level	
None	7 (20%)
Primary Level	21 (62%)
Secondary level	5 (15%)
Tertiary level	1 (3%)
Type of employment	
Unemployed/not working	12 (35%)
Small scale trader	15 (44%)
Casual worker	4 (12%)
Professional/skilled work	3 (9%)
Marital status	
Never married	1 (3%)
Married	19 (56%)
Separated/Divorced	7 (21%)
Widowed	7 (21%)
Living arrangements	
Alone	5 (15%)
Single generation household	4 (12%)
Multigenerational household	25 (73%)
Median household size	5 [2–9]
Residence (rural)	30 (88%)
Median duration since HIV diagnosis (years)	12 [10–15]
On ART treatment	34 (100%)
HIV status disclosure	
Non-disclosure	1 (3%)
Partial disclosure (to close family only)	18 (53%)
Full disclosure (beyond close family)	15 (44%)

Notes: ART, antiretroviral treatment; IQR, interquartile range.

Ethical Considerations

Written informed consent was obtained from all participants in the study. The study also obtained ethical clearance from the Kenya Medical Research Institute Scientific and Ethics Review Unit (KEMRI/SERU/CGMR-C/152/3804) and the Kilifi County Department of Health Services (HP/KCHS/VOL.X/171).

RESULTS

Sample Characteristics

We interviewed a total of 56 participants (34 OALWH, 11 healthcare providers and 11 primary caregivers) in this study. Among OALWH, 53% were women; most (82%) had up to a primary level of education, and their age ranged from 50 to 72 years. All the OALWH were on HIV treatment. Healthcare providers included six registered nurses, two clinical officers, two project managers of community-based organizations and one HIV counsellor. All the primary caregivers were family members, most of whom (73%) were female. Further sociodemographic information and HIV-related characteristics of the OALWH are summarized in **Table 1**.

TABLE 2 | Perceived forms of physical, mental, and psychosocial health challenges facing older adults living with HIV as discussed by study participants (HIV-Associated Neurobehavioral Disorders Study, Kilifi County, Kenya 2019).

Forms of health challenge	Number of in-depth interviews (among OALWH) where the health challenge was discussed (*N* = 34)	Number of in-depth interviews (among caregivers) where the health challenge was discussed (*N* = 11)	Number of in-depth interviews (among healthcare providers) where the health challenge was discussed (*N* = 11)
Physical complaints			
Comorbidities: chiefly ulcers/hyperacidity, hypertension, and diabetes	29	9	11
Wide-raging physical symptoms, e.g., pain/body aches, fatigue, insomnia	33	10	9
Functional impairments, e.g., difficulties walking, writing, holding things	18	3	3
Mental complaints			
Symptoms suggestive of common mental health problems, e.g., thinking too much, worry, stress, low mood, hopelessness/giving up easily	29	9	9
Cognitive complaints chiefly memory difficulties. Others including slow mental processing/learning, attention/concentration problems	22	7	4
Current drug and substance use, mainly "*mnazi*"' and "*ugoro*," which are the local palm wine and smokeless tobacco, respectively	5	0	9
Suicide and suicidal ideations	3	0	4
Psychotic-like symptoms, e.g., disorganized behaviour, aggression, lack of restraint and unwanted thoughts	1	3	3
Psychosocial complaints			
Financial difficulties, e.g., lacking school fees for dependents, walking long distances for HIV care	31	8	9
HIV-related stigma and discrimination especially internalized and enacted stigma	29	8	11
Ageism/ageist stereotype, e.g., neglect, verbal insults, vandalism	19	5	7
Isolation and lack of support	19	5	8
Loneliness	17	1	8
Food insecurity, e.g., skipping meals or going days without food	16	5	9

Perceived Biopsychosocial Challenges Confronted by OALWH

The different forms of biopsychosocial challenges faced by OALWH are summarized in **Table 2**. Overall, most of the OALWH shared their 10-plus years of experience living with HIV, from the time of diagnosis to their current state. The majority of the OALWH described moving from a state of shock, fear, anger, denial, hopelessness, or suicidal ideation upon diagnosis to a state of acceptance and ownership. This transition was not without challenges, as many of the OALWH noted going through traumatic experiences from family members, friends, workmates, and healthcare providers. Thereafter, they narrated moving from a state of ownership to a state of constant survival characterized by an array of health problems which we have conceptualized as physical (biological), mental (psychological) and social in the following sections according to the biopsychosocial model.

Perceived Physical Health Challenges

Physical complaints were commonly described by several participants. Key among these concerns was the onset of multiple comorbidities in these adults, which was frequently associated with pain, loss of control of one's body, emotional distress, and increased treatment burden. Hypertension, diabetes, ulcers/hyperacidity, hearing, and visual impairments were the most frequently reported comorbidities across the participants. Other conditions discussed (though to a lesser extent) included obesity, arthritis, stroke, teeth problems, cervical cancer, TB, and pneumonia. Apart from these comorbidities, somatic symptoms were also discussed in several interviews across the groups. Body

TABLE 3 | Participants' physical health challenges quotes (HIV-Associated Neurobehavioral Disorders Study, Kilifi County, Kenya 2019).

Perceived health problem	Examples
Multiple comorbidities	I am weak and constantly fatigued because I have ulcers, high blood pressure, and diabetes. My eyes are also painful and feel strained, and I sometimes experience toothache. As we are talking right now, my ears are not hearing well. So, all these diseases make me weak and significantly affect my wellbeing (*Female OALWH–10 years with HIV*)
	Ulcers is their main problem. Many of them complain of ulcers, and this is mainly because of stress. Anything small affects them. Sometimes you find one thinking too much and another telling you, "My children do not take care of me; they have forgotten about me" or "I have one child." Someone tells you about their child who died long ago but is still affected. Stress is a big problem because they pile up issues, not because of HIV but other issues. Another issue is food. The elderly must look for food for themselves and their irresponsible children, who may be drunkards. Often, you find that they deal with their stress and that of their children (*Nursing officer*)
	Last year, my hands were painful, and I could not bend. I carried out an X-ray and was told it was arthritis. I was told there was no treatment, and the only relief was by massaging myself and using painkillers. So, I bought clove oil, and it is what I have been using. There are improvements, but the problem is not resolved yet. I am also unable to work, and to make it worse, and I have difficulties sleeping whenever I am stressed. I was recently diagnosed with high blood pressure but am not taking medications yet. I also have ulcers, but I do not usually keep it in mind (*Female OALWH–11 years with HIV*)
Somatic symptoms	My knees are painful. Sometimes even squatting is a big challenge. I also cannot rise too quickly from a seated position; I have to support myself. I must also use painkillers for some relief before I can work. This has affected me because I cannot work without them. Whenever the analgesic effect wears out, it becomes very difficult to use my legs. I also experience headaches sometimes, and my relief is usually the painkiller. These painkillers have become my life now (*Female OALWH–2 years with HIV*)
	My pace has become very slow nowadays. I feel heavy, and there is nothing I am lifting or carrying. I often feel tired, and, at such times, I prefer walking around for some time. I must do this to ward off intrusive thoughts. Since being diagnosed, I have also grown weak and lost my libido. In fact, whenever I start having sex, I have this sensation of my waist being cut with a razor (*Male OALWH–10 years with HIV*)
	My husband cannot do heavy manual jobs. He used to work at the sea at night, which is usually cold and requires energy. It reached a point I had to stop him from going there anymore because he was weak and felt he was risking his life. Before this, he often used to complain of being sick. I was not at peace. I found it pointless for him to earn money that way and end up using it to medicate him. So, I told him to stay at home and do anything else. We are living by the mercies of God (caregiver)

pain, headaches, insomnia, fatigue or low energy, and limb numbness were also frequently reported. Some participants believed that the onset of the physical challenges was because of HIV-related factors (e.g., HIV infection itself, long-term ART), multimorbidity, old age, food insecurity, emotional distress, substance use, and the nature of someone's work. Participant quotes are given in **Table 3**.

Perceived Mental Health Challenges

We have discussed these issues under the following headings: symptoms suggestive of common mental health problems, cognitive symptoms, substance use problems, and others (suicidal ideation and psychotic symptoms). Participant quotes are given in **Table 4**.

Symptoms Suggestive of Common Mental Health Problems

Emotional and behavioral symptoms, suggestive of anxiety and depression, were described to be prevalent across the participant groups. Key among these symptoms included thinking too much, persistent stress, low mood, anger/irritability, worrying a lot, hopelessness, restlessness, panic attacks, and nightmares. Other prominent symptoms included insomnia, self-isolation, low self-esteem, headaches, and low libido. Overall, these symptoms were described to be on-and-off among the OALWH and were frequently associated with the exacerbation of physical conditions, chronic use of drugs, financial instability, and overall poor quality of life. For many participants, the onset and persistence of physical body changes (e.g., peripheral neuropathy, obesity, body weakness) were considered a significant risk for mental complaints.

Cognitive/Neurological Challenges

The commonly reported complaint in this category was memory difficulty, e.g., difficulties recalling important dates or finding items. Surprisingly, most OALWH reported that they rarely forgot to take their medications. Many healthcare providers corroborated this, although they also noted that there are some OALWH at risk of poor adherence caused by cognitive impairments. Other cognitive symptoms included attention/concentration, processing/learning, movement, and multi-tasking difficulties. Peripheral neuropathy was also reported to be a common neurological problem in these adults and was associated with significant distress. Among OALWH, the cognitive symptoms were viewed as an additional disease, and many did not understand its causes. The few who sought medical attention ended up being disappointed, sometimes being advised that it will resolve on its own or there is medicine, but it is costly.

Drugs and Substance use Problems

Current drug and substance use was mainly discussed by healthcare providers. In contrast, most OALWH reported having a history of drug and substance use, especially alcohol and tobacco but stopped following HIV diagnosis. However,

TABLE 4 | Participants' mental health quotes (HIV-Associated Neurobehavioral Disorders Study, Kilifi County, Kenya 2019).

Perceived health problem	Examples
Symptoms of stress, depression, anxiety, trauma	Living with HIV is difficult, my brother because you must take medications daily without missing and must live knowing that you are sick and could die any moment. This reality makes me depressed. I also do not know who will take care of my family if I die because my relatives are useless to me! I am jobless, and this makes me very sad and depressed because I have a family that needs to be cared for! I do not have money, getting food is a big problem, and to tell you the truth, I cannot even afford to pay school fees for my children. I must borrow to survive. As we are speaking, I have a court case because am unable to repay a loan I took (*Male OALWH–20 years with HIV*)
	My eyes cannot see well and are very itchy. Today in the morning, I had to compress them with hot water. The itchiness is often accompanied by coughing. I was prescribed some medications, but they were not helpful. You see this paper am holding; I cannot read anything on it unless I view it in very bright light during the day. At night, I can hardly make out the person calling my phone! This has affected me a lot. I am worried and do not know when this problem will end. Sometimes I want to work, e.g., write something, but I cannot. At night I must also depend on someone else to guide me. Other times I cannot work at all because of my eyesight problems. Whenever I am depressed, I just run to God (*Female OALWH–2 years with HIV*)
	My mum is generally stressed and very irritable. Sometimes she can get so stressed that she falls sick, forcing us to take her to the hospital (*Male Caregiver*)
	Sometimes, she gets very preoccupied with thoughts until she cries . . . not often, but it happens. Sometimes she also has trouble sleeping, and when I inquire why she tells me, "I am always thinking, and I do not know exactly what I am thinking about, and I do not have peace." I think she would love to be free with everyone and go anywhere she wants without people talking behind her back. She is sensitive, you know. When she hears people laughing, she usually asks me, "Why are they laughing? Are they laughing at me?" Sometimes, she does not come out of her room for two or 3 days and must force her to eat something (*Female Caregiver*)
	There is this client; her skin has spots, her jaw has dropped, and looks weak when she walks. She is often in deep thought; for instance, we could be in a seminar where many people participate, but you find her lost in her thoughts. We had to talk to her at some point, and we realized she had been abandoned by her husband, who had married another wife. We had to do a referral for this client because of these issues (*Project manager of a community-based organization*)
	You know these people are dealing with so many things which affect them. Stress, anxiety, and depression, and that is why screening is being done, and any positive case is linked with the psychiatric clinic (*Nursing officer*)
Cognitive symptoms	I can plan to do one or two things but later abandon them and do something different without any reason. For instance, I could be having a meeting, perhaps with some elders, but end up not doing and instead do other things. There is also this issue of forgetting, which is like a disease to me. I usually have a problem finding my things. Like yesterday, I could not find my money. I am worried about this problem, which is like a disease nowadays. I start doing one thing, then abandon it, and do the same to another. Sometimes my food gets burnt in the kitchen because I forget I was cooking and start doing other things. One time I decided to see a clinician about this disease because it was too much. I do not know whether it is because of these medications we are taking or something else. The clinician told me it would end with time. One thing I know, though, is that I was not like this before. This problem started when I began taking these medications. I am very surprised! I am not alone in this; many of my peers also complain of the same thing. Or could it be old age (*Female OALWH–13 years with HIV*)
	I can place my things in one place and forget about them. This can be money or even fruits. If I do not tell my husband that I have bought, e.g., fruits and have placed them in the cupboard, those bananas will go bad. He (my husband) will remember, but I will not. My body also becomes numb sometimes. My hand becomes heavy and immobile, especially in the morning. This extends to the shoulders and usually makes it impossible to carry things. The hands sometimes tremble and experience prickly feeling (of pins) in addition to numbness and general weakness. One of the legs is also involved in this (*Female OALWH–10 years with HIV*)
	To speak the truth, my husband does not concentrate nowadays. Actually, the real issue is his forgetfulness. It is a real concern for me. I have tried to make him understand that he has this challenge, but he never accepts it. I have suggested we look for medications, but he does not want to. He has also become very irritable lately. I think very few people will be able to tolerate him (*Female Caregiver*)
	You might explain something to one of them (OALWH) and moments later find that they contradict that same information. We have such cases, but not very many. Some take their ARVs and septrin/co-trimoxazole the same way when it is not supposed to be. In fact, some interchange these drugs when they come for their refill appointments. Because of this, we usually emphasize how the drugs should be taken and give them shorter appointments, e.g., weekly, for those who stay nearby. We also ask them to come with their treatment support persons, but some say they do not have them (*Nursing officer*)

(Continued on following page)

TABLE 4 | (*Continued*) Participants' mental health quotes (HIV-Associated Neurobehavioral Disorders Study, Kilifi County, Kenya 2019).

Perceived health problem	Examples
	My only addiction is to smokeless tobacco, but I stopped taking alcohol long ago. I have never smoked cigarettes before. I must use it (smokeless tobacco) every morning; otherwise, my heart will not be at peace; I will start feeling sad and not concentrate on any task. I only feel okay once I use it (*Female OALWH–2 months with HIV*)
	Adults of my age in this community are ill-mannered. They like taking alcohol and smoking cigarettes. They also have extra-marital affairs. Every morning, they must have a packet of cigarettes and ensure they do not miss a bottle of the local palm wine because they cannot afford beer. They have to take a bottle or two for them to sleep well (*Male OALWH—14 years with HIV*)
Substance use and suicide	I often feel like taking my own life. These thoughts come to me quite often, especially when I am stressed. Usually, a certain voice tells me that I am better off dead than alive, and another voice tells me not to do it. There is a fight between God and the devil. Sometimes I wake up in the middle of the night around midnight and start thinking about many things, which is how I lose my sleep entirely. I am just thinking, "I do not have money, my wife is unemployed, and my children are still in school. Where will I get food?" So, in the morning, I share this with my wife. At the church, we are also told that suicide is not the solution; it is adding the problems, so it is better to struggle but survive (*Male OALWH–14 years with HIV*)
	Not just suicidal ideations. Sometimes we also have cases of actual suicides. Last month, an older adult committed suicide. He was recently diagnosed with HIV, and two of his three wives also turned positive. We do not know what happened, but we received news that the old man had committed suicide 2 days later. So, it is a challenge (*Clinical officer*)

some confessed to being social drinkers. "*Mnazi*" and "*ugoro*" (smokeless tobacco or snuff) were the commonly used substances. Many providers emphasized that *mnazi* drinking is a big problem, noting that some OALWH came for their routine clinic appointments while drunk and sometimes forgot to take their ART drugs. Some providers also associated the *mnazi* drinking problem with unsuppressed viral loads, treatment default, and sexual risk-taking behaviors, e.g., multiple partners. The key underlying factors for the increased use of *mnazi* included family conflicts which often led to stress, unstable sexual partners, negative coping skills, culture, and easy access to these substances. *Ugoro*, the other commonly abused substance, was especially common among women. Beer, cigarettes, khat and marijuana were also discussed, although to a lesser extent.

Suicidal Ideation and Psychotic-like Symptoms

Three OALWH reported having intermittent suicidal ideations. This was corroborated by the healthcare providers. The commonly associated factors included persistent stress (caused mainly by financial difficulties and family conflicts), evil spirits, and HIV-related (e.g., getting tired of taking ART and not getting healed). Though limited, there were also few reports of psychotic-like symptoms (e.g., disorganized behaviour, aggression, lack of restraint and unwanted thoughts) across the three groups of participants. These cases were frequently observed around the time of HIV diagnosis.

Perceived Psychosocial Challenges

We present these issues under the following categories: a) financial challenges, b) stigma and discrimination, and c) loneliness and isolation. Participant quotes are given in **Table 5**.

Financial Challenges

This was discussed in virtually all the interviews we conducted. Many participants felt that financial difficulty was the most crucial issue affecting OALWH in the study setting because of its massive impact on food security, caregiving responsibilities, emotional wellbeing, and management of HIV and other comorbidities. Many OALWH reported skipping meals or going hungry for some days, lacking school fees for their dependents, and walking long distances to access HIV care for lack of money. This was corroborated by the healthcare providers and caregivers, who further stated that many of those who slept hungry tended to skip their medications, complaining of dizziness, headaches, and stomach discomfort. To some extent, this was associated with poor treatment outcomes, including unsuppressed viral load and poor retention in care.

Stigma and Discrimination

This theme incorporates HIV-related stigma and ageism (discrimination based on age). Despite relatively high levels of disclosure, many OALWH experienced HIV-related stigma. Discriminatory behaviour (enacted stigma from malicious gossip to outright discrimination, e.g., neglect, isolation, verbal insults) was reported to be common, especially in the most rural areas of the study setting. The perpetrators were mainly family members. Stigma was also reported to be common in mnazi drinking dens called "mangwe," burial ceremonies, and HIV clinics. Internalized stigma emerged as an important theme, especially among the OALWH and was frequently associated with self-isolation, anxiety or high consciousness of self, fear of seeking assistance, attending very far HIV clinics, stress, and irritability.

Many participants also highlighted discrimination based on age, which was perceived in multiple settings, including the home (mainly through isolation, neglect, and lack of respect from children), HIV clinic (e.g., scolded openly and verbal insults), and the community level. It also emerged that some community members around the study setting (especially in the most rural areas) regarded older people suspiciously. Many participants narrated hearing or witnessing several older people being beaten, beheaded, or burned alive in their houses for suspected witchcraft, and the perpetrators were mainly close family members.

TABLE 5 | Participants' psychosocial challenges quotes (HIV-Associated Neurobehavioral Disorders Study, Kilifi County, Kenya 2019).

Perceived health problem	Examples
Financial challenges	I am jobless, my brother. I have also lost my hands-on skills and experience with time. I am weak and do not have money. Getting food is a problem, and to speak the truth, even raising school fees for my children is a huge problem. Nevertheless, I have a very good friend, a lawyer, who is of great help to me. Sometimes, I eat at his place, lunch and dinner, but he does not know I live with HIV. Sometimes I am depressed and anxious because I do not know how to provide for my family. My relatives are of no help to me. Like yesterday, we did not have dinner, and I had to borrow the fare to come to this place. As we speak, I am in debt and face a court case because I cannot repay a loan. Often, I sleep hungry and must borrow to survive (*Male OALWH–20 years with HIV*)
	To speak the truth, I do not receive any support from my relatives, and this is not because there are no people to help. My husband and father died. I often sleep hungry. Sometimes, I only have a cup of porridge for three consecutive days … and this is usually borrowed from a neighbour so that I can take my medications. Other times, I survive on a cup of tea or hot water. Fare is also a big challenge. However, whenever I lack fare, I usually walk to the clinic from Bamba to Kilifi (around 50 km). I usually start my journey 2 days ahead of my clinic appointment and have two rest points in between, first at *Magogoni and* then at Kilifi at my uncle's place. From my uncle's place, I then walk to the clinic very early in the morning before 6 am (*Female OALWH–5 years with HIV*)
	Financial challenge is a big problem for these adults because they are neglected by their children sometimes. The day I am on duty at the clinic, I usually give many of them fare. You will hear many saying, "sister, please help me with fare, I walked to the clinic, and I have to walk back." If you have a good look at them, they appear exhausted, so you end up helping them. Even food is a challenge. In our discussions, the majority say that they have one meal per day and mind you, some fail to take their medications whenever they miss a meal due to dizziness claims (*Nursing officer*)
	The other day, we visited an elderly client in the community, a woman caring for two grandchildren living with HIV. The grandmother is unemployed, and the children's mother is not around. The grandchildren are in school. They need support with their schooling in addition to food. She is largely unable to provide all these and often must borrow. Sometimes, you find that even the skills you give them, e.g., rearing chicken or fish and making baskets, are not helpful because they are old and unable to work. In such cases, we assist them with food, counselling sessions, linkages, and referrals to foster treatment adherence and the wellbeing of the children (*Project manager of a community-based organization*)
	I usually borrow money from neighbours or friends to buy food whenever my mother does not have. I do not mind the debt because my target is to ensure that my mother has food to take her medications. However, it is a bit stressful because sometimes she sleeps hungry. And this is complicated by my father, who often quarrels my mother over small issues, increasing her stress. Every time my mum asks for money, he says he does not have it, and if we ask him how we will survive, he replies, "Can't your son look for the money?" It is frustrating because how can I take up this responsibility while in school? In fact, the one educating me is usually my grandfather (*Caregiver*)
Stigma and discrimination	The elderly living with HIV undergo many challenges in the community. For instance, you find one is sick, and no one is taking care of him at home. In fact, people will avoid interacting with this person, especially where he sleeps, out of fear of contracting the virus. Some of them have called me seeking help. Sadly, when I go to their homes, I find some have not even bathed for a whole week! In such a case, I usually clean up the person and assist him in eating. It is sad because the family places the food there; the person is sick and can hardly eat alone! Some are told to stay with their HIV because they know where they took it from! As we are speaking, there is a woman I would like to talk to because she stays in Malindi but takes her ART medications from Nakuru because she does not want relatives to know that she is living with HIV. So, HIV education has come for sure, but it is far from being complete (*Female Peer counsellor*)
	She is often in a low mood. She gets offended whenever she hears people talking and laughing on the other side. I think she would really like to be free and move about without people badmouthing her. (*Caregiver*)
	For men, there is a challenge, a huge challenge. Getting them is a very big challenge. We have tried to work with male champions to convince their fellow men to join us. Stigma is a big issue. In our meetings, you mainly find the ladies coming, and when you ask them about their husband's whereabouts, they often tell you, "He has gone to work and has sent me to listen to the messages on his behalf." So, they have that fear; they do not want to be seen. The case is not different in the primary facilities because many of them are not coming. He either sends the wife or comes but is very careful not to be seen, e.g., comes in through the back. Because of this fear, you find that some of the men do not want to be tested. We have several cases where the wife is living with HIV; the husband got tested and turned positive but is still in denial. You will find the wife saying, "We went and got tested with him but has insisted that the machines were not functioning and as such, he is not infected." Others also note that their husbands have constantly refused to start ART and use condoms, and whenever these issues are brought up, they end up quarrelling (*Project manager of a community-based organization*)
	That is a big problem (stigma). Ours is a small facility, so we schedule 1 day in a week to see the clients living with HIV. Surprisingly, even the community knows Tuesday is the day for those taking ARV drugs. So, most of them come very early in the morning. Therefore, I must come in very early to serve those who have stigma. Alternatively, that person will hang around the clinic from morning till evening when everyone has left so that people will not understand what she is doing there, or you will find that they will skip their appointed clinic dates (*Nursing officer*)
	Some of them are mistreated when they come for their appointments until I get angry! Let's say you are late for your appointment; you will be shouted at, insulted, and reprimanded like a child. In fact, some end up crying and I have to calm them down. It is sad because the culprits are usually the nurses who often shout at them, saying, "Take your drugs, or you will die of AIDS alone, and you will not see us!" It is shocking because some of them are treated very badly to the point that I am also angered. Some come to my desk, shedding tears, so I have to calm them down. At some point, it was too much that some of them transferred to other clinics (*Adherence counsellor*)
	The elderly are being burned alive and cut with pangas. As a matter of fact, some of my neighbours recently cut their elderly aunt severally with a panga because of witchcraft accusations. Later, their father also passed through the same ordeal by one of his children … the head was completely slashed off with a very sharp panga! And the reason is always witchcraft; I have not heard of any other thing. Such cases are numerous where I am living. I have witnessed four elders being cut with pangas, and the sad part is that these people will never expose each other to the police … even if I know it is you who did it, I will never say it. Even when the police come, the locals will never expose the culprit (*Female OALWH–12 years with HIV*)

(Continued on following page)

TABLE 5 | (*Continued*) Participants' psychosocial challenges quotes (HIV-Associated Neurobehavioral Disorders Study, Kilifi County, Kenya 2019).

Perceived health problem	Examples
Loneliness and isolation	I desire to have an exclusive male companion my age to spend the rest of my life with. Having one who is already married is problematic because sometimes I am very lonely and would want to call him, but I end up avoiding it out of fear, "What if he is with the wife? And you know it is not good to break someone's marriage." Because of such challenges, I would like to have my own man who does not belong to anyone, one I can relate to freely and love fully. You know, with someone else's husband, the love is incomplete, and it feels like I must hide constantly, and it reaches a point I feel afraid. Sometimes he does not answer my calls and sends a text message saying he is at home. So, you see, with such problems, I just want to get my own man who will live with me, someone I can talk with, especially when things are difficult because it is stressful at times (*Female OALWH–11 years with HIV*)
	Sometimes, I wish I could have friends with whom I can confide and share my challenges, but I am afraid of being discriminated. You cannot trust anyone. I have many friends, but they are all fake (*Male OALWH–20 years with HIV*)
	There are times he isolates herself from other people. You might see her seated alone and in deep thought. Sometimes she wakes up and begins to shed tears. She usually feels that her life has come to an end, perhaps (*Caregiver*)
	Whom will I share my problems with? I do not have anyone. Anyone I open myself to will want to know how and why my husband is facing those challenges. What is the cause? This will mean I start discussing and revealing the issues of my husband, which is not good (caregiver)

Loneliness and Isolation

This emerged as an important theme in the conversations with OALWH and healthcare providers. Despite living in multigenerational households, many of the OALWH expressed loneliness and isolation. Some had lost their partners, some their closest relatives and others saw their circle of friends getting smaller. Still, others felt neglected by those around them.

DISCUSSION

Summary of Key Findings

We conducted this study to gain a preliminary understanding of the health challenges facing OALWH on the coast of Kenya. Our study provides insight into the complex challenges of ageing with HIV and opens up opportunities for further epidemiologic research and subsequent development of tailored interventions for OALWH. Overall, our findings reveal that OALWH in this setting are particularly vulnerable to mental health problems, especially symptoms suggestive of common mental conditions. They are also at risk of physical health challenges, including comorbidities and somatic complaints. Mental and physical health impairments are complicated by psychosocial challenges, including poverty, lack of support, stigma, and discrimination. Noteworthily, there was an overlap of perceived risk factors across the three health domains (e.g., family conflicts, poverty, food insecurity), suggesting that OALWH who experience these shared cumulative risk factors are more likely to face multiple health challenges. It also implies that the action taken to mitigate any or some of the shared enabling factors is likely to have a preventive spillover effect across multiple health domains. Most of the views of OALWH on health challenges were corroborated by views from the providers and caregivers. However, a few disparities emerged in some of the perceived health challenges. Current drug and substance use, for instance, was reported mainly by healthcare providers, while cognitive complaints were discussed by OALWH.

Physical Health Challenges

Our discussions clearly showed that physical challenges are important concerns for older adults living with HIV on the coast of Kenya, given their negative impacts on other health domains and overall health. As the number of OALWH increases in many HIV clinics, HIV care will increasingly need to draw on a wide range of medical disciplines besides evidence-based screening and monitoring protocols [30]. Unfortunately, most healthcare providers presently lack guidance and training to identify and manage declines in physical and mental capacities in this population. The siloed provision of HIV care and other comorbidities could also imply that providers are unaware of the patients' other conditions. Our findings are similar to those reported in a recent qualitative exploration of challenges seeking HIV care services for OALWH [20]. Integration of services for HIV and non-communicable diseases in primary care may enable settings like Kenya to expand healthcare coverage for PLWH.

The current findings also revealed a prominent intersection between ageing and HIV. For most participants, ageing rather than HIV was the primary concern. This is not surprising considering that among PLWH with controlled viraemia, HIV infection often stops being the overriding comorbidity but is simply a key element in the overall milieu of multiple conditions [31, 32]. In a few instances, however, participants discussed that their experiences were associated with HIV, long-term medication use, or side effects, although their providers attributed these conditions to normal ageing. They advised the OALWH to "wait," and they will improve with time. Disagreements about the cause of a symptom or health condition may contribute to doubts about the effectiveness of treatment or conceal an emerging disease and contribute to delayed diagnoses such as medication side effects and polypharmacy.

Mental Health Challenges

Our finding of substantial symptoms suggestive of common mental health conditions among OALWH is consistent with previous reports of poor mental health among PLWH in the

study setting, albeit among younger populations [33, 34]. However, our study does not establish whether the burden among OALWH is higher or lower than that observed among young PLWH. Quantitative studies are needed to confirm this comparison. Nonetheless, OALWH may be facing a higher burden of common mental problems than their younger counterparts for different reasons. Firstly, many of the longest surviving OALWH may be significantly impacted by the legacy of the early years of the epidemic, including multiple bereavements and "survivor guilt" [35]. Secondly, the higher burden may also be attributed to the numerous challenges that OALWH face, e.g., poverty, food insecurity, caregiving responsibility, double stigma, and the onset of physical body changes, as evidenced in our study.

Since the beginning of the HIV epidemic, the manifestations of cognitive and neurological problems have been ubiquitous and frequently associated with poor treatment outcomes and impairment of activities of daily living [7]. In our study, the most frequently reported cognitive problem—memory difficulty—was commonly associated with stress and shame. Strikingly, healthcare providers seldom suspected cognitive impairments among OALWH and screenings were never done. This observation is similar to what has been reported in South Africa [32, 36]. Despite the reported memory challenges in this study, OALWH rarely forgot to take their medications (from their own self-reports and that of their providers). This finding is not unique in the HIV literature [37]. It is possible that OALWH are more organized and experienced and possibly more motivated after experiencing the initial devastating outcomes of the HIV pandemic. However, it is still essential to monitor the cognitive function of these adults to prevent treatment non-adherence, considering the multiple challenges they face, which are likely to impact their cognitive function and worsen as they grow older.

Our findings also noted a section of OALWH at risk of substance use dependence, especially home-brewed alcohol, called mnazi. This is not surprising given that the consumption of mnazi is common among the inhabitants of Kilifi because it is cheap and often less regulated [38]. The need to address this problem is even more crucial since it was associated with rising cases of sexual risk-taking behaviour and poor treatment outcomes in this cohort.

Psychosocial Challenges

Psychosocial factors are well-known predictors of treatment adherence, disease progression and quality of life for PLWH [39]. Findings from our exploratory study suggest that financial difficulties, loneliness, stigma, and discrimination are prevalent among OALWH in the study setting and are associated with mental complaints and physical health problems. Similar findings have been reported in Western Kenya among OALWH [20]. These findings are not surprising, given the country's prevailing situation of older adults. According to Help Age Kenya, the majority of older people in Kenya, especially those in rural areas, live in absolute poverty [40]. A recent report, the National Gender and Equality Commission Report, dubbed "Whipping Wisdom," also established that older adults in Kenya faced various forms of violence, including social stigma, neglect, abandonment, and hindrance from using and disposal of property [41].

Implications

Our study highlights opportunities for interventions and further research. It is important to reiterate that the health challenges faced by OALWH at the coast of Kenya are often interconnected and require a cohesive and collaborative response to achieve maximum benefits. Such interventions should target modifiable factors such as emotional support and integrate needed social and community support, e.g., case management services, food and nutrition support, financial assistance with caregiving responsibilities, and transportation. Context-specific interventions to help OALWH develop and nurture their own coping strategies are also critical in this population. Patient-centred care and patient self-management principles (e.g., self-reliance and empowerment) are critical elements in chronic care and are advocated as universal strategies in international frameworks of chronic care [42]. Integrated care models—which focus on the holistic view of the person by considering both medical and psychosocial needs, e.g., comprehensive geriatric assessment, are likely to improve the patient situation and the treatment outcomes. While OALWH are the primary target of most of the existing interventions in this cohort [43–45], research is required on how to build the capacity of healthcare providers, family members who act as informal caregivers and friends to provide support and care to those ageing with HIV. Future research should also examine the resources and resilience among these individuals to fully understand the vital role of resilience in empowering OALWH to enact processes that buffer health from the identified stressors. Future research is also needed to quantify the existing burden of physical and mental challenges in this population in Kilifi and confirm the risk and protective factors of these challenges. Furthermore, there is an urgent need for research to pilot and test the applicability and effectiveness of interventions underlying the determinants of physical and mental impairments in this setting.

Strengths and Limitations

To our knowledge, this is the first study to richly explore the health challenges of OALWH on the coast of Kenya and among the few studies in Kenya. Unlike previous studies, a key strength of this work is that participants comprised a diverse group of stakeholders. This ensured that the views were diverse and contrasted across participant groups. Using a biopsychosocial model helped us obtain a richer insight into the complexity of the identified health challenges. However, our findings emanate from a predominantly rural setting, and circumstances may differ from those in urban areas. Only OALWH who were on long-term HIV treatment were interviewed in this study; thus, their circumstances may also differ from those who are not in care or the newly diagnosed. As is the norm for qualitative studies in general, data collection, analysis, and interpretation are subject to individual influences and researcher biases; nonetheless, we countered this effect by maintaining reflexivity and constant

discussion with the research team to provide rigour and credibility to the study.

Conclusion

Our findings provide initial insight into the biopsychosocial challenges confronted by OALWH in a low-literacy Kenyan setting. The participants' views indicate that mental complaints (especially symptoms suggestive of common mental health conditions and memory difficulties), physical problems (particularly comorbidities and somatic symptoms) and psychosocial challenges (especially poverty, stigma, and discrimination) are of concern among OALWH. Many of the perceived risk factors for these challenges often overlap across the biopsychosocial domains. Our study also highlights several opportunities for interventions and future research to tackle these issues in the study setting. Future research should quantify the burden of these challenges, examine the resources available to these adults, pilot, and test feasible interventions in this setting, and in doing so, aim to improve the lives of older adults living with HIV.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Kenya Medical Research Institute Scientific and Ethics Review Unit. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

PM, CN, and AA conceptualized the study. PM, CN, RW, and AA designed the study. PM programmed the study questions on tablets and managed project data for the entire study period. PM analysed the data. PM, RW, CN, and AA contributed to the interpretation of the data. PM wrote the first draft of the manuscript and all the authors reviewed the subsequent versions and approved the final draft for submission. All authors contributed to the article and approved the submitted version.

FUNDING

This work was funded by the Wellcome Trust International Master's Fellowship to PM (Grant number 208283/Z/17/Z). Further funding supporting this work was from 1) the Medical Research Council (Grant number MR/M025454/1) to AA. This award is jointly funded by the UK Medical Research Council (MRC) and the UK Department for International Development (DFID) under MRC/DFID concordant agreement and is also part of the EDCTP2 program supported by the European Union; 2) DELTAS Africa Initiative (DEL-15-003). The DELTAS Africa Initiative is an independent funding scheme of the African Academy of Sciences (AAS)'s Alliance for Accelerating Excellence in Science in Africa (AESA) and supported by the New Partnership for Africa's Development Planning and Coordinating Agency (NEPAD Agency) with funding from the Wellcome Trust (107769/Z/10/Z) and the UK government. The funders did not have a role in the design and conduct of the study or interpretation of study findings.

AUTHOR DISCLAIMER

CONFLICT OF INTEREST

The authors declare that they do not have any conflicts of interest.

ACKNOWLEDGMENTS

An earlier version of this manuscript has been uploaded to medRxiv preprint server [46] ahead of peer review. We would also like to thank all the participants who took part in this study. This work is published with the permission of the director of Kenya Medical Research Institute.

REFERENCES

1. Autenrieth CS, Beck EJ, Stelzle D, Mallouris C, Mahy M, Ghys P. Global and Regional Trends of People Living with HIV Aged 50 and over: Estimates and Projections for 2000–2020. *PloS one* (2018) 13(11):e0207005. doi:10.1371/journal.pone.0207005
2. Hontelez JA, de Vlas SJ, Baltussen R, Newell M-L, Bakker R, Tanser F, et al. The Impact of Antiretroviral Treatment on the Age Composition of the HIV Epidemic in Sub-saharan Africa. *AIDS (London, England)* (2012) 26(0 1): S19–30. doi:10.1097/QAD.0b013e3283558526
3. Brennan-Ing M, Ramirez-Valles J, Tax A. Aging with HIV: Health Policy and Advocacy Priorities. *Health Edu Behav* (2021) 48(1):5–8. doi:10.1177/1090198120984368
4. Milic J, Russwurm M, Calvino AC, Brañas F, Sánchez-Conde M, Guaraldi G. European Cohorts of Older HIV Adults: POPPY, AGE H IV, GEPPO, COBRA and FUNCFRAIL. *Eur Geriatr Med* (2019) 10(2):247–57. doi:10.1007/s41999-019-00170-8
5. Rubtsova AA, Kempf M-C, Taylor TN, Konkle-Parker D, Wingood GM, Holstad MM. Healthy Aging in Older Women Living with HIV Infection: a Systematic Review of Psychosocial Factors. *Curr HIV/AIDS Rep* (2017) 14(1): 17–30. doi:10.1007/s11904-017-0347-y
6. Mwangala PN, Mabrouk A, Wagner R, Newton CR, Abubakar AA. Mental Health and Well-Being of Older Adults Living with HIV in Sub-saharan Africa: a Systematic Review. *BMJ open* (2021) 11(9):e052810. doi:10.1136/bmjopen-2021-052810
7. Brennan-Ing M. *Emerging Issues in HIV and Aging*. New York: Sage (2020). Available from: https://www.sageusa.org/wp-content/uploads/2020/07/emerging-issues-in-hiv-and-aging-may-2020.pdf; (Accessed August 21, 2021).
8. Siedner MJ. Aging, Health, and Quality of Life for Older People Living with HIV in Sub-saharan Africa: a Review and Proposed Conceptual Framework. *J Aging Health* (2019) 31(1):109–38. doi:10.1177/0898264317724549
9. Kuteesa MO, Wright S, Seeley J, Mugisha J, Kinyanda E, Kakembo F, et al. Experiences of HIV-Related Stigma Among HIV-Positive Older Persons in

Uganda–a Mixed Methods Analysis. *SAHARA-J: J Soc Aspects HIV/AIDS* (2014) 11(1):126–37. doi:10.1080/17290376.2014.938103
10. Wright CH, Longenecker CT, Nazzindah R, Kityo C, Najjuuko T, Taylor K, et al. A Mixed Methods, Observational Investigation of Physical Activity, Exercise, and Diet Among Older Ugandans Living with and without Chronic HIV Infection. *J Assoc Nurses AIDS Care* (2020) 32:640–51. doi:10.1097/JNC.0000000000000221
11. Mabisi K. *The Experiences of Older Women Living with HIV in Northern Uganda*. Oxford: Miami University (2018).
12. Schatz E, Seeley J, Negin J, Weiss HA, Tumwekwase G, Kabunga E, et al. "For Us Here, We Remind Ourselves": Strategies and Barriers to ART Access and Adherence Among Older Ugandans. *BMC Public Health* (2019) 19(1):131–13. doi:10.1186/s12889-019-6463-4
13. Kuteesa MO, Seeley J, Cumming RG, Negin J. Older People Living with HIV in Uganda: Understanding Their Experience and Needs. *Afr J AIDS Res* (2012) 11(4):295–305. doi:10.2989/16085906.2012.754829
14. Hlongwane N, Madiba S. Navigating Life with HIV as an Older Adult in South African Communities: A Phenomenological Study. *Int J Environ Res Public Health* (2020) 17(16):5797. doi:10.3390/ijerph17165797
15. Schatz E, Knight L. "I Was Referred from the Other Side": Gender and HIV Testing Among Older South Africans Living with HIV. *PLoS One* (2018) 13(4): e0196158. doi:10.1371/journal.pone.0196158
16. Knight L, Schatz E, Lewis KR, Mukumbang FC. 'When You Take Pills You Must Eat': Food (In) Security and ART Adherence Among Older People Living with HIV. *Glob Public Health* (2020) 15(1):97–110. doi:10.1080/17441692.2019.1644361
17. Knight L, Schatz E, Mukumbang FC. "I Attend at Vanguard and I Attend Here as Well": Barriers to Accessing Healthcare Services Among Older South Africans with HIV and Non-communicable Diseases. *Int J equity Health* (2018) 17(1):147–10. doi:10.1186/s12939-018-0863-4
18. Schatz E, Knight L, Mukumbang FC, Teti M, Myroniuk TW. 'You Have to Withstand that Because You Have Come for what You Have Come for': Barriers and Facilitators to Antiretroviral Treatment Access Among Older South Africans Living with HIV. *Sociol Health Illness* (2021) 43(3:624–41. doi:10.1111/1467-9566.13243
19. Harris TG, Flören S, Mantell JE, Nkambule R, Lukhele NG, Malinga BP, et al. HIV and Aging Among Adults Aged 50 Years and Older on Antiretroviral Therapy in Eswatini. *Afr J AIDS Res* (2021) 20(1):107–15. doi:10.2989/16085906.2021.1887301
20. Kiplagat J, Mwangi A, Chasela C, Huschke S. Challenges with Seeking HIV Care Services: Perspectives of Older Adults Infected with HIV in Western Kenya. *BMC Public Health* (2019) 19(1):929–12. doi:10.1186/s12889-019-7283-2
21. Kiplagat J, Huschke S. HIV Testing and Counselling Experiences: a Qualitative Study of Older Adults Living with HIV in Western Kenya. *BMC Geriatr* (2018) 18(1): 257–10. doi:10.1186/s12877-018-0941-x
22. Freeman E. Neither 'foolish'nor 'finished': Identity Control Among Older Adults with HIV in Rural Malawi. *Sociol Health illness* (2017) 39(5):711–25. doi:10.1111/1467-9566.12531
23. Engel GL. The Need for a New Medical Model: a challenge for Biomedicine. *Science* (1977) 196(4286):129–36. doi:10.1126/science.847460
24. Hillman J. A Call for an Integrated Biopsychosocial Model to Address Fundamental Disconnects in an Emergent Field: An Introduction to the Special Issue on "Sexuality and Aging". *Ageing Int* (2011) 36(3):303–12. doi:10.1007/s12126-011-9122-3
25. Halkitis PN, Krause KD, Vieira DL. Mental Health, Psychosocial Challenges and Resilience in Older Adults Living with HIV. *HIV and Aging* (2017) 42: 187–203. doi:10.1159/000448564
26. Heckman TG, Halkitis PN. Biopsychosocial Aspects of HIV and Aging. *Behav Med* (2014) 40 (3):81–4. doi:10.1080/08964289.2014.937630
27. Kenya National Bureau of Statistics. *The 2019 Kenya Population and Housing Census: Population by County and Sub-county*. Nairobi: Kenya National Bureau of Statistics (2019). Available from: https://www.knbs.or.ke/?wpdmpro=2019-kenya-population-and-housing-census-volume-iii-distribution-of-population-by-age-sex-and-administrative-units (Accessed July 23, 2021).
28. Ministry of Health (MOH). *Kenya HIV Estimates Report 2018*. Nairobi: National AIDS Control Council (2018).
29. Ritchie J, Spencer L. *Qualitative Data Analysis for Applied Policy Research. Analyzing Qualitative Data*. London and New York: Routledge (2002). p. 187–208.
30. Smit M, Brinkman K, Geerlings S, Smit C, Thyagarajan K, van Sighem A, et al. Future Challenges for Clinical Care of an Ageing Population Infected with HIV: a Modelling Study. *Lancet Infect Dis* (2015) 15(7):810–8. doi:10.1016/S1473-3099(15)00056-0
31. Guaraldi G, Milic J, Mussini C. Aging with HIV. *Curr HIV/AIDS Rep* (2019) 16(6):475–81. doi:10.1007/s11904-019-00464-3
32. Gouse H, Masson CJ, Henry M, Marcotte TD, London L, Kew G, et al. Assessing HIV Provider Knowledge, Screening Practices, and Training Needs for HIV-Associated Neurocognitive Disorders. A Short Report. *AIDS care* (2021) 33(4):468–72. doi:10.1080/09540121.2020.1736256
33. Nyongesa MK, Mwangi P, Kinuthia M, Hassan AS, Koot HM, Cuijpers P, et al. Prevalence, Risk and Protective Indicators of Common Mental Disorders Among Young People Living with HIV Compared to Their Uninfected Peers from the Kenyan Coast: a Cross-Sectional Study. *BMC psychiatry* (2021) 21(1): 90–17. doi:10.1186/s12888-021-03079-4
34. Abubakar A, Van de Vijver FJ, Fischer R, Hassan AS, Gona JK, Dzombo JT, et al. 'Everyone Has a Secret They Keep Close to Their Hearts': Challenges Faced by Adolescents Living with HIV Infection at the Kenyan Coast. *BMC public health* (2016) 16(1):197–8. doi:10.1186/s12889-016-2854-y
35. Cahill S, Valadéz R. Growing Older with HIV/AIDS: New Public Health Challenges. *Am J Public Health* (2013) 103(3):e7–e15. doi:10.2105/AJPH.2012.301161
36. Munsami A, Gouse H, Nightingale S, Joska JA. HIV-associated Neurocognitive Impairment Knowledge and Current Practices: A Survey of Frontline Healthcare Workers in South Africa. *J Community Health* (2021) 46(3): 538–44. doi:10.1007/s10900-020-00895-9
37. Ghidei L, Simone MJ, Salow MJ, Zimmerman KM, Paquin AM, Skarf LM, et al. Aging, Antiretrovirals, and Adherence: a Meta Analysis of Adherence Among Older HIV-Infected Individuals. *Drugs & aging* (2013) 30(10):809–19. doi:10.1007/s40266-013-0107-7
38. Ssewanyana D, Mwangala PN, Marsh V, Jao I, van Baar A, Newton CR, et al. Socio-ecological Determinants of Alcohol, Tobacco, and Drug Use Behavior of Adolescents in Kilifi County at the Kenyan Coast. *J Health Psychol* (2020) 25(12):1940–53. doi:10.1177/1359105318782594
39. Grov C, Golub SA, Parsons JT, Brennan M, Karpiak SE. Loneliness and HIV-Related Stigma Explain Depression Among Older HIV-Positive Adults. *AIDS care* (2010) 22(5):630–9. doi:10.1080/09540120903280901
40. Help Age Kenya. *Report on Status and Implementation of National Policy on Ageing in Kenya*. Nairobi: United Nations Department of Economic and Social Affairs (2014). Available from: https://www.un.org/esa/socdev/ageing/documents/workshops/Vienna/kenya.pdf (Accessed December 12, 2021).
41. The National Gender and Equality Commission. *Whipping Wisdom: Rapid Assessment on Violence against Older Persons in Kenya*. Nairobi: Ministry of Health (2014). Available from: https://www.ngeckenya.org/Downloads/Assessment-on-violence-against-older-persons-in-Kenya.pdf (Accessed December 12, 2021).
42. Thiyagarajan JA, Araujo de Carvalho I, Peña-Rosas JP, Chadha S, Mariotti SP, Dua T, et al. Redesigning Care for Older People to Preserve Physical and Mental Capacity: WHO Guidelines on Community-Level Interventions in Integrated Care. *PLoS Med* (2019) 16(10):e1002948. doi:10.1371/journal.pmed.1002948
43. Negin J, Rozea A, Martiniuk AL. HIV Behavioural Interventions Targeted towards Older Adults: a Systematic Review. *BMC Public Health* (2014) 14(1): 507–10. doi:10.1186/1471-2458-14-507
44. Knight L, Mukumbang FC, Schatz E. Behavioral and Cognitive Interventions to Improve Treatment Adherence and Access to HIV Care Among Older Adults in Sub-saharan Africa: an Updated Systematic Review. *Syst Rev* (2018) 7(1):114–0. doi:10.1186/s13643-018-0759-9
45. Bhochhibhoya A, Harrison S, Yonce S, Friedman DB, Ghimire PS, Li X. A Systematic Review of Psychosocial Interventions for Older Adults Living with HIV. *AIDS care* (2020) 33:971–82. doi:10.1080/09540121.2020.1856319
46. Mwangala PN, Wagner RG, Newton CR, Abubakar A. Navigating life with HIV as an older adult on the Kenyan coast: perceived health challenges seen through the biopsychosocial model [Internet]. *medRxiv [Preprint]* p. 35. Available from: https://doi.org/10.1101/2022.02.27.22271072 (Accessed June 09, 2023).

International Journal of Public Health
ORIGINAL ARTICLE
published: 29 June 2023
doi: 10.3389/ijph.2023.1605876

The Relationship Between Social Capital and Sleep Duration Among Older Adults in Ghana: A Cross-Sectional Study

Jonathan Aseye Nutakor[1], Lulin Zhou[1]*, Ebenezer Larnyo[2], Alexander Kwame Gavu[3], Irfan Mir Chohan[1], Stephen Addai-Dansoh[1] and Debashree Tripura[1]*

[1]School of Management, Jiangsu University, Zhenjiang, China, [2]Center for Black Studies Research, University of California, Santa Barbara, CA, United States, [3]Department of Educational Administration, College of Education, University of Saskatchewan, Saskatoon, SK, Canada

Objective: This study aims to investigate the connection between social capital and sleep duration among older adults in Ghana, as limited research has been conducted to explore this relationship.

Methods: This study utilized Wave 2 data from a sample of Ghanaian older adults from the World Health Organization Study on Global AGEing and Adult Health (SAGE). Self-reported data on social capital and sleep duration were compiled. Using ordered logistic regression, the relationship between social capital and sleep duration was examined.

Results: Older adults who did not participate in social activities showed the strongest association with the risk of short sleep ($p < 0.05$). Our study found that older adults who sleep for shorter periods tend to report better sleep quality. There was no correlation between medium and long sleep durations and social capital.

Conclusion: This study underscores the importance of more research to truly understand the complex connections between older adults' social participation, sleep, and health. It also has important implications for the promotion of good sleep in aging populations.

Keywords: older adults, social capital, sleep quality, sleep duration, sub-Saharan Africa

OPEN ACCESS

Edited by:
Stephen Ojiambo Wandera, Makerere University, Uganda

Reviewed by:
Thang Nguyen-Tien, Uppsala University, Sweden
Isidora Vujcic, University of Belgrade, Serbia

****Correspondence:***
Jonathan Aseye Nutakor
1000006300@ujs.edu.cn
Lulin Zhou
zll62@126.com

This Original Article is part of the IJPH Special Issue "Ageing and Health in Sub-Sahara Africa"

Received: *10 February 2023*
Accepted: *20 June 2023*
Published: *29 June 2023*

Citation:
Nutakor JA, Zhou L, Larnyo E, Gavu AK, Chohan IM, Addai-Dansoh S and Tripura D (2023) The Relationship Between Social Capital and Sleep Duration Among Older Adults in Ghana: A Cross-Sectional Study. Int J Public Health 68:1605876. doi: 10.3389/ijph.2023.1605876

INTRODUCTION

Aging is related to changes in sleep patterns and an increased risk for sleep disorders [1]; therefore, sleep health among older adults is a growing concern. Research indicates that older adults frequently suffer from insomnia, sleep apnea, restless leg syndrome, and circadian rhythm abnormalities [2]. These sleep disturbances can have severe health effects, including an increased risk of falls, cognitive impairment, and a compromised immune system [3, 4]. In addition, chronic medical disorders and the usage of specific medications might affect sleep in the elderly [5]. It is advised that this group adhere to a regular sleep schedule, maintain a pleasant sleep environment, participate in physical exercise, and avoid stimulants such as caffeine and electronic screens before bedtime [6].

Xiao et al. [7] conducted a study in China to investigate the relationship between social capital and sleep health. Their findings suggest that individuals with higher social capital tend to have better sleep

health, while those with lower social capital are at a higher risk of developing sleep disorders. The study highlights the importance of social connections and support in promoting healthy sleep habits, particularly in the context of a rapidly changing social landscape in China. Social capital refers to the resources and networks that individuals have access to as a result of their interactions with others, including friends, family, and community members. Studies have indicated a correlation between greater levels of social capital and improved sleep quality and fewer sleep disruptions [8, 9]. This may be because social ties provide support and a sense of belonging, which may reduce stress and anxiety and improve feelings of safety and security. On the other hand, low levels of social capital have been associated with poor sleep quality, an increase in sleep disruptions, and an elevated risk for sleep disorders [10, 11]. In addition, factors such as loneliness, social isolation, and lack of social support might have a poor effect on sleep health [12]. For instance, persons who experience feelings of isolation may have trouble falling or staying asleep owing to stress and anxiety. Those with strong social ties, on the other hand, may sleep better owing to heightened sensations of safety and security. According to a study by Kawachi et al. [13] in the United States, social capital is associated with self-reported health when socioeconomic status is taken into account. Overall, the association between social capital and sleep health outcomes underlines the significance of social ties and support in supporting healthy sleep [14].

Sleep disorders can lead to physical and mental exhaustion, disturbed moods, and impaired concentration, which can have a negative impact on family life, professional activities, and social interactions [2]. Studies have shown that not getting enough sleep increases the risk of stroke, heart disease, high blood pressure, diabetes, obesity, falls, death [15–17] and cancer [18, 19]. Recent statistics show that 7.7 million older adults in the US are socially isolated [12].

Despite evidence linking a lack of social support to negative sleep outcomes [20], the vast majority of prospective studies have focused on social support in the workplace, and these have either failed to control for or completely ignored participants' sleep duration [20]. No prior study has assessed this connection in an older Sub-Saharan African population, and few studies on social capital and sleep duration among the elderly have been conducted in Anglo-Saxon and Asian populations [21–26]. As a result, the purpose of this study is to investigate the association between social capital and sleep duration among older adults in Ghana. This study employed data from the World Health Organization's Study on Global AGEing and Adult Health—wave 2 to investigate the association that exists between social capital and sleep duration among older adults in Ghana. To the best of our knowledge, this is the first study in Ghana and sub-Saharan Africa to investigate the relationship between social capital and sleep duration in older adults.

METHODS

For this study, cross-sectional data were taken from the second wave of the World Health Organization Study on Global AGEing and Adult Health (SAGE). The SAGE study aimed to provide a comprehensive picture of the health and wellbeing of older adults globally and to inform efforts to promote healthy ageing and address the health needs of older populations. SAGE was carried out between 2014 and 2015 in six nations that fall within the low-and middle-income categories (China, Ghana, India, Mexico, Russia, and South Africa) [27]. We concentrated on the data that was gathered in Ghana since it was most relevant to the goals of this study. This data comprises individuals aged 50 and older. Ghana employed a stratified multi-stage cluster design with a nationally representative sample of individuals aged 50 and above. The administrative regions of Ashanti, Brong Ahafo, Central, Northern, Western, Greater Accra, Volta, Northern, Upper East, and Upper West as well as the type of residence (urban/rural) were stratified in the study sample [28]. This resulted in the formation of twenty different strata. Consequently, 251 enumeration areas (EA) were used as the primary sampling units (PSU) [28]. Participants in the interview were adults over the age of 50 from twenty households, as well as adults between the ages of 18 and 49 from four households. For those who were unable to participate in an interview due to health or cognitive issues, a proxy questionnaire was sent and filled out on their behalf. All interviewers who took part in the study obtained the necessary official training. Because the questionnaire was originally written in English, it was translated into several local languages to accommodate respondents who were unable to understand English [29, 30]. This means that the study includes participants from different ethnic and linguistic backgrounds, which is a strength of the study. Additionally, translating the questionnaire into local languages ensures that the questions are easily understood by all participants, regardless of their level of education or proficiency in English.

Measures

To assess social capital, three different variables were constructed. These include social support, social participation, and trust [31]. The determinants of social capital were derived from a combination of seventeen separate questions. To determine whether or not the respondents had a trusting relationship with the individuals (friends, neighbors, and family) in their immediate environment, questions about trust were posed to them. Participants were asked whether they think that people can be trusted, whether they have someone they can trust and confide in, and whether they trust their neighbors, coworkers, and strangers (**Supplementary File**). Three of the five trust-measuring questions included original responses such as 1) to a very great extent, 2) to a great extent, 3) neither great nor small, 4) to a small extent, and 5) to a very small extent. To create a binary "yes" or "no" variable, responses 1, 2, and 3 were considered as "yes" (indicating trust to some extent) and responses 4 and 5 as "no" (indicating lack of trust). With the remaining two questions, original responses were coded as 1) yes/can be trusted, and 2) no/cannot be too careful. Response 1 was considered as "yes" (indicating that most people can be

trusted/having someone to trust and confide in) and response 2 as "no" (indicating that one cannot be too careful in dealing with people/lacking someone to trust and confide in). In addition, questions on social participation focused on the participants' involvement with family, friends, neighbors, and public gatherings. Participants were asked how frequently they attended public meetings, clubs, religious services, went out, worked with other people in their neighborhood, visited friends in their homes, and engaged with community leaders, friends, and coworkers in the previous 12 months. Original responses included 1) never, 2) once or twice a year, 3) once or twice a month, 4) once or twice a week, and 5) daily. To recode these responses into a binary "yes" or "no" response, responses 1 and 2 were considered as "no" (indicating infrequent attendance) and responses 3, 4, and 5 as "yes" (indicating regular attendance). Concerning the respondents' access to social support, the question of whether or not they had persons with whom they could discuss their emotional needs, issues, or challenges was posed. Participants were asked how frequently they lack companionship, feel excluded, and sense isolation from others. Original responses were divided into four categories: 1) never, 2) rarely, 3) sometimes, and 4) often. To recode these responses into a binary "yes" or "no" variable, responses 1 and 2 were considered as "no" (indicating sufficient companionship) and responses 3 and 4 as "yes" (indicating a lack of companionship).

The amount of time spent sleeping by each participant the night before the research was the primary outcome of this investigation. During the course of the interview, the participants were asked the following question: "How many hours did you sleep last night?" For analysis, we classified the replies into three categories: fewer than 6 h, 6–8 h, and more than 8 h [28, 32]. Throughout the course of the research, we will refer to the group that sleeps for less than 6 h as short sleepers, the group that sleeps for 6–8 h as medium sleepers, and the group that sleeps for more than 8 h as long sleepers.

The analysis of this study took into account several covariates, including gender, age, residence, marital status, education level, household income quintile, chronic diseases (including stroke, diabetes, hypertension, and depression), lifestyle variables (including tobacco use, alcohol consumption, and body mass index), the quality of sleep, activities of daily living (ADL), and cognitive functioning. These were selected because prior research has established a connection between them and the amount of time spent sleeping [28, 33] as well as social capital [34, 35]. For a total of 21 assets, income quintiles were determined based on household ownership of durable items, home characteristics, and access to services (improved water, sanitation, and cooking fuel) [36]. To create the quintiles, a two-step random effect probit model was utilized. First, an asset ladder was created based on the endorsement rates of the various assets. This ladder was then used to place households on a similar scale, depending on asset ownership. As a result, a continuous income score is generated, from which quintiles are formed [36]. Self-reporting and validated symptom reporting served as the basis for the chronic condition study data. The interviewers inquired as to whether or not the respondent had been diagnosed with any of the following chronic conditions: stroke, diabetes, hypertension, or depression [29]. Data on alcohol and tobacco use was based on self-reported responses to questions on whether respondents had ever consumed alcohol or smoked tobacco. Body mass index (BMI) was calculated for each participant using their weight (kg) and height (m), and it was then divided into three categories: underweight, normal weight, overweight, and obese. Self-reported sleep quality was measured and classified as a binary outcome, with good/very good against other (moderate/poor/very poor). The physical functioning of the respondents was measured based on their self-reported activities of daily living. ADL refers to the fundamental personal activities involved in daily living. These basic self-care routines, which include walking, eating, dressing, using the restroom, and taking a shower, are taught to us as children [27]. The overall scores ranged from 0 to 10, with higher ADL scores indicating poorer physical functioning in older adults. In this study, cognitive function was evaluated objectively using a variety of cognitive tests (forward and backward digit spans; immediate and delayed verbal recall; and verbal fluency). To represent the respondents' overall cognitive function, a total cognitive score was created. Greater values indicated greater functional cognition [29].

Statistical Methods

In this study, the sample was characterized by the use of descriptive statistics. We used the following modelling strategy to construct ordered logistic regression models to investigate the connection that exists between social capital and the amount of time spent sleeping. In total, there were four different models. Trust, social participation, and social support were components of Model 1. In addition to trust, social participation, and social support, we adjusted for gender, age, residence, marital status, education level, and household income in model 2. In model 3, we made adjustments for tobacco use, alcohol consumption, and body mass index. Model 4 included adjustments for stroke, diabetes, hypertension, depression, sleep quality, ADL, and cognitive functioning. This analysis was carried out separately for each of the three different time frames of sleep. For all of the analyses, Stata/SE software (StataCorp College Station, TX) was utilized. If the value of p is less than 0.05, then the findings of the study are regarded as significant.

RESULTS

Table 1 contains the statistics that provide a summary of the data. The participants in this study are all 50 years old or older, making the total number of participants in this study 1,063. The total amount of time spent sleeping, on average, was 8.8 h. The majority of the respondents were male, making up 56.8% of the total. In terms of age, around 39.1% of respondents were under the age of 60, 38.1% were between the ages of 60 and 69, and 22.7% were beyond the age of 70. In comparison to their contemporaries who reside in urban areas, older individuals who live in rural areas made up more than half (55.1%) of those who

TABLE 1 | Summary statistics of the studied variables (World Health Organization Study on Global AGEing and Adult Health, Ghana, 2014–2015).

Variable	*N* = 1,063 *n* (%)	Short sleep (22) *n* (%)	Medium sleep (144) *n* (%)	Long sleep (897) *n* (%)
Trust score, mean (SD)	2.13 (0.74)	2.15 (0.99)	2.15 (0.80)	2.13 (0.73)
Social Participation score, mean (SD)	2.71 (0.87)	2.30 (0.96)	2.73 (0.99)	2.72 (0.85)
Social Support score, mean (SD)	1.26 (0.52)	1.08 (0.23)	1.22 (0.52)	1.28 (0.53)
Gender				
Male	604 (56.82)	11 (1.82)	79 (13.08)	514 (85.10)
Female	459 (43.18%)	11 (2.40)	65 (14.16)	383 (83.44)
Age				
50–59	416 (39.13)	11 (2.64)	65 (15.62)	340 (81.73)
60–69	405 (38.10)	7 (1.73)	54 (13.33)	344 (84.94)
70–79	188 (17.69)	4 (2.13)	21 (11.17)	163 (86.70)
80+	54 (5.08)	0 (0.00)	4 (7.41)	50 (92.59)
Residence				
Urban	477 (44.87)	13 (2.73)	80 (16.77)	384 (80.50)
Rural	586 (55.13)	9 (1.54)	64 (10.92)	513 (87.54)
Marital status				
Never married	30 (2.82)	0 (0.00)	6 (20.00)	24 (80.00)
Currently married	654 (61.52)	10 (1.53)	93 (14.22)	551 (84.25)
Cohabiting	10 (0.94)	1 (10.00)	1 (10.00)	8 (80.00)
Separated/Divorced	160 (15.05)	5 (3.12)	19 (11.88)	136 (85.00)
Widowed	209 (19.66)	6 (2.87)	25 (11.96)	178 (85.17)
Education				
Less than primary school	275 (25.87)	5 (1.82)	46 (16.73)	224 (81.45)
Primary school	206 (19.38)	6 (2.91)	25 (12.14)	175 (84.95)
Secondary school	255 (23.99)	5 (1.96)	23 (9.02)	227 (89.02)
High school	233 (23.99)	5 (1.96)	40 (15.69)	210 (82.35)
College/University/Postgraduate degree	72 (6.77)	1 (1.39)	10 (13.89)	61 (84.72)
Household income				
Lowest	389 (36.59)	11 (2.83)	53 (13.62)	325 (83.55)
2	86 (8.09)	2 (2.33)	8 (9.30)	76 (88.37)
3	162 (15.24)	3 (1.85)	22 (13.58)	137 (84.57)
4	228 (21.45)	3 (1.32)	32 (14.04)	193 (84.65)
Highest	198 (18.63)	3 (1.52)	29 (14.65)	166 (83.84)
Stroke				
Yes	20 (1.88)	0 (0.00)	3 (15.00)	17 (85.00)
No	1,043 (98.12)	22 (2.11)	141 (13.52)	880 (84.37)
Diabetes				
Yes	47 (4.42)	1 (2.13)	10 (21.28)	36 (76.60)
No	1,016 (95.58)	21 (2.07)	134 (13.19)	861 (84.74)
Hypertension				
Yes	170 (15.99)	5 (2.94)	37 (21.76)	128 (75.29)
No	893 (84.01)	17 (1.90)	107 (11.98)	769 (86.11)
Depression				
Yes	9 (0.85)	0 (0.00)	3 (33.33)	6 (66.67)
No	1,054 (99.15)	22 (2.09)	141 (13.38)	891 (84.54)
Tobacco				
Yes	89 (8.37)	2 (2.25)	16 (17.98)	71 (79.78)
No	974 (91.63)	20 (2.05)	128 (13.14)	826 (84.80)
Alcohol				
Yes	426 (40.08)	12 (2.82)	59 (13.85)	355 (83.33)
No	637 (59.92)	10 (1.57)	85 (13.34)	542 (85.09)
BMI				
Underweight	128 (12.04)	3 (2.34)	12 (9.38)	113 (88.28)
Normal weight	566 (53.25)	11 (1.94)	63 (11.13)	492 (86.93)
Overweight	223 (20.98)	2 (0.90)	39 (17.49)	182 (81.61)
Obese	146 (13.73)	6 (4.11)	30 (20.55)	110 (75.34)
Sleep quality				
Good/Very good	919 (86.45)	10 (1.09)	100 (10.88)	809 (88.03)
Other (moderate, poor, very poor)	144 (13.55)	12 (8.33)	44 (30.56)	88 (61.11)
ADL score, mean (SD)	1.14 (0.37)	1.12 (0.38)	1.09 (0.28)	1.15 (0.38)
Cognitive functioning score, mean (SD)	4.60 (1.19)	4.55 (1.13)	4.63 (1.20)	4.60 (1.19)

TABLE 2 | Ordered logistic regression analysis of the relationship between social capital and sleep duration (World Health Organization Study on Global AGEing and Adult Health, Ghana, 2014–2015).

	Model 1 Coef. [95% CI]	Model 2 Coef. [95% CI]	Model 3 Coef. [95% CI]	Model 4 Coef. [95% CI]
Short sleep				
Trust	0.006 [–5.26–0.539]	–0.124 [–0.679–0.431]	–0.159 [–0.720–0.402]	–0.193 [–0.766–0.379]
Social participation	–0.629 [–1.149 to –0.108] **	–0.632 [–1.159 to –0.104] **	–0.595 [–1.119 to –0.072]*	–0.412 [–0.981 to –0.155] *
Social Support	–1.436 [–3.115–0.242]	–1.388 [–3.079–0.303]	–1.339 [–3.018–0.338]	–1.473 [–3.182–0.236]
Gender		–0.474 [–1.515–0.567]	–0.250 [–1.392–0.891]	–0.212 [–1.442–1.017]
Age		–0.517 [–1.099–0.063]	–0.491 [–1.074–0.092]	–0.366 [–0.988–0.255]
Residence		–0.519 [–1.435–0.396]	–0.573 [–1.527–0.381]	–0.587 [–1.572–0.396]
Marital status		0.332 [–0.040–0.705]	0.308 [–0.06–0.681]	0.264 [–0.117–0.647]
Education		–0.012 [–0.373–0.349]	–0.010 [–0.371–0.351]	0.020 [–0.360–0.401]
Household income		–0.170 [–0.461–0.120]	–0.166 [–0.458–0.125]	–0.102 [–0.408–0.203]
Tobacco intake			0.096 [–1.47–1.664]	0.242 [–1.366–1.852]
Alcohol intake			–0.629 [–1.562–0.304]	–0.587 [–1.569–0.395]
BMI			0.001 [–0.536–0.537]	0.117 [–0.441–0.677]
Stroke				13.306 [–24.891–24.5]
Diabetes				0.661 [–1.539–2.863]
Hypertension				–0.331 [–1.508–0.846]
Depression				13.349 [–36.546–36.24
Sleep quality				2.019 [1.101–2.937] ***
ADL				0.025 [–1.267–1.318]
Cognition				–55.787 [–88.723–87.151]
Medium sleep				
Trust	0.054 [–0.183–0.291]	0.044 [–0.200–0.288]	–0.010 [–0.259–0.238]	–0.090 [–0.350–0.169]
Social participation	0.022 [–0.182–0.226]	–0.002 [–0.211–0.206]	–0.005 [–0.214–0.202]	0.061 [–0.160–0.284]
Social Support	–0.239 [–0.610–0.131]	–0.226 [–0.603–0.149]	–0.191 [–0.568–0.185]	–0.217 [–0.613–0.178]
Gender		0.011 [–0.408–0.430]	–0.045 [–0.508–0.417]	–0.131 [–0.619–0.355]
Age		–0.184 [–0.410–0.042]	–0.163 [–0.392–0.065]	–0.114 [–0.361–0.132]
Residence		–0.552 [–0.921 to –0.183] **	–0.426 [–0.810 to –0.041] *	–0.465 [–0.868 to –0.063] *
Marital status		–0.098 [–0.254–0.062]	–0.100 [–0.262–0.061]	–0.149 [–0.320–0.022]
Education		–0.102 [–0.254–0.049]	–0.108 [–0.260–0.043]	–0.107 [–0.267–0.053]
Household income		0.042 [–0.074–0.158]	0.043 [–0.073–0.160]	0.060 [–0.061–0.182]
Tobacco intake			–0.510 [–1.130–0.108]	–0.366 [–1.015–0.282]
Alcohol intake			–0.080 [–0.471–0.310]	0.037 [–0.371–0.447]
BMI			0.307 [0.083–0.532] **	0.305 [0.066–0.544] **
Stroke				0.033 [–1.366–1.433]
Diabetes				–0.016 [–0.824–0.790]
Hypertension				–0.594 [–1.087 to –0.102] **
Depression				–1.321 [–2.833–0.191]
Sleep quality				1.466 [1.017–1.916] ***
ADL				–0.770 [–1.471 to –0.069] *
Cognition				–0.070 [–0.242–0.101]
Long sleep				
Trust	0.044 [–0.178–0.267]	0.014 [–0.214–0.244]	–0.038 [–0.272–0.194]	–0.125 [–0.372–0.122]
Social participation	–0.072 [–0.266–0.121]	0.334 [–0.296–0.100]	–0.096 [–0.294–0.101]	–0.010 [–0.224–0.202]
Social Support	–0.357 [–0.723–0.008]	–0.341 [–0.711–0.029]	–0.305 [–0.675–0.064]	–0.365 [–0.756–0.025]
Gender		–0.062 [–0.460–0.336]	–0.080 [–0.519–0.358]	–0.170 [–0.638–0.297]
Age		–0.238 [–0.453 to –0.023] *	–0.217 [–0.434 to –0.001] *	–0.166 [–0.403–0.070]
Residence		–0.580 [–0.929 to –0.231] ***	–0.474 [–0.838 to –0.110]**	–0.527 [–0.913 to –0.140] **
Marital status		–0.033 [–0.183–0.116]	–0.038 [–0.189–0.113]	–0.087 [–0.249–0.073]
Education		–0.090 [–0.233–0.052]	–0.095 [–0.238–0.048]	–0.095 [–0.249–0.057]
Household income		0.011 [–0.098–0.121]	0.013 [–0.096–0.123]	0.038 [–0.078–0.155]
Tobacco intake			–0.451 [–1.042–0.139]	–0.302 [–0.932–0.327]
Alcohol intake			–0.181 [–0.549–0.186]	–0.061 [–0.451–0.328]
BMI			0.278 [0.066–0.490] **	0.293 [0.063–0.522] **
Stroke				0.245 [–1.162–1.653]
Diabetes				0.055 [–0.740–0.851]
Hypertension				–0.618 [–1.094 to –0.141] **
Depression				–1.109 [–2.634–0.415]
Sleep quality				1.726 [1.296–2.156] ***
ADL				–0.687 [–1.326 to –0.048] *
Cognition				–0.069 [–0.233–0.094]

The findings of the model are shown as Beta coefficients, 95% confidence intervals (CIs), and the p*-value.*
*p < *0.05*; **p < *0.01*; ***p < *0.001*.

Model 1: Trust + Social Participation + Social Support.
Model 2: Trust + Social Participation + Social Support + Gender + Age + Residence + Marital status + Education + Household income.
Model 3: Trust + Social Participation + Social Support + Gender + Age + Residence + Marital status + Education + Household income + Tobacco intake + Alcohol intake + BMI.
Model 4: Trust + Social Participation + Social Support + Gender + Age + Residence + Marital status + Education + Household income + Tobacco intake + Alcohol intake + BMI + Stroke + Diabetes + Hypertension + Depression + Sleep quality + ADL + Cognitive function.

responded to the survey. It was found that older adults who were currently married made up the majority (61.5%), followed by those who were widowed (19.6%), separated or divorced (15.1%), never married (2.8%), and cohabiting (0.9%). It is interesting to note that the majority of the respondents (25.8%) had not completed any schooling beyond primary school, as opposed to the minority (6.7%) who had completed college, university, or postgraduate study. The majority of respondents, approximately 36.5% of the total, belonged to the lowest income quintile, while 18.6% belonged to the highest income quintile. In terms of chronic diseases, those individuals who reported having experienced or been diagnosed with any of the following conditions were in the minority: depression (0.8%), diabetes (4.4%), hypertension (15.9%), and stroke (1.8%). In addition to this, the respondent's lifestyles were evaluated based on their consumption of tobacco and alcohol. Alcohol and cigarettes were never used by more than half of the respondents (59.9% and 91.6%, respectively). Nine hundred and nineteen of the respondents, or 86.4%, assessed the quality of their sleep as either good or very good.

The majority of respondents (84.3%) reported getting lengthy amounts of sleep, followed by those who said they got medium amounts of sleep (13.5%), and then those who said they got short amounts of sleep (2.1%). Respondents who were male, between the ages of 60 and 69, lived in rural areas, were currently married, had completed secondary education, were in the lowest income quintile, had normal weight, and reported having good quality sleep were among those who reported having a lengthy sleep. A similar pattern was observed among those who did not have a history of stroke, diabetes, hypertension, or depression, as well as among individuals who had never used tobacco or alcohol.

The findings of an ordered logistic regression are shown in **Table 2**, which investigates the relationship between social capital and sleep duration. There was a consistent finding across all models of a negative and statistically significant link between social participation and short sleep duration. The results of the medium and long sleep duration analysis did not show this pattern. After adjusting for all factors in Model 4, there was a positive correlation between sleep quality and long sleep duration among older adults. Our study found no correlation between social capital measures and medium sleep duration. On the other hand, there were significant connections found between the medium amount of time spent sleeping and one's location of residence, body mass index, hypertension, sleep quality, and ADL. The results for long sleep duration were the same as those for medium sleep: there was no significant connection between these two variables and any of the measures of social capital. Similar to medium sleep duration, there was a statistically significant connection between having a long sleep duration and one's location of residence, body mass index, hypertension, quality of sleep, and ADL.

DISCUSSION

In this study, we found that only social participation, as one of the measures of social capital, has a significant negative impact on short sleep duration among older adults. What this suggests is that worse social participation was cross-sectionally associated with an increased risk of short sleep, regardless of other relevant sociodemographic and behavioral covariates. In addition, older adults who do not participate in social activities showed the strongest association with the risk of short sleep. On the other hand, no significant associations between measures of social capital and medium and long sleep durations were observed.

Multiple factors may contribute to the relationship between low social participation and a greater risk of short sleep among older adults; a) loneliness: older adults with minimal social engagement may feel loneliness and depression, which may disrupt their sleep; b) boredom: older adults who do not participate in many social activities may suffer boredom and a lack of stimulation during the day, making it harder for them to fall asleep at night; c) inactivity: older adults with little social engagement are likely to be less physically active, which can also affect the quality of their sleep; d) chronic health issues: inadequate social involvement can increase the prevalence of chronic health disorders in older adults, such as arthritis or heart disease, and these illnesses can also impair sleep quality and length; e) Medication: older adults with minimal social engagement may be more prone to use sleep-inducing medication, which can have adverse side effects and become habit-forming over time.

Our findings significantly contribute to the growing body of research linking social participation with aging. Sleep deprivation is now widely recognized as a behavioral risk factor for healthy aging by epidemiologists [37–39]. Social participation, especially religious interaction, has been shown to reduce mortality and illness among the elderly in several studies [37–39]. Nevertheless, the processes through which social participation reduces illness or death are not fully known. Considering the correlation between quality sleep and longevity in later life, it's reasonable to assume that social participation has an impact on health outcomes in older adults.

Few studies have examined the prospective relationship between measures of social capital and sleep duration in older adults [21–26], even though the fact that sleep problems are more common in the elderly than in younger adults [40], and that both short and long sleep in the elderly is

associated with worse cognitive performance [41, 42], as well as increased likelihood of depression [43], falls [3], and impairment [4]. These findings cannot be directly compared to ours because they assessed different social connections and employed other measures of sleep duration, but they similarly established a significant effect of social capital on sleep outcomes. Similar to our study, in a sample of 1,417 older adults in Singapore, those with a poor social network had an elevated risk of sleeplessness [25]. In addition, two more studies [23] established that an increase in social participation was not related to better actigraphic measures of sleep quality and duration.

The study also observed a significant positive association between sleep quality and short sleep. A significant positive relationship between sleep quality and short sleep duration shows that those who sleep for shorter durations tend to report higher sleep quality. However, this association is likely to be complicated and can be affected by a variety of variables, including age, lifestyle, and health state. Although some people may be able to function effectively on less sleep, the majority of experts recommend 7–9 h of sleep every night for optimal health [44]. Chronic short sleep duration has been linked to adverse health effects, such as cardiovascular disease, obesity, and depression [45]. The optimal amount of sleep varies between individuals and may be impacted by age and health behaviors. People who obtain sufficient sleep report better sleep quality than those who do not.

Long sleep was shown to have a significant negative correlation with age. The cause of the significant negative correlation between age and long sleep duration is unclear, and there are some possible explanations. It is generally seen that older adults sleep less than younger individuals, which may indicate a negative correlation between age and sleep duration [46]. Changes in sleep patterns and demands, medical disorders, and lifestyle variables such as retirement, caregiving obligations, and increased daytime activities can all contribute to alterations in sleep patterns [47]. It is crucial to highlight that correlations do not always imply causality and further study is needed to determine the underlying processes driving this link.

Place of residence, hypertension, and activities of daily living were significantly and negatively correlated with medium and long sleep durations. Individuals with difficulty doing everyday tasks or who suffer from hypertension may choose to sleep for shorter durations [48]. Additionally, BMI had a negative correlation with medium and long sleep durations, as individuals with higher BMI may suffer from sleep apnea or other sleep-related respiratory issues [49]. Sleep apnea can lead to several nighttime awakenings, necessitating additional sleep to feel refreshed during the day.

Understanding how people from different backgrounds approach and experience social capital is essential for understanding the association between social contacts and health outcomes [50–52]. According to the Social-Ecological Model of Sleep Health [12, 53], social-contextual elements that underlie health in general and sleep health, in particular, are the root cause of sleep problems. This work investigates various aspects of social capital and the connection between those aspects and the amount of time spent sleeping by older adults.

A potential policy implication of the relationship between low social participation and a high risk of short sleep duration among older adults in Ghana may be addressed through community-building efforts and programs. This may involve collaborating with local groups and community leaders to provide activities, events, and opportunities for older individuals to engage with one another. Additionally, providing older adults with access to healthcare services, promoting good sleep habits, and educating healthcare practitioners and policymakers on the importance of addressing sleep health may help reduce the risk of short sleep duration and enhance their health and wellbeing.

Utilizing a nationally representative sample of older adults is a strength of this study because it allows for the results to be generalized to the larger population of older adults in the country. This increases the external validity and generalizability of the study's findings and reduces the potential for selection bias. The use of self-reported sleep quality and sleep duration, which may be impacted by recollection and social desirability biases, is a limitation of our study. Due to their low cost and ease of use, self-reported measures of sleep are often used in large prospective studies. Although objective measures of sleep duration are more reliable, self-reported data are the only way to obtain information on an individual's assessment of sleep quality. In addition, the translation of the questionnaire from English to other local languages may introduce concerns about reliability.

Conclusion

In line with the findings of this study, previous research has consistently demonstrated that older adults who engage in fewer social activities and have limited social connections are more prone to experiencing sleep-related difficulties, such as trouble initiating sleep, maintaining sleep, and early morning awakening. Several factors may contribute to this association, including heightened stress and anxiety levels, reduced physical activity, and disruptions in circadian rhythms. Consequently, it can be concluded that promoting social interaction and reducing social isolation among older adults may have a positive impact on their sleep quality. Implementing interventions such as community programs, enhancing healthcare accessibility, fostering robust social support networks, and encouraging healthy sleep habits are potential strategies to address the correlation between older adults' limited social participation and short sleep duration.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethical Review Committee (RPC146), and University of Ghana Medical School Ethics and Protocol Review Committee (Accra, Ghana). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JN and LZ designed the study. JN and EL performed data analysis. AG and SA-D verified the analytical methods. LZ supervised the findings of this work. JN and DT wrote original draft. AG and IC reviewed and edited original draft. All authors contributed to the article and approved the submitted version.

FUNDING

This study was funded by Research on the Construction and Supporting Strategy of Value-oriented Payment Model for Outpatient Care of Chronic Diseases (National Natural Science Foundation of China, grant number 71974064).

CONFLICT OF INTEREST

The authors declare that they do not have any conflicts of interest.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.ssph-journal.org/articles/10.3389/ijph.2023.1605876/full#supplementary-material

REFERENCES

1. Win T, Yamazaki T, Kanda K, Tajima K, Sokejima S. Neighborhood Social Capital and Sleep Duration: a Population Based Cross-Sectional Study in a Rural Japanese Town. *BMC Public Health* (2018) 18(1):343–11. doi:10.1186/s12889-018-5204-4
2. Léger D, Poursain B, Neubauer D, Uchiyama M. An International Survey of Sleeping Problems in the General Population. *Curr Med Res Opin* (2008) 24(1):307–17. doi:10.1185/030079907x253771
3. Fu L, Yu X, Zhang W, Han P, Kang L, Ma Y, et al. The Relationship between Sleep Duration, Falls, and Muscle Mass: a Cohort Study in an Elderly Chinese Population. *Rejuvenation Res* (2019) 22(5):390–8. doi:10.1089/rej.2018.2102
4. Chen T-Y, Lee S, Schade MM, Saito Y, Chan A, Buxton OM. Longitudinal Relationship between Sleep Deficiency and Pain Symptoms Among Community-Dwelling Older Adults in Japan and Singapore. *Sleep* (2019) 42(2):zsy219. doi:10.1093/sleep/zsy219
5. Mc Carthy CE. Sleep Disturbance, Sleep Disorders and Co-morbidities in the Care of the Older Person. *Med Sci* (2021) 9:31. doi:10.3390/medsci9020031
6. Markwald RR, Iftikhar I, Youngstedt SD. Behavioral Strategies, Including Exercise, for Addressing Insomnia. *Acsms Health Fit J* (2018) 22(2):23–9. doi:10.1249/FIT.0000000000000375
7. Xiao H, Zhang Y, Kong D, Li S, Yang N. Social Capital and Sleep Quality in Individuals Who Self-Isolated for 14 Days during the Coronavirus Disease 2019 (COVID-19) Outbreak in January 2020 in China. *Med Sci Monit Int Med J Exp Clin Res* (2020) 26:e923921. doi:10.12659/MSM.923921
8. Economou M, Madianos M, Peppou LE, Souliotis K, Patelakis A, Stefanis C. Cognitive Social Capital and Mental Illness during Economic Crisis: A Nationwide Population-Based Study in Greece. *Soc Sci Med* (2014) 100:141–7. doi:10.1016/j.socscimed.2013.11.006
9. Landstedt E, Almquist YB, Eriksson M, Hammarström A. Disentangling the Directions of Associations between Structural Social Capital and Mental Health: Longitudinal Analyses of Gender, Civic Engagement and Depressive Symptoms. *Soc Sci Med* (2016) 163:135–43. doi:10.1016/j.socscimed.2016.07.005
10. Kawachi I, Kennedy BP, Lochner K, Prothrow-Stith D. Social Capital, Income Inequality, and Mortality. *Am J Public Health* (1997) 87(9):1491–8. doi:10.2105/ajph.87.9.1491
11. Lindström M, Giordano GN. The 2008 Financial Crisis: Changes in Social Capital and its Association with Psychological Wellbeing in the United Kingdom–A Panel Study. *Soc Sci Med* (2016) 153:71–80. doi:10.1016/j.socscimed.2016.02.008
12. Cudjoe TKM, Roth DL, Szanton SL, Wolff JL, Boyd CM, Thorpe RJ, Jr. The Epidemiology of Social Isolation: National Health and Aging Trends Study. *Journals Gerontol Ser B* (2020) 75(1):107–13. doi:10.1093/geronb/gby037
13. Kawachi I, Kennedy BP, Glass R. Social Capital and Self-Rated Health: a Contextual Analysis. *Am J Public Health* (1999) 89(8):1187–93. doi:10.2105/ajph.89.8.1187
14. Robbins R, Jean-Louis G, Gallagher RA, Hale L, Branas CC, Gooneratne N, et al. Examining Social Capital in Relation to Sleep Duration, Insomnia, and Daytime Sleepiness. *Sleep Med* (2019) 60:165–72. doi:10.1016/j.sleep.2019.03.019
15. Jike M, Itani O, Watanabe N, Buysse DJ, Kaneita Y. Long Sleep Duration and Health Outcomes: a Systematic Review, Meta-Analysis and Meta-Regression. *Sleep Med Rev* (2018) 39:25–36. doi:10.1016/j.smrv.2017.06.011
16. Yin J, Jin X, Shan Z, Li S, Huang H, Li P, et al. Relationship of Sleep Duration with All-cause Mortality and Cardiovascular Events: a Systematic Review and Dose-response Meta-analysis of Prospective Cohort Studies. *J Am Heart Assoc* (2017) 6(9):e005947. doi:10.1161/JAHA.117.005947
17. Itani O, Jike M, Watanabe N, Kaneita Y. Short Sleep Duration and Health Outcomes: a Systematic Review, Meta-Analysis, and Meta-Regression. *Sleep Med* (2017) 32:246–56. doi:10.1016/j.sleep.2016.08.006
18. Chen Y, Tan F, Wei L, Li X, Lyu Z, Feng X, et al. Sleep Duration and the Risk of Cancer: a Systematic Review and Meta-Analysis Including Dose–Response Relationship. *BMC Cancer* (2018) 18:1149–13. doi:10.1186/s12885-018-5025-y
19. Stone CR, Haig TR, Fiest KM, McNeil J, Brenner DR, Friedenreich CM. The Association between Sleep Duration and Cancer-specific Mortality: a Systematic Review and Meta-Analysis. *Cancer Causes Control* (2019) 30:501–25. doi:10.1007/s10552-019-01156-4
20. Kent de Grey RG, Uchino BN, Trettevik R, Cronan S, Hogan JN. Social Support and Sleep: A Meta-Analysis. *Heal Psychol* (2018) 37(8):787–98. doi:10.1037/hea0000628
21. McHugh JE, Lawlor BA. Perceived Stress Mediates the Relationship between Emotional Loneliness and Sleep Quality over Time in Older Adults. *Br J Health Psychol* (2013) 18(3):546–55. doi:10.1111/j.2044-8287.2012.02101.x
22. Chen J-H, Waite LJ, Lauderdale DS. Marriage, Relationship Quality, and Sleep Among US Older Adults. *J Health Soc Behav* (2015) 56(3):356–77. doi:10.1177/0022146515594631
23. Chen J-H, Lauderdale DS, Waite LJ. Social Participation and Older Adults' Sleep. *Soc Sci Med* (2016) 149:164–73. doi:10.1016/j.socscimed.2015.11.045
24. Stafford M, Bendayan R, Tymoszuk U, Kuh D. Social Support from the Closest Person and Sleep Quality in Later Life: Evidence from a British Birth Cohort Study. *J Psychosom Res* (2017) 98:1–9. doi:10.1016/j.jpsychores.2017.04.014
25. Cheng GH-L, Malhotra R, Chan A, Østbye T, Lo JC. Weak Social Networks and Restless Sleep Interrelate through Depressed Mood Among Elderly. *Qual Life Res* (2018) 27:2517–24. doi:10.1007/s11136-018-1895-3
26. Yu B, Steptoe A, Niu K, Ku P-W, Chen L-J. Prospective Associations of Social Isolation and Loneliness with Poor Sleep Quality in Older Adults. *Qual Life Res* (2018) 27:683–91. doi:10.1007/s11136-017-1752-9
27. Dai B, Nutakor JA, Zhou J, Larnyo E, Asare MK, Danso NAA. Association between Socioeconomic Status and Physical Functioning Among Older Adults in Ghana. *J Public Health* (2022) 30:1411–20. doi:10.1007/s10389-020-01471-0
28. Nutakor JA, Dai B, Gavu AK, Antwi O-A. Relationship between Chronic Diseases and Sleep Duration Among Older Adults in Ghana. *Qual Life Res* (2020) 29:2101–10. doi:10.1007/s11136-020-02450-4

29. Nutakor JA, Dai B, Zhou J, Larnyo E, Gavu AK, Asare MK. Association between Socioeconomic Status and Cognitive Functioning Among Older Adults in Ghana. *Int J Geriatr Psychiatry* (2020) 36:756–65. doi:10.1002/gps.5475
30. Larnyo E, Dai B, Nutakor JA, Ampon-Wireko S, Larnyo A, Appiah R. Examining the Impact of Socioeconomic Status, Demographic Characteristics, Lifestyle and Other Risk Factors on Adults' Cognitive Functioning in Developing Countries: an Analysis of Five Selected WHO SAGE Wave 1 Countries. *Int J Equity Health* (2022) 21(1):31–20. doi:10.1186/s12939-022-01622-7
31. Nutakor JA, Zhou L, Larnyo E, Addai-Danso S, Tripura D. Socioeconomic Status and Quality of Life: An Assessment of the Mediating Effect of Social Capital. *Healthcare (Basel)* (2023) 11:749. doi:10.3390/healthcare11050749
32. Miller MA, Wright H, Ji C, Cappuccio FP. Cross-sectional Study of Sleep Quantity and Quality and Amnestic and Non-amnestic Cognitive Function in an Ageing Population: the English Longitudinal Study of Ageing (ELSA). *PLoS One* (2014) 9(6):e100991. doi:10.1371/journal.pone.0100991
33. Grandner MA, Petrov MER, Rattanaumpawan P, Jackson N, Platt A, Patel NP. Sleep Symptoms, Race/ethnicity, and Socioeconomic Position. *J Clin Sleep Med* (2013) 9(9):897–905. doi:10.5664/jcsm.2990
34. Lynch JW, Kaplan GA, Shema SJ. Cumulative Impact of Sustained Economic Hardship on Physical, Cognitive, Psychological, and Social Functioning. *N Engl J Med* (1997) 337(26):1889–95. doi:10.1056/NEJM199712253372606
35. Strawbridge WJ, Wallhagen MI. Self-rated Health and Mortality over Three Decades: Results from a Time-dependent Covariate Analysis. *Res Aging* (1999) 21(3):402–16. doi:10.1177/0164027599213003
36. Biritwum RB, Mensah G, Minicuci N, Yawson AE, Naidoo N, Chatterji S, et al. Household Characteristics for Older Adults and Study Background from SAGE Ghana Wave 1. *Glob Health Action* (2013) 6:20096. doi:10.3402/gha.v6i0.20096
37. Hill TD, Angel JL, Ellison CG, Angel RJ. Religious Attendance and Mortality: An 8-year Follow-Up of Older Mexican Americans. *J Gerontol Ser B Psychol Sci Soc Sci* (2005) 60(2):S102–9. doi:10.1093/geronb/60.2.s102
38. Hummer RA, Rogers RG, Nam CB, Ellison CG. Religious Involvement and US Adult Mortality. *Demography* (1999) 36(2):273–85. doi:10.2307/2648114
39. Zhang W. Religious Participation and Mortality Risk Among the Oldest Old in China. *J Gerontol Ser B Psychol Sci Soc Sci* (2008) 63(5):S293–7. doi:10.1093/geronb/63.5.s293
40. Neikrug AB, Ancoli-Israel S. Sleep Disorders in the Older Adult–A Mini-Review. *Gerontology* (2010) 56(2):181–9. doi:10.1159/000236900
41. Ding G, Li J, Lian Z, Cai C, Lu M, Gu H. Tracheobronchial Foreign Body Aspiration in Children: A Retrospective Single-center Cross-Sectional Study. *Medicine (Baltimore)* (2020) 99(13):e20480. doi:10.1097/MD.0000000000020480
42. Low DV, Wu MN, Spira AP. Sleep Duration and Cognition in a Nationally Representative Sample of US Older Adults. *Am J Geriatr Psychiatry* (2019) 27(12):1386–96. doi:10.1016/j.jagp.2019.07.001
43. van den Berg JF, Luijendijk HJ, Tulen JHM, Hofman A, Neven AK, Tiemeier H. Sleep in Depression and Anxiety Disorders: a Population-Based Study of Elderly Persons. *J Clin Psychiatry* (2009) 70(8):1105–13. doi:10.4088/JCP.08m04448
44. Panel CC, Watson NF, Badr MS, Belenky G, Bliwise DL, Buxton OM, et al. Recommended Amount of Sleep for a Healthy Adult: a Joint Consensus Statement of the American Academy of Sleep Medicine and Sleep Research Society. *J Clin Sleep Med* (2015) 11(6):843–4. doi:10.5665/sleep.4716
45. Jin B, Zhang H, Song F, Wu G, Yang H. Interaction of Sleep Duration and Depression on Cardiovascular Disease: a Retrospective Cohort Study. *BMC Public Health* (2022) 22(1):1752. doi:10.1186/s12889-022-14143-3
46. Rani S, Singh K, Kumari A. Study of Sleep Disorder in Elderly: A Review. *Indian J Heal Wellbeing* (2019) 10(4–6):95–7.
47. Miner B, Kryger MH. Sleep in the Aging Population. *Sleep Med Clin* (2017) 12(1):31–8. doi:10.1016/j.jsmc.2016.10.008
48. Uchmanowicz I, Markiewicz K, Uchmanowicz B, Kołtuniuk A, Rosińczuk J. The Relationship between Sleep Disturbances and Quality of Life in Elderly Patients with Hypertension. *Clin Interv Aging* (2019) 14:155–65. doi:10.2147/CIA.S188499
49. Jehan S, Zizi F, Pandi-Perumal SR, Wall S, Auguste E, Myers AK, et al. Obstructive Sleep Apnea and Obesity: Implications for Public Health. *Sleep Med Disord Int J* (2017) 1(4):00019. doi:10.15406/smdij.2017.01.00019
50. Kim HS, Sherman DK, Taylor SE. Culture and Social Support. *Am Psychol* (2008) 63(6):518–26. doi:10.1037/0003-066X
51. Rokach A, Orzeck T, Cripps J, Lackovic-Grgin K, Penezic Z. The Effects of Culture on the Meaning of Loneliness. *Soc Indic Res* (2001) 53:17–31. doi:10.1023/a:1007183101458
52. Campos B. What Is the Role of Culture in the Association of Relationships with Health? *Soc Personal Psychol Compass* (2015) 9(12):661–77. doi:10.1111/spc3.12226
53. García EL, Banegas JR, Perez-Regadera AG, Cabrera RH, Rodriguez-Artalejo F. Social Network and Health-Related Quality of Life in Older Adults: a Population-Based Study in Spain. *Qual Life Res* (2005) 14:511–20. doi:10.1007/s11136-004-5329-z

International Journal of Public Health
ORIGINAL ARTICLE
published: 07 August 2023
doi: 10.3389/ijph.2023.1605900

Short Physical Performance Battery and Study of Osteoporotic Fractures Index in the Exploration of Frailty Among Older People in Cameroon

Salvatore Metanmo[1†], *Nadine Simo-Tabue*[2†], *Callixte Kuate-Tegueu*[3,4], *Michel Bonnet*[2], *Antoine Gbessemehlan*[5], *Fabiola Metanmo*[6], *Moustapha Dramé*[2,7,8] *and Maturin Tabue-Teguo*[2,5,8]*

[1]*Inserm U1094, IRD U270, EpiMaCT—Epidemiology of Chronic Diseases in Tropical Zone, Institute of Epidemiology and Tropical Neurology, Omega Health, University of Limoges, CHU Limoges, Limoges, France,* [2]*Pôle de Gériatrie/Gérontologie CHU de Martinique, Equipe EpiCliV, Université des Antilles, Fort-de-France-Martinique, France,* [3]*Faculty of Medicine and Biomedical Sciences, The University of Yaoundé 1, Yaounde, Cameroon,* [4]*Neurology Department, Laquintinie Hospital of Douala, Douala, Cameroon,* [5]*Inserm U1219 Bordeaux Population Health Center, Université de Bordeaux, Bordeaux, France,* [6]*Division of Geriatrics, Limoges Hospital Center, Limoges, France,* [7]*Department of Clinical Research and Innovation, University Hospital of Martinique, Fort-de-France, Martinique, France,* [8]*Equipe EpiCliV, Université des Antilles, Pointe à Pitre, France*

Objectives: To investigate the relationship between the Short Physical Performance Battery (SPPB) and the Study of Osteoporotic Fractures (SOF) index.

Methods: We present data from a cross-sectional survey conducted in Cameroon. Frailty was defined as an SOF index > 0. The sensitivity and specificity of the SPPB were investigated. Principal component analysis (PCA) was performed to assess the contribution of each subtest of the SPPB to the relationship with the SOF.

Results: Among 403 people included (49.6% women), average age of 67.1 (±6.2) years, 35.7% were frail according to the SOF. After determining the best SPPB threshold for diagnosing frailty (threshold = 9, Se = 88.9%, Sp = 74.9%), 47.9% were frail according to the SPPB. The first dimension of PCA explained 55.8% of the variability in the data. Among the subtests of the SPPB, the chair stand test item was the component most associated with the SOF index.

Conclusion: Despite the overlap between the SOF and the SPPB, our results suggest that a negative result on the five chair-stands test alone would be sufficient to suspect physical frailty.

Keywords: frailty, Africa, elderly, epidemiology, Cameroon

OPEN ACCESS

Edited by:
Elke Loichinger, Federal Institute for Population Research, Germany

***Correspondence:**
Maturin Tabue-Teguo
tabue.maturin@gmail.com

This Original Article is part of the IJPH Special Issue "Ageing and Health in Sub-Sahara Africa"

[†]*These authors have contributed equally to this work*

Received: *16 February 2023*
Accepted: *26 July 2023*
Published: *07 August 2023*

Citation:
Metanmo S, Simo-Tabue N, Kuate-Tegueu C, Bonnet M, Gbessemehlan A, Metanmo F, Dramé M and Tabue-Teguo M (2023) Short Physical Performance Battery and Study of Osteoporotic Fractures Index in the Exploration of Frailty Among Older People in Cameroon. Int J Public Health 68:1605900. doi: 10.3389/ijph.2023.1605900

INTRODUCTION

Frailty is a geriatric condition characterized by an increased vulnerability to external stressors [1]. This state increases risk of occurrence of adverse health conditions, such as falls, disability, dependence, nursing home admission, hospitalization, and death [2]. Many measurement tools have been developed since the 1990 to assess or measure frailty in older adults. Some of them are used in population-based studies as screening tools, while others are more suitable and effective for the screening and/or diagnosis of frailty in the clinical setting [1]. Several operational definitions of

frailty exist [1, 3, 4]. The Study of Osteoporotic Fractures SOF index [5] is one of the most promising instruments for the assessment of frailty across healthcare settings, including among community-dwellers [6]. The SOF index is associated with adverse health events [6, 7]. It is easy and quick (less than 5 min) to perform, and is useful both for screening purposes in population-based studies, and for the diagnosis of frailty in the clinical setting [1]. The SOF essentially captures the physical dimension of frailty.

The Short Physical Performance Battery (SPPB) first described in 1994 [8] is a widely used test for measuring functional status and physical performance [8–12], particularly lower limb function. It is a composite comprising three sub-tests, namely, the balance test, the gait speed test and the chair stand test. As with the SOF index, low SPPB scores are predictive of various health events, including falls, limitations in the activities of daily living, disability, admission and readmission to hospital [13]. A recent review reported an association between lower SPPB scores and higher mortality risk [12]. The SPPB is also used in the assessment of sarcopenia, especially in the community context [14–16].

In Africa, few studies have used the SPPB to assess physical frailty, even though it is now well established that physical frailty is a geriatric syndrome whose main cause is sarcopenia, a pathology linked to loss of muscle mass and strength [11, 17–20]. To the best of our knowledge, no study in Africa has evaluated the SPPB compared to the SOF. Despite the likely risk of overlap, we feel it is important to determine the relationship between SPPB and SOF, and to identify which component of SPPB is most associated with frailty (as assessed by the SOF) in clinical practice among persons aged over 55 years in Cameroon. Considering that the component of the SPPB contribute to the total score of the SPPB, each component probably has a different weight, especially in clinical practice. Determining the contribution of each component could help clinicians to better identify the frailty syndrome. Similarly, a component with a high weighting could also be leveraged to improve knowledge among patients and their families, in order to propose pre-diagnosis at home.

The aim of this study was to explore the relationship between the SOF index and the SPPB (accuracy diagnostic of SPPB) as a screening tool for physical frailty in a population of older people from sub-Saharan Africa (SSA), and secondly, to identify which component of the SPPB is most associated with the SOF index.

METHODS

Between 1st January and 31st May 2019, a cross-sectional study was conducted among the general population in the city of Douala in Cameroon. Any person aged 55 years and over who was a member of a mutual health insurance company (MUPAC), able to stand up without support, and able to walk 4 m was eligible. Participants with severe health problems, including neurological disorders and blindness were excluded. The details of the survey procedures have previously been described elsewhere [16].

Assessment of SPPB

The SPPB is a battery comprising three tests, each scored from 0 to 4 [8]. The first is the gait speed test, which assesses the time taken to walk 4 m. The second is the chair stand test, in which the participant is asked to perform five chair-stands as quickly as possible, without using the arms, and the time taken to do the five chair-stands is recorded. The last component of the SPPB is the balance test, in which the participant's ability to stand with their feet in each of three positions (side-by-side stand, semi-tandem stand and tandem stand) is assessed. Each position must be maintained for at least 10 s. The less time required, the better the physical performance. The overall score (SPPB) also follows the same interpretation rule.

Assessment of Frailty Status: The SOF Index

Frailty status was assessed using the SOF index [21], which comprises three items, each scored from 0 to 3. The first is self-reported involuntary weight loss—the participant meets the criterion for weight loss if they lost >5% of their body weight in last 2–3 years without intent to lose weight. The second item is a chair stand test, which assess the participant's ability to get up from a chair 5 times without using their arms. The participant meets the chair-stand criterion is they fail to get up successfully all 5 times. The third items is reduced energy level, corresponding to a participant who replies "No" to the question "Do you feel full of energy?". Higher SOF scores correspond to greater frailty. For the purposes of this study, participants with an SOF index ≥1 were considered frail.

This study was approved by the Ethics Committee of the Université des Montagnes (Bangangté-Cameroon) under the number N°2019/049/UdM/CIE. Written informed consent was obtained from all participants before inclusion in the study.

The full procedures for performing and scoring the SPPB and SOF index are given in the **Supplementary Files S1, S2**. All participants performed both tests. However, the SPPB and the SOF index were performed at a distance (2 days) from each other in order to avoid bias in the results due to test repetition.

Statistical Analysis

Descriptive analysis of the socio-demographic and clinical characteristics of the study population was performed. Quantitative data are presented as medians and interquartiles and categorical variables are presented as number and percentage. To explore the relationship between the SPPB and the SOF index, several analyses were conducted. First, we calculated the correlation coefficient between the SOF index and the SPPB, and between the SOF index and each sub-test of the SPPB. Second, to plot a Receiver Operating Characteristic (ROC) curve between the SPPB and the SOF index, several different thresholds of the SPPB were tested. For each threshold tested, the rate of true and false positives in relation to the SOF index was recorded. The area under the ROC curve was estimated (AUC). Third, based on the most discriminant threshold of the SPPB, we calculated the Kappa coefficient for agreement between the SPPB and the SOF (both considered as categorical variables) with the associated confidence interval. The Landis and Koch

TABLE 1 | Correlation between the study of osteoporotic fractures index and the subtests of the short physical performance battery, Douala, Cameroon. 2019.

Variables	Spearman's correlation coefficient	*p*-value
Total SPPB	−0.68	<0.001
Balance test	−0.33	<0.001
Gait speed test	−0.39	<0.001
Chair stand test	−0.67	<0.001

SPPB, short physical performance battery.

classification [22] was used to characterize agreement as poor, slight, fair, moderate, substantial or almost perfect.

Principal component analysis (PCA) was performed between the subtests of the SPPB and the SOF. Active variables used to perform PCA were: balance test, gait speed test, chair stand test and SOF frailty index. The overall SPPB score, age and sex were used as supplementary observations. PCA was performed after data were centered or normalized. A study of the variables and individuals was carried out after PCA had been performed. p-values < 0.05 were considered statistically significant. All analyses were performed using the software R version 4.0.3.

RESULTS

Study Population Characteristics

The median age of the study population was 67 years, and 49.6% were female. The median score of the different subtests of the SPPB was 3, while the median total SPPB score was 10.0 (8.0, 11.0). The median SOF score was 0.0 (0.0, 1.0) and 144 (35.7%) participants had a score ≥ 1, and were considered to have physical frailty. The other socio-demographic and clinical characteristics of our population are presented in **Supplementary Table S1**.

Relationship Between SPPB and SOF

Correlation Between the Two Methods

The Spearman correlation coefficients for the correlations between the SPPB, its subtests, and the SOF index are presented in **Table 1**. The SOF and SPPB were strongly negatively correlated (r = −0.68). The three components of the SPPB were significantly negatively correlated with the SOF index, but of these three components, only the correlation between the SOF index and the chair stand test (−0.67) was as strong as the correlation between the SOF and the SPPB.

ROC Curve and AUC

Different thresholds for the SPPB were tested, and the resulting ROC curve for the relation between the SPPB and SOF is shown in **Figure 1**. A selection of thresholds with their associated diagnostic performance is presented in **Supplementary Table S2**. An SPPB score of 9 was the cut-off that best discriminated impaired from non-impaired participants (Youden index = 0.64). The area under the ROC curve (AUC) was 0.82.

Agreement Between the Two Methods

To calculate the agreement between the SPPB and the SOF index, the threshold of 9 was used, as per the previous analysis; 193 (47.9%) participants had an SPPB score ≤ 9. **Table 2** shows the distribution of patients according to each of the two assessment methods (SPPB and SOF). The Kappa coefficient was 0.60 [95% CI: 0.52–0.67], p < 0.001, corresponding to moderate agreement between the SPPB and the SOF for frailty screening.

Principal Component Analysis (PCA)

Description of the Dimensions

Supplementary Figure S1 shows the different dimensions derived from the PCA and the percentage of inertia. The first two dimensions explained 77% of the total variability, i.e., 77% of the information in the data was summarized by the first plane of

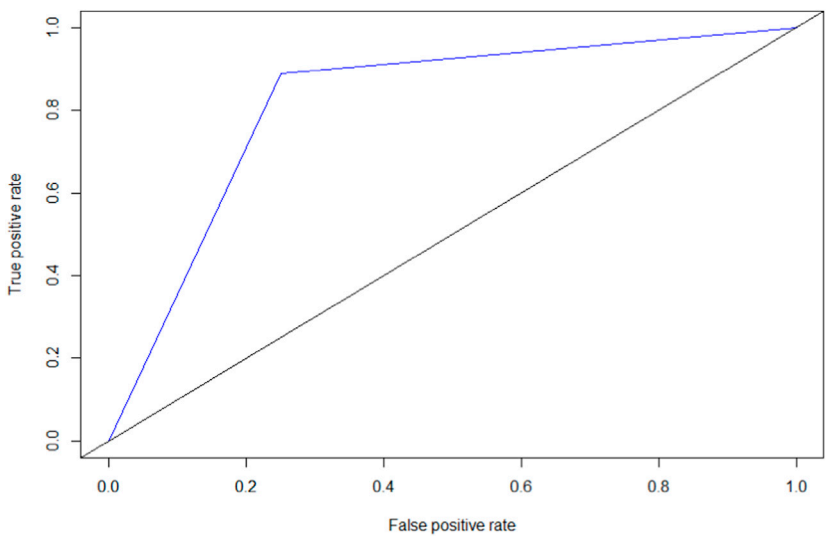


FIGURE 1 | Receiver operating characteristic curve for the short physical performance battery and the study of osteoporotic fractures index, Douala, Cameroon. 2019.

the PCA. Note that a plane is made up of two consecutive dimensions. Thus, dimension 1 and dimension 2 form the first plane, while dimension 3 and 4 form the second plane, and so on.

Study of Variables

All variables were associated with dimension 1. The correlation coefficient was greater than |0.5| for all, except age (correlation = −0.248) (**Supplementary Table S3**). From **Supplementary Table S3** and **Figure 2**, it can be seen that the subtests of the SPPB, as well as the overall SPPB score were positively correlated with the first dimension, while the SOF index was negatively correlated with this dimension. From **Figure 2**, it can be seen that the SOF index, the balance test, the chair stand test and the SPPB are well represented by the PCA in the first plane, unlike age, which is not well represented.

Second plane (dimensions 3 and 4): Gait speed was the best represented variable on the second plane, mainly by the third dimension (**Supplementary Figure S2**), with which it was positively correlated (correlation coefficient = 0.71).

Quality of Projection of Variables in the Plane. Apart from age, all variables were well represented in the first plane. **Table 3** shows the quality of representation (Cos2) of each variable on the first two dimensions and therefore in the foreground. The balance test is the best represented variable in the main PCA plane, in particular by the second dimension. The chair stand test, the overall SOF index and the SPPB were mostly represented by the main dimension of the PCA.

Contribution of the Variables to the First and Second Main Dimensions. The main contributor to the creation of dimension 1 was the SOF, although its contribution was not very large (ctr = 34.018), followed by the chair stand test (ctr = 30.382). The contributions of the other variables to the creation of the different PCA dimensions are presented in **Table 3**.

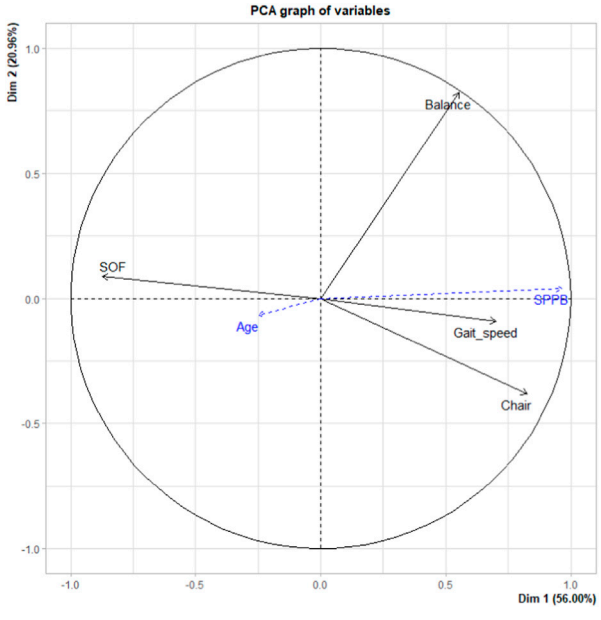


FIGURE 2 | Representation of variables in the first plane by principal component analysis, Douala, Cameroon. 2019.

TABLE 2 | Agreement between classification on the short physical performance battery (using a cut-off = 9) and the study of osteoporotic fractures index, Douala, Cameroon. 2019.

		SOF		Total
		Frail	Robust	
SPPB	Frail	128	65	193
	Robust	16	194	210
	Total	144	259	406

SOF, study of osteoporotic fractures index; SPPB, short physical performance battery.

Qualitative Variable: Sex. About 6.7% (correlation ratio R^2 = 0.067) of the variability of the coordinates of individuals on the first dimension was explained by the variable "sex". The barycenter of men is located on the right of the graph, while that of women is on the left (**Figure 3**). In other words, compared to women, men more often had a higher score on the SPPB and its components. **Supplementary Table S4** presents the quality of presentation of each modality of the sex variable, as well as the associated v.tests. The v.test values indicate that on dimension 1, the coordinates of the sex category are significantly different from zero.

Study of Individuals

The SPPB, gait speed test, balance test and chair stand test variables were all positively related to dimension 1. Individuals on the right side of the graph had high values for these tests, while individuals on the left had lower scores. Conversely, individuals on the left of the graph had a high SOF index while those on the right had a lower SOF score (**Figure 3**).

Dimension 2 was highly correlated with the balance test (r = 0.82). Individuals on the upper part of the graph had higher scores on the balance test while those on the lower part of the graph had lower scores on this test (**Figure 3**).

Supplementary Figure S3 displays the individuals graph, showing a selection of individuals whose representation quality is > 0.8. The qualitative variable "sex" is also represented by the barycenters for each sex (male/female). **Figure 3** shows the graph of individuals with ellipses. Individuals are colored by sex. The ellipse for men is shifted slightly to the right compared to that of women, which supports the fact that men often had a higher overall score on the SPPB than women, and conversely a lower SOF score than women. This slight difference between women and men is only significant on dimension 1 of the PCA due to the value of the v.test.

DISCUSSION

Prevalence of Frailty and the Value of the SOF Index as a Screening Tool

According to WHO and the World Bank, despite being on an upward trend, life expectancy in Cameroon was only 58 years

TABLE 3 | Quality of projection and contribution of the variables to the construction of the first plane, Douala, Cameroun. 2019.

Variables	Cos2			Contribution	
			Active variables		
	Dimension 1	Dimension 2	1st plane	Dimension 1	Dimension 2
Balance test	0.306	0.677	0.983	13.649	80.707
Gait speed test	0.492	0.008	0.5	21.951	0.993
Chair stand test	0.681	0.146	0.827	30.382	17.402
SOF	0.762	0.008	0.77	34.018	0.898
			Supplementary variables		
SPPB	0.932	0.002	0.934		
Age	0.062	0.004	0.066		

SOF, study of osteoporotic fractures index; SPPB, short physical performance battery.

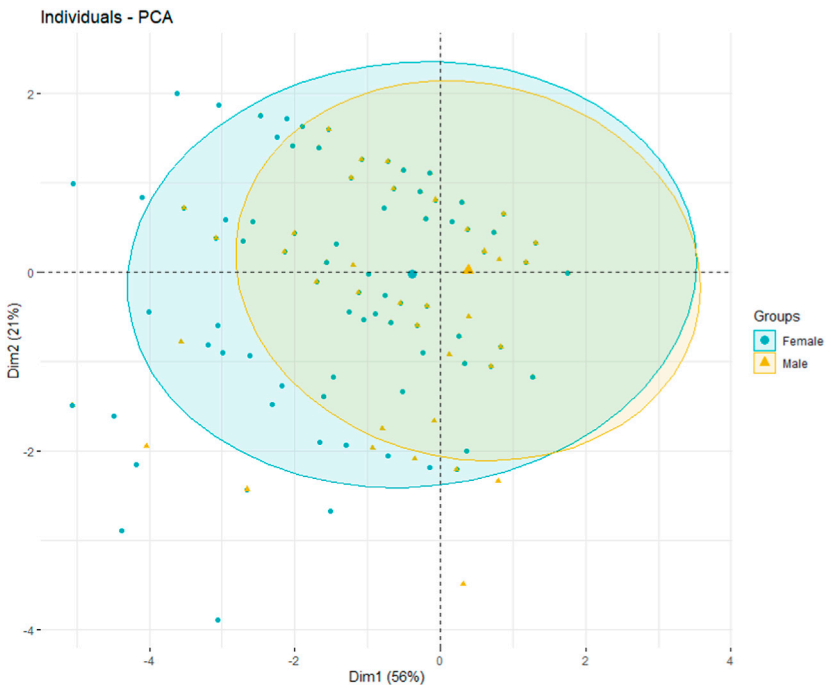


FIGURE 3 | Graph of individuals grouped by sex, Douala, Cameroon. 2019.

at birth in 2019 [23, 24]. This low value justifies why in Cameroon, as in other SSA countries, people are considered to be "old" relatively earlier than their Caucasian counterparts. The median age (67 years) found in our sample is therefore not exceptional in this part of the world and could be representative of older people in Cameroon. The prevalence of physical frailty assessed using the SOF index (35.7%), despite our selection criteria, could be an argument in favor of this representativeness. The SOF index is a validated tool in the assessment of physical frailty and is widely used in the literature in many fields of application [6, 25–27]. One diagnostic study reported that the SOF index was of good value for diagnosing frailty (specificity = 99.5%); it is therefore more valuable as a diagnostic tool than as a screening tool [28].

The Relationship Between SOF Index and SPPB

The best SPPB cut-off for assessing frailty in this population was nine points. Indeed, this cut-off had the best Youden index (0.64), and an AUC of 0.82, for sensitivity and specificity of 88.9% and 74.9%, respectively. Our results are in agreement with several studies that have used a cut-off of 9 in the SPPB to differentiate frail from robust people [18, 29, 30]. However, other cut-off values can be found depending on purpose of performing the SPPB. For example, one

study reported that an SPPB score ≤8 was the best cut-off when the objective was to determine frailty, while the optimal threshold was ≤10 when the objective was to determine onset of the frailty process (pre-frailty) [20]. Another recent study found that using a threshold of ≤7, sensitivity and specificity were very similar (0.80 and 0.83, respectively) [17]. One of the common reasons for these differences in results could be the wide variability of reference tests in the diagnosis of frailty. Indeed, in this study, frailty was determined using the Cardiovascular Health Study (CHS) phenotype (phenotype model), 26- and 34-item frailty index (deficit accumulation model) [17]. Their survey was conducted in a general population (like ours) and the gender distribution was similar (54.8% were female in their study) [17]. Conversely, the higher age (76 ± 6.8 years) in their population could explain the discrepancies between our two populations.

In addition to the reference test, the difference between our results and other reports in the literature may be due to other factors such as socio-economic level. For example, in a multicenter diagnostic study evaluating the physical performance of the SPPB (with a threshold of 9) in the diagnosis of frailty using the Fried phenotype (i.e., weight loss, exhaustion, weakness, mobility limitation and low physical activity) as a reference, the SPPB had better diagnostic performance (Se = 92%, Sp = 80%) in a population in Canada and worse diagnostic performance (Se = 81%, Sp = 52%) in a population in Brazil [18]. The authors underlined that the SPPB discriminated frailty better among older people with a higher socio-economic level.

The correlations found between the SPPB (and its subtests) and the SOF index remain mathematical and require careful interpretation. A measure of agreement using the Kappa index is more clinically relevant. The agreement between the SPPB and the SOF index was moderate (according to the Landis and Koch classification) and significant for a threshold ≤9 on the SPPB. The ability of the SPPB to classify participants as frail or robust is therefore not a matter of chance. To the best of our knowledge, few studies in the literature have explored the agreement between the SPPB and diagnostic tools for frailty. Our study therefore provides the first results of this agreement in a population from SSA.

The majority of studies that have assessed the relevance of using the SPPB in frailty have been diagnostic accuracy studies, limited to the assessment of the diagnostic performance of the SPPB [17–20, 31]. By using PCA, our study not only enables us to explore this relationship from another point of view, but also provides additional insights. Although the total SPPB score was not an active variable in the PCA, the first dimension of the PCA appeared to be the SPPB, with a very strong correlation (0.96) observed between the SPPB and the first dimension. In other words, studying the different correlations between the variables and the first dimension (which is the main dimension of the PCA) amounts to studying the correlations between these variables and the total score of the SPPB.

The SPPB and the SOF Index Overlap

Indeed, both these tests contain the chair stand test item. The objective of this sub-test is different in the SPPB, which measures the time taken to do the five chair-stands, as compared to the SOF, where the ability to do the five chair-stands is assessed in a binary (yes/no) manner, regardless of the time taken. However, both assessment methods involve stimulation of the osteo-motor system.

As expected in our study, the subtest of the SPPB that was most strongly correlated with the first dimension was the chair stand test, and the SOF index was highly correlated with this same dimension. However, this observation provides new information beyond the simple overlap that exists between the SOF and the SPPB. Indeed, this result suggests that in the assessment of physical frailty, the chair stand test is of high value in this population, although our study population was younger. The PCA was used to synthesize the information from our 403 patients and dimension 1 had the largest share in this synthesis. Dimension 1 almost represents the SPPB, while the SOF and the chair stand test (as a subtest of the SPPB) are highly correlated with it. In other words, the information coming from these 403 individuals is best explained (or summarized) by the chair stand test. A low score on this test (regardless of the context in which it is performed) may be an early warning of physical frailty in a young-aged patient. Our study is not the first to make this observation or to conclude that the SPPB is useful for the early detection of frailty [10, 18]. Indeed, in a previous study, a low SPPB score was observed in patients with normal gait speed and according to the authors, their results suggested that the physical performance battery may detect early signs of frailty even before the onset of gait slowing [10].

The gait speed test is considered to be a good predictor of health status in the elderly. Indeed, one study showed that usual gait speed of less than 1 m/s identifies persons at high risk of health-related outcomes in well-functioning older people [32]. Another study found that gait speed alone was useful in estimating the risk of disability in community-based populations [9]. These results are different from what was observed in our population, where the test most correlated with frailty was the chair stand test. The populations in the previous studies were older than ours, and it has been suggested that walking speed impairments may occur late in the disability process [10]. Furthermore, the effect of age in the disability process is well established. We therefore hypothesize that the chair stand test has more diagnostic value in the early identification (i.e., in the young-older person who is still walking normally) of the disability process.

In short, the chair stand test alone could be proposed to clinicians in routine practice as a means to detect the onset of physical frailty in individuals from the age of 55. This test is simple to perform, and can also be proposed to patients' families for even earlier screening. Like Cameroon, sub-Saharan African countries (or more generally developing countries) face a number of challenges, such as lower life expectancy (lower than in developed countries), less well developed healthcare systems (fewer efficient screening tools and healthcare personnel, for example), and sometimes precarious sanitary conditions. The chair stand test is simple to implement, and can be carried out by any general practitioner. It is not very time-consuming, and suitable for use as part of a routine consultation. It is

inexpensive, requiring only a chair, and can be used for the early detection of frailty. The chair stand test is therefore an excellent alternative for the screening and exploration of frailty in these countries.

A more recent study performed PCA only with the three subtests of the SPPB, to investigate the contribution of each subtest to the overall score [11]. The authors found that all subtests contributed more or less equally to the overall score, with a slightly greater contribution from the balance test. These results cannot really be considered different from ours because of the active variables included in the PCA. Indeed, our PCA was constructed on four scores including the SOF index score and therefore the information is certainly on the subtests of the SPPB but related to frailty. In this PCA, moreover, the balance test is better represented, more strongly correlated, and contributed above all to the construction of the second dimension. It therefore probably measures something else in this population.

When considering frailty in the elderly, the notions of age and gender are two determining factors [33, 34]. The PCA also explored the role of gender in frailty. In our population, men appeared to have better physical performance than women, particularly with regard to the chair stand test, although this difference seems minimal.

Our study has some limitations. First, it was a cross-sectional study and the results deserve to be consolidated by longitudinal studies. The choice of the reference test (SOF index), which is known to overlap with the SPPB, could also be considered as a limitation. However, this choice enabled us to highlight the important role of the subtest at the origin of this overlap. Finally, we do not have the scores for each sub-test of the SOF index, as we did for the SPPB. This would have enabled us to better explore these two tests, particularly to observe differences and the impact that the two methods of doing the chair stand test may have. Conversely, some strengths of our study can be noted. First, this is the first time that a study of this type has been conducted in a population from SSA, and sample size is relatively large. Second, exploring the relationship between frailty and SPPB test scores via PCA enabled a different approach to the value of each subtest in screening/diagnosing frailty.

Conclusion

In conclusion, the SPPB could be a valid tool for the identification of frailty in older people in SSA. Our results suggest that in a young geriatric population, a low score on the chair stand test could be an early warning sign of failing health, even when the scores of the other subtests and the overall SPPB score appear to be good. This test alone could be offered both in routine clinical practice and to families for early detection of frailty. However, these hypotheses need to be tested through longitudinal studies.

AUTHOR CONTRIBUTIONS

NS-T and MT-T designed the study; NS-T, MT-T, and CK-T collected the data; MT-T, SM, NS-T, and CK-T developed the data analysis strategy; SM analyzed the data; SM, NS-T, FM, MD, and MB interpreted the results and drafted the manuscript. AG interpretation and draft the manuscript. All authors contributed to the article and approved the submitted version.

CONFLICT OF INTEREST

The authors declare that they do not have any conflicts of interest.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.ssph-journal.org/articles/10.3389/ijph.2023.1605900/full#supplementary-material

REFERENCES

1. Dent E, Kowal P, Hoogendijk EO. Frailty Measurement in Research and Clinical Practice: A Review. *Eur J Intern Med* (2016) 31:3–10. doi:10.1016/j.ejim.2016.03.007
2. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, et al. Frailty in Older Adults: Evidence for a Phenotype. *J Gerontol A Biol Sci Med Sci* (2001) 56(3):M146–156. doi:10.1093/gerona/56.3.m146
3. Checa-López M, Oviedo-Briones M, Pardo-Gómez A, Gonzales-Turín J, Guevara-Guevara T, Carnicero JA, et al. FRAILTOOLS Study Protocol: A Comprehensive Validation of Frailty Assessment Tools to Screen and Diagnose Frailty in Different Clinical and Social Settings and to Provide Instruments for Integrated Care in Older Adults. *BMC Geriatr* (2019) 19(1):86. doi:10.1186/s12877-019-1042-1
4. Redín-Sagredo MJ, Aldaz Herce P, Casas Herrero A, Gutiérrez-Valencia M, Martínez-Velilla N. Heterogeneity Amongst Different Diagnostic Tools in Frailty Screening. *An Sist Sanit Navar* (2019) 42(2):169–78. doi:10.23938/ASSN.0642
5. Black DM, Steinbuch M, Palermo L, Dargent-Molina P, Lindsay R, Hoseyni MS, et al. An Assessment Tool for Predicting Fracture Risk in Postmenopausal Women. *Osteoporos Int J Establ Result Coop Eur Found Osteoporos Natl Osteoporos Found USA* (2001) 12(7):519–28. doi:10.1007/s001980170072
6. De Buyser SL, Petrovic M, Taes YE, Toye KRC, Kaufman JM, Lapauw B, et al. Validation of the FNIH Sarcopenia Criteria and SOF Frailty index as Predictors of Long-Term Mortality in Ambulatory Older Men. *Age Ageing* (2016) 45(5):602–8. doi:10.1093/ageing/afw071
7. Luciani A, Dottorini L, Battisti N, Bertuzzi C, Caldiera S, Floriani I, et al. Screening Elderly Cancer Patients for Disabilities: Evaluation of Study of Osteoporotic Fractures (SOF) index and Comprehensive Geriatric Assessment (CGA). *Ann Oncol Off J Eur Soc Med Oncol* (2013) 24(2):469–74. doi:10.1093/annonc/mds471
8. Guralnik J, Simonsick E, Ferrucci L, Glynn RJ, Berkman LF, Blazer DG, et al. A Short Physical Performance Battery Assessing Lower Extremity Function: Association with Self-Reported Disability and Prediction of Mortality and Nursing home Admission. *J Gerontol Medical Sci* (1994) 42(2):85–94. doi:10.1093/geronj/49.2.m85
9. Guralnik JM, Ferrucci L, Pieper CF, Leveille SG, Markides KS, Ostir GV, et al. Lower Extremity Function and Subsequent Disability: Consistency across Studies, Predictive Models, and Value of Gait Speed Alone Compared with the Short Physical Performance Battery. *J Gerontol A Biol Sci Med Sci* (2000) 55(4):M221–31. doi:10.1093/gerona/55.4.m221
10. Verghese J, Xue X. Identifying Frailty in High Functioning Older Adults with normal Mobility. *Age Ageing* (2010) 39(3):382–5. doi:10.1093/ageing/afp226
11. Tabue-Teguo M, Dartigues JF, Simo N, Kuate-Tegueu C, Vellas B, Cesari M. Physical Status and Frailty index in Nursing home Residents: Results from the

INCUR Study. *Arch Gerontol Geriatr* (2018) 74:72–6. doi:10.1016/j.archger.2017.10.005
12. De Fátima Ribeiro Silva C, Ohara DG, Matos AP, Pinto ACPN, Pegorari MS. Short Physical Performance Battery as a Measure of Physical Performance and Mortality Predictor in Older Adults: A Comprehensive Literature Review. *Int J Environ Res Public Health* (2021) 18(20):10612. doi:10.3390/ijerph182010612
13. Treacy D, Hassett L. The Short Physical Performance Battery. *J Physiother* (2018) 64(1):61. doi:10.1016/j.jphys.2017.04.002
14. Jyväkorpi SK, Ramel A, Strandberg TE, Piotrowicz K, Błaszczyk-Bębenek E, Urtamo A, et al. The Sarcopenia and Physical Frailty in Older People: Multi-Component Treatment Strategies (SPRINTT) Project: Description and Feasibility of a Nutrition Intervention in Community-Dwelling Older Europeans. *Eur Geriatr Med* (2021) 12(2):303–12. doi:10.1007/s41999-020-00438-4
15. Lee SY, Choo PL, Pang BWJ, Lau LK, Jabbar KA, Seah WT, et al. SPPB Reference Values and Performance in Assessing Sarcopenia in Community-Dwelling Singaporeans - Yishun Study. *BMC Geriatr* (2021) 21(1):213. doi:10.1186/s12877-021-02147-4
16. Metanmo S, Kuate-Tegueu C, Gbessemehlan A, Dartigues JF, Ntsama MJ, Nguegang Yonta L, et al. Self-Reported Visual Impairment and Sarcopenia Among Older People in Cameroon. *Sci Rep* (2022) 12(1):17694. doi:10.1038/s41598-022-22563-9
17. Jung HW, Baek JY, Jang IY, Guralnik JM, Rockwood K, Lee E, et al. Short Physical Performance Battery as a Crosswalk between Frailty Phenotype and Deficit Accumulation Frailty Index. *J Gerontol A Biol Sci Med Sci* (2021) 76(12):2249–55. doi:10.1093/gerona/glab087
18. Da Câmara SMA, Alvarado BE, Guralnik JM, Guerra RO, Maciel ÁCC. Using the Short Physical Performance Battery to Screen for Frailty in Young-Old Adults with Distinct Socioeconomic Conditions. *Geriatr Gerontol Int* (2013) 13(2):421–8. doi:10.1111/j.1447-0594.2012.00920.x
19. Chang SF, Yang RS, Lin TC, Chiu SC, Chen ML, Lee HC. The Discrimination of Using the Short Physical Performance Battery to Screen Frailty for Community-Dwelling Elderly People. *J Nurs Scholarsh Off Publ Sigma Theta Tau Int Honor Soc Nurs* (2014) 46(3):207–15. doi:10.1111/jnu.12068
20. Perracini MR, Mello M, de Oliveira Máximo R, Bilton TL, Ferriolli E, Lustosa LP, et al. Diagnostic Accuracy of the Short Physical Performance Battery for Detecting Frailty in Older People. *Phys Ther* (2020) 100(1):90–8. doi:10.1093/ptj/pzz154
21. Ensrud KE, Ewing SK, Taylor BC, Fink HA, Cawthon PM, Stone KL, et al. Comparison of 2 Frailty Indexes for Prediction of Falls, Disability, Fractures, and Death in Older Women. *Arch Intern Med* (2008) 168(4):382–9. doi:10.1001/archinternmed.2007.113
22. Landis JR, Koch GG. The Measurement of Observer Agreement for Categorical Data. *Biometrics* (1977) 33(1):159–74. doi:10.2307/2529310
23. Organisation mondiale de la Selon. *l'espérance de vie au Cameroun est inférieure à la moyenne en Afrique malgré les dépenses en santé* (2022). Available at: https://actucameroun.com/2020/06/24/selon-loms-lesperance-de-vie-au-cameroun-est-inferieure-a-la-moyenne-en-afrique-malgre-les-depenses-en-sante/ (Accessed April 4, 2022).
24. Organisation mondiale de la Selon. *Espérance de vie à la naissance, hommes (années) - Cameroon | Data* (2022). Available from: https://donnees.banquemondiale.org/indicator/SP.DYN.LE00.MA.IN?locations=CM (Accessed April 4, 2022).
25. Trombetti A, Hars M, Hsu FC, Reid KF, Church TS, Gill TM, et al. Effect of Physical Activity on Frailty: Secondary Analysis of a Randomized Controlled Trial. *Ann Intern Med* (2018) 168(5):309–16. doi:10.7326/M16-2011
26. Boulos C, Salameh P, Barberger-Gateau P. Malnutrition and Frailty in Community Dwelling Older Adults Living in a Rural Setting. *Clin Nutr Edinb Scotl* (2016) 35(1):138–43. doi:10.1016/j.clnu.2015.01.008
27. Mohamad MI, Khater MS. Evaluation of Insulin like Growth Factor-1 (IGF-1) Level and its Impact on Muscle and Bone mineral Density in Frail Elderly Male. *Arch Gerontol Geriatr* (2015) 60(1):124–7. doi:10.1016/j.archger.2014.08.011
28. Seto E, Setiati S, Laksmi PW, Tamin TZ. Diagnostic Test of a Scoring System for Frailty Syndrome in the Elderly According to Cardiovascular Health Study, Study of Osteoporotic Fracture and Comprehensive Geriatric Assessment Based Frailty Index Compared with Frailty Index 40 Items. *Acta Med Indones* (2015) 47(3):183–7.
29. Imamura K, Yamamoto S, Suzuki Y, Yoshikoshi S, Harada M, Osada S, et al. Comparison of the Association between Six Different Frailty Scales and Clinical Events in Patients on Hemodialysis. *Nephrol Dial Transpl Off Publ Eur Dial Transpl Assoc - Eur Ren Assoc.* (2022) 38:455–62. doi:10.1093/ndt/gfac047
30. Bandinelli S, Lauretani F, Boscherini V, Gandi F, Pozzi M, Corsi AM, et al. A Randomized, Controlled Trial of Disability Prevention in Frail Older Patients Screened in Primary Care: The FRASI Study. Design and Baseline Evaluation. *Aging Clin Exp Res* (2006) 18(5):359–66. doi:10.1007/BF03324831
31. Kim MJ, Yabushita N, Kim MK, Nemoto M, Seino S, Tanaka K. Mobility Performance Tests for Discriminating High Risk of Frailty in Community-Dwelling Older Women. *Arch Gerontol Geriatr* (2010) 51(2):192–8. doi:10.1016/j.archger.2009.10.007
32. Cesari M, Kritchevsky SB, Penninx BWHJ, Nicklas BJ, Simonsick EM, Newman AB, et al. Prognostic Value of Usual Gait Speed in Well-Functioning Older People-Rresults from the Health, Aging and Body Composition Study. *J Am Geriatr Soc* (2005) 53(10):1675–80. doi:10.1111/j.1532-5415.2005.53501.x
33. O'Caoimh R, Sezgin D, O'Donovan MR, Molloy DW, Clegg A, Rockwood K, et al. Prevalence of Frailty in 62 Countries across the World: A Systematic Review and Meta-Analysis of Population-Level Studies. *Age Ageing* (2021) 50(1):96–104. doi:10.1093/ageing/afaa219
34. Collard RM, Boter H, Schoevers RA, Oude Voshaar RC. Prevalence of Frailty in Community-Dwelling Older Persons: A Systematic Review. *J Am Geriatr Soc* (2012) 60(8):1487–92. doi:10.1111/j.1532-5415.2012.04054.x
35. Gómez JF, Curcio CL, Alvarado B, Zunzunegui MV, Guralnik J. Validity and Reliability of the Short Physical Performance Battery (SPPB): A Pilot Study on Mobility in the Colombian Andes. *Colomb Med Cali Colomb* (2013) 44(3):165–71. doi:10.25100/cm.v44i3.1181

International Journal of Public Health
ORIGINAL ARTICLE
published: 25 October 2023
doi: 10.3389/ijph.2023.1606072

The Effect of Family Wealth on Physical Function Among Older Adults in Mpumalanga, South Africa: A Causal Network Analysis

Keletso Makofane[1]*, *Lisa F. Berkman*[2], *Mary T. Bassett*[3] and *Eric J. Tchetgen Tchetgen*[1,4]

[1]Center for Causal Inference, Department of Biostatistics, Epidemiology and Informatics, University of Pennsylvania, Philadelphia, PA, United States, [2]Harvard Center for Population and Development Studies, Harvard University, Cambridge, MA, United States, [3]FXB Center for Health and Human Rights, Harvard University, Boston, MA, United States, [4]Department of Statistics and Data Science, The Wharton School, University of Pennsylvania, Philadelphia, PA, United States

Objectives: The aging of the South African population could have profound implications for the independence and overall quality of life of older adults as life expectancy increases. While there is evidence that lifetime socio-economic status shapes risks for later function and disability, it is unclear whether, and how, the wealth of family members shapes these outcomes. We investigated the relationship between outcomes activities of daily living (ADL), grip strength, and gait speed, and the household wealth of non-coresident family members.

Methods: Using data from Health and Aging in Africa: A Longitudinal Study of an INDEPTH Community in South Africa (HAALSI) and the Agincourt Health and Demographic Surveillance System (AHDSS), we examined the relationship between physical function and household and family wealth in the 13 preceding years. HAALSI is a cohort of 5,059 adults who were 40 years or older at baseline in 2014. Using auto-g-computation—a recently proposed statistical approach to quantify causal effects in the context of a network of interconnected units—we estimated the effect of own and family wealth on the outcomes of interest.

Results: We found no evidence of effects of family wealth on physical function and disability.

Conclusion: Further research is needed to assess the effect of family wealth in early life on physical function and disability outcomes.

Keywords: causal inference, network spillover, socioeconomic status, epidemiologic study, aging population, physical function, disability

OPEN ACCESS

Edited by:
Tobias Vogt,
University of Groningen, Netherlands

Reviewed by:
Stéphane Cullati,
University of Fribourg, Switzerland

***Correspondence:**
Keletso Makofane
keletso.makofane@gmail.com

This Original Article is part of the IJPH Special Issue "Ageing and Health in Sub-Sahara Africa."

Received: *06 April 2023*
Accepted: *19 September 2023*
Published: *25 October 2023*

Citation:
Makofane K, Berkman LF, Bassett MT and Tchetgen Tchetgen EJ (2023) The Effect of Family Wealth on Physical Function Among Older Adults in Mpumalanga, South Africa: A Causal Network Analysis. Int J Public Health 68:1606072. doi: 10.3389/ijph.2023.1606072

INTRODUCTION

A demographic transition is underway in South Africa. Between 2020 and 2030, the proportion of the population that is over 65 will grow by one fifth—from 5.5% in 2020 to 6.7% in 2030 [1]. If not offset by improvements in healthy aging, this transition could have profound implications for the independence and overall quality of life of older adults [2]. To anticipate how these changes could be patterned in South Africa in the future, we investigated the relationship between socioeconomic status and outcomes related to disability.

Over the life course, social status arrays a multitude of exposures which are "embodied" by individuals, shaping later health outcomes [3–5]. Prior studies have established a robust positive association between higher socioeconomic status and performance-based measures of physical function [6–10] and a negative association with self-reported limitations in basic and instrumental activities of daily living [11–14]. There is consistent evidence that lower childhood socioeconomic status is associated with lower physical function in later life [14–16], and mixed evidence that these effects persist even after accounting for adult socioeconomic status [17, 18]. These findings are based largely on studies that were conducted in high income countries, though there is a growing body of evidence from low- and middle-income countries including South Africa [19, 20].

While it is clear that individuals' access to material resources shapes the risk of disability, it is not well understood whether and how the resources held by family members shape these outcomes. This is a crucial gap. In South Africa, households are embedded in local kinship-based networks of support, exchanging resources including labor and food with one another [21]. Under the assumption that the wealth of a particular household is a determinant of its members' ability to provide resources to members of other households, the level of wealth held by family members could be an important determinant of the physical function of the individual.

Guided by the Disablement Process [22, 23], a conceptual model that posits a causal pathway moving from pathology to impairment to functional limitation and to disability, we investigated the relationship between socioeconomic status and Activities of Daily Living (ADL), grip strength, and gait speed. The ADL scale is widely used to assess the severity of limitations among older and chronically ill patients that hinder the completion of tasks thought to be habitual and universally performed: bathing, dressing, going to the toilet, transferring, continence, and feeding [24]. We consider it a measure of disability. We consider hand grip strength to be a measure of impairment, assessing overall losses in muscle mass and strength [25], and gait speed to be measure of functional limitation, assessing the ability to perform the action of walking. Understanding how functional limitations and disability are shaped by the wealth of family members could shape welfare policy by, for instance, identifying the need for additional support among poor households which are connected only to other poor households (compared with poor households which are connected to wealthy ones).

Using data from Health and Aging in Africa: A Longitudinal Study of an INDEPTH Community in South Africa (HAALSI) and the Agincourt Health and Demographic Surveillance System (AHDSS), we examined the relationship between physical function and household wealth in the 13 preceding years. We quantified the effect of a one-standard-deviation increase in household wealth on average physical function using regression analysis. We establish a causal interpretation for these regression results drawing on auto-g-computation—a recently proposed statistical approach to quantify spillover causal effects on a network of interconnected units [26]. This approach allows us to decompose the overall effect of household wealth on disability and physical function into a causal component attributable to the change in each individual's own household resources, and a component attributable to the change in the household resources of non-coresident family members. We present estimates of these effects, along with the assumptions under which they may be interpreted as causal.

METHODS

Data and Study Setting

Covering a 420 km^2 region of Mpumalanga Province, South Africa, Agincourt Health and Demographic Surveillance System (AHDSS) has conducted an annual survey of households, collecting information on births, deaths, migrations, and family relationships since 1992. In addition, AHDSS fieldworkers collected information on household wealth once every 2 years beginning in 2001 and annually since 2013 [27, 28]. The Health and Aging in Africa: A Longitudinal Study of an INDEPTH Community in South Africa (HAALSI) is a longitudinal cohort or older adults nested in the AHDSS. The HAALSI cohort is comprised of 5,059 adults who were sampled from residents of AHDSS who were over 40 years of age in 2014 [29].

We used AHDSS data on household wealth as the main exposure and HAALSI data on disability and physical function as the main outcome. Since this study used secondary data, IRB approvals were not required.

Social Network

To quantify the resources held in family networks, we constructed a sociocentric family network among all individuals in the AHDSS. In this network, nodes represent individuals and ties represent their relationships with first- or second-degree relatives. First-degree relatives are defined as parents, children, and conjugal partners, and second-degree relatives are the first-degree relatives of first-degree relatives. For a given individual, we use the term 'family members' to mean the group consisting of first- and second-degree relatives.

We used a sub-network consisting only of members of the HAALSI cohort along with their family members, regardless of whether the latter were themselves in the HAALSI cohort or not. We call this the HAALSI community network (HCNet).

Measures

Household and Network Wealth

Household wealth was assessed using a Demographic and Health Survey (DHS) asset index that incorporates information on household infrastructure and goods [20, 30]. Measurements of household wealth were made every 2 years from 2001 to 2013. For each year in this period, each individual in the HCNet is associated with the measure of household wealth that was recorded for her household. Network wealth was calculated as the sum of household wealth among the households of family members (See **Figure 1**). Where two or more family members lived in the same household, that household's wealth contributed only once to network wealth.

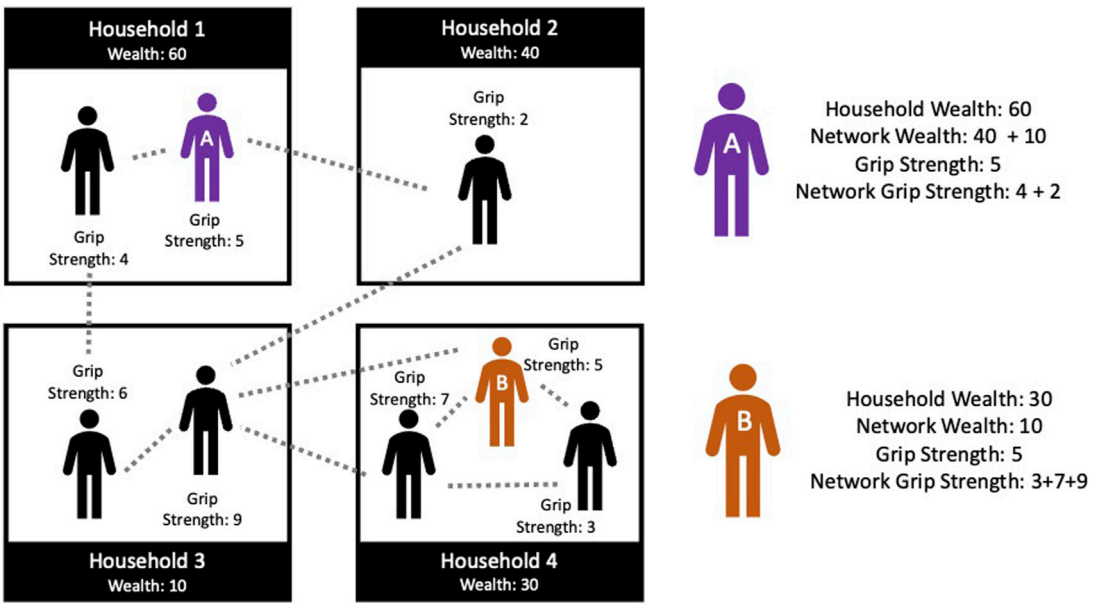


FIGURE 1 | Agincourt Health and Demographic Surveillance System Network Schematic. Dotted lines indicate family relationships. Boxes indicate households. Each individual has an individual Grip Strength score and each household has a Household Wealth value. Network Wealth is the sum of Household Wealth values for connected households. Network Grip Strength is the sum of Grip Strength scores among connected individuals. (Health and Aging in Africa: A Longitudinal Study in South Africa, Mpumalanga, South Africa, 2001 to 2014).

Individual and Network Physical Functioning

In HAALSI, individual grip strength was measured using a Smedley digital hand dynamometer, taking two measurements per hand. Following [20], we used the average of the grip strength measures on the participant's self-reported dominant hand. For participants who reported being ambidextrous, we took the average of the two highest measures regardless of which hand they were measured on. Measures above 75 kg were treated as out of range and therefore missing. An individual's network grip strength was measured as the sum of grip strength values among her family members who were over 40 years of age in 2014.

Individual and Network Gait Speed

Individual gait speed was measured among HAALSI participants using a timed walk. Interviewers marked a length of 2.5 meters on an obstacle-free floor. The respondent was asked to walk from one end to the other, and she was timed. The respondent was then asked to turn around and return to the point of origin while being timed. Gait speed was calculated by dividing 5 by the sum of the times (in seconds). Gait speeds below 0.2 m/s or above 2 m/s were treated as out of range and therefore missing. Network gait speed was measured as the sum of gait speed values among family members who were over 40 years of age in 2014.

Individual and Network Activities of Daily Living

Limitations in activities of daily living (ADL) was measured in HAALSI using a set of questions asking whether the respondent is unable, or finds it difficult, to bathe, eat, get out of bed, toilet, or walk across the room unaided. Individual ADL is equal to 1 if the individual had at least one limitation and 0 otherwise. Network ADL is the sum of ADL values among each individual's family members who were above 40 years of age in 2014.

Statistical Analysis

We conducted descriptive analysis for the above measures, as well as covariates formal education, employment, receipt of pension income, children, and marital status at HAALSI baseline. We also used these variables in the data imputation model. We included age and gender as potential confounders of the relationships between wealth measures and physical function measures. To help explain a surprising finding below, we conducted further analysis comparing time spent walking across individuals in different wealth quartiles. We present an abbreviated discussion of statistical and causal inference methods here. Details can be found in **Supplementary Material**.

Statistical Model

We assume the outcome data arose from a conditional Markov Random Field [26, 31] defined by the assumption that one individual's outcome is independent of any other individual's observations if a) the pair of individuals are not each other's family members b) we condition on the exposures and covariates of the first individual and her family members, and on the outcomes of family members.

We further assume that the conditional mean of physical function is described by the following model:

$$E\left[Y_{i,2014}^{ind}\middle|\mathbf{L}=\mathbf{l},\mathbf{A}=\mathbf{a},\mathbf{Y}=\mathbf{y}\right]=\beta_{0,t}+\beta_{1,t}a_{i,t}^{hh}+\beta_{2,t}l_{i}^{ind}+\beta_{3,t}a_{i,t}^{net}+\phi_{2014}y_{i,2014}^{net}$$

where for individual i during year t, $Y^{ind}_{i,2014}$ is the value of the individual outcome, $y^{net}_{i,2014}$ is the value of the network outcome, $a^{hh}_{i,t}$ is household wealth, $a^{net}_{i,t}$ is network wealth, and l^{ind}_{i} is an individual-level covariate value. Using linear regression, we estimated this model separately for each year t and each of the three physical function outcomes under investigation.

Though we only show one covariate, in analyses, this model included time-invariant covariates age (40–50; 51–60; 61–70; >70) and gender (male; female) as measured in AHDSS since these potentially determine household wealth and physical function.

Causal Estimands

Using auto-g-computation, we establish causal interpretation for the parameters of the conditional mean model shown above [26]. Combining estimated parameter estimates from the model with information on network structure, household membership, and age among AHDSS residents, we calculated the average direct effect (ADE), average spillover effect (ASE), and average total effect (ATE) of household wealth on disability and physical function.

For a given individual, we define the spillover effect as the change in outcome that results from holding the individual's household wealth fixed while increasing wealth for every other individual by one standard deviation. ASE is then the quantity we estimate by computing the spillover effect separately for each individual in the network and then taking an average over the network. Conversely, we define the direct effect as the change in outcome that results from increasing an individual's household wealth by one standard deviation, holding fixed the household wealth of all others. ADE is the average of this quantity. ATE is the on-average change in outcome that would result from a simultaneous one standard deviation increase in wealth for every household. ATE is the sum of ADE and ASE.

Identification Assumptions

ADE, ASE, and ATE are identified under the assumption that there is no unaccounted-for confounding. We included age and gender as potential confounders in the conditional mean model. This is consistent with past studies on the impact of socioeconomic status on health as assessed over long time horizons [8, 15, 32–34].

Unconfoundedness in the network setting also implies that there are no unmeasured common causes of the physical function measures taken on a pair of family members. If this were untrue, physical function outcomes would be correlated among family members—a condition we empirically test. Finally, we assume that the functional form we chose for the conditional mean model is correct.

Estimation

Parameters of the conditional mean model were estimated using general estimating equations with robust standard errors. We constructed Wald confidence intervals for each of these. Since ADE, ASE, and ATE are deterministic functions of the coefficients, we estimated them by plugging-in estimated values of the coefficients into the function. Based on the asymptotic distribution of the regression coefficients, we constructed confidence intervals for these causal estimates using the parametric bootstrap.

Estimating the parameters of the conditional mean models was complicated by the fact that the observations belonging to a pair of individuals who are connected in the family network are possibly correlated with each other. This is true when $\phi_{2014,q} \neq 0$. In this case, proceeding as if the observations were independent may lead to biased estimates. To overcome this challenge, we used the coding estimator described in [26], which requires that the conditional mean model be fitted using a sub-set of the data such that no pair of individuals in the sub-set is connected in the family network. Further details are shown in **Supplementary Material**.

Missing Data

Some individuals were missing data on household wealth, inducing missingness in network wealth. In addition, physical function was only measured among HAALSI participants and not among all AHDSS residents. This meant that among HAALSI participants, network physical function measures are not possible to compute directly. If we attempted to compute network physical function by summing over only the valid values of physical function among each respondent's direct ties, they would be right-censored. To account for missingness, we conducted two separate sets of analyses. The main analysis, which we present here, is based on multiple imputation using chained equations. This analysis is predicated on the assumption that missingness depends only on observed variables [35]. The secondary analysis, reported in **Supplementary Material**, dropped entries that were missing the outcome value or mean-imputed household wealth. Results from the latter analysis are unbiased under the stronger assumption that data are missing completely at random [35]. Details about imputation are shown in **Supplementary Material**.

RESULTS

Descriptive Analysis

At baseline, a quarter of HAALSI respondents were over 70 years of age and half were over 60 years of age (**Table 1**). Slightly more than half of the respondents were women, over half had some formal education and a small minority were employed, about a third received pension income, about half were married and/or living with a romantic partner, and the vast majority had children. Respondents whose household wealth was above the median tended to have higher formal education and employment, were more likely to receive pension income and were more likely to have children. They also tended to have higher wealth embedded in their family network. Wealthier members of the HAALSI cohort had higher grip strength, lower gait speed, and fewer limitations in activities of daily living than poorer members.

Conditional Mean Model

In **Figure 2**, we show results from the conditional mean models for ADL, grip strength, and gait speed, respectively. Since we did

TABLE 1 | Descriptive Statistics. (Health and Aging in Africa: A Longitudinal Study in South Africa, Mpumalanga, South Africa, 2001 to 2014).

	Above median wealth (N = 2,374)	Below median wealth (N = 2,378)	Overall (N = 4,752)
Age			
40–49	463 (19.5%)	491 (20.6%)	954 (20.1%)
50–59	637 (26.8%)	656 (27.6%)	1,293 (27.2%)
60–69	680 (28.6%)	529 (22.2%)	1,209 (25.4%)
70+	593 (25.0%)	702 (29.5%)	1,295 (27.3%)
Missing	1 (0.0%)	0 (0%)	1 (0.0%)
Gender			
Male	1,098 (46.3%)	1,084 (45.6%)	2,182 (45.9%)
Female	1,276 (53.7%)	1,294 (54.4%)	2,570 (54.1%)
Any Formal Education			
Yes	1,533 (64.6%)	1,019 (42.9%)	2,552 (53.7%)
No	832 (35.0%)	1,353 (56.9%)	2,185 (46.0%)
Missing	9 (0.4%)	6 (0.3%)	15 (0.3%)
Employment			
Yes	403 (17.0%)	314 (13.2%)	717 (15.1%)
No	1964 (82.7%)	2058 (86.5%)	4,022 (84.6%)
Missing	7 (0.3%)	6 (0.3%)	13 (0.3%)
Receives Pension Income			
Yes	859 (36.2%)	826 (34.7%)	1,685 (35.5%)
No	1,515 (63.8%)	1,552 (65.3%)	3,067 (64.5%)
Has Children			
Yes	2,283 (96.2%)	2,183 (91.8%)	4,466 (94.0%)
No	89 (3.7%)	194 (8.2%)	283 (6.0%)
Missing	2 (0.1%)	1 (0.0%)	3 (0.1%)
Married			
Yes	1,438 (60.6%)	1,014 (42.6%)	2,452 (51.6%)
No	933 (39.3%)	1,363 (57.3%)	2,296 (48.3%)
Missing	3 (0.1%)	1 (0.0%)	4 (0.1%)
Grip Strength			
Mean (SD)	24.3 (8.74)	23.2 (8.64)	23.7 (8.71)
Median [Min, Max]	23.1 [0, 73.6]	22.3 [0, 74.6]	22.7 [0, 74.6]
Missing	218 (9.2%)	230 (9.7%)	448 (9.4%)
Gait Speed			
Mean (SD)	0.672 (0.243)	0.689 (0.275)	0.680 (0.259)
Median [Min, Max]	0.625 [0.200, 1.67]	0.625 [0.200, 1.67]	0.625 [0.200, 1.67]
Missing	178 (7.5%)	193 (8.1%)	371 (7.8%)
Any ADL			
Yes	176 (7.4%)	237 (10.0%)	413 (8.7%)
No	2,191 (92.3%)	2,141 (90.0%)	4,332 (91.2%)
Missing	7 (0.3%)	0 (0%)	7 (0.1%)
Network Wealth			
Mean (SD)	12.2 (6.26)	10.1 (6.79)	11.1 (6.62)
Median [Min, Max]	11.4 [0, 41.0]	9.96 [0, 42.2]	10.7 [0, 42.2]
Missing	720 (30.3%)	603 (25.4%)	1,323 (27.8%)

not reject the hypothesis that $\phi = 0$ for ADL or gait speed, we concluded that for these outcome measures, observations were conditionally independent. i.e., Knowing about one individual's ADL or gait speed does not provide any information about the ADL or gait speed of individuals directly connected to him after adjusting for individual and network exposures and covariates. As a result, for these two outcomes, we fitted regression models using all available data. By contrast, there was evidence of positive conditional network dependence of grip strength among directly connected individuals, so we used the coding estimator described above, which required the use of a subset of data for estimation.

Causal Estimates

Since for gait speed and for ADL, network wealth and network physical function were not associated with the outcome, as shown in **Figure 3**, the average spillover effect was 0 for both these outcomes. There was some statistical evidence of a positive average direct effect of household wealth on grip strength in the years 2001 (0.923 95% CI: 0.551–1.294), 2003 (0.481 95% CI: 0.087–0.864), 2005 (0.767 95% CI: 0.346–1.184), 2007 (1.044 95% CI: 0.649–1.417), 2009 (1.124 95% CI: 0.684–1.55), 2011 (1.382 95% CI: 0.969–1.779), and 2013 (0.987 95% CI: 0.574–1.391), though the average spillover effect of household wealth on grip strength was 0 across all years for this outcome as well. There was evidence of a negative direct effect of wealth on ADL in the years 2007 (−0.016 95% CI: −0.03 to −0.002), 2011 (−0.024 95% CI: −0.039 to −0.01), and 2013 (−0.018 95% CI: −0.034 to −0.003).

Surprisingly, there was evidence of a negative direct effect of wealth on gait speed in 2001 (−0.022 95% CI:

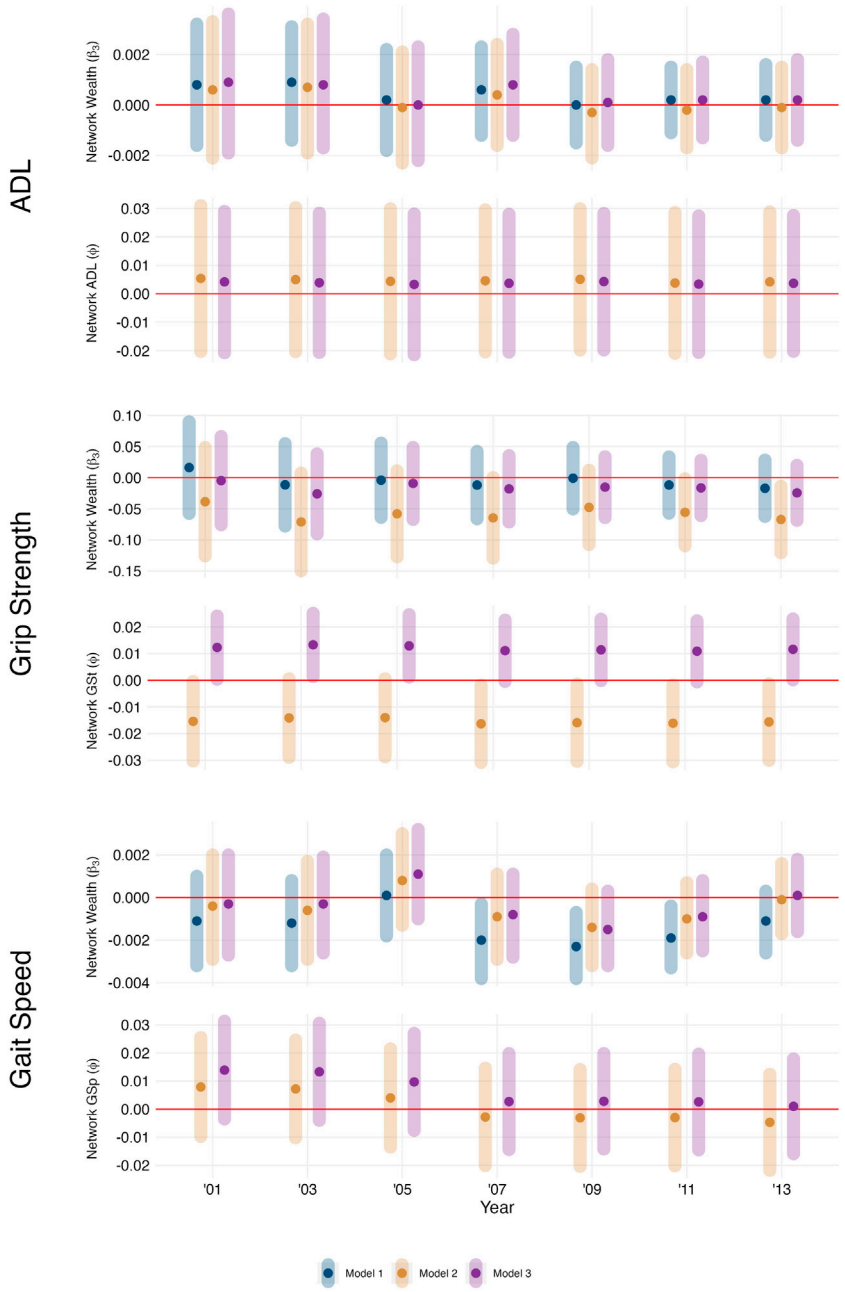


FIGURE 2 | Conditional Mean Model Results for Activities of Daily Living (ADL), Grip Strength (GSt), and Gait Speed (GSp). Model 1 includes Network Wealth and Household Wealth as predictors. Model 2 includes these as well as Network ADL as predictors. Model 3 includes these as predictors and adjusts age and gender as potential confounders. The top row shows the point estimate and confidence interval for network wealth ($\beta_{3,t}$), and the second bottom shows the coefficient for the network value of the physical function outcome (ϕ_{2014}). (Health and Aging in Africa: A Longitudinal Study in South Africa, Mpumalanga, South Africa, 2001 to 2014).

−0.038 to −0.007), 2003 (−0.023 95% CI: −0.038 to −0.009), 2005 (−0.022 95% CI: −0.04 to −0.004), 2007 (−0.023 95% CI: −0.039 to −0.007), and 2009 (−0.03 95% CI: −0.049 to −0.011). One possible explanation for this is that wealth shapes the amount of time spent walking. HAALSI respondents in the lowest quartile of household wealth walked for 2.3 h (95% CI: 2.14–2.47) per day while those in the second lowest quartile walked for 2 h (1.87–2.09) and those in the highest quartile walked for 2.1 h (1.97–2.32) (See **Figure 4**).

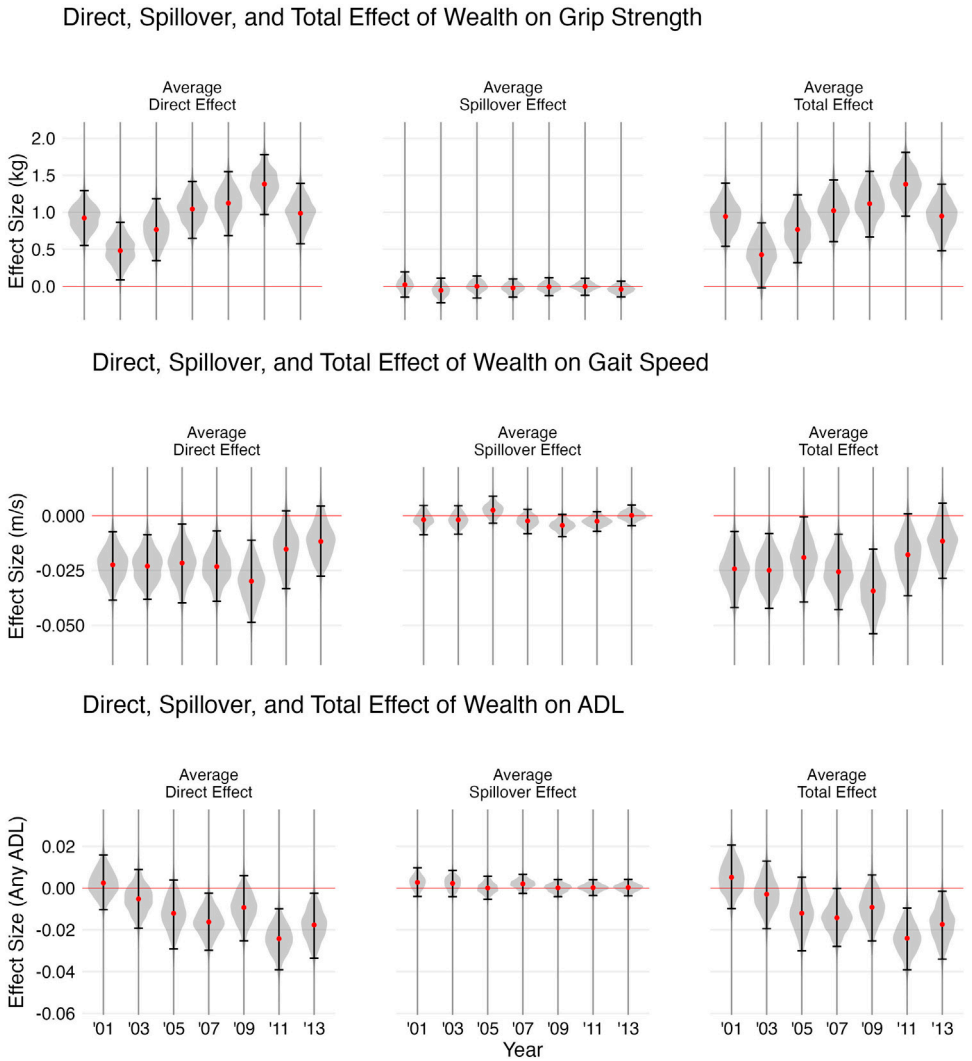


FIGURE 3 | Causal Estimates of the Effect of Wealth on Activities of Daily Living (ADL), Grip Strength, and Gait Speed. The first column shows the point estimate and confidence interval for Average Direct Effect (ADE), the second column shows results for Average Spillover Effect (ASE), and the final column shows results for Average Total Effect (ATE). (Health and Aging in Africa: A Longitudinal Study in South Africa, Mpumalanga, South Africa, 2001 to 2014).

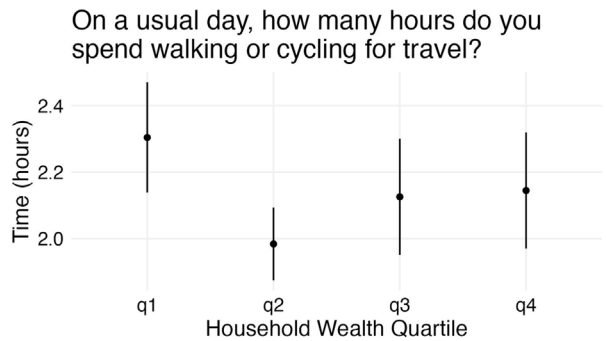


FIGURE 4 | Time spent walking by Household Wealth. (Health and Aging in Africa: A Longitudinal Study in South Africa, Mpumalanga, South Africa, 2001 to 2014).

DISCUSSION

Overall, we found no evidence of spillover effects of household wealth on measures of physical function or disability. We found evidence of a direct effect of household wealth on slower gait speed and a direct effect of household wealth on higher grip strength. Finally, we found weak evidence of a direct negative effect of wealth on limitations in ADL.

These measures offer different insights about the disablement process. We consider ADL a limited measure of disability, assessing the perceived capability of individuals to accomplish tasks demanded by their social environment without directly measuring those demands [23]. We consider hand grip strength to be a measure of impairment, assessing overall losses in muscle mass and

strength [25] and gait speed to be measure of functional limitation, assessing the ability to perform the action of walking. The latter two measures are "objective" and not based on self-report. Unlike ADL, they detect relatively small changes in function and are not susceptible to the systematic biases associated with self-report, though they might be susceptible to other kinds of biases [4].

For grip strength and ADL, our results are broadly consistent with the extant literature on functional limitations and disability among older adults. Socio-economic status has consistently found to be positively correlated with performance-based measures of physical function [6–10] and negatively associated with variables based on self-reported limitations in basic and instrumental activities of daily living [11–14]. That household wealth is negatively associated with gait speed is inconsistent with similar studies globally, but consistent with earlier work using the HAALSI dataset; [20] found that those in the highest quintile of household wealth had lower gait speed than those in the lowest quintile.

Our finding of null spillover effects of socioeconomic status echoes a result from a comparable study. Using the China Health and Retirement Longitudinal Study data which, like HAALSI, is a Health and Retirement Study (HRS) sister study, [36] found that "family economic support" — financial support by parents, children, or siblings—was not associated with health outcomes, including ADL, among older adults. It should be noted, however, that family economic support was not quantified as in our study; it was operationalized as a dichotomous variable indicating whether there was any family support or not.

There may be contextual reasons for the negative association between wealth and gait speed. Cross-country comparisons show that not only are population levels of impairment, limitation, and disability variable across settings [13, 20, 37, 38], the quantitative relationships among socioeconomic status, physical function, and self-reported limitations are context-dependent as well ([39]; [40–42]). In particular, in Agincourt, people of lower socio-economic status do more walking than those of higher status, possibly accounting for their faster walk speed. There is a body of research suggesting that increased physical activity plays a role in the prevention of limitations in physical function [43, 44].

Alternatively, this negative association could be a result of sample selection bias. Higher wealth likely increased the probability of surviving until enrollment into HAALSI through mechanisms other than gait speed, and higher gait speed might have also been positively associated with the probability of being in the HAALSI cohort. This kind of bias would induce a negative association between gait speed and wealth.

It is possible that there are spillover effects of wealth on physical function and disability that we failed to detect in this study. Our earliest measurements of wealth were in 2001—only 13 years prior to the measurement of the health outcomes. For the youngest members of HAALSI, wealth was measured beginning in their early 30s. For the oldest members of HAALSI, wealth was measured from their late 50s. These measures might miss an earlier critical window during which shared resources are more important, etiologically. There is robust evidence that early life conditions shape mid-life physical function. Birth weight, pre-pubertal height gain, pubertal growth, infant motor development all predict mid-life grip strength [45].

It is not possible to rule out reverse causation: it might be the case that prior ADL limitations, low gait speed and weak hand grip lowered the ability of HAALSI participants to generate income for their households due to unemployment [46], leading to lower wealth. It might also be that these effects were transmitted across family ties. Agincourt, however, has a chronically high unemployment rate, ranging from 63% as measured in the 2001 census to 52% as measured in the 2011 census [47]. As a result, the share of household income that is comprised of government transfers, including the state disability grant, is high. In 2019, Statistics South Africa reported this figure to be 54% across Mpumalanga Province, with a further 22% of income gained from remittances [48]. It is not clear whether functional limitations would decrease income via wages or increase income via grants and remittances, so it is difficult to anticipate the existence and direction of bias due to reverse causation.

Finally, physical function outcomes were likely measured with error, potentially attenuating the strength of the relationships between (network) wealth and the outcomes. Furthermore, our measure of socioeconomic status might be relatively insensitive to social gradients as they affect physical function, and therefore insensitive to networked social gradients. A prior study using HAALSI data showed steeper gradients in health outcomes when using a consumption-based measure of socioeconomic status rather than the wealth-based measure we used here [49]. Given the high unemployment and large number of households that receive government transfers in Agincourt, it is possible that using government transfers as a measure of socioeconomic status would show stronger social gradients than we found. It is also possible that understanding which relationships are more likely to transmit resources than others would allow for the detection of stronger social gradients. Future studies should investigate spillover using consumption-based measures of socio-economic status as well as measures based on government transfers along with the wealth-based measures we have used here and measures of the nature and closeness of relationships among family members.

Our study provides evidence that in adulthood, impairment, physical limitation and disability are shaped by one's own household wealth but not necessarily the wealth of family members in other households. These results suggest that knowing about the socio-economic status of family members will not help us to predict the burden of disability among the aging South African population. Further research is needed to assess the effect of wealth and family wealth in early life on these same outcomes, and if those effects are significant, to assess the different causal pathways that connect exposure and outcome. To enable this work, it is crucial to cultivate network datasets, possibly combining data from epidemiologic studies with data that are passively collected from social media and mobile devices.

ETHICS STATEMENT

Ethical approval was not required for the studies involving humans because this is a secondary analysis of a study that had ethical approval. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

KM conducted the analysis and drafted the manuscript. ET contributed to methodology. KM, LB, MB, and ET critically discussed and revised manuscript.

FUNDING

The HAALSI study was supported by the U.S. National Institute on Aging (grant number P01 AG041710).

CONFLICT OF INTEREST

The authors declare that they do not have any conflicts of interest.

ACKNOWLEDGMENTS

We thank batho ba Lešabane ‘a Matebele, Mapheke ‘a Gabele, Ratala, Hudu le Molimi, Sibilo sa Nyawane; Dikgogwa tsa mohlakamotala. This work was completed as part of KM’s dissertation entitled “Networked resources and health in South Africa: Towards a Materialist Social Network Epidemiology” [50]. We are grateful to the Agincourt Health and Demographic Surveillance System (particularly Drs. Stephen Tollman, Kathy Kahn, and Chodziwadziwa Kabudula) for sharing the network data used in this analysis; and the HAALSI study (particularly, LB, Livia Montana, and Julia Rohr) for availing the physical function data. We are indebted to the University of Pennsylvania Center for Causal Inference (particularly ET) for extending to KM refuge from a grueling experience of racism in the workplace. Without that refuge and recovery, it would have taken much longer to prepare this work for publication.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.ssph-journal.org/articles/10.3389/ijph.2023.1606072/full#supplementary-material

REFERENCES

1. United Nations, Department of Economic and Social Affairs, Population Division. *World Population Prospects 2019, Volume II: Demographic Profiles*. ST/ESA/SER. A/427 (2019).
2. Guralnik JM. Robine and Michel’s "Looking Forward to A General Theory on Population Aging": Population Aging across Time and Cultures: Can We Move From Theory to Evidence? *Journals Gerontol Ser A, Biol Sci Med Sci* (2004) 59(6):M606–8. doi:10.1093/gerona/59.6.m606
3. Coppin AK, Ferrucci L, Lauretani F, Phillips C, Chang M, Bandinelli S, et al. Low Socioeconomic Status and Disability in Old Age: Evidence from the InChianti Study for the Mediating Role of Physiological Impairments. *Journals Gerontol Ser A, Biol Sci Med Sci* (2006) 61(1):86–91. doi:10.1093/gerona/61.1.86
4. Guralnik JM, Fried LP, Salive ME. Disability as a Public Health Outcome in the Aging Population. *Annu Rev Public Health* (1996) 17:25–46. doi:10.1146/annurev.pu.17.050196.000325
5. Krieger N. *Epidemiology and the People’s Health: Theory and Context*. Oxford University Press (2001).
6. Borges VS, Lima-Costa MFF, Andrade FBde. A Nationwide Study on Prevalence and Factors Associated with Dynapenia in Older Adults: ELSI-Brazil. *Cadernos De Saude Publica* (2020) 36(4):e00107319. doi:10.1590/0102-311X00107319
7. Demakakos P, Cooper R, Hamer M, Oliveira Cde, Hardy R, Breeze E. The Bidirectional Association between Depressive Symptoms and Gait Speed: Evidence from the English Longitudinal Study of Ageing (ELSA). *PLoS One* (2013) 8(7):e68632. doi:10.1371/journal.pone.0068632
8. Mohd Hairi F, Mackenbach JP, Andersen-Ranberg K, Avendano M. Does Socio-Economic Status Predict Grip Strength in Older Europeans? Results from the SHARE Study in Non-Institutionalised Men and Women Aged 50+. *J Epidemiol Community Health* (2010) 64(9):829–37. doi:10.1136/jech.2009.088476
9. Sanderson WC, Scherbov S. Measuring the Speed of Aging Across Population Subgroups. *PLoS One* (2014) 9(5):e96289. doi:10.1371/journal.pone.0096289
10. Tampubolon G. Growing up in Poverty, Growing Old in Infirmity: The Long Arm of Childhood Conditions in Great Britain. *PLoS One* (2015) 10(12):e0144722. doi:10.1371/journal.pone.0144722
11. Andrade JM, Duarte YAde O, Alves LC, Andrade FCD, Souza Junior PRBde, Lima-Costa MF, et al. Frailty Profile in Brazilian Older Adults: ELSI-Brazil. *Revista De Saude Publica* (2018) 2(2):17s. doi:10.11606/S1518-8787.2018052000616
12. d’Orsi E, Xavier AJ, Steptoe A, Oliveira Cde, Ramos LR, Orrell M, et al. Socioeconomic and Lifestyle Factors Related to Instrumental Activity of Daily Living dynamics:Results From the English Longitudinal Study of Ageing. *J Am Geriatr Soc* (2014) 62(9):1630–9. doi:10.1111/jgs.12990
13. Wahrendorf M, Reinhardt JD, Siegrist J. Relationships of Disability with Age Among Adults Aged 50 to 85: Evidence From the United States, England and Continental Europe. *PLoS One* (2013) 8(8):e71893. doi:10.1371/journal.pone.0071893
14. Zhong Y, Wang J, Nicholas S. Gender, Childhood and Adult Socioeconomic Inequalities in Functional Disability Among Chinese Older Adults. *Int J Equity Health* (2017) 16(1):165. doi:10.1186/s12939-017-0662-3
15. Birnie K, Martin RM, Gallacher J, Bayer A, Gunnell D, Ebrahim S, et al. Socio-Economic Disadvantage from Childhood to Adulthood and Locomotor Function in Old Age: A Lifecourse Analysis of the Boyd Orr and Caerphilly Prospective Studies. *J Epidemiol Community Health* (2011) 65(11):1014–23. doi:10.1136/jech.2009.103648
16. Landös A, Arx Mvon, Cheval B, Sieber S, Kliegel M, Gabriel R, et al. Childhood Socioeconomic Circumstances and Disability Trajectories in Older Men and Women: A European Cohort Study. *Eur J Public Health* (2019) 29(1):50–8. doi:10.1093/eurpub/cky166
17. Dodds R, Denison HJ, Ntani G, Cooper R, Cooper C, Sayer AA, et al. Birth Weight and Muscle Strength: A Systematic Review and Meta-Analysis. *J Nutr Health Aging* (2012) 16(7):609–15. doi:10.1007/s12603-012-0053-9
18. Vable AM, Gilsanz P, Kawachi I. Is It Possible to Overcome the ’Long Arm’ of Childhood Socioeconomic Disadvantage Through Upward Socioeconomic Mobility? *J Public Health (Oxford, England)* (2019) 41(3):566–74. doi:10.1093/pubmed/fdz018
19. Brennan-Olsen SL, Bowe SJ, Kowal P, Naidoo N, Quashie NT, Eick G, et al. Functional Measures of Sarcopenia: Prevalence, and Associations With Functional Disability in 10,892 Adults Aged 65 Years and over from Six Lower- and Middle-Income Countries. *Calcified Tissue Int* (2019) 105(6):609–18. doi:10.1007/s00223-019-00609-x

20. Payne CF, Wade A, Kabudula CW, Davies JI, Chang AY, Gomez-Olive FX, et al. Prevalence and Correlates of Frailty in an Older Rural African Population: Findings From the HAALSI Cohort Study. *BMC Geriatr* (2017) 17(1):293. doi:10.1186/s12877-017-0694-y
21. Madhavan S, Mee P, Collinson M. Kinship in Practice: Spatial Distribution of Children's Kin Networks. *J South Afr Stud* (2014) 40(2):401–18. doi:10.1080/03057070.2014.906211
22. Pope AM, Tarlov AR. *Disability in america: Toward a National Agenda for Prevention*. ERIC (1991).
23. Verbrugge LM, Jette AM. The Disablement Process. *Soc Sci Med (1982)* (1994) 38(1):1–14. doi:10.1016/0277-9536(94)90294-1
24. Katz S, Ford AB, Moskowitz RW, Jackson BA, Jaffe MW. Studies of Illness in the Aged - the Index of ADL: A Standardized Measure of Biological and Psychosocial Function. *JAMA* (1963) 185:914–9. doi:10.1001/jama.1963.03060120024016
25. Patel SM, Duchowny KA, Kiel DP, Correa-de-Araujo R, Fielding RA, Travison T, et al. Sarcopenia Definition & Outcomes Consortium Defined Low Grip Strength in Two Cross-Sectional, Population-Based Cohorts. *J Am Geriatr Soc* (2020) 68(7):1438–44. doi:10.1111/jgs.16419
26. Tchetgen Tchetgen EJ, Fulcher IR, Shpitser I. Auto-g-computation of Causal Effects on a Network. *J Am Stat Assoc* (2020) 116:833–44. doi:10.1080/01621459.2020.1811098
27. Kabudula CW, Houle B, Collinson MA, Kahn K, Gómez-Olivé FX, Tollman S, et al. Socioeconomic Differences in Mortality in the Antiretroviral Therapy Era in Agincourt, Rural South Africa, 2001-13: A Population Surveillance Analysis. *Lancet Glob Health* (2017) 5(9):e924–35. doi:10.1016/S2214-109X(17)30297-8
28. Kahn K, Collinson MA, Gómez-Olivé FX, Mokoena O, Twine R, Mee P, et al. Profile: Agincourt Health and Socio-Demographic Surveillance System. *Int J Epidemiol* (2012) 41(4):988–1001. doi:10.1093/ije/dys115
29. Gómez-Olivé FX, Montana L, Wagner RG, Kabudula CW, Rohr JK, Kahn K, et al. Cohort Profile: Health and Ageing in Africa: A Longitudinal Study of an INDEPTH Community in South Africa (HAALSI). *Int J Epidemiol* (2018) 47(3):689–90j. doi:10.1093/ije/dyx247
30. Rutstein SO, Johnson K, Measure OM. *The DHS Wealth index*. MEASURE DHS: ORC Macro (2004).
31. Besag J. Spatial Interaction and the Statistical Analysis of Lattice Systems. *J R Stat Soc Ser B (Methodological)* (1974) 36(2):192–225. doi:10.1111/j.2517-6161.1974.tb00999.x
32. Minkler M, Fuller-Thomson E, Guralnik JM. Gradient of Disability Across the Socioeconomic Spectrum in the United States. *New Engl J Med* (2006) 355(7):695–703. doi:10.1056/NEJMsa044316
33. Osler M, Madsen M, Nybo Andersen A-M, Avlund K, McGue M, Jeune B, et al. Do Childhood and Adult Socioeconomic Circumstances Influence Health and Physical Function in Middle-Age? *Soc Sci Med (1982)* (2009) 68(8):1425–31. doi:10.1016/j.socscimed.2009.01.014
34. Rautio N, Heikkinen E, Ebrahim S. Socio-economic Position and its Relationship to Physical Capacity Among Elderly People Living in Jyväskylä, Finland: Five- and Ten-Year Follow-Up Studies. *Soc Sci Med (1982)* (2005) 60(11):2405–16. doi:10.1016/j.socscimed.2004.11.029
35. Rubin DB. Inference and Missing Data. *Biometrika* (1976) 63(3):581–92. doi:10.1093/biomet/63.3.581
36. Tang S, Xu Y, Li Z, Yang T, Qian D. Does Economic Support Have an Impact on the Health Status of Elderly Patients with Chronic Diseases in China? - Based on CHARLS (2018) Data Research. *Front Public Health* (2021) 9:658830. doi:10.3389/fpubh.2021.658830
37. Tavares Milhem Ygnatios N, Oliveira Cde, Vaz de Melo Mambrini J, Bof de Andrade F, Lima-Costa MF, Lustosa Torres J. Differences in Disability and Nutritional Status Among Older Brazilian and English Adults: The Brazilian Longitudinal Study of Aging (ELSI-Brazil) and English Longitudinal Study of Aging (ELSA) Cohorts. *Am J Clin Nutr* (2021):nqab060. doi:10.1093/ajcn/nqab060
38. Xu D, Arling G, Wang K. A Cross-Sectional Study of Self-Rated Health Among Older Adults: A Comparison of China and the United States. *BMJ open* (2019) 9(7):e027895. doi:10.1136/bmjopen-2018-027895
39. Chan KS, Kasper JD, Brandt J, Pezzin LE. Measurement Equivalence in ADL and IADL Difficulty across International Surveys of Aging: Findings From the HRS, SHARE, and ELSA. *Journals Gerontol Ser B, Psychol Sci Soc Sci* (2012) 67(1):121–32. doi:10.1093/geronb/gbr133
40. Guralnik J, Bandeen-Roche K, Bhasin Sa. R, Eremenco S, Landi F, Muscedere J, et al. Clinically Meaningful Change for Physical Performance: Perspectives of the ICFSR Task Force. *J Frailty Aging* (2020) 9(1):9–13. doi:10.14283/jfa.2019.33
41. Miller ME, Magaziner J, Marsh AP, Fielding RA, Gill TM, King AC, et al. Gait Speed and Mobility Disability: Revisiting Meaningful Levels in Diverse Clinical Populations. *J Am Geriatr Soc* (2018) 66(5):954–61. doi:10.1111/jgs.15331
42. Peterson MD, Duchowny K, Meng Q, Wang Y, Chen X, Zhao Y. Low Normalized Grip Strength Is A Biomarker for Cardiometabolic Disease and Physical Disabilities Among U.S. And Chinese Adults. *Journals Gerontol Ser A, Biol Sci Med Sci* (2017) 72(11):1525–31. doi:10.1093/gerona/glx031
43. Lee S-Y, Tung H-H, Liu C-Y, Chen L-K. Physical Activity and Sarcopenia in the Geriatric Population: A Systematic Review. *J Am Med Directors Assoc* (2018) 19(5):378–83. doi:10.1016/j.jamda.2018.02.003
44. Oliveira JS, Pinheiro MB, Fairhall N, Walsh S, Chesterfield Franks T, Kwok W, et al. Evidence on Physical Activity and the Prevention of Frailty and Sarcopenia Among Older People: A Systematic Review to Inform the World Health Organization Physical Activity Guidelines. *J Phys Activity Health* (2020) 17(12):1247–58. doi:10.1123/jpah.2020-0323
45. A Sayer A, Stewart C, Patel H, Cooper C. The Developmental Origins of Sarcopenia: From Epidemiological Evidence to Underlying Mechanisms. *J Dev Origins Health Dis* (2010) 1(3):150–7. doi:10.1017/S2040174410000097
46. Ahrenfeldt LJ, Möller S. The Reciprocal Relationship between Socioeconomic Status and Health and the Influence of Sex: A European SHARE-Analysis Based on Structural Equation Modeling. *Int J Environ Res Public Health* (2021) 18(9):5045. doi:10.3390/ijerph18095045
47. Statistics South Africa. *Key Statistics - Bushbuckridge* (2021). Available at: http://www.statssa.gov.za/?page_id=993&id=bushbuckridge-municipality (Accessed August 23, 2023).
48. Statistics South Africa. *Labour Market Dynamics in south africa, 2019* (2019). Available at: http://www.statssa.gov.za/publications/Report-02-11-02/Report-02-11-022019.pdf (Accessed August 23, 2023).
49. Riumallo-Herl C, Canning D, Kabudula C. Health Inequalities in the South African Elderly: The Importance of the Measure of Social-Economic Status. *The J Econ Ageing* (2019) 14:100191. doi:10.1016/j.jeoa.2019.01.005
50. Makofane K. Networked Resources and Health in South Africa: Towards a Materialist Social Network Epidemiology. [Doctoral dissertation]. Harvard University (2021).

International Journal of Public Health
ORIGINAL ARTICLE
published: 23 November 2023
doi: 10.3389/ijph.2023.1606273

How Do Older Adults in a Sub-Saharan African Community Perceive and Cope With Their Disability? An Interpretive Phenomenological Analysis

Judith Ifunanya Ani[1]*, *Kezia Batisai*[1], *Loretta F. C. Ntoimo*[2] *and Uche C. Isiugo-Abanihe*[3]

[1]Department of Sociology, Faculty of Humanities, University of Johannesburg, Johannesburg, South Africa, [2]Department of Demography and Social Statistics, Faculty of Social Sciences, Federal University Oye-Ekiti, Oye, Nigeria, [3]Department of Sociology, Faculty of the Social Sciences, University of Ibadan, Ibadan, Nigeria

Objective: The study explored the perceptions and coping strategies employed by older adults in a Sub-Saharan African community in relation to their disabilities.

Methods: The research utilized an Interpretive Phenomenological Analysis methodology and conducted semi-structured interviews with a purposive sample of households. The study recruited a total of 36 older adults aged 65 years and above, aiming to capture a diverse range of insights and perspectives within the Sub-Saharan African community.

Results: Three interrelated themes pertaining to the perception of disability emerged: the impact of old age, disabilities caused by diseases, and disabilities attributed to external factors such as witchcraft. In coping with disability, two interrelated themes emerged: pragmatic coping strategies and unpragmatic coping strategies.

Conclusion: This study offers valuable insights into the nuanced perception of disability and coping mechanisms utilized by older adults within the Sub-Saharan African community. By exploring their lived experiences, the findings contribute to a better understanding of the challenges they face. These insights have important implications for policy development and public health initiatives.

Keywords: older adults, disability, coping strategies, interpretive phenomenological analysis, Sub-Saharan Africa

OPEN ACCESS

Edited by:
Elke Loichinger, Federal Institute for Population Research, Germany

Reviewed by:
Eleni Koutsogeorgou-Andreou, University of Wales Trinity Saint David, United Kingdom

***Correspondence:**
Judith Ifunanya Ani
ani.judithifunanya@yahoo.com

This Original Article is part of the IJPH Special Issue "Ageing and Health in Sub-Sahara Africa"

Received: *03 June 2023*
Accepted: *13 November 2023*
Published: *23 November 2023*

Citation:
Ani JI, Batisai K, Ntoimo LFC and Isiugo-Abanihe UC (2023) How Do Older Adults in a Sub-Saharan African Community Perceive and Cope With Their Disability? An Interpretive Phenomenological Analysis. Int J Public Health 68:1606273. doi: 10.3389/ijph.2023.1606273

INTRODUCTION

Sub-Saharan Africa is projected to experience significant population growth in the coming decades, including a rise in the number of older adults. The population of older adults aged 65 years and above in the region is expected to increase from 32 million in 2019 to 101 million by 2050 [1, 2]. Consequently, Scholars emphasize the need to strengthen care and support systems for older adults in this region to address the impending challenges [3, 4]. Research, policies, and programs are also called for to improve the wellbeing of older adults and mitigate potential negative impacts on public health [5, 6]. Ageing correlates with higher disability rates, diminishing independence [7]. It also associates with anxiety, restrictions, health challenges, and difficulties [8]. In developing nations with high poverty rates, ageing and disability are often neglected policy concerns [9]. Disability is defined as limitations from impairments, hindering daily activities and functional independence [10]. Disability is intricate, requiring coping strategies involving cognitive and behavioral approaches

to manage challenges [11]. The perception of disability, akin to coping, significantly influences health outcomes [12]. Recognizing and addressing the complexity of disability, while promoting effective coping, can enhance wellbeing and overall health for individuals with disabilities.

Coping is categorized into types like "active versus passive," "approach versus avoidance," "problem-focused versus emotion-focused," and "adaptive versus maladaptive" [13, 14]. Active, approach, problem-focused, and adaptive coping maintain control and address stressors, while passive, avoidance, emotion-focused, and maladaptive coping involve resignation and inefficient defense mechanisms. Coping also involves engagement (focusing on the problem, seeking support) and disengagement (employing defense mechanisms, denial) [15]. In engagement coping, individuals find meaning through values and beliefs, while disengagement coping, in uncontrollable situations, may involve reliance on religious beliefs and denial.

Considering the interconnectedness of individuals in social structures [16], exploring disability perception and coping through Interpretive Phenomenological Analysis (IPA) is crucial. IPA unveils themes in personal narratives [17], offering insight into overlooked aspects in lived experiences. It links individual experiences with broader societal and global interpretations, providing a comprehensive understanding of how individuals navigate disability challenges in their social and cultural contexts. Understanding how older adults perceive disability and cope is crucial for policy development and public health improvement. Research exploring their perspectives, challenges, and coping mechanisms can inform tailored support systems and interventions to improve wellbeing and quality of life. This study, therefore, explores disability perceptions and coping strategies among older adults in a Sub-Saharan African community, providing an interpretive perspective on the dual challenges of old age and disability, contributing to gerontological literature, and revealing the interplay between individual and societal contexts.

METHODS

Design

This qualitative study employed in-depth interviews and the Interpretive Phenomenological Analysis (IPA) framework to explore how older adults perceive and cope with disabilities. Following IPA's recommended stages [18], from formulating questions to data analysis, the research aimed for a hermeneutic interpretation of participants' experiences. The rigorous approach provided deep insights into their perspectives and coping mechanisms, capturing nuanced aspects of older adults' experiences with disabilities.

Study Location and Participant Sample

The study addressed the dearth of data on older adults with disabilities and their coping strategies in an Igbo-speaking community in Enugu State, south-eastern Nigeria. Purposive sampling involved recruiting participants aged 65 or older, living with a disability for at least 12 months. Community gatekeepers identified eligible participants, and disability determination relied on self-reported need for assistance in at least one Activity of Daily Living (ADL) or Instrumental Activity of Daily Living (IADL). Communication was facilitated by two trained research assistants proficient in participants' dialects. The study included 36 participants, meeting criteria for theoretical saturation [19] and following the Interpretive Phenomenological Analysis (IPA) methodology [20].

Interviews

The study employed a semi-structured interview approach to gather data on participants' demographic characteristics, perceptions of disability, coping strategies, societal dynamics, governmental involvement, and challenges of living with disability in old age. Researchers, skilled in qualitative research and Interpretive Phenomenological Analysis (IPA), conducted interviews. In cases where coherent responses were not possible, interviews were discontinued for accurate reflection. The hour-long interviews, conducted in participants' homes for comfort, were audio-recorded in both English and Igbo. Igbo interviews were translated and transcribed for analysis and interpretation.

Research Quality

The study adhered to key principles such as relevance, context sensitivity, coherence, transparency, rigour, and commitment to the research process. Emphasizing relevance, the study aimed to inform policy and public health initiatives, particularly focusing on older adults living with a disability. Context sensitivity was evident in aligning with research objectives. Transparency was maintained through a detailed description of participant recruitment and data analysis, enhancing study credibility. Rigour and commitment were upheld by researchers through attentive interviews and thorough transcriptions analysis. They acknowledged personal experiences but demonstrated willingness to set aside biases, displaying expertise in using the Interpretive Phenomenological Analysis (IPA) methodology, reaffirming their dedication to the research.

Analysis

Transcript analysis followed a methodical approach, involving reading for familiarity, identifying significant statements, coding, and grouping into themes. Manifest and latent content were considered, aiming to reveal both surface-level and deeper meanings. Integrity, trustworthiness, and credibility were prioritized for a balanced representation. Reflexivity acknowledged biases, and researchers consciously bracketed perspectives [21–24] for objectivity. Pseudonyms protected identities, and coping strategies were categorized as "pragmatic" or "unpragmatic." The study adhered to rigorous procedures, ensuring an accurate and nuanced interpretation while maintaining transparency and credibility.

Ethics Approval and Consent to Participate

This study was approved by the University of Ibadan Social Sciences and Health Research Ethics Committee (UI/SSHREC/2019/0006). The study was conducted in accordance with the local legislation and institutional requirements. The participants

provided their written consent to participate in this study. Ethical considerations such as respect for persons, confidentiality, voluntariness, non-malfeasance, and sensitivity were carefully taken into account throughout the study.

RESULTS

Participants Information

The study included 36 participants, with a higher female representation (58.3%). The majority (47.2%) were aged 65–69, and nearly 70% were married, with over 80% having more than four children. Only 5.6% had tertiary education, and none were employed. The prevalent disabilities reported were mobility-related (e.g., from stroke) and pain-related. (See **Table 1**).

Perception of Disability

Participants' disability perceptions were categorized into three themes: the effect of old age, attributing disability to diseases, and perceiving disability as inflicted by external forces like witchcraft. The first theme sees disability as a natural consequence of aging. The second emphasizes the belief that diseases or health conditions caused disabilities. The third theme reflects a view where some participants see their disabilities as inflicted by external factors, indicating a more adversarial perspective.

Specifically on the effect of old age, participants said:

> . . .I am old and my body is weak. I am not able to do things I used to because I am old. It is very difficult to move around because of the pain. . . -Paul
>
> . . .When one begins to grow old, he will not be able to do things they were used to in their younger days. . . -Obigwe
>
> . . .Old age is beautiful but it comes with some problems. You wake up one morning and find out things are changing. You are not able to wake up as you used to before. . . -Sussana
>
> I used to encourage younger ones to take care of their health in their youth because old age has a lot of challenges it gives to people who are not prepared. -Theresa

On their disabilities being caused by disease, participants expressed their perspectives in the following manner:

TABLE 1 | Demographic characteristics of older adults with disabilities (Enugu, 2021).

Variable	Frequency (*N* = 36)	Percentage (100%)
Gender		
Male	15	41.7
Female	21	58.3
Age		
65–69	17	47.2
70–74	9	25.0
75–79	6	16.7
80+	4	11.1
Mean Age: 71.75		
Marital Status		
Currently Married	25	69.4
Previously Married	11	30.6
Number of Children Had		
None	2	5.6
1	0	0.0
2	0	0.0
3	5	13.9
4 and above	29	80.6
Highest Level of Education		
No Formal Education	5	13.9
Primary	17	47.2
Secondary	12	33.3
Tertiary	2	5.6
Currently in the Labour Force		
Yes	0	0.0
No	36	100
Type of Disability Participants Had		
Mobility-related (Stroke)	15	41.7
Sight-related (Blindness)	5	13.9
Pain-related (rheumatoid arthritis)	14	38.9
Dementia	2	5.6

> . . .My blindness was caused by a disease. That was what my doctor told me. . . -Nneoma
>
> Sometimes, I feel my hands shake and I cannot see clearly. The doctor told me that the reason why my hands shake is called Parkinson disease. . . -Ejike
>
> . . .Something happened to me when I was a child and my parents did not treat it medically. They were going to native doctors who gave them some herbs that I took. Before they could get me to the hospital after some months, I was already blind. The doctor said it was a disease that could have been treated but because they came in late, the damage was already so much. . . -Mazi Okeke
>
> . . .My knees pain me so much. It is caused by what the doctor called rheumatoid arthritis. The pain is excruciating, especially in the morning when I wake up. I have been treating it. I take painkillers and other prescribed medications. . . -Mama Ifeanyi

Participants, in these accounts, recognized a close link between their disabilities and specific diseases or health conditions. They associated disability onset with disease progression, acknowledging the profound impact on physical functioning. By understanding this connection, participants emphasized the importance of managing and treating underlying health conditions to potentially alleviate or mitigate resulting impairments.

Participants described their disabilities as inflicted by an enemy, conveying a sense of intentional harm. Phrases like "My disability was like an attack" or "It felt like someone cast a spell on me" reflected a belief in malicious intent or deliberate harm from an external source. By framing their disabilities in this way, participants attributed a personal struggle and perceived themselves as victims of a hostile force.

Accordingly:

> I do not doubt that my sickness was sent by my enemies through accident. I was on my way from the market, about to cross the road to the other side; a careless driver knocked me down and ran away. How do I explain this if not an evil attack? . . .-IgweAgu
>
> Some people are not happy because you are progressing. What do you call them but witches? They are enemies. They see you happy and the next thing is that they send an arrow against you spiritually and then people will call it sickness but I know it is spiritual. How do you explain walking and suddenly, something enters your eyes and like a joke, you become blind? -Innocent
>
> I was on my way from the market when I suddenly felt a sharp pain in my head. I screamed and that was the beginning of my trouble. We did some consultations with the herbalist and he said someone sent stroke sickness to me. I began noticing some changes in my body. He gave me some herbs that would help but unfortunately, it did not work because it is spiritual. That was how I became unable to stand or do anything. It was like a film, the type they do on Africa Magic Nollywood but here I am. People are evil. Witches can cast a spell and see me today, down with a stroke. Unbelievable! -Mama Chiegeonu

Coping With Disability

Through our analysis, we identified two major coping strategies employed by older adults with disabilities. These coping strategies were categorized as pragmatic and unpragmatic coping strategies. By categorizing coping strategies as pragmatic and unpragmatic, we aimed to capture the diverse approaches that older adults with disabilities employ to navigate their daily lives.

Pragmatic Coping

Pragmatic coping signifies acceptance and understanding of disability. Participants employ active, problem-focused approaches to manage disabilities, aiming to regain control, maintain independence, and make positive changes in their lives. These strategies reflect resilience and determination to overcome challenges, maintaining a sense of agency in managing disabilities.

For instance, a participant who sought medical attention to cope with his disability said:

> I am already old. My body is weak. Living with a disability is difficult. To help me survive until God calls me, I try as much as possible to get medical attention always. The last time I was at the hospital for a check-up, the doctor told me my blood pressure was rising. He gave me some drugs and I feel better now. I wonder if I had not visited. I probably may have died of high blood pressure without knowing -Sam

Surviving daily, especially through remittance was one of the major hallmarks of adaptive (pragmatic) coping daily. To them, their ability to adapt to their disability was contingent on the support they received.

A participant said,

> Not only do I have to cope with my disability daily, but I have to ensure that I survive daily too. While I commit my difficulty to God, I look up to my children for support. My children are my source of support. I do not have any other means. They provide for me by sending money for me to care for myself. -Patricia

Unpragmatic Coping

Participants also discussed unpragmatic coping strategies, which were characterized by a more passive, state of helplessness and emotion-focused approach to dealing with their disabilities. These strategies involved resignation, denial, a sense of helplessness and abandonment by the government in the face of their impairments. Participants who adopted unpragmatic coping strategies often expressed feelings of sadness, frustration, and withdrawal.

Accordingly,

> . . .My enemies have seen my destiny and they want to destroy it but they have failed. My pastor told me that it was an attack. Even a native doctor said the same thing. Some rituals were done for cleansing and we have also been praying since then. It is over 5 years now. I feel so helpless. . . -NwanyiOji

Participants emphasized societal failures, particularly by the government, during interviews. They expressed frustrations and disappointment with inadequate support for older adults with disabilities, citing a lack of infrastructure, limited healthcare services, and insufficient social support systems. Participants felt overlooked, limiting their ability to cope with disabilities.

Specifically,

> . . .It is not easy having to depend on someone for your livelihood but what do we do since we are out of the government coverage. There are no provisions for us. . . We lack government support and it makes it more difficult to cope every day. The government has failed us. Our society has failed us. . . .Assessing healthcare is difficult. . . I wish the government can look towards us to help us. It is not the fault of any old person to be in this condition. It is frustrating. . . -Mama Okechukwu

> I have to beg daily for my sustenance. Begging is not a pleasant experience. Some will look down on me thinking that I am a ritualist who wants to use their money for diabolic purposes. Some will just throw twenty naira (20.00) at me, although it is better than nothing. Some days the rain will beat me and I get cold. On other days, the sun will make me regret my life. There are some days I do not get up to one hundred naira (100.00). It is not easy at all. I wish the government could do something for us at least for once so we do not die before our time -Mama Ijeoma

Another who also begged for alms said:

> . . . The government has not helped in any way. I go out to beg by the roadside. People help me with money and that is how I survive. . . It is not easy at all. Sometimes, you can stay by the roadside all day to beg for alms and receive only two hundred naira (200.00) in a whole day. It is so sad. . .-Roseline

Reflecting further, another accounted:

> I was born in 1946. . . My husband is late. . . As you can see, I can't walk and I have been living like this for about 45 years. . . I suffered so much in my life but I thank God. I am so weak now. It is so tough. If not for the church and private individuals, I do not know what would have become of me. When I do not receive alms from them, I struggle to get to the roadside to beg passers-by for alms. Some of them who are touched by my condition drop money for me. . . I beg for food and money. Sometimes when it rains, I get drenched because I sit under a thatched roof to beg. . . I am dying of hunger. . . Begging is not a pleasant experience. The government has made life miserable for us. . . -Mama Nkechi

Acknowledging societal failures underscores the importance of comprehensive support systems and society's proactive role in promoting the wellbeing and rights of older adults with disabilities. It highlights the need for policy changes and collective efforts to address their needs, ensuring dignity, care, and support rather than allowing them to be left in helplessness and frustration due to their disabilities.

In our analysis, we observed a coping mechanism of alms begging, not just due to a lack of formal government assistance but also influenced by the economic hardships faced by their children. Participants shared relying on alms begging to meet basic needs and financial support, as their children could not adequately provide. Older adults with disabilities resorted to seeking assistance through begging due to insufficient financial support from their children.

> . . .I beg for alms not because I do not have children but because they do not have good jobs and cannot support me adequately. . . -Nweze

> My children find it difficult to provide for themselves. It is even more burdensome for them to provide for me. The economy is hard. Everything is expensive even food. It is so sad and I am not happy that my children cannot cater comfortably for themselves and talk more of me. . .-Nnabuike

These accounts reveal the intricate interplay between economic factors, family dynamics, and coping strategies. Narratives underscore the financial strain on older adults with disabilities and their families, influencing coping mechanisms like alms begging. The interconnectedness of social and economic factors in shaping their experiences is evident. Findings stress the need for comprehensive social welfare programs, economic support, and employment opportunities to alleviate financial burdens and offer alternative support for older adults with disabilities. Addressing economic hardships can promote more sustainable and dignified coping strategies, reducing reliance on alms begging for survival.

Dependence on remittances has emotional and psychological implications for older adults with disabilities. Participants relied on financial support from family members in other locations, often through remittances, to cope with disabilities and meet basic needs. However, this dependence brought feelings of insecurity, vulnerability, and a sense of burden on supporting family members. The uncertainty of remittances, which could fluctuate or cease, led to anxiety and emotional distress among participants.

> . . .Although my children do their best to provide for me it is not always easy to depend entirely on them as it

> affects my emotions and I become worried when I do not hear from them or receive anything from them. . . -Mama Uka

Furthermore, participants described a loss of autonomy and independence as they had to depend on others for their financial wellbeing. This was seen as a reminder of their disability and a constant source of emotional strain. It also contributed to a sense of powerlessness and diminished self-esteem, as they felt unable to contribute to their financial support or make independent decisions regarding their lives.

> . . .Depending on anyone has never been my style before now, I work hard. If not for my disability, I would not be waiting for my children to send anything before I take care of myself or eat. It is sad. My independence is gone. It is a whole new phase of life but there is nothing I can do about it. . . -Mazi Obinna

These findings highlight the complex emotional dynamics that arise from financial dependence for older adults with disabilities. While financial support is essential for their survival, it also poses emotional challenges and psychological implications, further leveraging a sense of helplessness in the face of their disability. Understanding these emotional and psychological dimensions is, therefore, crucial for developing support systems and interventions that address not only the financial needs but also the emotional wellbeing of older adults with disabilities.

DISCUSSION

The study explored perceptions and coping strategies of older adults with disabilities in a sub-Saharan African community. Notably, the community places high cultural value on children, evident in the participants' substantial number of offspring. Mobility-related disabilities, mainly stroke, emerged as prevalent, with participants acknowledging stroke as a major cause of disability and mortality risk [25, 26].

In African cultures, disability perception extends beyond medical explanations, shaped by cultural and spiritual influences. In the studied community, older adults attribute disabilities to old age, disease, or affliction by an enemy. Old age is culturally esteemed, linked to wisdom, respect, and spiritual significance in this particular community [27]. However, it is also commonly believed that old age brings about physical and mental decline [28]. The understanding that disabilities are linked to old age arises from acknowledging the natural weakening of the body and increased vulnerability to health conditions with age. Consequently, disabilities are viewed as an expected outcome of the aging process.

Disease, notably stroke, is a prominent factor identified by older adults as a cause of disabilities in the community. Sub-Saharan Africa faces health challenges, including infectious diseases and limited access to quality healthcare. Chronic non-communicable diseases, like cardiovascular diseases, stroke, rheumatoid arthritis, diabetes, and respiratory conditions, pose a substantial health burden, especially among older adults. These chronic diseases have long-term implications for health and functioning [29–31]. The link between disabilities and diseases in older adults mirrors the health landscape and challenges in Africa, where infectious diseases and chronic conditions contribute significantly to disabilities. Recognizing prevalent diseases and their impact is crucial for implementing effective prevention, treatment, and management strategies. This emphasizes the need for public health interventions, improved healthcare access, and initiatives addressing the burden of infectious diseases and chronic conditions to reduce disabilities and enhance overall wellbeing in African communities.

In many African cultures, the belief in supernatural causation of disabilities, observed in the studied community, is deeply ingrained. Witchcraft, sorcery, and evil spirits are considered potential causes [32, 33], reflecting a worldview where disabilities result from malevolent intentions or spiritual attacks. This belief system serves to make sense of disabilities within cultural and spiritual contexts. These cultural beliefs significantly impact individuals with disabilities, influencing social interactions, stigma, and the availability and utilization of support services in African societies.

Coping with a disability, as observed in the study, involves two main approaches: pragmatic coping and non-pragmatic coping. Pragmatic coping strategies include seeking medical attention, enabling individuals to adapt, develop new perspectives, prioritize healthcare, and adopt a positive mindset to handle stressors. Older adults using pragmatic coping often show better social capital, fewer depressive symptoms, improved quality of life, and positive psychological wellbeing [34]. Recognition and acceptance of the inevitability of old age motivate them to seek healthcare to maximize their remaining time.

Perceiving disability as an affliction caused by an enemy may lead individuals to consult spiritualists for coping, aligning with personal beliefs. While religious coping can be positive [35, 36], participants in this study described a form of coping that leaned towards unpragmatic and negative aspects. This coping approach resulted in emotional distress, unmet recovery expectations, and adaptation difficulties. The findings align with the transactional theory of stress and coping [37], emphasizing the influence of perception, coping ability, and available resources on adaptive responses. Understanding individuals' coping strategies and beliefs is crucial for developing interventions that promote effective coping and overall wellbeing.

Coping with disability in this community is significantly influenced by dependence on children, rooted in the cultural and economic importance placed on high fertility and intergenerational wealth flow. Scholars [38] argue that high fertility rates are rational in societies valuing both spiritual and economic aspects of marital fertility. This belief persists, with family structure and wealth flow linked, emphasizing the benefits of having many children for upward wealth flow to parents. Larger households are maintained, and the power of the household head is often tied to the number of children. Children are seen as an economic investment, relied upon for support in parents' old age.

Contemporary Africa experiences a decline in support for the elderly due to limited resources among the younger generation [4]. This trend exposes older adults to poverty, alms begging, and destitution. The study, supported by previous findings [39], highlights government neglect of older adults' welfare, echoing participants' frustrations. Government inaction may stem from negligence, insufficient analysis of challenges, or an assumption that issues will self-resolve. Societal failure to address older adults' welfare emphasizes the urgent need for government intervention and formal social welfare programs. Recognizing vulnerabilities and challenges is crucial for promoting wellbeing and addressing issues like poverty and destitution.

In this community, alms begging is prevalent, especially among older adults whose children lack the financial means to adequately support them. The absence of comprehensive aging programs in national development plans [40] contributes to poverty, leading to reliance on charity. Financial constraints faced by the younger generation limit their support for older adults [41]. The lack of a social safety net or pension scheme further compounds financial difficulties for elderly individuals not covered by such programs [42]. Many older adults in this community, having worked in the informal sector, lack savings or retirement funds, compelling some to resort to alms begging. Importantly, soliciting alms does not imply childlessness; scholars [43] argue it often results from children's inability to provide, exacerbated by the absence of formal support structures in society.

Conclusion and Recommendations

The study provides comprehensive insights into the perceptions and coping strategies of older adults with disabilities in a sub-Saharan African community, emphasizing cultural and spiritual influences. It identifies causes such as old age, diseases, and perceived affliction by enemies, and distinguishes pragmatic and unpragmatic coping approaches, highlighting the significant role of children for support. Challenges arise from declining familial support and limited social welfare systems, leading some to resort to alms begging. Recommendations include culturally sensitive interventions, prioritizing welfare policies, and addressing specific health conditions. The study urges government commitment through national development plans and social safety nets. Despite insights, limitations are acknowledged, and future research should employ mixed-methods approaches for a more nuanced exploration of older adults' experiences with disabilities.

ETHICS STATEMENT

The studies involving humans were approved by the University of Ibadan Social Sciences and Health Research Ethics Committee (UI/SSHREC). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JA conceptualized the study, contributed to writing the manuscript, collected data, and analyzed and interpreted the findings. KB contributed to the analysis and interpretation of the findings. LN contributed to the analysis and interpretation of the findings. UI-A conceptualized, contributed to writing and interpreted the findings. All authors contributed to the article and approved the submitted version.

CONFLICT OF INTEREST

The authors declare that they do not have any conflicts of interest.

REFERENCES

1. United Nations, Department of Economic and Social Affairs, Population Division. *World Population Prospects: 2019 (ST/ESA/SER.A/423)*. United Nations: United Nations, Department of Economic and Social Affairs, Population Division (2019).
2. United Nations, Department of Economic and Social Affairs, Population Division. *World Population Ageing 2019: Highlights (ST/ESA/SER.A/430)*. United Nations: United Nations, Department of Economic and Social Affairs, Population Division (2019).
3. Adamek M, Chane S, Kotecho M. Family and Kin Care of Elders in Sub-Saharan Africa. In: Maharaj P, Mokomane Z, editors. *Health & Care in Old Age in Africa*. London: Routledge (2020). p. 61–77. doi:10.4324/9780429020759
4. Ani IJ. Care and Support for the Elderly in Nigeria: A Review. *Niger J Sociol Anthropol* (2014) 12(1):9–27. doi:10.36108/NJSA/4102/12(0110)
5. Adamek ME, Gebremariam Kotecho M, Chane S, Gebeyaw G. Challenges and Assets of Older Adults in Sub-Saharan Africa: Perspectives of Gerontology Scholars. *J Aging Soc Pol* (2021) 34(1):108–26. doi:10.1080/08959420.2021.1927614
6. McLigeyo SO. Ageing Population in Africa and Other Developing Communities: A Public Health Challenge Calling for Urgent Solutions. *East Afr Med J* (2002) 79(6):281–3. doi:10.4314/eamj.v79i6.8846
7. Ani IJ, Isiugo-Abanihe UC. Disability Among Older Adults in South-Eastern Nigeria. *Int J Aging Hum Develop* (2023) 97(3):374–94. doi:10.1177/00914150221132162
8. Awuviry-Newton K, Tavener M, Wales K, Byles J. Interpretative Phenomenological Analysis of the Lived Experiences of Older Adults Regarding Their Functional Activities in Ghana. *J Prim Care Community Health* (2020) 11:2150132720931110. doi:10.1177/2150132720931110
9. Groce N, Kembhavi G, Wirz S, Lang R, Trani J-F, Kett M. *Poverty and Disability – A Critical Review of the Literature in Low and Middle-Income Countries*. Working Paper Series, (16). London: UCL Leonard Cheshire Disability and Inclusive Development Centre (2011).
10. World Health Organisation. *International Classification of Impairments, Disabilities and Handicaps: A Manual of Classification Relating to the Consequences of Diseases*. Geneva: WHO (1980).
11. Peres M, Lucchetti G. Coping Strategies in Chronic Pain. *Curr Pain Headache Rep* (2010) 14:331–8. doi:10.1007/s11916-010-0137-3
12. Leventhal H, Diefenbach M, Leventhal E. Illness Cognition: Using Common Sense to Understand Treatment Adherence and Affect Cognition Interactions. *Cognit Ther Res* (1992) 16:143–63. doi:10.1007/bf01173486
13. Van Damme S, Crombez G, Eccleston C. Coping With Pain: A Motivational Perspective. *Pain* (2008) 139:1–4. doi:10.1016/j.pain.2008.07.022
14. Lazarus RS, Folkman S. *Stress, Appraisal, and Coping*. New York: Springer (1984).

15. Carver CS, Connor-Smith J. Personality and Coping. *Annu Rev Psychol* (2010) 61:679–704. doi:10.1146/annurev.psych.093008.100352
16. Pargament KI. *The Psychology of Religion and Coping: Theory, Research, Practice*. New York: Guilford Press (2001).
17. Crowther S, Ironside P, Spence D, Smythe L. Crafting Stories in Hermeneutic Phenomenology Research: A Methodological Device. *Qual Health Res* (2017) 27(6):826–35. doi:10.1177/1049732316656161
18. Smith J, Flowers P, Larkin M. *Interpretative Phenomenological Analysis: Theory, Method, and Research*. London: Sage (2019).
19. Saunders B, Sim J, Kingstone T, Baker S, Waterfield J, Bartlam B, et al. Saturation in Qualitative Research: Exploring its Conceptualization and Operationalization. *Qual quantity* (2018) 52(4):1893–907. doi:10.1007/s11135-017-0574-8
20. Hefferon K, Gil-Rodriguez E. Interpretative Phenomenological Analysis. *Psychol* (2011) 24(10):756–9.
21. Chan ZC, Fung YL, Chien WT. Bracketing in Phenomenology: Only Undertaken in the Data Collection and Analysis Process. *Qual Rep* (2013) 18:1–9. doi:10.46743/2160-3715/2013.1486
22. Finlay L. *Phenomenology for Therapists: Researching the Lived World*. Chichester, UK: Wiley-Blackwell (2011).
23. Tufford L, Newman P. Bracketing in Qualitative Research. *Qual Soc Work* (2010) 11:80–96. doi:10.1177/1473325010368316
24. Gearing RE. Bracketing in Research: A Typology. *Qual Health Res* (2004) 14:1429–52. doi:10.1177/1049732304270394
25. World Health Organization. *WHO STEPS Stroke Manual: The WHO STEPwise Approach to Stroke Surveillance*. Geneva: World Health Organization (2006).
26. Perry L, McLaren S. Coping and Adaptation at Six Months After Stroke: Experiences With Eating Disabilities. *Int J Nurs Stud* (2003) 40:185–95. doi:10.1016/s0020-7489(02)00060-3
27. Malone J, Dadswell A The Role of Religion, Spirituality And/or Belief in Positive Ageing for Older Adults. *Geriatrics (Basel, Switzerland)* (2018) 3(2):28. doi:10.3390/geriatrics3020028
28. Shrira A, Bodner E, Palgi Y. The Interactive Effect of Subjective Age and Subjective Distance-To-Death on Psychological Distress of Older Adults. *Aging Ment Health* (2014) 18(8):1066–70. doi:10.1080/13607863.2014.915925
29. Gureje O, Ogunniyi A, Kola L. The Profile and Impact of Probable Dementia in a Sub-Saharan African Community: Results From the Ibadan Study of Aging. *J psychosomatic Res* (2006) 61(3):327–33. doi:10.1016/j.jpsychores.2006.07.016
30. Akinyemi RO, Ovbiagele B, Adeniji OA, Sarfo FS, Abd-Allah F, Adoukonou T, et al. Stroke in Africa: Profile, Progress, Prospects and Priorities. *Nat Rev Neurol* (2021) 17:634–56. doi:10.1038/s41582-021-00542-4
31. Mugisha JO, Schatz EJ, Randell M, Kuteesa M, Kowal P, Negin J, et al. Chronic Disease, Risk Factors and Disability in Adults Aged 50 and Above Living With and Without HIV: Findings From the Wellbeing of Older People Study in Uganda. *Glob Health Action* (2016) 9:31098. doi:10.3402/gha.v9.31098
32. Etieyibo E, Omiegbe O. Religion, Culture, and Discrimination Against Persons With Disabilities in Nigeria. *Afr J Disabil* (2016) 5(1):a192. doi:10.4102/ajod.v5i1.192
33. Abosi CO, Ozoji ED. *Educating the Blind: A Descriptive Approach*. Ibadan: Spectrum Books (1985).
34. Buono V, Corallo F, Bramanti P, Marino S. Coping Strategies and Health-Related Quality of Life After Stroke. *J Health Psychol* (2015) 1:13. doi:10.1177/1359105315595117
35. Wachholtz AB, Pearce MJ, Koenig H. Exploring the Relationship Between Spirituality, Coping, and Pain. *J Behav Med* (2007) 30:311–8. doi:10.1007/s10865-007-9114-7
36. Rippentrop EA, Altmaier EM, Chen JJ, Found EM, Keffala VJ. The Relationship Between Religion/Spirituality and Physical Health, Mental Health, and Pain in a Chronic Pain Population. *Pain* (2005) 116:311–21. doi:10.1016/j.pain.2005.05.008
37. Lazarus RS, Folkman S. Transactional Theory and Research on Emotions and Coping. *Eur J Personal* (1987) 1(3):141–69. doi:10.1002/per.2410010304
38. Caldwell JC, Caldwell. P. The Cultural Context of High Fertility in Sub-Saharan Africa. *Popul Develop Rev* (1987) 13(3):409–37. doi:10.2307/1973133
39. Togonu-Bickersteth F, Akinyemi A. Ageing and National Development in Nigeria: Costly Assumptions and Challenges for the Future. *Afr Popul Stud* (2014) 27:361–71. doi:10.11564/27-2-481
40. Kola L, Owumi B. Causes of Poverty in Old Age, Not a Structural Failing? *J Aging Soc Pol* (2019) 31(5):467–85. doi:10.1080/08959420.2019.1642692
41. Ani IJ, Isiugo-Abanihe UC. Unmet Needs for Support: A Study of Older Persons With Disability in Enugu State, Nigeria. *Niger J Sociol Anthropol* (2022) 20(1):14–30. doi:10.36108/NJSA/2202.02.0110
42. Tanyi PL, Andre P, Mbah P, Compaore Y, Senderowicz L. Care of the Elderly in Nigeria: Implications for Policy. *Cogent Soc Sci* (2018) 4(1):1–18. doi:10.1080/23311886.2018.1514688
43. Togonu-Bickersteth F, Akinnawo EO, Akinyele OS, Ayeni E. Public Alms Solicitation Among the Yoruba Elderly in Nigeria. *South Afr J Gerontol* (1997) 6(2):26–31. doi:10.21504/sajg.v6i2.117

International Journal of Public Health
ORIGINAL ARTICLE
published: 21 December 2023
doi: 10.3389/ijph.2023.1605891

Examining the Utilization of Social Capital by Ghanaians When Seeking Care for Chronic Diseases: A Personal Network Survey

Brady Hooley[1,2]*, *Elom Hillary Otchi*[3,4], *Samuel Mayeden*[5], *Alfred Edwin Yawson*[3,6], *Koku Awoonor-Williams*[7] *and Fabrizio Tediosi*[1,2]

[1]Swiss Tropical and Public Health Institute (Swiss TPH), Basel, Switzerland, [2]University of Basel, Basel, Switzerland, [3]Korle Bu Teaching Hospital, Accra, Ghana, [4]Accra College of Medicine, Accra, Ghana, [5]Ghana Health Service, Accra, Ghana, [6]Medical School, University of Ghana, Accra, Ghana, [7]Department of Policy, Planning, Monitoring and Evaluation, Ghana Health Service, Accra, Ghana

Objectives: With limited social security and health protection in Ghana, intergenerational support is needed by those living with NCDs, who incur recurrent costs when seeking NCD care. We measured the level of informal support received by NCD patients and identified factors that influence support provision.

Methods: We surveyed 339 NCD patients from three hospitals in Ghana, who listed their social ties and answered questions about their relationship and support frequency. We analyzed the relationship between social support, demographic and health information, characteristics of social ties, and network characteristics.

Results: Participants described 1,371 social ties. Nearly 60% of respondents reported difficulties in their usual work or household duties due to chronic illness, which was also the strongest predictor of support. Patients with higher wellbeing reported less social support, while older age and having co-habitant supporters were negatively associated with support, indicating caregiver burnout.

Conclusion: Ghanaian NCD patients receive support from various caregivers who may not be able to handle the increasing healthcare and social needs of an aging population. Policies should therefore enhance resource pooling and inclusiveness for old age security.

Keywords: Ghana, NCDs, social capital, social support, informal care

OPEN ACCESS

Edited by:
Andrea Madarasova Geckova, University of Pavol Jozef Šafárik, Slovakia

Reviewed by:
Peter Delobelle, University of Cape Town, South Africa
One reviewer who chose to remain anonymous

***Correspondence:**
Brady Hooley
brady.hooley@swisstph.ch

This Original Article is part of the IJPH Special Issue "Ageing and Health in Sub-Sahara Africa"

Received: *14 February 2023*
Accepted: *29 November 2023*
Published: *21 December 2023*

Citation:
Hooley B, Otchi EH, Mayeden S, Yawson AE, Awoonor-Williams K and Tediosi F (2023) Examining the Utilization of Social Capital by Ghanaians When Seeking Care for Chronic Diseases: A Personal Network Survey. Int J Public Health 68:1605891. doi: 10.3389/ijph.2023.1605891

INTRODUCTION

Ghana is facing a growing challenge of both communicable and non-communicable diseases [1, 2]. Limited availability of health services for NCDs has made it difficult for patients to receive the care they need, complicating their engagement in care [3]. The current system, as outlined in the Ghana Health Service (GHS) Community-based Health Planning and Services (CHPS) policy, limits certain types of healthcare professionals and facilities from providing some services, which leads to inadequate and unequal access to NCD care services, particularly at the primary care level [1].

In Ghana, primary healthcare services are delivered by a mix of public, faith-based, and self-financing private facilities, organized into a multi-level system consisting of district hospitals, health

centers, and CHPS Compounds, providing basic public health and clinical services [4]. Although some form of NCD care is available within each level of the health system, medications for NCDs are not regularly offered at health centers and CHPS Compounds, which are the most accessible facilities for the majority of the population [5]. CHPS Compounds may provide NCD screening services such as blood pressure and blood glucose measurement. However, these facilities must refer patients to higher levels of the health system for definitive NCD diagnoses and treatment. The NCD services provided at health centers can be more variable and depend on the specific credentials of the facility, yet a shortage of healthcare professionals adequately trained to provide NCD care at CHPS Compounds and health centers drives patients to self-refer to the district hospital level (or higher) for even basic NCD care services [6].

For rural populations in particular, substantial opportunity costs associated with travelling to seek care can further drive this already vulnerable group into poverty and hinder their engagement in care and adherence to treatment [6, 7]. While most patients attending public health facilities have health insurance to mitigate the direct medical costs of obtaining NCD care, patients often rely upon financial support from their family and friends to cope with the non-medical costs of care-seeking. However, this support tends to wane throughout the duration of one's chronic illness [8–10].

Intergenerational support is a form of social capital and a cultural norm in sub-Saharan Africa (SSA), whereby parents support and care for their children and in turn, their children support them as they age [11]. Social capital is considered a sympathetic behavior that extends beyond a reciprocal or transactional relationship [12], compensating for a lack of widespread social security for aging adults in sub-Saharan Africa, and plays a major role in pooling resources and facilitating older patients' access to healthcare services [13]. In this manner, intergenerational support is grounded on principles of sympathy, reciprocity, and a sense of responsibility and duty. However, as the population ages and the burden of communicable and non-communicable diseases increases, the burden of providing support also increases and undermines the reliability of the support that the older patients can expect to receive [11, 14].

The receipt of financial support may be particularly important for people living with NCDs, who experience substantial recurrent travel and opportunity costs when accessing centralized NCD care services [15]. Previous research directly surveyed caregivers in Ghana to study the financial burden of caring for older family members and found that the purchase of household goods represented the largest direct cost, with direct transfers of money being relatively less prevalent [16]. This study investigated the personal networks of patients seeking care for chronic diseases in Ghana. Employing multilevel models, the study aimed to identify factors that influence their mobilization of social capital. Additionally, the results revealed the cumulative cost of support borne by the patients' social networks.

METHODS

This study used a personal network survey to quantify NCD patients' receipt of informal support in relation to their socioeconomic and health status, and personal network characteristics. Similar to classic "whole" network data, personal network data allows one to study a network of social ties in relation to individual members of a key population; in this case, patients seeking care for NCDs [17–19].

We aimed to recruit 100 NCD patients each from the Tamale Teaching Hospital, Kintampo North Municipal Hospital, and Hohoe Municipal Hospital, located in the Northern, Middle, and Southern zones of Ghana, respectively. As patients seeking care for NCDs frequently experience difficulties in receiving appropriate care from community-level health facilities [6], we purposively selected hospitals in order to facilitate the recruitment of patients with chronic illnesses. In March and April 2022, trained research assistants recruited potential respondents as they waited to be seen by a clinician and administered the questionnaire in English or a local language following their consultation. Patients were eligible for participation if they had ever been diagnosed with at least one chronic health condition, were at least 50 years of age, and did not display any indications of cognitive impairment. We also collected three blood pressure measurements from each participant, such that we report the mean of the final two measurements. Data was collected using tablets and Open Data Kit (ODK) [20], and data was uploaded to a secure server in Switzerland at the end of each day of data collection.

Questionnaire

The questionnaire, described in greater detail in the **Supplementary Material**, is similar to that used in a previous study [21]. We first collected information on participants' sociodemographic information and chronic disease history before asking participants to list the six most important adults in their lives and provide information on the informal social support provided by these members of their social network (**Supplementary Box S1**).

The key outcome of interest was how frequently named social ties provide support to their respective participants, and the questionnaire asked participants to report on their social networks' provision of emotional, informational, and material support, described to participants as:

- Emotional support: "How frequently does [a given social tie] give you emotional support? Such as comforting you, making you feel respected or loved, or praying with/for you."
- Informational support: "How frequently does [a given social tie] give you informational support? Such as sharing advice and knowledge, or helping you understand your doctor's instructions."
- Material support: "How frequently does [a given social tie] give you material support? Such as giving you money for healthcare or bus tickets, helping you with tasks at home, taking you to the health facility."

Analysis

Our primary aim was to assess the amount of material and non-material support received as an outcome, including support from individual alters and the cumulative support experienced by participants. In our primary analysis, we combined emotional and informational support into a single category of non-material support. In our **Supplementary Material** we also provide separate analyses for emotional support and informational support, allowing for a more comprehensive examination of the data.

We quantified social support using a categorical measure of frequency, which we converted to a count of person-days of support per month (as seen in **Supplementary Table S1**) [21, 22]. We used descriptive statistics to explore participant characteristics and participant-level summaries of network and support characteristics, and bivariate analyses to explore predictors of support provision. For alter-level variables we used linear regression while clustering variance at the participant level and for participant-level variables we used Welch t-tests.

We initially planned to employ Poisson regression to investigate the relationship between our predictor variables and the count of person-days of support exchanged between individuals (alters) and our study participants. However, due to the observed overdispersion of the outcome data, we found it necessary to utilize negative binomial regression, a determination supported by likelihood ratio tests [23, 24]. Similar to Poisson regression, negative binomial regression yields incidence rate ratios. These ratios indicate that, for categorical predictor variables, the incidence rate at one category level is x times that of the reference level. For continuous predictor variables, the incidence rate ratio demonstrates the impact of a one-unit increase, representing a 1-x percent difference in the outcome.

To investigate the influence of various participant-level, tie-level, and network-level predictors on social support in terms of the count of person-days of support provided over the past month, we employed multilevel negative binomial regression. Additionally, we included a random intercept term to account for participant-level clustering. Our modelling process unfolded in four incremental steps: we constructed separate models for material and non-material support. We gradually integrated the participants' random intercept, participant-level predictors, tie-level predictors, and network-level predictors to create the comprehensive model.

At the participant level, we investigated if participants' age, Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS) score [25], Multidimensional Scale of Perceived Social Support (MSPSS) score, chronic illness-related productivity limitations, and multimorbidities were associated with the receipt of support. The WEBWBS is a validated self-report scale designed to measure an individual's mental wellbeing or psychological flourishing. The abridged version consists of 7 items covering aspects such as positive affect, satisfying interpersonal relationships, and a sense of personal accomplishment. Respondents rate their experiences over the past 2 weeks on a 5-point Likert scale. The WEMWBS is widely used in research and clinical settings to assess an individual's mental wellbeing and to monitor changes in mental health and wellbeing over time [25]. Likewise, the MSPSS is also a validated self-report scale and uses 12 items rated on a 7-point Likert scale to measure an individual's perceived social support [26–28]. For both the WEMWBS and MSPSS, scores of the individual items are summed to arrive at a single score, which were included in the models as continuous predictor variables. However, due to excessive collinearity, we did not include the MSPSS in the final model specifications.

At the alter level, we sought to determine if family members and household members differ in their support provision relative to non-family ties or those living outside the household.

In terms of network characteristics, we hypothesized that ties would provide less support to participants who have a larger number of supportive ties overall while participants with more non-family ties would receive more support. The rationale underlying these hypotheses is that a "bystander effect" may lead individual ties to be less likely to support the participant if they perceive there to be others who are willing to provide support, while non-family ties and those not residing in the same household may be more willing and able to support the participant if they are less likely to have experienced caregiver fatigue.

We used STATA version 16 for data cleaning and manipulation, R version 4.2.1 for analyses, and Python 3.9.7 and the "NetworkX" package for network visualization.

Ethics Statement

This study received ethical approval from the Korle Bu Teaching Hospital (KBTH) Institutional Review Board (IRB) (Ref: KBTH-STC 000147/2021). Prior to recruitment, we presented the study's objectives to potential participants and described in detail the information they would be asked to provide. We informed potential participants that they may refuse blood pressure measurements and/or withdraw from the study at any time without consequences and all participants provided written informed consent before participation. In cases where potential participants were unable to write, we accepted verbal consent *in lieu* of written consent.

RESULTS

This study interviewed a total of 339 participants, who provided information about their relationships with 1,371 alters. Patients had a mean age of 62.4 years, most were married or living with a partner (65.2%), just over half had completed primary school, and only 23.6% had a formal occupation. Diabetes (44.2%) and hypertension (69%) were the most commonly-reported chronic diseases, and nearly 60% of respondents reported being unable to accomplish their usual work or household duties due to their chronic illness (**Table 1**). On average, participants named four social ties each, of which 80% provided emotional support, 40% provided informational support, and 50% provided financial or other material support (**Table 1**).

Initial exploratory analyses using bivariate statistics suggested that men receive less non-material support (6.7 person-days)

TABLE 1 | Summary of participant-level variables disaggregated by gender, with chi-square *p*-values (Ghana, March and April 2022).

		Overall	Women	Men	*p*-value
n		339	173	166	
Age, mean (SD)		62.4 (10.1)	62.5 (10.3)	62.3 (9.9)	0.859
Marital status, *n* (%)	Divorced	19 (5.6)	10 (5.8)	9 (5.4)	<0.001***
	Widowed	63 (18.6)	55 (31.8)	8 (4.8)	
	Never Married	9 (2.7)	2 (1.2)	7 (4.2)	
	Living with partner	26 (7.7)	7 (4.0)	19 (11.4)	
	Married	195 (57.5)	81 (46.8)	114 (68.7)	
	Separated	27 (8.0)	18 (10.4)	9 (5.4)	
Education, *n* (%)	None	106 (36.3)	64 (40.3)	42 (31.6)	0.017*
	Some primary	44 (15.1)	28 (17.6)	16 (12.0)	
	Primary	31 (10.6)	17 (10.7)	14 (10.5)	
	Some secondary	34 (11.6)	21 (13.2)	13 (9.8)	
	Secondary	41 (14.0)	13 (8.2)	28 (21.1)	
	College	36 (12.3)	16 (10.1)	20 (15.0)	
Household size, mean (SD)		5.5 (3.6)	5.1 (2.9)	5.9 (4.1)	0.025*
Occupation, *n* (%)	Caring for home/children	25 (8.7)	22 (13.6)	3 (2.4)	<0.001***
	Private Formal Sector	17 (5.9)	4 (2.5)	13 (10.3)	
	Public Servant	51 (17.7)	20 (12.3)	31 (24.6)	
	Retired	54 (18.8)	21 (13.0)	33 (26.2)	
	Self-employed, small business	94 (32.6)	71 (43.8)	23 (18.3)	
	Subsistance Farmer	47 (16.3)	24 (14.8)	23 (18.3)	
Paid work in past year, *n* (%)	Yes	117 (34.5)	55 (31.8)	62 (37.3)	0.336
Productivity loss due to illness, *n* (%)	Never	147 (43.4)	71 (41.0)	76 (45.8)	0.533
	Sometimes	99 (29.2)	55 (31.8)	44 (26.5)	
	Completely	93 (27.4)	47 (27.2)	46 (27.7)	
Days of work/productivity lost to illness, mean (SD)		10.4 (13.2)	10.5 (13.0)	10.4 (13.4)	0.954
Current HI, *n* (%)	Yes	282 (83.4)	147 (85.5)	135 (81.3)	0.380
Paid for own HI, *n* (%)	I do not know	1 (0.4)	1 (0.7)		0.002**
	No	19 (6.7)	14 (9.5)	5 (3.7)	
	Yes, partially	17 (6.0)	15 (10.2)	2 (1.5)	
	Yes, completely	245 (86.9)	117 (79.6)	128 (94.8)	
Perceived health status, *n* (%)	Bad	35 (10.9)	20 (12.3)	15 (9.4)	0.039*
	Moderate	110 (34.3)	66 (40.7)	44 (27.7)	
	Good	151 (47.0)	65 (40.1)	86 (54.1)	
	Very good	25 (7.8)	11 (6.8)	14 (8.8)	
Diabetes, *n* (%)	Yes	150 (44.2)	87 (50.3)	63 (38.0)	0.029*
Hypertension, *n* (%)	Yes	234 (69.0)	121 (69.9)	113 (68.1)	0.799
Epilepsy, *n* (%)	Yes	9 (2.7)	3 (1.7)	6 (3.6)	0.328
Asthma, *n* (%)	Yes	14 (4.1)	9 (5.2)	5 (3.0)	0.459
Other chronic illness, *n* (%)	Yes	36 (10.6)	12 (6.9)	24 (14.5)	0.038*
Systolic BP, mean (SD)		139.3 (19.6)	139.1 (20.9)	139.5 (18.3)	0.881
Diastolic BP, mean (SD)		92.1 (16.5)	92.5 (17.4)	91.8 (15.5)	0.713
Stage II Hypertension, n (%)	Yes	218 (64.3)	116 (67.1)	102 (61.4)	0.335
Tie count, mean (SD)		3.9 (1.9)	3.9 (1.9)	4.0 (1.9)	0.849
Tie weight, mean (SD)		0.7 (0.1)	0.8 (0.1)	0.7 (0.1)	0.016*
Proportion of women in support network, mean (SD)		0.4 (0.3)	0.4 (0.3)	0.4 (0.3)	0.760
% of alters who provide emotional support, mean (SD)		0.8 (0.3)	0.9 (0.3)	0.8 (0.3)	0.381
% of alters who provide informational support, mean (SD)		0.4 (0.4)	0.4 (0.4)	0.3 (0.4)	0.076
% of alters who provide material support, mean (SD)		0.5 (0.4)	0.5 (0.4)	0.4 (0.4)	0.010*

* = p < *0.05,* ** = p < *0.01,* *** = p < *0.001.*

compared to women (9.9 person-days) and less material support (8.9 person-days) compared to women (12.7 person-days) (**Supplementary Table S** and **Figure 1**). **Figure 1** demonstrates these between-group differences, both in terms of the proportion of one's social ties that provide support and the frequency of support received by patients. However, when controlling for other variables in multivariate mixed effects negative binomial regression models, we did not find a significant difference in the amount of support received by men and women (**Tables 2**, **3**).

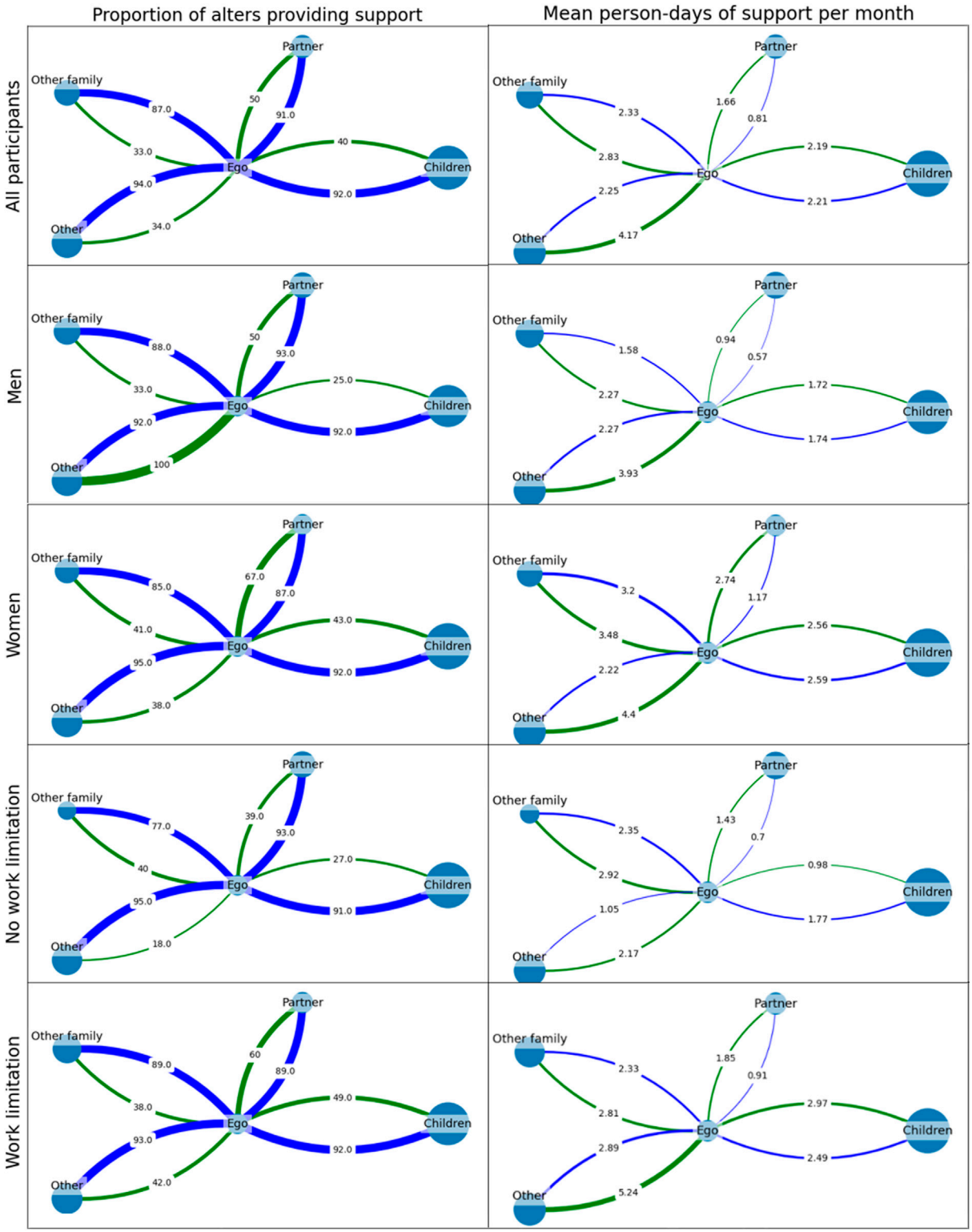


FIGURE 1 | Average cluster graphs depicting participants' receipt of support from each of four classes of social tie. Node size corresponds to the relative prevalence of each relation type within the network. The left column represents the proportion of ties that provide non-material support (blue) and material support (green), while the right represents the average number of support events provided by each class of tie per month (Ghana, March and April 2022).

TABLE 2 | Multilevel negative binomial regression models for predicting the count of person-days of informal social support provided by alters to egos over the past month (N_2 = 339, N_1 = 1,371) (Ghana, March and April 2022).

Support type:	Overall		Non-material		Material	
Predictors	**Incidence Rate Ratios**	***p***	**Incidence Rate Ratios**	***p***	**Incidence Rate Ratios**	***p***
(Intercept)	5.63*** (3.53–8.98)	<0.001	3.22*** (2.06–5.05)	<0.001	3.56*** (1.99–6.38)	<0.001
Ego age	0.80** (0.70–0.92)	0.001	0.81*** (0.71–0.91)	<0.001	0.88 (0.74–1.03)	0.119
Ego gender: Men	0.90 (0.70–1.16)	0.426	0.86 (0.68–1.08)	0.195	0.90 (0.65–1.24)	0.510
Living with partner: Yes	0.81 (0.61–1.08)	0.158	0.96 (0.74–1.25)	0.788	0.67* (0.47–0.96)	0.028
Wellbeing score	0.86* (0.75–0.98)	0.026	0.80*** (0.71–0.91)	<0.001	1.02 (0.87–1.20)	0.765
Only hypertension: Yes	0.76 (0.55–1.05)	0.097	0.94 (0.70–1.26)	0.687	0.68 (0.45–1.01)	0.058
Multimorbidities: Yes	0.89 (0.65–1.23)	0.487	0.90 (0.68–1.19)	0.455	0.92 (0.62–1.36)	0.662
Ever missed work due to NCD: Yes	2.63*** (1.96–3.53)	<0.001	1.90*** (1.45–2.48)	<0.001	3.46*** (2.39–5.02)	<0.001
Alter relation: partner	1.06 (0.76–1.47)	0.728	0.48** (0.29–0.80)	0.004	1.54* (1.03–2.29)	0.034
Alter relation: Other family	0.78* (0.62–0.99)	0.042	0.85 (0.65–1.10)	0.211	0.56*** (0.40–0.78)	0.001
Alter relation: other	0.84 (0.67–1.04)	0.108	0.96 (0.74–1.24)	0.740	0.56*** (0.41–0.75)	<0.001
Alter same age or older than ego: Yes	0.90 (0.73–1.11)	0.321	0.84 (0.66–1.07)	0.156	1.05 (0.78–1.41)	0.761
Alter gender: Men	1.43*** (1.22–1.68)	<0.001	1.18 (0.98–1.42)	0.074	1.49*** (1.21–1.85)	<0.001
Alter resides with ego: yes	0.23*** (0.19–0.28)	<0.001	0.17*** (0.14–0.22)	<0.001	0.26*** (0.20–0.34)	<0.001
% of "other" ties composing network	1.08 (0.97–1.21)	0.153	0.97 (0.88–1.08)	0.620	1.18* (1.03–1.35)	0.019
Number of named social ties	0.89** (0.82–0.96)	0.004	0.89** (0.82–0.96)	0.004	0.86** (0.77–0.95)	0.004

*p < *0.05* **p < *0.01* ***p < *0.001*.

TABLE 3 | Negative binomial regression models for predicting the total count of person-days of informal social support received by egos from all of their alters over the past month (*N* = 339) (Ghana, March and April 2022).

Support type:	Non-material		Material	
Predictors	**Incidence Rate Ratios**	***p***	**Incidence Rate Ratios**	***p***
(Intercept)	35.18*** (10.23–120.96)	<0.001	21.00*** (5.44–81.05)	<0.001
Ego age	0.98* (0.97–1.00)	0.013	0.99 (0.98–1.00)	0.109
Ego gender: Men	0.88 (0.68–1.15)	0.354	0.80 (0.59–1.07)	0.138
Living with partner: Yes	0.86 (0.64–1.16)	0.323	0.70* (0.51–0.97)	0.033
Wellbeing score	0.93*** (0.90–0.95)	<0.001	0.95*** (0.93–0.98)	0.001
Hypertension: Yes	0.88 (0.57–1.36)	0.570	0.87 (0.54–1.39)	0.557
Diabetes: Yes	1.21 (0.78–1.88)	0.383	1.11 (0.69–1.80)	0.672
Ever missed work due to NCD: Yes	1.90*** (1.36–2.65)	<0.001	2.59*** (1.80–3.73)	<0.001
% of "other" ties composing network	1.37 (0.83–2.25)	0.213	1.78* (1.07–2.96)	0.027
Number of named social ties	1.20*** (1.11–1.29)	<0.001	1.14** (1.05–1.24)	0.002
% of women composing network	0.97 (0.61–1.53)	0.880	1.18 (0.73–1.92)	0.507
Hypertension: Yes × Diabetes: Yes	0.89 (0.51–1.57)	0.696	0.99 (0.54–1.82)	0.973

*p < *0.05* **p < *0.01* ***p < *0.001*.

The provision of non-material support was influenced by several factors, including the age of the patient, WEMWBS score, productivity loss due to chronic illness, and number of reported social ties. Additionally, the relationship between the patient and their social ties, the gender of the social ties, and their residence location also played a significant role in determining the level of non-material support provided (**Table 2**, see **Supplementary Table S3** for disaggregated analysis of emotional and informational support). In terms of household and gender, negative binomial regression models indicated that egos' partners and those living in the same household provided less support, while men tended to provide more support than women (**Table 2**).

We also found that alters provided more support to younger egos, those with work limitations, and lower WEMWBS scores, yet provided less support to those with a larger network of social ties (**Table 2**, **Figure 1**). **Figure 1** clearly demonstrates the differences in the amount of support received by people with and without NCD-related work limitations, particularly in how "other" social ties provide substantially more support to people living with work limitations than without. Together, the directionalities of these effects suggest that alters provide the most support to patients with the greatest need for support. Among the predictors at the social ties level, partners and those living in the same household provided the least amount of support, suggesting compassion fatigue.

We analyzed the provision of tie-level support and found that WEMWBS score, chronic illness-related productivity loss, and number of reported social ties were important predictors of overall non-material support received by the ego (**Table 3**, see **Supplementary Table S4** for disaggregated analysis of emotional and informational support). This pattern was also observed when analyzing overall material support received, with additional factors such as living with a partner and the proportion of non-family ties in one's social network also playing a role (**Table 3**).

For the provision of material support, we found that egos' marital status, chronic illness-related productivity loss, number of non-kin social ties, and overall number of reported social ties were important predictors, while alters' relation to the ego, gender, and residence location were also important predictors (**Table 2**). As with non-material support, alters provided more support to egos whose chronic condition limits their ability to work. However, they provided notably less support to those who were married and had a larger network of social ties (**Table 2**). While there was no association between the proportion of non-family ties in egos' networks and the provision of non-material support, egos with more non-family ties receive significantly more material support than those whose networks were mostly composed of family members. However, non-family ties and "other" family ties provided less support than egos' children or partners (**Table 3**), suggesting that the overall structure and composition of social networks is as important as the characteristics of individual social ties when it comes to determining the mobilization of social capital.

DISCUSSION

This study examined the personal networks of patients to understand the factors that drive the mobilization of social capital among Ghanaians seeking care for NCDs. We found important predictors of support mobilization at the individual, social network, and relationship levels. These predictors contributed to significant variability in both giving and receiving social support, yielding some surprising findings. Contrary to our expectations, we observed that older patients and those with better mental wellbeing did not receive the most support, despite older patients' greater need for it and the demonstrated protective effect of receiving support, respectively [29].

However, the relationship between mental wellbeing and social support is complex and may involve multiple potential causal pathways to consider. While previous research has shown that social support can have a protective effect on mental wellbeing [29], it is also possible that individuals with higher levels of mental wellbeing are perceived as having less need for support. Further investigation is needed to fully understand the different patient typologies that may exist. A larger, longitudinal study would be beneficial, as it would allow for the examination of the dynamic relationships between mental wellbeing and social support over time, and establish the temporal precedence of these variables.

Our study found that older patients generally need more support, but surprisingly, they receive less support from their social network. This could be due to caregiver fatigue and burnout, or the reduction of social connections over time [30, 31]. The occurrence of compassion fatigue and burnout is further supported by our finding that alters living in the same household as the ego provide substantially less non-material and material support, and that one's partner also provides less non-material support than other types of relation (**Table 2**, **Supplementary Table S2**).

The strongest predictor of social support with the largest effect size was whether patients' chronic illness ever prevented them from working or performing their usual household duties. Patients' reduced ability to work is also a more readily observed outcome of their illness and the greater provision of support to these patients may demonstrate the need-based provision of support or even the redistribution of household or family resources to account for variable, differential labor productivity.

Contrary to previous work in Ghana and sub-Saharan Africa [16, 32], we found that care recipients more frequently reported men as caregivers than women.

Previous studies focused on caregiving from the perspective of caregivers, which may explain unexpected differences in care recipients' perception and reporting of informal care. For example, gender roles and expectations (e.g., women providing informal care and performing household work) could cause underreporting of women's contributions to care [33]. To have a more complete understanding of the burden and function of informal care, future studies should involve both caregivers and care recipients.

Although participants more frequently identified family members as social ties, non-family ties were reported to provide more support during the 1 month recall period. Furthermore, having a higher proportion of non-family ties within one's network was predictive of receiving greater overall support. On an individual basis, non-family ties may provide more support over this relatively short 1 month recall period if, for example, they are less routinely mobilized relative to family ties.

Previous research has investigated the notion that "weaker" non-family ties provide bridging social capital, which expands the patient's pool of resources and enables the sharing and exchange of both financial and non-financial support [34–36]. Bridging social capital can give patients access to new resources, reducing the risk of resource depletion through overuse. These ties, being less familiar, may be less prone to compassion fatigue compared to stronger ties, such as close relatives.

The conclusions drawn from this study bear limitations, primarily due to its exclusive focus on patients who are seeking healthcare, without comparing them to a random sample of people with NCDs. The challenge of obtaining such a sample via a household survey is underscored by the low awareness of hypertension among Ghanaians, with estimates as low as 20% [37–39]. Additionally, it is important to note that the results may not fully represent the true extent of social support experienced by NCD patients, as they rely solely on self-reports from the patients themselves. For instance, there is a possibility that respondents may have underreported support received from household members, as they may perceive such assistance as routine family or household resource-sharing, thus not explicitly categorized as "social support." Conversely, receiving support less frequently from individuals outside the household may be seen as a more exceptional event, making it easier to recall and report as social support. To obtain a more holistic understanding of informal support for NCD patients, future research should consider adopting a mixed-methods approach. This approach should involve both the recipients and providers of support, facilitating an exploration of the motivations, determinants, and functions of support, while also addressing any disparity in perceptions between the two groups.

Conclusion

Patients seeking care for NCDs reported receiving support from a variety of caregivers, and we identified a number of factors that influence the level of support received. As the population in SSA ages and the burden of chronic illness increases, the demand for informal care may soon outstrip the ability of younger generations to provide it. To address this issue, policymakers should focus on improving resource pooling and inclusivity for old age security and social health protection, reducing the financial stress of aging and chronic illness for both caregivers and recipients. Additionally, they should consider expanding old age security, while respecting traditional customs of intergenerational support, by aligning social security schemes and poverty reduction strategies with national values and expectations.

ETHICS STATEMENT

The studies involving humans were approved by the Korle Bu Teaching Hospital (KBTH) Institutional Review Board (IRB) (Ref: KBTH-STC 000147/2021). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

BH and FT developed the research design. BH drafted the initial version of the manuscript and performed the analysis under the supervision of FT. KA-W, EO, SM, and AY provided inputs on the methodology and implemented the data collection. All authors contributed to the article and approved the submitted version.

FUNDING

This manuscript is part of the research project "Health systems governance for an inclusive and sustainable social health protection in Ghana and Tanzania" funded via the Swiss Programme for Research on Global Issues for Development (R4D), a joint research funding programme of the Swiss National Science Foundation and the Swiss Agency for Development and Cooperation (Grant #: 183760). The funders were not involved in the study design, data collection, analysis, interpretation of findings, the writing of this article or the decision to submit it for publication.

CONFLICT OF INTEREST

The authors declare that they do not have any conflicts of interest.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.ssph-journal.org/articles/10.3389/ijph.2023.1605891/full#supplementary-material

REFERENCES

1. Kushitor MK, Boatemaa S. The Double Burden of Disease and the Challenge of Health Access: Evidence From Access, Bottlenecks, Cost and Equity Facility Survey in Ghana. *PLoS One* (2018) 13(3):e0194677. doi:10.1371/journal.pone.0194677
2. Agyei-Mensah S, De-Graft Aikins A. Epidemiological Transition and the Double Burden of Disease in Accra, Ghana. *J Urban Health* (2010) 87(5):879–97. doi:10.1007/s11524-010-9492-y
3. Adler AJ, Laar AK, Kotoh AM, Legido-Quigley H, Perel P, Lamptey P, et al. Barriers and Facilitators to the Implementation of a Community-Based Hypertension Improvement Project in Ghana: A Qualitative Study of ComHIP. *BMC Health Serv Res* (2020) 20(1):67. doi:10.1186/s12913-019-4774-x
4. Awoonor-Williams JK, Sory EK, Nyonator FK, Phillips JF, Wang C, Schmitt ML. Lessons Learned From Scaling up a Community-Based Health Program in the Upper East Region of Northern Ghana. *Glob Health Sci Pract* (2013) 1(1):117–33. doi:10.9745/GHSP-D-12-00012
5. Braimah JA, Sano Y, Atuoye KN, Luginaah I. Access to Primary Health Care Among Women: The Role of Ghana's Community-Based Health Planning and Services Policy. *Prim Health Care Res Dev* (2019) 20:e82. doi:10.1017/S1463423619000185
6. Nyaaba GN, Masana L, de-Graft Aikins A, Beune E, Agyemang C. Factors Hindering Hypertension Control: Perspectives of Front-Line Health Professionals in Rural Ghana. *Public Health* (2020) 181:16–23. doi:10.1016/j.puhe.2019.11.007
7. Nielsen JØ, Shrestha AD, Neupane D, Kallestrup P. Non-Adherence to Anti-Hypertensive Medication in Low- and Middle-Income Countries: A Systematic Review and Meta-Analysis of 92443 Subjects. *J Hum Hypertens* (2017) 31(1):14–21. doi:10.1038/jhh.2016.31
8. Wolff JL, Mulcahy J, Huang J, Roth DL, Covinsky K, Kasper JD. Family Caregivers of Older Adults, 1999–2015: Trends in Characteristics, Circumstances, and Role-Related Appraisal. *The Gerontologist* (2018) 58(6):1021–32. doi:10.1093/geront/gnx093
9. Aikins AD-G. Healer Shopping in Africa: New Evidence From Rural-Urban Qualitative Study of Ghanaian Diabetes Experiences. *BMJ* (2005) 331(7519):737. doi:10.1136/bmj.331.7519.737
10. Isac C, Lee P, Arulappan J. Older Adults With Chronic Illness –Caregiver Burden in the Asian Context: A Systematic Review. *Patient Educ Couns* (2021) 104(12):2912–21. doi:10.1016/j.pec.2021.04.021
11. Twum-Danso Imoh A. Framing Reciprocal Obligations Within Intergenerational Relations in Ghana Through the Lens of the Mutuality of Duty and Dependence. *Childhood* (2022) 29(3):439–54. doi:10.1177/09075682221103343
12. Robison LJ, Schmid AA, Siles ME. Is Social Capital Really Capital? *Rev Soc Economy* (2002) 60(1):1–21. doi:10.1080/00346760110127074
13. Akinrolie O, Okoh AC, Kalu ME. Intergenerational Support Between Older Adults and Adult Children in Nigeria: The Role of Reciprocity. *J Gerontological Soc Work* (2020) 63(5):478–98. doi:10.1080/01634372.2020.1768459
14. Kpessa-Whyte M. Aging and Demographic Transition in Ghana: State of the Elderly and Emerging Issues. *The Gerontologist* (2018) 58(3):403–8. doi:10.1093/geront/gnx205
15. Oyando R, Njoroge M, Nguhiu P, Sigilai A, Kirui F, Mbui J, et al. Patient Costs of Diabetes Mellitus Care in Public Health Care Facilities in Kenya. *Int J Health Plann Manage* (2020) 35(1):290–308. doi:10.1002/hpm.2905
16. Nortey ST, Aryeetey GC, Aikins M, Amendah D, Nonvignon J. Economic Burden of Family Caregiving for Elderly Population in Southern Ghana: The

Case of a Peri-Urban District. *Int J Equity Health* (2017) 16(1):16. doi:10.1186/s12939-016-0511-9
17. Fernández-Peña R, Molina JL, Valero O. Personal Network Analysis in the Study of Social Support: The Case of Chronic Pain. *Int J Environ Res Public Health* (2018) 15(12):2695. doi:10.3390/ijerph15122695
18. Harling G, Kobayashi LC, Farrell MT, Wagner RG, Tollman S, Berkman L. Social Contact, Social Support, and Cognitive Health in a Population-Based Study of Middle-Aged and Older Men and Women in Rural South Africa. *Soc Sci Med* (2020) 260:113167. doi:10.1016/j.socscimed.2020.113167
19. McCarty C, Lubbers MJ, Vacca R, Molina JL. *Conducting Personal Network Research: A Practical Guide*. New York, NY: Guilford Publications (2019). p. 293.
20. Hartung C, Lerer A, Anokwa Y, Tseng C, Brunette W, Borriello G. Open Data Kit: Tools to Build Information Services for Developing Regions. In: *Proceedings of the 4th ACM/IEEE International Conference on Information and Communication Technologies and Development*. London United Kingdom: ACM (2010).
21. Hooley B, Mtenga S, Tediosi F. Informal Support Networks of Tanzanians With Chronic Diseases: Predictors of Support Provision and Treatment Adherence. *Int J Public Health* (2022) 67:1605366. doi:10.3389/ijph.2022.1605366
22. Harling G, Morris KA, Manderson L, Perkins JM, Berkman LF. Age and Gender Differences in Social Network Composition and Social Support Among Older Rural South Africans: Findings From the HAALSI Study. *The Journals Gerontol Ser B.* (2020) 75(1):148–59. doi:10.1093/geronb/gby013
23. Musunuru A, Proffitt D, Ewing R, Greene WH. Poisson and Negative Binomial Regression Analysis. In: *Advanced Quantitative Research Methods for Urban Planners*. Phoenix, AZ, USA: Routledge (2020). p. 74–94.
24. Hilbe JM. *Negative Binomial Regression*. 2 ed. Cambridge: Cambridge University Press (2011).
25. Tennant R, Hiller L, Fishwick R, Platt S, Joseph S, Weich S, et al. The Warwick-Edinburgh Mental Well-Being Scale (WEMWBS): Development and UK Validation. *Health Qual Life Outcomes* (2007) 5(1):63. doi:10.1186/1477-7525-5-63
26. Gyasi RM, Phillips DR, Amoah PA. Multidimensional Social Support and Health Services Utilization Among Noninstitutionalized Older Persons in Ghana. *J Aging Health* (2018) 32(3-4):227–39. doi:10.1177/0898264318816217
27. Wilson A, Yendork JS, Somhlaba NZ. Psychometric Properties of Multidimensional Scale of Perceived Social Support Among Ghanaian Adolescents. *Child Indicators Res* (2017) 10(1):101–15. doi:10.1007/s12187-016-9367-1
28. Zimet GD, Dahlem NW, Zimet SG, Farley GK. The Multidimensional Scale of Perceived Social Support. *J Personal Assess* (1988) 52(1):30–41. doi:10.1207/s15327752jpa5201_2
29. Gyasi RM, Phillips DR, Abass K. Social Support Networks and Psychological Wellbeing in Community-Dwelling Older Ghanaian Cohorts. *Int Psychogeriatr* (2019) 31(07):1047–57. doi:10.1017/S1041610218001539
30. Antonucci TC, Ajrouch KJ, Birditt KS. The Convoy Model: Explaining Social Relations From a Multidisciplinary Perspective. *The Gerontologist* (2014) 54(1):82–92. doi:10.1093/geront/gnt118
31. Gérain P, Zech E. Do Informal Caregivers Experience More Burnout? A Meta-Analytic Study. *Psychol Health Med* (2021) 26(2):145–61. doi:10.1080/13548506.2020.1803372
32. Bhan N, Rao N, Raj A. Gender Differences in the Associations Between Informal Caregiving and Wellbeing in Low- and Middle-Income Countries. *J Women's Health* (2020) 29(10):1328–38. doi:10.1089/jwh.2019.7769
33. Agyemang-Duah W, Mensah CM, Peprah P, Arthur F, Addai B, Abalo EM. Informal Health Care: Examining the Role of Women and Challenges Faced as Caregivers in Rural and Urban Settings in Ghana. *J Public Health* (2019) 27(3):321–7. doi:10.1007/s10389-018-0953-1
34. Hawkins RL, Maurer K. Bonding, Bridging and Linking: How Social Capital Operated in New Orleans Following Hurricane Katrina. *The Br J Soc Work* (2009) 40(6):1777–93. doi:10.1093/bjsw/bcp087
35. Granovetter MS. The Strength of Weak Ties. *Am J Sociol* (1973) 78(6):1360–80. doi:10.1086/225469
36. Fontes BASM, Eichner K. A Formação Do capital Social em uma Comunidade de Baixa Renda. *Revista hispana para el análisis de redes sociales* (2004) 7(2). doi:10.5565/rev/redes.59
37. Tannor EK, Nyarko OO, Adu-Boakye Y, Owusu Konadu S, Opoku G, Ankobea-Kokroe F, et al. Prevalence of Hypertension in Ghana: Analysis of an Awareness and Screening Campaign in 2019. *Clin Med Insights Cardiol* (2022) 16:11795468221120092. doi:10.1177/11795468221120092
38. Sanuade OA, Awuah RB, Kushitor M. Hypertension Awareness, Treatment and Control in Ghana: A Cross-Sectional Study. *Ethn Health* (2020) 25(5):702–16. doi:10.1080/13557858.2018.1439898
39. Lamloum D, Fassio F, Osetinsky B, Tediosi F. Care Cascades for Hypertension in Low-Income Settings: A Systematic Review and Meta-Analysis. *Int J Public Health* (2023) 68:1606428. doi:10.3389/ijph.2023.1606428

International Journal of Public Health
ORIGINAL ARTICLE
published: 15 February 2024
doi: 10.3389/ijph.2024.1606284

Prevalence and Factors Associated With Frailty Among Older Adults Living With HIV Compared to Their Uninfected Peers From the Kenyan Coast

Patrick N. Mwangala[1,2,3]*, *Carophine Nasambu*[2], *Ryan G. Wagner*[4], *Charles R. Newton*[1,2,5,6] *and Amina Abubakar*[1,2,5,6]

[1]Institute for Human Development, Aga Khan University, Nairobi, Kenya, [2]Centre for Geographic Medicine Research Coast, Kenya Medical Research Institute (KEMRI), Kilifi, Kenya, [3]School of Public Health, University of the Witwatersrand, Johannesburg, South Africa, [4]MRC/Wits Rural Public Health and Health Transitions Research Unit (Agincourt), Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa, [5]Department of Psychiatry, Warneford Hospital, University of Oxford, Oxford, United Kingdom, [6]Department of Public Health, Pwani University, Kilifi, Kenya

Objectives: a) To document the prevalence and correlates of frailty among older adults living with HIV (OALWH) and their uninfected peers, and b) Investigate HIV status as an independent predictor of frailty.

Methods: This cross-sectional study was conducted between 2020 and 2021 at the Kenyan coast among 440 older adults aged ≥50 years (257 OALWH). Frailty was assessed using the Reported Edmonton Frail Scale. Logistic regression was used to examine the correlates of frailty.

Results: The prevalence of frailty was significantly higher among OALWH (24%) than their uninfected peers (13%). HIV seropositivity was not independently associated with frailty. Sleeping difficulties, ageism, higher waist/hip ratio, visiting traditional healers, HIV treatment change/interruption, prolonged illness following HIV diagnosis, and self-reported diabetes were significantly associated with higher odds of frailty. Residing in larger households, having higher income, having friends, being male and light physical activities were significantly associated with reduced odds of frailty.

Conclusion: The prevalence of frailty is elevated among OALWH; however, factors other than HIV are predominant, particularly psychosocial factors. Multicomponent interventions are needed to prevent/delay and manage frailty in this setting.

Keywords: HIV, aging, frailty, correlates, sub-Saharan Africa

OPEN ACCESS

Edited by:
Olaf von dem Knesebeck, University Medical Center Hamburg-Eppendorf, Germany

Reviewed by:
Michel Oris, University of Geneva, Switzerland
One reviewer who chose to remain anonymous

***Correspondence**
Patrick N. Mwangala,
patrick.nzivo@aku.edu,
pmwangala27@gmail.com

This Original Article is part of the IJPH Special Issue "Ageing and Health in Sub-Sahara Africa"

Received: *06 June 2023*
Accepted: *31 January 2024*
Published: *15 February 2024*

Citation:
Mwangala PN, Nasambu C, Wagner RG, Newton CR and Abubakar A (2024) Prevalence and Factors Associated With Frailty Among Older Adults Living With HIV Compared to Their Uninfected Peers From the Kenyan Coast. Int J Public Health 69:1606284. doi: 10.3389/ijph.2024.1606284

INTRODUCTION

Recent years have witnessed a remarkable rise in the population of older adults in developing countries, including Kenya, making caring for the elderly a public health priority [1]. A better understanding of the factors that influence healthy ageing is crucial for designing appropriate therapies to prevent functional decline, maintain independence, and preserve the quality of life of

these adults. In this context, increasing attention has been paid to geriatric syndromes, especially frailty, as a potential explanation of the health diversity among older adults [2]. Although a universal definition is still lacking, frailty is commonly conceptualized as the increased vulnerability to external and internal stressors resulting from a significant loss of physiologic reserve [3]. Several pathophysiological pathways, including cellular senescence, mitochondrial dysfunction, oxidative stress, and dysregulation of inflammatory processes, underlie the frailty syndrome [4]. Growing evidence from systematic reviews also links frailty with adverse health outcomes, including emergency hospital admissions [5], disability [6], poor quality of life [7], dementia [8], and premature mortality [9]. Given the high burden, negative impacts on older adults, and the dynamic nature of frailty, identifying the determinants of frailty is imperative, especially among vulnerable older adults such as those ageing with HIV.

Frailty has been examined extensively in recent years; however, most work has been conducted in older populations in high-income countries (HICs). Some work has been conducted in LMICs, but this has been confined to Brazil, Mexico, China [10] and South Africa [11–14]. So far, results indicate that the prevalence of frailty is highly variable, both between countries and between populations within a country, due to differences in the populations studied and the measurement of frailty. A recent meta-analysis of European studies showed a frailty prevalence of 12% among community-based studies and 45% in non-community-based studies [15]. In Latin America, the prevalence of frailty among community-dwelling older adults was 20%, with a range of 8%–43% in the studies reviewed [16]. Among OALWH, the global prevalence of frailty ranges from 5% to 29% [17]. In SSA, there has been growing attention to the risks of frailty in the ageing population, both in the general population and among people living with HIV (PLWH). To our knowledge, about a dozen studies on frailty have been conducted among older adults in the general population in SSA: South Africa [11–14], Tanzania [18–20], Ghana [13, 14], Nigeria [21], and Burkina Faso [22] with prevalence estimates ranging from 5.4% [11] to 63.3% [21]. Only two studies have focused on OALWH [23], with prevalence estimates ranging from 2.8% to 14.7%.

Identifying the risk and protective factors of frailty may be useful for developing interventions designed to prevent and/or lower the burden that frailty places on a person and provide future directions for public health policy. Indeed, numerous studies have focused on identifying the factors associated with frailty, including the role of biological, lifestyle, and psychological factors [18]. Among older adults in the general population, sociodemographic factors (e.g., being female, older age, low education levels, low income, living alone), physical factors (e.g., obesity, malnourishment, hearing loss, visual impairment, persistent pain), lifestyle factors (e.g., smoking, alcohol consumption, sedentary behaviours) and psychological factors (e.g., depressive symptoms, and sleeping problems) have been identified as risk factors for frailty [24–33]. Most of these studies have focused on sociodemographic factors. However, recently published studies have focused more on lifestyle-related, psychological, and biological factors associated with frailty, which may reflect a growing interest in potentially modifiable factors for frailty. Among OALWH, less research on risk and protective factors has been conducted. In a past systematic review [17], the predictors of frailty included older age, comorbidities, diagnosis of acquired immunodeficiency syndrome (AIDS) and low current $CD4^+$ cell count.

Like many parts of SSA, Kenya's population of older adults is increasing rapidly. In the most recent population census of 2019, the proportion of older adults aged ≥50 years was about 11%, representing approximately 5.2 million individuals [34]. Kenya is also witnessing an increase in chronic age-related conditions [35], which coincides with a high prevalence of HIV among those aged ≥50 years [36]. Hence, establishing the current burden and determinants of frailty is essential if health and social care services are to meet the needs of Kenya's ageing population. The present study aims to: a) determine the prevalence of frailty among OALWH compared to their uninfected peers; b) investigate HIV status as an independent predictor of frailty in the older adults; and c) investigate the determinants of frailty among the older adults at the coast of Kenya.

METHODS

Study Design and Setting

This was a cross-sectional study carried out at the Kenyan coast in Mombasa and Kilifi counties between 2020 and 2021. With an estimated population of about 1.5 million people [37], most Kilifi residents are rural inhabitants of the Mijikenda tribe, whose primary source of livelihood is subsistence farming and small-scale trading. In Kilifi, the prevalence of HIV in adults is 4.5% [38]. Mombasa County borders Kilifi to the north and hosts Mombasa City, the second-largest city and chief port of Kenya. It has a population of about 1.2 million residents [37]. Given its urban nature, the county is made up of the local (Mijikenda and Swahili) and immigrant communities from other parts of Kenya. At about 60%, the formal sector provides the majority of employment in Mombasa County [39]. The prevalence of HIV in adults in Mombasa is about 7.5% [38].

Study Participants and Recruitment

Older Adults Living With HIV (OALWH)

We recruited the OALWH from two public HIV-specialized clinics in Mombasa and Kilifi counties (one in each). We specifically selected the two clinics because of their wide client catchment area and their large volume of potential participants. To be included, clients had to be aged ≥50 years of age, have a confirmed HIV seropositivity status, be on HIV treatment, and be willing and able to provide informed consent for their involvement.

In both HIV clinics, two community health volunteers or healthcare providers assisted us in reviewing existing records to identify potential clients. Efforts were made to contact all potential clients who had contact details (in alphabetical order) to invite them to participate in our study. Study introductions were conducted in person by a research assistant before any enrolment. Participant recruitment began in

Mombasa County; however, it was interrupted by the onset of the COVID-19 pandemic after recruiting and assessing only 72 OALWH. Upon resumption of project activities, the recruitment and assessment of remaining clients (n = 368) took place in Kilifi County.

HIV Uninfected Older Adults

All the older adults without HIV were recruited from Kilifi County. The Kilifi Health and Demographic Surveillance System (KHDSS) was used to identify families with eligible older adults. Subsequently, potential participants aged ≥50 years were randomly identified from the existing database and followed up at their homes using Global Positioning System (GPS) coordinates by our trained research assistants. Project information was shared with all individuals who expressed interest in participation. As inclusion criteria, individuals had to be ≥50 years old, inhabitants of Kilifi county, and provide consent to their involvement, including willingness to be tested for HIV using a rapid HIV testing kit (OraQuick) for a confirmation of their HIV seronegative status.

Sample Size Calculations

We calculated our sample size using a previous study [40], which reported significant differences in the prevalence estimate of frailty between OALWH and their uninfected counterparts. Power analyses in Stata (using effect estimates and comparison of two group proportions) were conducted to estimate the required sample size. An overall sample of 310 was required to detect a difference in frailty between OALWH and uninfected peers at 80% power and a 5% level of statistical significance. A sample of 450 participants was deemed sufficient, allowing for missing data.

Measures

We programmed all our research instruments on Android tablets using the Research Electronic Data Capture (REDCap) platform [41] for face-to-face interviewer administration. The first author (the study coordinator) trained the research assistants for 2 weeks to facilitate the proper administration of the study tools. All study tools not previously adapted to the local language of Swahili underwent recommended adaptation procedures, that is, forward translation, forward translation review, back translation, harmonization by a panel of experts, pilot testing, pilot testing review, and proofreading [42].

Sociodemographic and Asset Index Form

Sociodemographic characteristics, including participants' age, sex, marital status, educational level, occupational status, household size, income, living arrangements and number of dependents, were captured in REDCap. We also collected information on individual and family ownership of disposable assets for asset index computation as a proxy for socioeconomic status. The participants also provided information on their food security in the past week, access to social support, social network of close friends, the number of people living with HIV in the household, and whether they were taking care of sick family members at the time and visiting traditional healers.

General Health Information

We also gathered the participants' anthropometric details (such as height, weight, blood pressure, waist, and hip circumference), hours spent on sedentary activities in a day, sexual activity, number of medications one was using, self-reported comorbidities, past medical history, and common complaints, e.g., fatigue, pain, sleeping difficulties, visual and hearing problems.

For OALWH, we also asked HIV-specific questions relating to the disclosure of HIV status, access to the HIV clinic, and past medical history, e.g., cART regimen change/interruption and prolonged illness after HIV diagnosis. Information pertaining to their current ART regimen and overall duration on ART were extracted from their medical records. We also collected 10 mL of venous blood samples from the OALWH for viral load measurement.

Psychosocial Measures

Psychosocial variables included HIV-related stigma, functional disability, loneliness, and age-related discrimination (ageism). All these constructs were assessed using interviewer-administered Likert scales, the brief 12-item HIV stigma scale [43], the 12-item World Health Organization Disability Assessment Schedule 2 [44], UCLA 8-item loneliness scale [45], and the 20-item ageism survey [46]. In each scale, a higher score translates into a greater level of impairment.

Measures of Frailty

We assessed frailty using the modified Reported Edmonton Frail Scale [47]. It assesses nine domains of frailty: cognition, general health status, functional independence, social support, medication use, nutrition, mood, continence, and self-reported functional performance. Each domain comprises a set of questions examining the construct. Test scores range from 0–18, and participants are classified conventionally into 5 categories, with a higher score representing a higher degree of frailty: 0–5 (not frail), 6–7 (apparently vulnerable), 8–9 (mild frailty), 10–11 (moderate frailty) and 12–18 (severe frailty). In the current study, we collapsed these categories into three: 0–5 (non-frail), 6–7 (pre-frail) and 8–18 (frail) to enable meaningful analysis of the correlates of frailty [48, 49].

Data Analysis

We conducted all our analyses in STATA version 15.0 (StataCorp LP, College Station, TX, United States). We utilized descriptive statistics to summarize sample characteristics. Specifically, independent Student's t-test and Chi-square test were used to compare differences in independent variables. Proportions were used to estimate the prevalence of frailty among OALHW and their uninfected peers. To examine HIV status as an independent predictor of frailty, we used logistic regression analyses adjusting for relevant exposure variables that accounted for differences in frailty. Examination of the correlates of frailty applied logistic regression models to explore univariate associations between the binary outcome variables (frailty) and the various exposure variables. Expose variables with a p-value <0.15 in the univariate analysis were then entered into the multivariable models using forward selection. In all models, collinearity was

TABLE 1 | Characteristics of the study population by HIV status, *n* = 440 (The HIV-associated Neurocognitive Disorders study, Kenya, 2020 and 2021).

Characteristic	Total sample *n* = 440	HIV status		
		HIV uninfected older adults, *n* = 183	HIV-infected older adults, *n* = 257	*p*-value
Age (years)				
50–59	227 (51.6)	84 (45.9)	143 (55.6)	
60–69	171 (38.9)	74 (40.4)	97 (37.7)	0.02
≥70	42 (9.5)	25 (13.7)	17 (6.6)	
Sex				
Female	258 (58.6)	98 (53.6)	160 (62.3)	0.07
Male	182 (41.4)	85 (46.4)	97 (37.7)	
Marital status				
Never married	12 (2.8)	4 (2.2)	8 (3.1)	
Separated/Divorced/Widowed	181 (41.1)	45 (24.6)	136 (52.9)	<0.001[e]
Married/cohabiting	247 (56.1)	134 (73.2)	113 (44.0)	
Education level				
None	162 (36.8)	90 (49.2)	72 (28.0)	
Primary	182 (41.4)	65 (35.5)	117 (45.5)	<0.001[e]
Secondary	73 (16.6)	22 (12.0)	51 (19.9)	
Tertiary	23 (5.2)	6 (3.3)	17 (6.6)	
Employment				
Unemployed	288 (65.5)	126 (68.9)	162 (63.0)	
Employed	116 (26.3)	39 (21.3)	77 (30.0)	0.1
Retired	36 (8.2)	18 (9.8)	18 (7.0)	
Household size				
One to two people	69 (15.7)	15 (8.2)	54 (21.0)	
Three to six people	297 (67.5)	131 (71.6)	166 (64.6)	0.001
Above seven people	74 (16.8)	37 (20.2)	37 (14.4)	
Monthly household income (Ksh)				
≤10,000	279 (63.4)	69 (37.7)	210 (81.7)	
Above 10,000	161 (36.6)	114 (62.3)	47 (18.3)	<0.001
Living arrangements				
Multiple generational families	359 (81.6)	169 (92.3)	190 (73.9)	
Single generational families	41 (9.3)	6 (3.3)	35 (13.6)	<0.001[e]
Alone	40 (9.1)	8 (4.4)	32 (12.5)	
Number of dependents, mean (SD)	3.2 (2.6)	3.6 (2.5)	2.9 (2.7)	0.01
Caring for a sick family member, OM = 2				
Yes	291 (66.4)	104 (57.1)	187 (73.1)	0.001
No	147 (33.6)	78 (42.9)	69 (26.9)	
Social network of close friends (*yes or no question*) OM = 1				
None	19 (4.3)	4 (2.2)	15 (5.9)	
Yes	420 (95.7)	179 (97.8)	241 (91.4)	0.1[e]
Access to instrumental/social support				
None	199 (45.2)	93 (50.8)	106 (41.2)	
Sometimes	215 (48.9)	83 (45.4)	132 (51.4)	0.07
Most of the time	26 (5.9)	7 (3.8)	19 (7.4)	
Seeking the services of traditional healers OM = 4				
No	399 (91.5)	166 (90.7)	233 (92.1)	0.6
Yes	37 (8.5)	17 (9.3)	20 (7.9)	
History of cerebrovascular accident OM = 4				
No	427 (97.9)	178 (97.3)	249 (98.4)	0.5[e]
Yes	9 (2.1)	5 (2.7)	4 (1.6)	
Food insecurity (lack of food in the past week), OM = 3				
Never	293 (67.1)	134 (73.6)	159 (62.4)	
Sometimes	119 (27.2)	45 (24.7)	74 (29.0)	0.002[e]
Most of the time/always	25 (5.7)	3 (1.7)	22 (8.6)	
Asset index score[a]—mean (SD)	2.3 (1.5)	1.9 (1.2)	2.5 (1.6)	<0.001

(Continued on following page)

TABLE 1 | (*Continued*) Characteristics of the study population by HIV status, *n* = 440 (The HIV-associated Neurocognitive Disorders study, Kenya, 2020 and 2021).

Characteristic	Total sample *n* = 440	HIV status		
		HIV uninfected older adults, *n* = 183	HIV-infected older adults, *n* = 257	*p*-value
Body mass index—mean (SD), OM = 11	24.9 (6.0)	24.7 (6.1)	25.0 (5.9)	0.7
High waist-hip ratio				
No	202 (46.3)	77 (42.1)	125 (49.4)	0.1
Yes	234 (53.7)	106 (57.9)	128 (50.6)	
Loneliness score[b]—mean (SD), OM = 3	13.9 (3.7)	13.0 (3.4)	14.6 (3.7)	<0.001
Functional disability score[c]—mean (SD), OM = 2	2.5 (4.3)	1.5 (3.0)	3.1 (4.9)	<0.001
Ageism score[d]—mean (SD)	4.2 (5.9)	3.0 (4.4)	5.0 (6.6)	<0.001
Hours spent in sedentary activities in a day, mean (SD), OM = 12	4.5 (2.6)	4.3 (2.1)	4.6 (2.9)	0.3
Days spent doing light activities in the past week, mean (SD), OM = 5	5.6 (2.4)	4.6 (3.0)	6.4 (1.6)	<0.001
Sexually active, OM = 4				
Yes	206 (47.3)	105 (57.4)	101 (39.9)	<0.001
No	230 (52.7)	78 (42.6)	152 (60.1)	
Sleeping difficulties in the past month, OM = 4				
None	276 (63.3)	125 (68.3)	151 (59.7)	
Sometimes	131 (30.1)	53 (29.0)	78 (30.8)	0.01[e]
Most of the time/always	29 (6.6)	5 (2.7)	24 (9.5)	
Frequent bodily pain				
No	334 (75.9)	134 (73.2)	200 (77.8)	0.3
Yes	106 (24.1)	49 (26.8)	57 (22.2)	
Self-reported hearing ability OM = 4				
Very good	360 (82.6)	151 (82.5)	209 (82.6)	0.90
Averagely/very bad	76 (17.4)	32 (17.5)	44 (17.4)	
Self-reported Hypertension, OM = 4				
No	322 (73.9)	138 (75.4)	184 (72.7)	0.5
Yes	114 (26.1)	45 (24.6)	69 (27.3)	
Self-reported diabetes, OM = 4				
No	412 (94.5)	175 (95.6)	237 (93.7)	0.4[e]
Yes	24 (5.5)	8 (4.4)	16 (6.3)	
Number of medications participants are currently using, mean (SD), OM = 8	1.6 (1.6)	0.4 (1.2)	2.4 (1.2)	<0.001

All numbers are reported as frequencies with percentages unless otherwise stated p-*values are for the difference between OALWH and their uninfected peers by sample characteristic. SD, standard deviation; OM, observation with missing value; Ksh Kenya shillings.*

[a]*Score range = 0 to 8, higher scores indicate better socioeconomic status.*

[b]*Score range = 8 to 27, higher scores indicate greater loneliness.*

[c]*Score range = 0 to 33, higher scores indicate increasing disability.*

[d]*Score range = 0 to 34, higher scores indicate increasing agism.*

[e]*based on Fisher's exact test.*

checked, and for all hypothesis tests, a two-tailed *p*-value <0.05 was deemed statistically significant. We checked the overall fit of the final models using Hosmer and Lemeshow's goodness of fit, where a *p*-value of >0.05 was considered a good fit.

RESULTS

Sample Characteristics

Our sample comprised 440 participants, 257 (58%) of whom were OALWH. An overall response rate of 90% was achieved at recruitment. Among the respondents, 6 (1.4%) did not complete the outcome measure. **Table 1** gives the details of the demographic and biopsychosocial information of these participants. In brief, the mean age of the respondents was 60.1 (SD = 6.9) years and 58.6% were female. The majority of the participants were unemployed (65.5%), had a monthly household income of less than 10,000 Kenyan shillings—about $90 (63.4%), lived in multigenerational households (81.6%), and had caregiving responsibilities (66.4%). Moreover, close to half of them reported being sexually active, and a similar proportion reported that they were not accessing/receiving adequate social support. Adults living with HIV were likely to be younger, unmarried, more educated, have lower monthly household income, live alone, and have fewer dependents.

TABLE 2 | HIV-related, clinical, and psychosocial characteristics of OALWH, *n* = 257 (The HIV-associated Neurocognitive Disorders study, Kenya, 2020 and 2021).

Characteristic	Mean (SD) or frequency (%)
HIV status disclosure	
Yes	245 (95.3%)
No	12 (4.7%)
Household HIV burden, mean (SD); OM = 5	1.4 (1.6)
cART regimen	
First line	233 (90.7%)
Second line	23 (8.9%)
Third line	1 (0.4%)
cART regimen change/interruption since HIV diagnosis	
Yes	110 (42.8%)
No	147 (57.2%)
Duration on cART (years), mean (SD), OM = 10	11.4 (4.3)
Viral suppression, OM = 45	
Yes	208 (98.1%)
No	4 (1.9%)
Access to HIV clinic, OM = 4	
Easily accessible	169 (66.8%)
Not easily accessible	84 (33.2%)
History of a neurological condition, OM =4	
No	236 (93.3%)
Yes	17 (6.7%)
History of prolonged illness following HIV diagnosis, OM = 6	
No	223 (88.8%)
Yes	28 (11.2%)
Perceived HIV-stigma score, OM = 1	
Personalized stigma[a]—mean (SD)	5.0 (1.9)
Disclosure concerns[b]—mean (SD)	8.6 (2.0)
Concerns about public attitudes[c]—mean (SD)	7.6 (2.2)
Negative self-image[d]—mean (SD)	6.4 (2.1)
Overall stigma[e]—mean (SD)	27.5 (5.4)

[a]*Score range = 3 to 12, higher scores indicate greater stigma.*
[b]*Score range = 3 to 12, higher scores indicate greater stigma.*
[c]*Score range = 3 to 12, higher scores indicate greater stigma.*
[d]*Score range = 3 to 12, higher scores indicate greater stigma.*
[e]*Score range = 12 to 44, higher scores indicate greater stigma; OM, observation with missing value; cART, combination antiretroviral therapy.*

HIV-Related Characteristics of Older Adults Living With HIV

All the OALWH were receiving HIV treatment, most (90%) of whom were on a first-line cART regimen. Most (95.3%) of them had disclosed their HIV status. The mean (SD) duration of HIV treatment was 11.4 (4.3) years. Additionally, nearly all of them (98.1%) had suppressed viral load (≤1,000 copies/mL). Further details are highlighted in **Table 2**.

Frailty Prevalence Estimates

The overall prevalence of frailty across the sample was 19.4% (95% CI: 15.7–23.4). Groupwise, older adults living with HIV presented with a significantly higher prevalence of frailty (23.9%) than their uninfected peers (12.8%), $p < 0.01$ (**Table 3**).

Association Between HIV Status and Frailty

In univariate logistic regression analyses (**Table 4**), HIV seropositivity was significantly associated with higher odds of frailty (OR 2.13; 95% CI 1.26, 3.60). However, in the multivariable logistic regression model (**Table 4**), HIV seropositivity was not significantly associated with frailty (aOR 1.26; 95% CI 0.60, 2.63).

Determinants of Frailty in Older Adults Living With HIV

Table 5 presents results from univariate and multivariate logistic regression analyses exploring the determinants of frailty among older adults living with HIV.

In the multivariable logistic regression model, factors significantly associated with higher odds of frailty among OALWH were sleeping difficulties in the past month, increasing ageism scores, visiting traditional healers, high waist-to-hip ratio, a history of cART regimen change/interruption, and a history of prolonged illness after HIV diagnosis. On the other hand, having a social network of close friends, a larger household, a higher household income (≥10,000 Ksh; about $86) and taking part in light physical activities such as walking in the past week were significantly associated with lower odds of frailty.

Determinants of Frailty in Older Adults Without HIV

In multivariable analyses (**Table 6**), sleeping difficulties in the past month, self-reported diabetes, and light physical activities in the past week were significantly associated with higher odds of

TABLE 3 | Prevalence of frailty in OALWH versus their uninfected peers (The HIV-associated Neurocognitive Disorders study, Kenya, 2020 and 2021).

	Older adults without HIV, *n* = 179		Older adults living with HIV, *n* = 255		Total sample, *n* = 434		*p*-value (between groups)
	Number	Prevalence (95% CI)	Number	Prevalence (95% CI)	Number	Prevalence (95% CI)	
Not frail	119	66.5 (59.1–73.3)	140	54.9 (48.6–61.1)	259	59.7 (54.9–64.3)	0.02
Prefrail	37	20.7 (15.0–27.3)	54	21.2 (16.3–26.7)	91	21.0 (17.2–25.1)	0.9
Frail	23	12.8 (8.3–18.7)	61	23.9 (18.8–29.6)	84	19.4 (15.7–23.4)	<0.01

95% CI, 95% confidence interval.
Note: The number of respondents reported in this table (434) is slightly lower than the overall sample size (440) because six participants were dropped from the analysis due to incomplete data on the frailty tool.

TABLE 4 | Association between HIV status and frailty among older adults (The HIV-associated Neurocognitive Disorders study, Kenya, 2020 and 2021).

Covariate	Positive screen for frailty	
	Crude analysis OR (95% CI)	**Adjusted analysis aOR (95% CI)**
HIV status		
Seronegative	Ref	Ref
Seropositive	2.13** (1.26, 3.60)	1.26 (0.60, 2.63)
Sex		
Female		Ref
Male		1.29 (0.62, 2.70)
Age (years)		
50–59		Ref
60–69		1.26 (0.64, 2.50)
Above 70		1.20 (0.40, 3.61)
Abnormal waist-hip ratio		
No		Ref
Yes		2.75** (1.41, 5.37)
Household size		
One to two people		Ref
Three to six people		0.37* (0.17, 0.82)
Seven and above		0.36 (0.12, 1.04)
Monthly household income (Ksh)		
≤10,000		Ref
Above 10,000		0.49 (0.22, 1.08)
Social network of close friends		
No		Ref
Yes		0.34 (0.10, 1.17)
Caring for a sick family member		
No		Ref
Yes		0.51* (0.27, 0.97)
Functional disability score		1.05 (0.98, 1.12)
Ageism score		1.08** (1.03, 1.13)
Sleeping difficulties for the past month		
None		Ref
Sometimes		3.70** (1.93, 7.10)
Most of the time/always		2.94 (0.99, 8.76)
Sexually active		
No		Ref
Yes		0.54 (0.26, 1.10)
Seeking the services of traditional healers		
No		Ref
Yes		2.95* (1.24, 7.05)
Self-reported hearing		
Very good		Ref
Averagely/very bad		1.58 (0.78, 3.22)
History of cerebrovascular accident		
No		Ref
Yes		5.87 (0.85, 40.68)
Number of individuals in the final model		427
Hosmer-Lemeshow Test		$X^2 = 402.62$; $p = 0.36$
Variance explained		30.81%

CI, confidence interval; OR, odds ratio; aOR, adjusted odds ratio; Ref, reference group.

** – p-value < 0.05, ** – p-value < 0.01.*

Note: The number of individuals in the final model (427) is slightly lower than the actual sample size (440) because some of the observations had missing values.

TABLE 5 | Univariate and multivariable analysis of correlates of frailty among OALWH (The HIV-associated Neurocognitive Disorders study, Kenya, 2020 and 2021).

Covariate	Positive screen for frailty by mod-REFS	
	Univariate analysis OR (95% CI)	**Multivariable analysis aOR (95% CI)**
Age (years)		
50–59	Ref	Ref
60–69	0.96 (0.53, 1.76)	1.58 (0.63, 3.96)
≥70	0.66 (0.18, 2.41)	0.33 (0.05, 2.05)
Sex		
Female	Ref	Ref
Male	1.09 (0.60, 1.99)	1.32 (0.52, 3.39)
Monthly household income (Ksh)		
≤10,000	Ref	Ref
Above 10,000	0.26*** (0.09, 0.76)	0.13** (0.03, 0.60)
Household size		
One to two	Ref	Ref
Three to six	0.33*** (0.17, 0.63)	0.35** (0.12, 0.99)
Above seven	0.26*** (0.09, 0.73)	0.26 (0.06, 1.15)
Caring for a sick family member		
No	Ref	—
Yes	0.13*** (0.07, 0.24)	—
Having close friends (*social network*)		
No	Ref	Ref
Yes	0.09*** (0.03, 0.31)	0.13*** (0.03, 0.56)
Access to instrumental/social support		
Not accessing	Ref	—
Sometimes	2.53*** (1.33, 4.84)	—
Most of the time/always	1.48 (0.44, 5.05)	—
Food insecurity (lack of food in the past week)		
Never	Ref	
Sometimes	2.36*** (1.27, 4.40)	—
Most of the time/always	1.25 (0.43, 3.67)	—
A+sset index, mean (SD)	1.16* (0.97, 1.38)	—
Waist hip ratio		
Normal	Ref	Ref
Abnormal	2.23*** (1.22, 4.06)	3.67*** (1.48, 9.10)
Self-reported Hypertension		
No	Ref	—
Yes	0.37*** (0.19, 0.74)	—
Loneliness score, mean (SD)	1.15*** (1.06, 1.24)	—
Functional disability score, mean (SD)	1.13*** (1.06, 1.20)	—
Ageism score, mean (SD)	1.14*** (1.08, 1.19)	1.11*** (1.04, 1.18)
Days spent doing light activities in the past week, mean (SD)	0.69*** (0.58, 0.82)	0.77*** (0.61, 0.98)
Hours spent in sedentary behaviours in a day, mean (SD)	0.79*** (0.70, 0.90)	—
Sexually active		
No	Ref	—
Yes	0.60* (0.33, 1.11)	—
Sleeping difficulties in the past month		
None	Ref	Ref
Sometimes	5.44*** (2.77, 10.71)	2.80** (1.14, 6.87)
Most of the time/always	7.82*** (3.04, 20.15)	1.92 (0.49, 7.43)
Seeking the services of traditional healers		
No	Ref	Ref
Yes	5.60*** (2.17, 14.46)	9.86*** (2.45, 39.68)
HIV status disclosure (*family/relatives*)		
No	Ref	—
Yes	3.55*** (1.91, 6.61)	—

(Continued on following page)

TABLE 5 | (*Continued*) Univariate and multivariable analysis of correlates of frailty among OALWH (The HIV-associated Neurocognitive Disorders study, Kenya, 2020 and 2021).

Covariate	Positive screen for frailty by mod-REFS	
	Univariate analysis OR (95% CI)	**Multivariable analysis aOR (95% CI)**
History of a neurological condition		
No	Ref	—
Yes	5.15*** (1.87, 14.21)	—
Prolonged period of illness following HIV diagnosis		
No	Ref	Ref
Yes	3.72*** (1.66, 8.35)	6.58*** (2.13, 20.33)
ART Regimen		
1st line	Ref	—
2nd line	3.07*** (1.27, 7.38)	—
Mean HIV duration (SD)	1.05* (0.98, 1.13)	—
Viral suppression		
Yes	Ref	—
No	8.56* (0.87, 84.01)	—
cART regimen change/interruption since HIV diagnosis		
No	Ref	Ref
Yes	6.86*** (3.55, 13.26)	3.36*** (1.43, 7.91)
Access to HIV clinic		
Not easily accessible	Ref	—
Easily accessible	1.77* (0.90, 3.52)	—
Perceived HIV-stigma score, mean (SD)		
Personalized stigma	0.85* (0.72, 1.00)	—
Disclosure concerns	1.37*** (1.16, 1.62)	—–
Concerns about public attitudes	1.18** (1.02, 1.36)	—
Overall stigma	1.05** (0.99, 1.11)	—
n for the final model		248
Variance explained		43.35%
Hosmer-Lemeshow test		X^2 = 235.00; *p*-value = 0.07
cvMean AUC (95% CI)		0.90 (0.86, 0.95)

Only a priori *variables (age, sex) and those with* p-*value < 0.15 in the univariate analysis or multivariable* p *< 0.05 are presented here. OR, odds ratio; aOR, adjusted odds ratio; Ref, reference group; cvMean AUC, cross-validated mean area under the curve for the final multivariable model.*

** – p-value < 0.15, ** – p-value < 0.05, *** – p-value < 0.01.*

Note: The number of individuals in the final model (248) is slightly lower than the actual sample size for older adults living with HIV (257) because some of the observations had missing values.

frailty among the HIV uninfected older adults. Conversely, being male was significantly associated with reduced odds of frailty in these adults.

DISCUSSION

Our study adds to the growing number of reports on the burden and determinants of frailty in low- and middle-income countries. In this study, the prevalence of frailty was significantly higher in OALWH (23.9%; 95% CI 18.8–29.6) compared to their uninfected peers (12.8%; 95% CI 8.3–18.7); however, HIV seropositivity was not significantly associated with frailty after adjusting for biopsychosocial factors. To our knowledge, there have been only two previous studies of frailty among OALWH in SSA. The first one, a cross-sectional sample of 145 OALWH (67% female) on ART and a median age of 57 years in Tanzania, reported a low prevalence of frailty (2.8%) [50]. The other one, a population-based cohort of 614 older adults (292 OALWH) in South Africa, reported a frailty prevalence of 17.7% in OALWH compared to 14.7% in their uninfected peers [51]. The variations in frailty prevalence could partly be attributed to differences in frailty measurement and the fact that older adults are a highly heterogeneous group, having different genetic backgrounds, medical profiles, and biological, as well as social-environmental factors at different stages of life, thus highlighting the need for country-specific frailty data using tools validated within the country or region of interest. Our finding of a higher prevalence of frailty in OALWH than their uninfected peers is consistent with previous evidence, which has demonstrated both higher frequency of frailty in OALWH and the development of frailty at earlier ages for OALWH than for individuals without HIV [17]. Many factors may predispose OALWH to elevated rates of frailty, including the effects of persistent inflammation from HIV (even in well-controlled viraemia),

TABLE 6 | Univariate and multivariable analysis of correlates of frailty among HIV-uninfected older adults (The HIV-associated Neurocognitive Disorders study, Kenya, 2020 and 2021).

Covariate	Positive screen for frailty by mod-REFS	
	Univariate analysis OR (95% CI)	**Multivariable analysis aOR (95% CI)**
Age (years)		
50–59	Ref	Ref
60–69	1.73 (0.62, 4.81)	0.91 (0.26, 3.22)
≥70	3.38** (1.02, 11.24)	4.61 (0.95, 22.29)
Sex		
Female	Ref	Ref
Male	2.29* (0.89, 5.86)	0.26** (0.07, 0.94)
Monthly household income (Ksh)		
≤10,000	Ref	—
Above 10,000	0.51* (0.21, 1.24)	—
Number of close family members/friends one interacted with at least once in the past month, mean (SD)	0.90* (0.81, 1.01)	—
Loneliness score, mean (SD)	1.11* (0.97, 1.26)	—
Functional disability score, mean (SD)	1.13** (1.00, 1.27)	—
Ageism score, mean (SD)	1.08* (0.99, 1.17)	—
Days spent doing light activities in the past week, mean (SD)	1.25** (1.03, 1.52)	1.29** (1.01, 1.66)
Sexually active		
No	Ref	—
Yes	0.27*** (0.11, 0.70)	—
Sleeping difficulties in the past month		
None	Ref	Ref
Sometimes	6.27*** (2.35, 16.70)	4.30** (1.41, 13.07)
Most of the time/always	11.05** (1.58, 77.26)	14.72** (1.11, 194.78)
Self-reported hearing		
Very good	Ref	—
Averagely/very bad	4.69*** (1.83, 11.99)	—
Frequent bodily pain		
No	Ref	—
Yes	2.39* (0.97, 5.89)	—
Self-reported diabetes		
No	Ref	Ref
Yes	8.00*** (1.85, 34.64)	8.35** (1.23, 56.92)
Self-reported hypertension		
No	Ref	—
Yes	3.29** (1.33, 8.11)	—
Number of medications participants are currently using, mean (SD)	1.38* (0.98, 1.93)	—
n for the final model		177
Variance explained		30.33%
Hosmer-Lemeshow test		X^2 = 110.02; *p*-value = 0.97
cvMean AUC (95% CI)		0.87 (0.79, 0.94)

Only a priori *variables (age, sex) and those with* p-*value < 0.15 in the univariate analysis or multivariable* p *< 0.05 are presented here. OR, odds ratio; aOR, adjusted odds ratio; Ref, reference group; cvMean AUC, cross-validated mean area under the curve for the final multivariable model. * – p-value < 0.15, ** – p-value < 0.05, *** – p-value < 0.01.*
Note: The number of individuals in the final model is slightly lower than the actual sample size of older adults without HIV because some of the observations had missing values.

toxic effects of earlier cART regimens, delayed initiation of ART, and higher rates of multimorbidity [52].

Literature suggests that it is a constellation of environmental, disease-specific, and biological factors that contribute to frailty [17, 24–33], though most of the evidence is concentrated in HICs. In the present study, the factors significantly associated with frailty were predominantly psychosocial, many of which are potentially modifiable with appropriate programs and interventions. Consistent with previous studies [33, 53], our study showed that sleeping difficulties were associated with higher odds of frailty in OALWH and their uninfected peers. Sleep problems may impact frailty in numerous ways, including decreased energy expenditure, elevated inflammatory response, disturbed hormonal pathways, tissue growth and repair [53].

These mechanisms may explain the associations observed. Interventions targeting sleeping problems—such as exercise and mindfulness-based stress reduction, may have potential clinical implications for OALWH and their uninfected peers.

Increasing ageism scores were also significantly associated with elevated odds of frailty in OALWH in our study. Ageism, commonly conceptualized as the stereotyping, prejudice and discrimination against people based on age, is becoming increasingly important in older adults [54]. Very few studies have examined the possible association between frailty and ageism. Our finding is consistent with the limited previous research [55]. Persistent exposure to ageism could lead to the internalization of the ageist messages by the OALWH, thus becoming part of their unconscious beliefs. In some cases, the adults may act subconsciously to fulfil the ageist stereotypes, even if detrimental to their health and wellbeing, e.g., physiologic stress response, and physical functioning performance, which may influence frailty. The observed association could also be explained by the health status and higher educational levels among OALWH.

A higher waist/hip ratio was also significantly associated with elevated odds of frailty among OALWH in our study, consistent with previous findings of a positive association between central/abdominal obesity and frailty [56, 57]. As HIV infection has become a manageable chronic illness, it has been progressively accompanied by a growing prevalence of overweight and obesity [58]. Moreover, long-term treatment with cART may contribute to lipodystrophy, often characterized by fat redistribution with a relative increase in abdominal fat [59]. Lipid depositions and infiltration in muscle fibre may bring about frailty by decreasing mobility and increasing loss of muscle strength. Interventions to minimize obesity and sedentary behaviour could potentially be beneficial in addressing frailty.

Visiting traditional healers was significantly associated with elevated odds of frailty among OALWH in our study. We are not aware of previous research that has examined this relationship. Plausibly, frail individuals visit the healers to have their frailty symptoms addressed, especially when the primary care services fail to address these concerns. A previous qualitative exploration of the health and wellbeing of OALWH in the study setting has linked seeking help or treatment from traditional and certain faith healers with poor health outcomes, including defaulting HIV treatment and unsuppressed viral load [60]. Healthcare providers have a reason to be concerned, given the observed impacts of untreated or improperly treated HIV on the development of frailty among OALWH.

Only two HIV-related factors were associated with elevated odds of frailty in our sample: a history of cART regimen change/interruption and prolonged illness following HIV diagnosis. These factors may be indicators of virological failure, ART toxicity or late HIV diagnosis, commonly associated with poorer health outcomes and risk of severe disease. Indeed, previous research has revealed an independent positive association between AIDS diagnosis, viral-load non-suppression, low CD4 count and frailty [17, 61]. Many of the OALWH who have lived with HIV for several years may be significantly impacted by the legacy of the early years of the epidemic, thus predisposing them to a heightened risk of frailty. These adults will more likely require additional support to manage the challenges of ageing with HIV successfully.

Several social factors, e.g., social isolation, social networks, socioeconomic status, social support, social engagement, and social capital, have the potential to influence the health of older adults [62]. In our study, higher monthly household income, residence in a larger household, and having a social network of close friends were all associated with reduced odds of frailty among OALWH, thus confirming previous research [17, 31] and highlighting the importance of promoting positive social factors to aid healthy ageing in older adults living with HIV. These factors may, directly and indirectly, affect frailty, e.g., food security, energy expenditure, and better health-seeking behaviours.

Physical activities have the potential to promote physical function, prevent falls and improve general health, hence delaying the onset and progression of frailty. In our study, participating in light physical activities such as walking was associated with reduced odds of frailty among OALWH, confirming previous research [63]. Exercise may also have positive effects on obesity, stress, loneliness in the case of group activities and muscular strength, which have been identified as potential risk factors for the incidence of frailty. However, light physical activities were associated with elevated odds of frailty among the HIV uninfected older adults in our study. This was a surprise finding, inconsistent with previous investigations [64–66]. This warrants more exploration in the study setting.

Self-reported diabetes was also associated with higher odds of frailty among HIV uninfected older adults in our study, consistent with previous reports [67]. Prospective evidence suggests that unhealthy behaviours and obesity may partly explain the association, and to a larger extent, by poor glucose control and altered serum lipid profile among individuals with diabetes, suggesting that diabetes nutritional therapy may reduce the risk of frailty [67]. Individuals with diabetic neuropathy are particularly at an increased risk of early-onset frailty [68]. Prevention programmes in the pre-frail states through appropriate exercise, nutrition and glycemic control may delay the development of frailty in these adults.

Similar to previous studies, this study showed that males are less likely to be frail than females, suggesting that being male is a protective factor against frailty [24]. Differences in physical activity, muscle mass and higher fat percentages may explain gender discrepancies in frailty. This may also be a question of selection—a classical observation in gerontological research where women live longer but in poorer health [69]. In this respect, men experience more life-threatening chronic conditions compared to women who experience more "non-life-threatening" conditions associated with more morbidity—as such the men who survive are those who tend to have better health status. Still, our observation may be related to social stigma of males appearing/acting/reporting weakness, that is, social preference bias, given the self-reported nature of the construct.

Implications

The prevalence of frailty in this study was relatively high for both OALWH and their uninfected peers. Preventing, delaying, or treating frailty is more critical in this

setting, given its high burden and the fact that frailty is a known predictor of future disability and dependency. Within the clinical practice, an easy-to-use frailty score will allow the easy identification of those at risk, thus allowing planning of future health and social care needs of these adults. Our study also highlighted some of the correlates of frailty in this setting. Many of the factors identified, such as sleeping difficulties, social engagement, ageism, and visiting traditional healers, are potentially modifiable with appropriate programs. Our findings provide the foundation for developing culturally appropriate interventions and healthcare strategies to prevent, delay and manage frailty and its consequences to improve the health and functional status of older adults at risk of frailty. Individual, community-based, or clinic-based interventions such as comprehensive geriatric assessment, physical activity, promoting social engagement, addressing discrimination, and proper management of comorbidities, e.g., diabetes, may benefit older adults. Wider public health approaches, including proactive testing of older adults to avoid late diagnosis and advanced immunosuppression, will benefit OALWH. Our results also highlight the need for well-designed prospective studies to establish the incidence, pathophysiology, predictors of transition and outcomes of frailty in this population and assess potential interventions.

Strengths and Limitations

Our study is among the very few reports on frailty in SSA and the first one in Kenya. It extends the existing evidence base regarding the prevalence and correlates of frailty in low-resource settings like Kenya. A further strength is the use of a relatively large sample size of people ≥50 years living with HIV and the inclusion of a community-based comparison group which enabled us to give a detailed profile of frailty in this population. We also collected detailed information on sociodemographic, physical, lifestyle and psychological factors, which helped us examine the correlates of frailty in this population. The primary limitation, nonetheless, was the use of a cross-sectional design, which precludes any conclusions on causality. Besides, our sample was predominantly from a rural setting; thus, our participants' experiences may differ from those in urban places. Also, the OALWH were invited to participate from a health facility (i.e., not a population-based sample) and may not be entirely representative of all OALWH in this area. For instance, the sample of OALWH in the study had very high levels of cART treatment and viral suppression, and our observations would probably be different in individuals not seeking care (either because they are unaware of their status or do not believe they need treatment).

Conclusion

In this cross-sectional study, we found a significantly higher prevalence of frailty among OALWH (24%) compared to their uninfected peers (13%). However, HIV seropositivity was not significantly associated with frailty after adjustment for demographic, psychosocial and physical factors, underscoring the importance of these factors. Specifically, OALWH who experience sleeping difficulties, ageism, have a high waist/hip ratio, visit traditional healers, have a history of cART regimen change/interruption and prolonged illness after HIV diagnosis have higher odds of frailty. In contrast, those who reside in larger households, have higher household income, have a social network of friends, and engage in light physical activity have reduced odds of frailty. On the other hand, HIV-uninfected older adults with sleeping difficulties, self-reported diabetes and taking part in light physical activities have elevated odds of frailty, while being male is associated with reduced odds of frailty. These factors should be considered in designing and implementing programs to prevent, delay, or treat frailty in this setting. Further prospective work is required to investigate the directionality and potential mediators of the association between frailty and the observed correlates.

DATA AVAILABILITY STATEMENT

Application for data access can be made through the Data Governance Committee of the KEMRI Wellcome Trust Research Programme who will review the application and advise as appropriate, ensuring that uses are compatible with the consent obtained from participants for data collection. Requests can be sent to the coordinator of the Data Governance Committee using the following email, dgc@kemri-wellcome.org.

ETHICS STATEMENT

The studies involving humans were approved by the Kenya Medical Research Institute Scientific and Ethics Review Unit (Ref: KEMRI/SERU/CGMR-C/152/3804). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

PM, CRN, and AA conceptualized the study. PM, CRN, RW, and AA designed the study. PM and CN programmed the study questions on tablets and managed project data for the entire study period. PM analysed the data. PM, CN, RW, CRN, and AA contributed to the interpretation of the data. PM wrote the first draft of the manuscript, and all the authors reviewed the subsequent versions and approved the final draft for submission.

FUNDING

This work was funded by the Wellcome Trust International Master's Fellowship to PM (Grant number 208283/Z/17/Z). Further funding supporting this work was from 1) the Medical Research Council (Grant number MR/M025454/1) to AA. This award is jointly funded by the UK Medical Research Council (MRC) and the UK Department for International Development (DFID) under MRC/DFID

concordant agreement and is also part of the EDCTP2 program supported by the European Union; 2) DELTAS Africa Initiative [DEL-15-003]. The DELTAS Africa Initiative is an independent funding scheme of the African Academy of Sciences (AAS)'s Alliance for Accelerating Excellence in Science in Africa (AESA) and supported by the New Partnership for Africa's Development Planning and Coordinating Agency (NEPAD Agency) with funding from the Wellcome Trust [107769/Z/10/Z] and the UK government. The funders did not have a role in the design and conduct of the study or interpretation of study findings. RW is supported by the South African National Research Foundation (119234).

AUTHOR DISCLAIMER

The views expressed in this publication are those of the author(s) and not necessarily those of AAS, NEPAD Agency, Wellcome Trust or the UK government.

CONFLICT OF INTEREST

The authors declare that they do not have any conflicts of interest.

ACKNOWLEDGMENTS

An earlier version of this manuscript has been uploaded to Research Square preprint server ahead of peer review [70]. We would also like to thank all the participants who voluntarily participated in this study. We are grateful to the community health volunteers and healthcare providers at the HIV clinics for their overwhelming support during the study. We also acknowledge Sadaka Charo, Richard Karisa, Irene Kasichana, Maureen Nyadzua, Haprity Mwangata, Linda Moranga, Khamis Katana, Beatrice Kabunda, Katana Ngombo, Alfred Ngombo, Collins Kipkoech, and Martha Kombe for their role in data collection. This work is published with the permission of the director of the Kenya Medical Research Institute.

REFERENCES

1. Nations U. *Department of Economic and Social Affairs, Population Division* (2019). World Population Ageing 2019: Highlights (ST/ESA/SER. A/430).
2. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in Elderly People. *The lancet* (2013) 381(9868):752–62. doi:10.1016/S0140-6736(12)62167-9
3. Sezgin D, O'Donovan M, Cornally N, Liew A, O'Caoimh R. Defining Frailty for Healthcare Practice and Research: A Qualitative Systematic Review With Thematic Analysis. *Int J Nurs Stud* (2019) 92:16–26. doi:10.1016/j.ijnurstu.2018.12.014
4. Viña J, Tarazona-Santabalbina FJ, Pérez-Ros P, Martínez-Arnau FM, Borras C, Olaso-Gonzalez G, et al. Biology of Frailty: Modulation of Ageing Genes and its Importance to Prevent Age-Associated Loss of Function. *Mol aspects Med* (2016) 50:88–108. doi:10.1016/j.mam.2016.04.005
5. Kojima G. Frailty as a Predictor of Emergency Department Utilization Among Community-Dwelling Older People: A Systematic Review and Meta-Analysis. *J Am Med Directors Assoc* (2019) 20(1):103–5. doi:10.1016/j.jamda.2018.10.004
6. Kojima G. Frailty as a Predictor of Disabilities Among Community-Dwelling Older People: A Systematic Review and Meta-Analysis. *Disabil Rehabil* (2017) 39(19):1897–908. doi:10.1080/09638288.2016.1212282
7. Crocker TF, Brown L, Clegg A, Farley K, Franklin M, Simpkins S, et al. Quality of Life Is Substantially Worse for Community-Dwelling Older People Living With Frailty: Systematic Review and Meta-Analysis. *Qual Life Res* (2019) 28(8):2041–56. doi:10.1007/s11136-019-02149-1
8. Kojima G, Taniguchi Y, Iliffe S, Walters K. Frailty as a Predictor of Alzheimer Disease, Vascular Dementia, and All Dementia Among Community-Dwelling Older People: A Systematic Review and Meta-Analysis. *J Am Med Directors Assoc* (2016) 17(10):881–8. doi:10.1016/j.jamda.2016.05.013
9. Kojima G, Iliffe S, Walters K. Frailty Index as a Predictor of Mortality: A Systematic Review and Meta-Analysis. *Age and ageing* (2018) 47(2):193–200. doi:10.1093/ageing/afx162
10. Gray WK, Richardson J, McGuire J, Dewhurst F, Elder V, Weeks J, et al. Frailty Screening in Low-and Middle-Income Countries: A Systematic Review. *J Am Geriatr Soc* (2016) 64(4):806–23. doi:10.1111/jgs.14069
11. Payne CF, Wade A, Kabudula CW, Davies JI, Chang AY, Gomez-Olive FX, et al. Prevalence and Correlates of Frailty in an Older Rural African Population: Findings From the HAALSI Cohort Study. *BMC Geriatr* (2017) 17(1):293–10. doi:10.1186/s12877-017-0694-y
12. Barker FJ, Davies JI, Gomez-Olive FX, Kahn K, Matthews FE, Payne CF, et al. Developing and Evaluating a Frailty Index for Older South Africans—Findings From the HAALSI Study. *Age and ageing* (2021) 50(6):2167–73. doi:10.1093/ageing/afab111
13. Biritwum R, Minicuci N, Yawson A, Theou O, Mensah G, Naidoo N, et al. Prevalence of and Factors Associated With Frailty and Disability in Older Adults From China, Ghana, India, Mexico, Russia and South Africa. *Maturitas* (2016) 91:8–18. doi:10.1016/j.maturitas.2016.05.012
14. Hoogendijk EO, Rijnhart JJ, Kowal P, Pérez-Zepeda MU, Cesari M, Abizanda P, et al. Socioeconomic Inequalities in Frailty Among Older Adults in Six Low-And Middle-Income Countries: Results From the WHO Study on Global AGEing and Adult Health (SAGE). *Maturitas* (2018) 115:56–63. doi:10.1016/j.maturitas.2018.06.011
15. O'Caoimh R, Galluzzo L, Rodríguez-Laso Á, Van der Heyden J, Ranhoff AH, Lamprini-Koula M, et al. Prevalence of Frailty at Population Level in European ADVANTAGE Joint Action Member States: A Systematic Review and Meta-Analysis. *Annali dell'Istituto superiore di sanita* (2018) 54(3):226–38. doi:10.4415/ANN_18_03_10
16. Da Mata FAF, Pereira PPS, Andrade KRC, Figueiredo ACMG, Silva MT, Pereira MG. Prevalence of Frailty in Latin America and the Caribbean: A Systematic Review and Meta-Analysis. *PloS one* (2016) 11(8):e0160019. doi:10.1371/journal.pone.0160019
17. Levett TJ, Cresswell FV, Malik MA, Fisher M, Wright J. Systematic Review of Prevalence and Predictors of Frailty in Individuals With Human Immunodeficiency Virus. *J Am Geriatr Soc* (2016) 64(5):1006–14. doi:10.1111/jgs.14101
18. Lewis EG, Coles S, Howorth K, Kissima J, Gray W, Urasa S, et al. The Prevalence and Characteristics of Frailty by Frailty Phenotype in Rural Tanzania. *BMC Geriatr* (2018) 18(1):283–11. doi:10.1186/s12877-018-0967-0
19. Lewis EG, Wood G, Howorth K, Shah B, Mulligan L, Kissima J, et al. Prevalence of Frailty in Older Community-Dwelling Tanzanians According to Comprehensive Geriatric Assessment. *J Am Geriatr Soc* (2018) 66(8):1484–90. doi:10.1111/jgs.15433
20. Gray WK, Orega G, Kisoli A, Rogathi J, Paddick S-M, Longdon AR, et al. Identifying Frailty and Its Outcomes in Older People in Rural Tanzania. *Exp Aging Res* (2017) 43(3):257–73. doi:10.1080/0361073X.2017.1298957
21. Adebusoye LA, Cadmus EO, Owolabi MO, Ogunniyi A. Frailty and Mortality Among Older Patients in a Tertiary Hospital in Nigeria. *Ghana Med J* (2019) 53(3):210–6. doi:10.4314/gmj.v53i3.5
22. Witham MD, Davies JI, Bärnighausen T, Bountogo M, Manne-Goehler J, Payne CF, et al. Frailty and Physical Performance in the Context of Extreme Poverty: A Population-Based Study of Older Adults in Rural Burkina Faso. *Wellcome open Res* (2019) 4:135. doi:10.12688/wellcomeopenres.15455.1
23. Mwangala PN, Mabrouk A, Wagner R, Newton CR, Abubakar AA. Mental Health and Well-Being of Older Adults Living With HIV in Sub-Saharan

Africa: A Systematic Review. *BMJ open* (2021) 11(9):e052810. doi:10.1136/bmjopen-2021-052810
24. Feng Z, Lugtenberg M, Franse C, Fang X, Hu S, Jin C, et al. Risk Factors and Protective Factors Associated With Incident or Increase of Frailty Among Community-Dwelling Older Adults: A Systematic Review of Longitudinal Studies. *PloS one* (2017) 12(6):e0178383. doi:10.1371/journal.pone.0178383
25. Verlaan S, Ligthart-Melis GC, Wijers SL, Cederholm T, Maier AB, de van der Schueren MA. High Prevalence of Physical Frailty Among Community-Dwelling Malnourished Older Adults–A Systematic Review and Meta-Analysis. *J Am Med Directors Assoc* (2017) 18(5):374–82. doi:10.1016/j.jamda.2016.12.074
26. Mello AC, Engstrom EM, Alves LC. Health-Related and Socio-Demographic Factors Associated With Frailty in the Elderly: A Systematic Literature Review. *Cadernos de saude publica* (2014) 30:1143–68. doi:10.1590/0102-311x00148213
27. Kojima G, Iliffe S, Walters K. Smoking as a Predictor of Frailty: A Systematic Review. *BMC Geriatr* (2015) 15(1):131–7. doi:10.1186/s12877-015-0134-9
28. Tian R, Almeida OP, Jayakody DM, Ford AH. Association Between Hearing Loss and Frailty: A Systematic Review and Meta-Analysis. *BMC Geriatr* (2021) 21(1):333–13. doi:10.1186/s12877-021-02274-y
29. Tan BKJ, Man REK, Gan ATL, Fenwick EK, Varadaraj V, Swenor BK, et al. Is Sensory Loss an Understudied Risk Factor for Frailty? A Systematic Review and Meta-Analysis. *The Journals Gerontol Ser A* (2020) 75(12):2461–70. doi:10.1093/gerona/glaa171
30. Saraiva MD, Suzuki GS, Lin SM, de Andrade DC, Jacob-Filho W, Suemoto CK. Persistent Pain Is a Risk Factor for Frailty: A Systematic Review and Meta-Analysis From Prospective Longitudinal Studies. *Age and ageing* (2018) 47(6):785–93. doi:10.1093/ageing/afy104
31. Kojima G, Taniguchi Y, Kitamura A, Fujiwara Y. Is Living Alone a Risk Factor of Frailty? A Systematic Review and Meta-Analysis. *Ageing Res Rev* (2020) 59:101048. doi:10.1016/j.arr.2020.101048
32. Kehler DS, Hay JL, Stammers AN, Hamm NC, Kimber DE, Schultz AS, et al. A Systematic Review of the Association Between Sedentary Behaviors With Frailty. *Exp Gerontol* (2018) 114:1–12. doi:10.1016/j.exger.2018.10.010
33. Pourmotabbed A, Boozari B, Babaei A, Asbaghi O, Campbell MS, Mohammadi H, et al. Sleep and Frailty Risk: A Systematic Review and Meta-Analysis. *Sleep and Breathing* (2020) 24(3):1187–97. doi:10.1007/s11325-020-02061-w
34. Kenya National Bureau of Statistics. *Kenya Population and Housing Census Volume III*. Nairobi: Distribution of Population by Age and Sex (2019).
35. Ministry of Health. *Kenya STEPwise Survey for Non-Communicable Diseases Risk Factors 2015 Report*. Kenya Nairobi: Ministry of Health (2015).
36. National AIDS and STI Control Programme. *Preliminary KENPHIA 2018 Report*. Nairobi: NASCOP (2020).
37. Kenya National Bureau of Statistics. *The 2019 Kenya Population and Housing Census. Volume I* (2019). Population by County and Sub-County 2019. Available From: http://housingfinanceafrica.org/app/uploads/VOLUME-I-KPHC-2019.pdf (Accessed March 9, 2022).
38. National AIDS Control Council (NACC). *Kenya HIV County Profiles 2016*. Kenya: National AIDS Control Council (2016).
39. Mombasa County Government. *First County Integrated Development Plan 2013* (2013). Available From: http://kenyachamber.co.ke/wp-content/uploads/2017/02/1st-CIDP-2013-2017-Mombasa-County.pdf (Accessed April 13, 2022).
40. Kooij KW, Wit FW, Schouten J, van der Valk M, Godfried MH, Stolte IG, et al. HIV Infection Is Independently Associated With Frailty in Middle-Aged HIV Type 1-Infected Individuals Compared With Similar But Uninfected Controls. *Aids* (2016) 30(2):241–50. doi:10.1097/QAD.0000000000000910
41. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research Electronic Data Capture (REDCap)—A Metadata-Driven Methodology and Workflow Process for Providing Translational Research Informatics Support. *J Biomed Inform* (2009) 42(2):377–81. doi:10.1016/j.jbi.2008.08.010
42. Abubakar A, Van De Vijver FJ. How to Adapt Tests for Sub-Saharan Africa. In: *Handbook of Applied Developmental Science in Sub-Saharan Africa*. New York, NY: Springer (2017). p. 197–212.
43. Reinius M, Wettergren L, Wiklander M, Svedhem V, Ekström AM, Eriksson LE. Development of a 12-Item Short Version of the HIV Stigma Scale. *Health Qual Life Outcomes* (2017) 15(1):115–9. doi:10.1186/s12955-017-0691-z
44. Üstün TB, Chatterji S, Kostanjsek N, Rehm J, Kennedy C, Epping-Jordan J, et al. Developing the World Health Organization Disability Assessment Schedule 2.0. *Bull World Health Organ* (2010) 88:815–23. doi:10.2471/BLT.09.067231
45. Hays RD, DiMatteo MR. A Short-Form Measure of Loneliness. *J Personal Assess* (1987) 51(1):69–81. doi:10.1207/s15327752jpa5101_6
46. Palmore E. The Ageism Survey: First Findings. *The gerontologist* (2001) 41(5):572–5. doi:10.1093/geront/41.5.572
47. Rose M, Yang A, Welz M, Masik A, Staples M. Novel Modification of the Reported Edmonton Frail Scale. *Australas J Ageing* (2018) 37(4):305–8. doi:10.1111/ajag.12533
48. Richards SJ, D'Souza J, Pascoe R, Falloon M, Frizelle FA. Prevalence of Frailty in a Tertiary Hospital: A Point Prevalence Observational Study. *Plos one* (2019) 14(7):e0219083. doi:10.1371/journal.pone.0219083
49. Rubtsova AA, Sabbag S, Sundermann E, Nguyen AL, Ellis RJ, Moore DJ, et al. Frailty and Neurocognitive Impairment: Impacts on Quality of Life in HIV. *The J Assoc Nurses AIDS Care JANAC* (2020) 31(3):290–300. doi:10.1097/JNC.0000000000000142
50. Bristow C, George G, Hillsmith G, Rainey E, Urasa S, Koipapi S, et al. Low Levels of Frailty in HIV-Positive Older Adults on Antiretroviral Therapy in Northern Tanzania. *J Neurovirol* (2021) 27(1):58–69. doi:10.1007/s13365-020-00915-3
51. Edwards A, Siedner MJ, Nash S, Neuman M, Danaviah S, Smit T, et al. HIV Serostatus, Inflammatory Biomarkers and the Frailty Phenotype Among Older People in Rural KwaZulu-Natal, South Africa. *Afr J AIDS Res* (2020) 19(3):177–85. doi:10.2989/16085906.2020.1790398
52. Willig AL, Overton ET, Saag MS. The Silent Epidemic–Frailty and Aging With HIV. *Total patient care in HIV & HCV* (2016) 1(1):6–17.
53. Piovezan RD, Poyares D, Tufik S. Frailty and Sleep Disturbances in the Elderly: Possible Connections and Clinical Implications. *Sleep Sci* (2013) 6(4):175–9.
54. Lamont RA, Swift HJ, Abrams D. A Review and Meta-Analysis of Age-Based Stereotype Threat: Negative Stereotypes, Not Facts, Do the Damage. *Psychol Aging* (2015) 30(1):180–93. doi:10.1037/a0038586
55. Zora S, Cella A, Poli S, Veronese N, Zini E, Giannoni P, et al. Ageism" Is Associated With Self-Reported Multidimensional Frailty in Community-Dwelling Older Subjects: A Population-Based Study. *Front Med* (2021) 8:734636. doi:10.3389/fmed.2021.734636
56. Hawkins KL, Zhang L, Ng DK, Althoff KN, Palella FJ, Kingsley LA, et al. Abdominal Obesity, Sarcopenia, and Osteoporosis Are Associated With Frailty in Men Living With and Without HIV. *AIDS (London, England)* (2018) 32(10):1257–66. doi:10.1097/QAD.0000000000001829
57. Shah K, Hilton TN, Myers L, Pinto JF, Luque AE, Hall WJ. A New Frailty Syndrome: Central Obesity and Frailty in Older Adults With the Human Immunodeficiency Virus. *J Am Geriatr Soc* (2012) 60(3):545–9. doi:10.1111/j.1532-5415.2011.03819.x
58. Crum-Cianflone N, Roediger MP, Eberly L, Headd M, Marconi V, Ganesan A, et al. Increasing Rates of Obesity Among HIV-Infected Persons During the HIV Epidemic. *Plos one* (2010) 5(4):e10106. doi:10.1371/journal.pone.0010106
59. Calmy A, Hirschel B, Cooper DA, Carr A. A New Era of Antiretroviral Drug Toxicity. *Antivir Ther* (2009) 14(2):165–79. doi:10.1177/135965350901400203
60. Mwangala PN, Wagner RG, Newton CR, Abubakar A. Navigating Life With HIV as an Older Adult on the Kenyan Coast: Perceived Health Challenges Seen Through the Biopsychosocial Model. *Int J Public Health* (2023) 68:1605916. doi:10.3389/ijph.2023.1605916
61. Melo GC, Carvalho ACA, Mendes MLT, do Nascimento RO, de Araújo KCGM, Tanajura DM, et al. Association Between Frailty Phenotype, Quantification of Plasma HIV-1 RNA, CD4 Cell Count and HAART in HIV-Positive Subjects: A Systematic Review and Meta-Analysis of Observational Studies. *AIDS care* (2021) 34:1–10. doi:10.1080/09540121.2021.1956414
62. Andrew MK. Social Vulnerability in Old Age. In: *Brocklehurst's Textbook of Geriatric Medicine and Gerontology*. Elsevier (2010). p. 198–204.
63. Erlandson KM, Piggott DA. Frailty and HIV: Moving From Characterization to Intervention. *Curr HIV/AIDS Rep* (2021) 18:157–75. doi:10.1007/s11904-021-00554-1

64. Han CY, Miller M, Yaxley A, Baldwin C, Woodman R, Sharma Y. Effectiveness of Combined Exercise and Nutrition Interventions in Prefrail or Frail Older Hospitalised Patients: A Systematic Review and Meta-Analysis. *BMJ open* (2020) 10(12):e040146. doi:10.1136/bmjopen-2020-040146
65. De Labra Pinedo C, Guimaraes-Pinheiro C, Maseda A, Lorenzo-López T, Millán-Calenti JC. Effects of Physical Exercise Interventions in Frail Older Adults: A Systematic Review of Randomized Controlled Trials. *BMC Geriatr* (2015) 15. doi:10.1186/s12877-015-0155-4
66. Paw MJ, van Uffelen JG, Riphagen I, Wv M. The Functional Effects of Physical Exercise Training in Frail Older People. *Sports Med* (2008) 38(9):781–93. doi:10.2165/00007256-200838090-00006
67. García-Esquinas E, Graciani A, Guallar-Castillón P, López-García E, Rodríguez-Mañas L, Rodríguez-Artalejo F. Diabetes and Risk of Frailty and its Potential Mechanisms: A Prospective Cohort Study of Older Adults. *J Am Med Directors Assoc* (2015) 16(9):748–54. doi:10.1016/j.jamda.2015.04.008
68. Tuttle LJ, Bittel DC, Bittel AJ, Sinacore DR. Early-Onset Physical Frailty in Adults With Diabesity and Peripheral Neuropathy. *Can J Diabetes* (2018) 42(5):478–83. doi:10.1016/j.jcjd.2017.12.001
69. Park C, Ko FC. The Science of Frailty: Sex Differences. *Clin Geriatr Med* (2021) 37(4):625–38. doi:10.1016/j.cger.2021.05.008
70. Mwangala PN, Nasambu C, Wagner RG, Newton CR, Abubakar A. Prevalence and Factors Associated With Frailty in Older Adults From the Kenyan Coast. *Researchsquare* (2022). doi:10.21203/rs.3.rs-1763887/v1

International Journal of Public Health
ORIGINAL ARTICLE
published: 19 February 2024
doi: 10.3389/ijph.2024.1606571

Individual and Community-Contextual Level Factors Associated With Wellbeing Among Older Adults in Rural Zambia

Andrew Banda[1,2*†], *Jaco Hoffman*[1,3†] *and Vera Roos*[1†]

[1]Optentia Research Unit, North-West University, Vanderbijlpark, South Africa, [2]Department of Demography, Population Science, Monitoring and Evaluation, University of Zambia, Lusaka, Zambia, [3]The Oxford Institute of Population Ageing, University of Oxford, Oxford, United Kingdom

Objective: This article aims to identify individual and community-contextual level factors associated with the wellbeing of older adults (50 years and older) in rural Zambia.

Methods: Data from the nationally representative 2015 Living Conditions Monitoring Survey (LCMS) was used. Employing multilevel mixed effects, the individual and community-contextual factors on wellbeing were determined.

Results: Overall, 31.7% of rural older adults perceived their wellbeing as good. Both individual and community-contextual level factors are associated with the wellbeing of older adults in rural communities. At the individual level, wellbeing was associated with higher education attainment. Community-contextual factors significantly associated with wellbeing included improved housing, access to piped tap water within the premises, own charcoal or income to purchase firewood.

Conclusion: The findings foreground the imperative to analyse both individual and community-contextual level factors of wellbeing to generate and present evidence for investments in education across the life course and for the development of infrastructure towards increasing the wellbeing of rural older adults. Additionally, the results provide a basis for planning by devising policies and programmes for older people to thrive and for no one to be left behind regardless the setting.

Keywords: individual and contextual factors, wellbeing, older adults, rural communities, Zambia

OPEN ACCESS

Edited by:
Nino Kuenzli,
Swiss Tropical and Public Health Institute (Swiss TPH), Switzerland

Reviewed by:
David McQueen,
Universitt Bern, Switzerland
One reviewer who chose to remain anonymous

***Correspondence**
Andrew Banda,
andrew.banda08@gmail.com

†ORCID:
Andrew Banda
orcid.org/0000-0003-1575-3884
Jaco Hoffman
orcid.org/0000-0003-0357-3739
Vera Roos
orcid.org/0000-0003-2851-5826

This Original Article is part of the IJPH Special Issue "Ageing and Health in Sub Sahara Africa"

Received: *31 August 2023*
Accepted: *24 January 2024*
Published: *19 February 2024*

Citation:
Banda A, Hoffman J and Roos V (2024) Individual and Community-Contextual Level Factors Associated With Wellbeing Among Older Adults in Rural Zambia. Int J Public Health 69:1606571. doi: 10.3389/ijph.2024.1606571

INTRODUCTION

As the global population ages, efforts to ensure older people's wellbeing and quality of life, are becoming more prominent [1]. While rural areas worldwide face diverse and unique challenges providing social services due to resource constraints, geographical location, and diversity in cultural and social settings, the situation is more pronounced in developing countries [2, 3]. Developing countries will generally experience faster growth in absolute numbers of older people than developed countries [4]. For instance, the Sub-Saharan Africa (SSA) region is, population-wise, the youngest region [5], resulting in low prioritisation and implementation of ageing issues in national policies [6]. The region will experience the fastest growth rate in the absolute number of older people compared to any other region due to past fertility patterns and the current young age structure [7]. It is

estimated to triple from 46 million in 2015 to 161 million by 2050 [8, 9]. Among SSA countries, Zambia has a young population with about 79% (15,570,950) under 35 years. The proportion of the population aged 50 years and over has steadily increased, averaging 8% (1,673,149) in 2022 and projected to grow to about 10% in 2035 [10, 11].

The 2022 Zambia Census of Population and Housing estimates that 6 out of 10 people live in rural areas [11], with most older people residing in rural areas where 79% of the general population is poor [12]. The rapid growth of the ageing population and the growing number of older people living in rural communities raise concerns about their socio-economic wellbeing, health and social care, the type of support available and access to daily living needs such as food, housing, energy and water to support their wellbeing [4, 13]. Limited infrastructure, economic constraints, changing social dynamics and cultural norms, coupled with persistent policy gaps, pose challenges for ageing well in rural communities [14, 15]. Rurality as such, and ageing processes associated with such settings make it contested spaces at the dynamic nexus of older people's active and passive interactions with existing and potential community-contextual characteristics [14], impacting efforts towards the attainment of Sustainable Development Goals (SDGs), particularly those relating to health and social wellbeing.

The World Health Organisation (WHO) defines wellbeing as "a state of complete physical, mental, and social wellbeing, and not merely the absence of disease or infirmity" [16]. The WHO policy-oriented definition embodies aspects related to individual factors (e.g., health, education), and also community-contextual factors (e.g., access to services, general living conditions) [16, 17]; including the development and maintenance of positive interactions with local communities and contexts [18]. In its call for action to improve the wellbeing of older persons, The United Nations Decade of Healthy Ageing (2021–2030) positions communities as particularly important as they foster the abilities of older people by creating age-friendly environments that are good places to "grow, live, work, play, and age" [16]. We use community-contextual level factors to describe the tangible aspects of rural settings within which ageing and wellbeing are influenced.

There is growing interest in older people living in rural and remote areas as these locales face unique challenges and opportunities that affect their general wellbeing [2, 19]. Despite the often-perceived serenity of rural communities with strong social bonds and networks [20] as a distinctive feature, these areas generally have an older demographic profile with limited supportive services, often described as age-unfriendly resource-vulnerable settings [21].

Ageing in SSA rural communities particularly presents unprecedented socio-economic, cultural, structural, and public health challenges because of weak or non-existent policy frameworks on ageing [22]. Rural areas in Zambia, face disproportionately increased demands and associated costs in delivering health and social care services because of accessibility issues due to inadequate infrastructure and service limitations [23]. Rural communities tend to be geographically isolated due to a lack of investment in public transport and poor infrastructure to host and deliver essential services, in addition to low educational attainment among older adults [24] and high rural poverty [25]. The interplay of these factors in rural settings creates a challenging environment for older people's wellbeing.

For ageing well in rural areas, Bosch-Farré et al. identify eight elements, namely: health, information, practical assistance, financial conditions, physical and mental activity, the company of friends and family, transport and safety [26]. Community-contextual characteristics for this article include environmental factors, accessibility of health and social services and the quality of available infrastructure [15]. The wellbeing of older Zambians also involves community support and care, anchored in the intergenerational extended family [27]. However, the family system is in flux [28, 29]: a dynamic compounded by the impact of HIV and AIDS, with a significant number of orphans left under the care of older people with no steady income to support themselves and their dependents [30, 31].

In response to rural ageing, a large body of literature has emerged on rural ageing, health systems, and economic and social implications in Europe and North America [32, 33], but much less about the factors of rural ageing and wellbeing in the least developed countries [34, 35]. The literature, therefore, broadly points to the inadequacy of community-context related factors in the analysis of wellbeing within rural settings. The gap identified, beckons scholars to move beyond a monolithic analysis of individual factors disaggregated by the blanket clustering of settings (broad rural or urban categorisations) towards an analysis of context-specific factors associated with the settings within which older persons live and through which they experience ageing. This dynamic interplay between older adults and relevant community-context characteristics requires further analysis to identify factors associated with older adults' wellbeing. Such analysis considers complexity, here viewed through the lens of a critical realist approach that seeks to understand and explain complex relationships that underlie the social world and society's perceived knowledge of it. Understanding the individual and community-contextual factors associated with the wellbeing of older people within the dynamic interplay with rural contexts provides an opportunity to promote older people's wellbeing, thereby helping attain the goals of the 2030 Decade of Healthy Ageing [16], the Madrid Plan of Action [36], the AU Policy Framework and Plan of Action on Ageing (2022) as well as contributing to the rural ageing agenda as proposed by the Age-friendly cities/communities Framework [37].

This paper presents the individual, socio-economic conditions of rural older people and the rural community-contextual factors in understanding what influences the wellbeing of older people (50 years and older) in rural Zambia.

METHODS

Data Source and Population

The data analysed in this study are from the 2015 LCMS, a nationally representative cross-sectional population-based household survey. The 2015 LCMS is the seventh wave in the

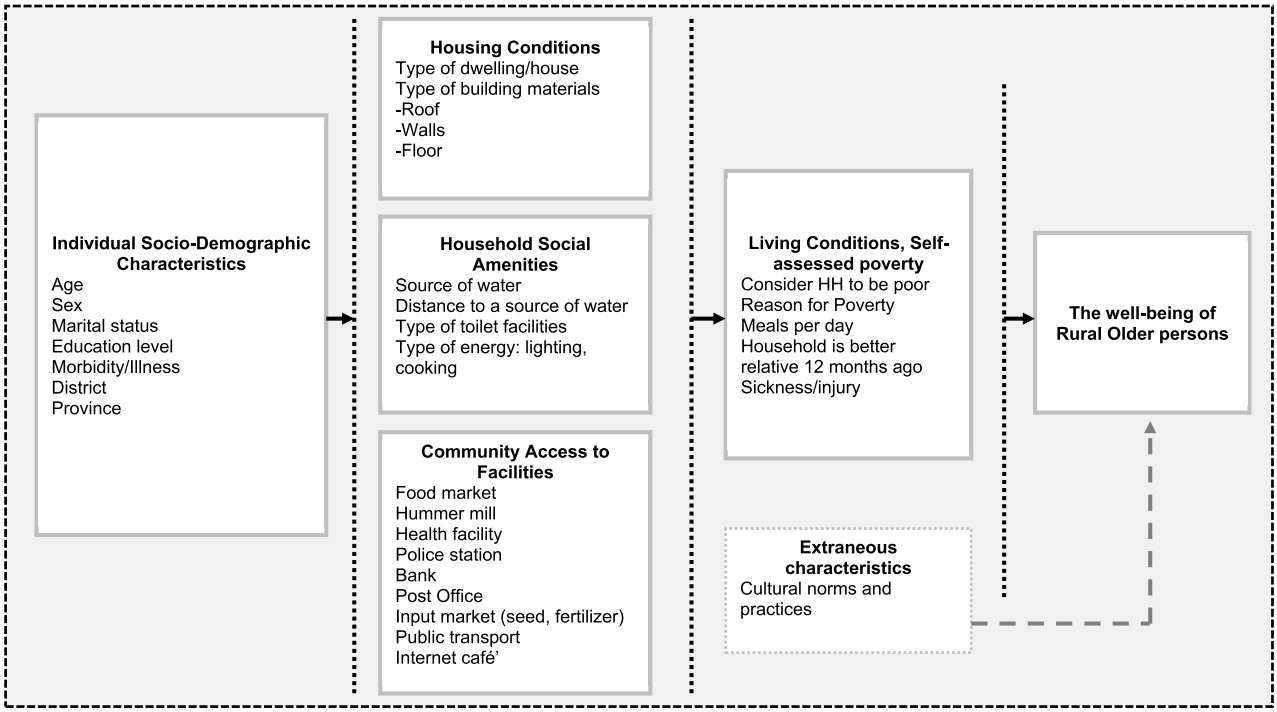


FIGURE 1 | Factors influencing the wellbeing of rural older adults in Zambia (2015 Living Conditions Monitoring Survey, Zambia).

series. Previous studies were conducted in 1996, 1998, 2002/2003, 2004, 2006, and 2010. The main aim of the LCMS is to monitor and highlight the living conditions of people. The LCMS collects information on the general living conditions, household income and expenditure, food security and coping strategies, economic activities, education attainment and health status of household members, housing conditions, as well as access to community-based facilities and services such as health facilities, banks and transport [24].

The 2015 LCMS covered 12,251 households in 664 randomly selected enumeration areas (EAs) across the ten provinces of Zambia. In the case of rural EAs, households were listed and stratified according to the scale of their agricultural activity areas (farming blocks as a way of demarcation typical for rural settings) [20]. Therefore, four explicit strata were created at the second sampling stage in each rural EA: the Small-Scale Agricultural Stratum (SSAS), the Medium-Scale Agricultural Stratum (MSAs), the Large-Scale Agricultural Stratum (LSAS) and the Non-Agricultural Stratum (NAS). In each stratum, 7, 5, and 3 households were selected from the SSAS, MSAS and NAS, respectively. In each rural EA, a minimum of 15 households were selected without large-scale agricultural households.

Measures

The outcome variable (wellbeing) was computed as a composite variable from four variables to assess access to amenities (facilities) in rural communities and self-assessed poverty—a three-response category measured self-assessed poverty: non-poor, moderately poor and poor. In assessing access to facilities, respondents were asked if they have a facility within the community, if they have used it in the last 12 months, and how far this resource is from the village. This analysis used these measures of self-assessed poverty and access to facilities because they provided a good indication of life satisfaction and the general living conditions of older people in rural Zambia. **Figure 1** shows the summary classification of variables used in this study.

To assess wellbeing, a discrete binary variable coded as (1) if the respondent residing in the rural area described his/her household to be non-poor, has the facility within the community, has used the facility in the last 12 months, and the facility is within 5 km radius of the village (community); if otherwise, (0) is used.

The explanatory variables were categorised into two (2) broad categories: individual and community-contextual variables. Individual-level variables included the socioeconomic and demographic characteristics of older people, such as sex and age. The age of the respondents was categorised into intervals from 50–64, 65–74, and 75+. 75+ was coded in that manner because there were few older people in ages over 90 years. The level of education was categorised as 1 = primary education, 2 = secondary education, 3 = postsecondary education, and older people's marital status was coded into three categories: 1 = single, 2 = married/living with a partner, 3 = divorced/separated and 4 = widowed. The general health wellbeing was assessed by whether an older person was ill or injured in the last 7 days before the survey and the number of meals per day.

Community-contextual variables included variables that described older people's housing conditions and the type of material used for the walls, roofs, and floors. Housing variables

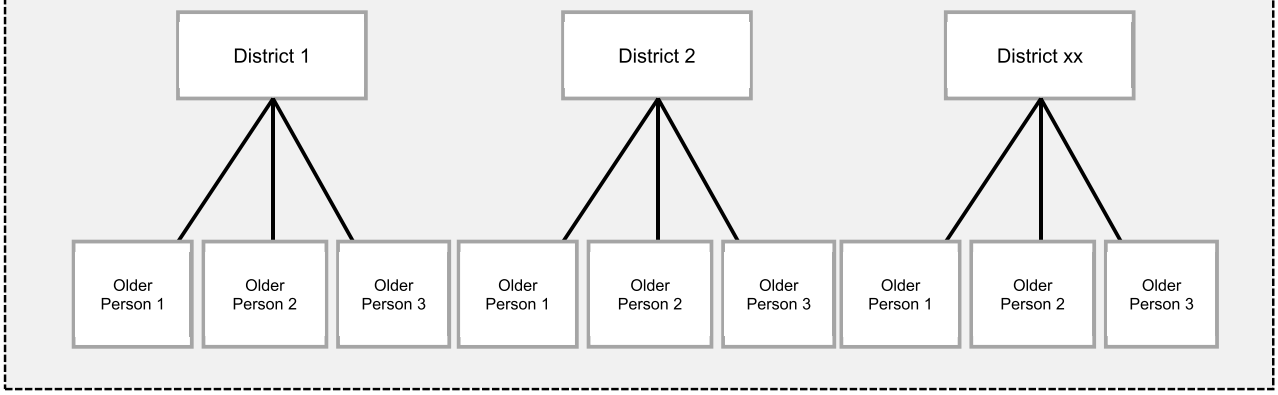


FIGURE 2 | Hierarchical data structure, older people (N), level 1 are nested in districts (K), level 2 (2015 Living Conditions Monitoring Survey, Zambia).

were identified to provide the general living conditions or settings for older people. Four categorical variables were used: one variable described the type of dwelling (housing), and three variables were used to describe materials used for walls, roofs, and floors.

Similarly, access to water, type of toilet facility (sanitation) and the type of energy for cooking and lighting were used to describe further community-level elements that support older people's wellbeing at the household level. Whether the house was connected to electricity was also included in the analysis. All these variables were categorical.

Statistical Analysis

The study analysis was performed in two steps. The first step involved descriptive and bivariate analysis in describing older people's wellbeing by selecting explanatory characteristics (individual, household, and community characteristics). The second step involved multilevel regression modelling to measure the effect on the wellbeing of older people, first of individual characteristics: age, education attainment, morbidity (sickness); and second of community-contextual characteristics: type of dwelling, materials used for roof, walls and floor, source of water, and type of energy for cooking and lighting. Adjusted odds ratios (AOR) and a 95% confidence interval were used to report results. Multilevel regression was necessary because of the hierarchical nature of the data, which may violate one of the important assumptions of independence of the residuals [38] if ordinary logistic regression was used and may obscure factors of wellbeing that are a result of the hierarchical structure of older adults living in rural communities. **Figure 2** shows the hierarchical data structure, in which older people (N) (the lower-level units) are nested in districts (K) (the higher-level units).

Figure 2 shows the data has a natural nested structure, where older people are nested in districts. The district was used as a unit of analysis because services are designed to cover the administrative level of the district. As such, all EA-level data were pulled into the districts they belong to.

A two-level multilevel analysis was used to examine the influence of individual and community-contextual factors on the wellbeing of older people. Older people (individual participants) constitute level 1. Older people are nested in districts which constitute level 2. In this analysis, districts are a level rather than a predictor/variable. On the other hand, variables such as education (no education, primary, and secondary level), marital status, type of housing, and water source are factors since their categories are both non-random and theoretically meaningful.

Multilevel regression analysis results were obtained using four (4) models. The null model (empty) was fitted without explanatory variables to predict random variability of the intercept and show the total variance in the wellbeing of older rural people. Model 1 examined the effects of individual-level characteristics of older adults on wellbeing. Model 2 examined the effects of community contextual-level characteristics, and Model 3 examined the combined effects of individual and community contextual-level characteristics, with results fixed at a 95% confidence level. The inter-class correlation (ICC) for each model was calculated to explain the proportion of variation attributable to the higher level of variation and compare models. The Proportional Change in Variance (PCV) was also calculated for each model regarding the empty model to show the power of the factors in the models in explaining the outcome variable.

Only significant variables from the bivariate and correlation analysis using Pearson's chi-square test ($p < 0.05$) (5%) were added to the models. All analyses were conducted using Stata software version 14.0.

RESULTS

Characteristics

A total of 14,531 older people's data were captured for this analysis. In this case, 70 rural districts out of the total of

TABLE 1 | Summary description of contextual characteristics (N = 14,531) (2015 Living Conditions Monitoring Survey, Zambia).

Description	Count	%
The wellbeing of rural older adults	4,675	31.7
Access to Social amenities (facilities)		
Percent or rural adults reporting using a social amenity/facility(s)[a]	2,182	15.2
Percent of rural adults reporting having a facility (s)[a] within 5 KM radius	1,660	12.1
Older People's Self-Assessed Poverty Status		
Non-poor	1,196	15.2
Moderately poor	5,332	37.4
Very poor	7,996	55.6
Older People's Self-Assessed Poverty Status relative 12 months ago		
Better off	2,669	18.2
The same	7,836	53.7
Worse off	4,009	28.1

[a]*Facilities included: Food market, Hummer mill, Health Facility, Police station, Bank, Post office, Farming Input market (Fertilizer, seed), public transport, internet café.*

116 districts were included. The mean number of older people per rural district (n = 70) was 208, ranging from 34 to 663. Good wellbeing was experienced among 31.7% (95% CI: 30.739, 32.661) of older people (**Table 2**). Access to community facilities in rural areas was very low. **Table 1** shows that only 15% and 12% of older people had used a facility and had a facility within a 5 km radius of the community (district), respectively.

The average age of older people in the study was 62 (SD = 9.5), with the majority (63%) between 50–64 years. About 71% of older people were married or living with a partner, and 20% and 8% were widowed and divorced or separated, respectively. More than half of rural older people (58%) had a primary level of education, and 1 in 50 had a higher level of education. Among the total number of older people, the prevalence of morbidity in the last 7 days before the survey was 59%. There were significant relationships between wellbeing by gender ($p < 0.01$), level of education ($p < 0.001$), marital status ($p < 0.001$) and morbidity prevalence in the last 7 days before the survey ($p < 0.05$) (**Table 2**).

About half of older adults (49%) lived in traditional housing, with one in every five housing units (55%) used grass or leaves as materials for roofing (thatching) and about 4 in every 10 older adults in housing units (39%) constructed with mud bricks (**Table 2**). Concerning energy for cooking and lighting, only 2% of older adults in rural areas reported that their houses were connected to electricity, about nine in ten older adults (88%) collected firewood for cooking, and more than two-thirds (72%) used a hand-held torch for lighting. Regarding the type of toilet facilities, 53% were using a pit latrine (toilet) without a slab. About one-third (35%) of older adults accessed water from boreholes, 28% from unprotected wells and 18% from local water sources (e.g., rivers, lakes, streams, dams, rainwater (**Table 3**). There were significant differences in wellbeing in relation to: 1) the type of housing, 2) the type of materials used for the roofs, walls and floors, 3) the main source of water, and 4) the energy source for cooking and lighting (**Table 2**).

Table 3 shows the multilevel mixed-effect results of individual and contextual factors associated with the wellbeing of older adults in rural areas. In the null model (Model 0), the wellbeing of older adults, the regional level variance was statistically significant with a variance level of 0.66 ($p < 0.001$). The ICC coefficients show that 17% of the variance in the wellbeing of older adults was attributed to differences in individual-level and community contextual-level factors. So, the inter-district differences were confirmed. The PCV in Model 1 shows that only 1% of the variation in the wellbeing of older adults was explained by individual-level factors. In Model 2, a PCV of 16% implies that variation in the wellbeing of older adults in rural areas was explained by community-level characteristics.

In Model 3, the results of a multilevel analysis on the wellbeing of older adults were statistically significant in relation to the individual-level variables (level of education and prevalence of morbidity). Concerning the contextual-level factors, the type of dwelling (house), materials used for roofs, walls, and floors, the main local water source, the type of energy used for cooking and lighting, and the type of sanitation service (toilet) statistically significant influenced older adults' wellbeing in rural settings.

Education Attainment and Morbidity

The results show that older adults in rural areas with higher education attainment were more likely to experience good wellbeing compared to older adults with no education (AOR = 2.075, 95% CI: 0.58, 2.73) (**Figure 3**). The prevalence of morbidity (illness in the last 7 days) among rural older adults reduced the odds of wellbeing by 88% compared to older people who were not sick 7 days before the survey (AOR = 0.875, 95% CI: 0.80, 0.96).

Housing

Housing conditions were an important element of wellbeing. Results showed that an improvement in the types of housing increased the wellbeing odds by 28% for older people who lived in improved traditional houses (AOR = 1.281, 95% CI: 1.12, 1.46) and doubled for those who lived in modern detached houses compared to older people who lived in traditional huts (AOR = 2.264, 95% CI: 1.89, 2.71).

Water

Older adults with access to a borehole had 18% higher odds of wellbeing than older adults who accessed water directly from a river/

TABLE 2 | Bivariate analysis of the wellbeing of rural older adults with individual and community-contextual characteristics in Zambia (2015 Living Conditions Monitoring Survey, Zambia).

Characteristics	Total *N* = 14,531	Wellbeing (older people 50+)		
		Yes (%)	95% CI	*p* -value
Age, m(SD)	61.7 (9.5)	61.8 (9.2)		
Age (Grouped)				
50–64	63.4	31.9	[30.8, 33.1]	$p > 0.1$
65–74	25.4	32.2	[30.3, 34.1]	
75+	11.2	296	[27.1, 32.3]	
Sex				
Male	72.6	32.4	[31.4, 33.5]	$p < 0.01$
Female	27.4	29.9	[28.2, 31.6]	
Level of Education				
No education	16.8	32.4	[30.2, 34.7]	
Primary	57.8	29.3	[28.1, 30.5]	$p < 0.001$
Secondary	23	34.3	[32.5, 36.2]	
Higher	2.3	62.5	[56.9, 67.8]	
Marital Status				
Never married	0.2	0.4	[0.2, 1.2]	
Married/Living with partner	71.1	31.9	[30.9, 33.0]	$p < 0.001$
Separated/Divorced	8	39.2	[35.8, 42.7]	
Widowed	20.7	28.4	[26.6, 30.4]	
Morbidity (Sick in the last 2 weeks)				
Yes (Sick, injured or both)	27.7	33.3	[31.5, 35.0]	$p < 0.05$
No	72.3	31.2	[30.1, 32.2]	
Number of Meals Per Day[a]				
One/two	58.7	28.6	[27.5, 29.7]	$p < 0.001$
Three or more	42.2	36.3	[34.8, 37.8]	
Province				
Central	14.8	30.7	[28.1, 33.4]	
Copperbelt	7.5	38.6	[36.2, 41.1]	
Eastern	17.4	34.3	[31.8, 36.8]	
Luapula	9.8	27.8	[25.3, 30.5]	
Lusaka	3.6	36.1	[32.9, 39.4]	
Muchinga	7.8	30.7	[28.1, 33.4]	
Northern	10.1	39	[35.9, 42.2]	$p < 0.001$
North Western	4.8	32.7	[28.8, 36.7]	
Southern	14.4	30.4	[27.9, 33.1]	
Western	9.9	20.7	[18.4, 23.3]	
Type of Dwelling (House)				
Traditional hut	49.8	27.1	[25.9, 28.4]	
Improved traditional house	31.9	30.6	[29.0, 32.2]	
Detached house	17.1	46.5	[44.1, 48.8]	$p < 0.001$
Flat/Apartment/multi-unit	0.3	24	[16.2, 33.9]	
Semi-detached house/servants' quarter/cottage	0.9	53.4	[44.0, 62.5]	
Type of Materials Used for the Walls (House)[a]				
Mud brick	38.8	32.7	[31.2, 34.1]	
Burnt bricks	38.6	34.7	[33.2, 36.3]	
Compressed mud	10.2	28.8	[26.0, 31.8]	$p < 0.001$
Compressed cement bricks/concrete blocks/slab	0.6	60.8	[52.2, 68.9]	
Cement blocks	1.8	31.6	[25.8, 38.0]	
Iron sheets/asbestos/cardboard/wood/grass	1.3	15.9	[10.9, 22.6]	
Pole and dagga/mud	8.6	18.2	[15.8, 20.9]	
Type of Materials Used for Roof (House)[b]				
Thatched/palm leaf	55.4	28.2	[27.0, 29.4]	
Palm/Bamboo/wood planks/cardboard	0.6	45.9	[33.8, 58.4]	$p < 0.001$
Metal iron sheets	42.5	35.9	[34.5, 37.3]	
Asbestos	1.3	45.5	[38.3, 52.8]	
Type of Materials Used for Floor (House)				
Concrete	5.2	50.6	[46.4, 54.9]	

(Continued on following page)

TABLE 2 | (*Continued*) Bivariate analysis of the wellbeing of rural older adults with individual and community-contextual characteristics in Zambia (2015 Living Conditions Monitoring Survey, Zambia).

Characteristics	Total *N* = 14,531	Wellbeing (older people 50+)		
		Yes (%)	95% CI	*p* -value
Cement	18.2	41.5	[39.2, 43.8]	
Brick	0.5	53.9	[38.7, 68.3]	
Tiles	0.2	31.4	[18.6, 47.7]	$p < 0.001$
Mud	75.1	28.1	[27.1, 29.1]	
Other	0.2	10.9	[5.6, 20.1]	
Don't Know	0.6	16.4	[9.9, 25.8]	
Main Source of Water[c]				
Directly from river/lake/stream/dam/rainwater	17.9	30.3	[28.1, 32.6]	
Unprotected well	28	29.5	[27.9, 31.2]	
Protected well	12.8	35.5	[32.9, 38.2]	
Borehole	35.8	32.3	[30.7, 33.8]	$p < 0.001$
Protected spring	2.2	26.5	[21.7, 31.9]	
Public tap	1.4	47.4	[40.1, 54.8]	
Own tap	0.8	54	[46.1, 61.6]	
Other taps (nearby building)/Water Kiosk/Bought	0.9	37.7	[26.9, 49.8]	
Energy Used for Cooking[d]				
Collected firewood	87.5	30.6	[29.6, 31.6]	
Purchased firewood	1.5	60	[52.8, 66.7]	
Charcoal own product	3.7	35.1	[31.0, 39.5]	$p < 0.001$
Charcoal purchased	6.4	37.9	[34.7, 41.2]	
Electricity	0.9	43.6	[35.7, 51.9]	
Energy Used for Lighting				
Kerosine/paraffin/diesel	2.1	47.3	[40.8, 53.8]	
Electricity	1.5	56.5	[51.3, 61.6]	
Solar panel	7.5	43.6	[40.1, 47.2]	
Candle	7.4	35.2	[32.0, 38.5]	$p < 0.001$
Open fire	4.2	27	[23.1, 31.4]	
Torch	71.9	30	[28.9, 31.1]	
None	2.4	20.2	[15.7, 25.5]	
Other	2.9	26.3	[21.9, 31.1]	
Type of Toilet Facility[d]				
Own flush toilet inside/outside household	0.7	53.9	[46.5, 61.1]	
Own pit latrine with slab	11.4	41.5	[38.6, 44.5]	
Communal pit latrine with slab	2.4	24.3	[19.3, 30.1]	
Neighbours/another HH pit latrine with slab	0.5	55.3	[42.2, 67.7]	
Own pit latrine without a slab	53.1	31.2	[29.9, 32.4]	$p < 0.001$
Communal pit latrine without a slab	3.5	22.3	[18.2, 27.1]	
Pit latrine without a slab	18.8	30.4	[28.4, 32.5]	
None	4.4	27.6	[23.5, 32.1]	
Other	5.1	29.1	[25.1, 33.4]	

[a]*Missing.*
[b]*52 missing.*
[c]*39 missing.*
[d]*7 missing.*

stream/rainwater (AOR = 1.175, 95% CI: 1.03, 1.34). Similarly, older people who had access to a public tap (AOR = 2.493, 95% CI: 1.68, 3.70) and had their tap within the premises (AOR 2.720, 95% CI: 1.56, 4.76) as a source of water in rural areas were more than two times more likely to report good wellbeing than older adults who sourced water directly from rivers/lakes/streams/rainwater. The odds of wellbeing were generally lower for older people in rural areas without access to proper sanitation services (toilets).

Energy

For older adults who purchased firewood as a source of energy for cooking, their odds of wellbeing were more than three times higher compared to older adults who collected firewood for this purpose (AOR = 3.349, 95% CI: 2.54, 4.43) and older people who had their charcoal had 38% higher odds of wellbeing compared to older adults who collected firewood (AOR = 1.376, 95% CI: 1.14, 1.67). Relatedly, among older adults whose source of energy for lighting was an open fire or other sources of energy, the likelihood of wellbeing decreased by 44% (AOR = 0.438, 95% CI: 0.31, 0.62) and 32% (AOR = 0.317, 95% CI: 0.22, 0.45), respectively.

The random effects in the final model show that the variance of the random intercept remained statistically significant across the models, suggesting divergence across the rural areas even after accounting for

TABLE 3 | Fixed and random effects result in the association of Wellbeing of rural older people with the individual and community-contextual factors in Zambia (2015 Living Conditions Monitoring Survey, Zambia).

Characteristics	Model 0		Model I		Model II		Model III	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Age (Grouped)								
50–64			1	[1, 1]			1	[1, 1]
65–74			1.055	[0.97, 1.15]			1.08	[0.98, 1.19]
75+			1.923	[1.81, 1.05]			1.04	[1.07, 1.39]
Level of Education								
No education			1	[1, 1]			1	[1, 1]
Primary			0.945	[0.85, 1.06]			0.938	[0.84, 1.05]
Secondary			1.061	[0.94, 1.20]			0.931	[0.81, 1.06]
Higher			2.992***	[2.38, 3.77]			2.075***	[1.58, 2.73]
Morbidity (Sick in the last 7 days)								
Yes			1	[1, 1]			1	[1, 1]
No			0.944	[0.87, 1.03]			0.875**	[0.80, 0.96]
Province								
Central					1	[1, 1]	1	[1, 1]
Copperbelt					0.577	[0.25, 1.35]	0.564	[0.24, 1.34]
Eastern					0.765	[0.32, 1.84]	0.745	[0.31, 1.82]
Luapula					0.758	[0.31, 1.83]	0.759	[0.31, 1.85]
Lusaka					0.863	[0.29, 2.57]	0.88	[0.29, 2.67]
Muchinga					0.908	[0.37, 2.24]	0.874	[0.35, 2.18]
Northern					1.078	[0.46, 2.53]	1.068	[0.45, 2.55]
North-western					0.584	[0.25, 1.40]	0.573	[0.24, 1.38]
Southern					0.626	[0.27, 1.43]	0.609	[0.26, 1.41]
Western					0.839	[0.35, 2.04]	0.811	[0.33, 1.99]
Type of Dwelling (House)								
Traditional hut					1	[1, 1]	1	[1, 1]
Improved traditional house					1.273***	[1.11, 1.45]	1.281***	[1.12, 1.46]
Detached house					2.312***	[1.93, 2.76]	2.264***	[1.89, 2.71]
Flat/apartment/multi-unit					0.888	[0.50, 1.56]	1.055	[0.60, 1.86]
Semi-detached house/servants' quarter/cottage					1.822**	[1.22, 2.71]	1.881**	[1.27, 2.79]
Type of Materials Used for Roof (House)								
Thatched/palm leaf					1	[1, 1]	1	[1, 1]
Palm/bamboo/wood planks/cardboard					1.003	[0.62, 1.63]	0.964	[0.59, 1.56]
Metal iron sheets					0.830*	[0.72, 0.96]	0.830**	[0.72, 0.96]
Asbestos					0.669*	[0.45, 0.99]	0.698+	[0.47, 1.04]
Type of Materials Used for the Walls (House)								
Mud brick					1	[1, 1]	1	[1, 1]
Burnt bricks					0.691***	[0.62, 0.78]	0.682***	[0.61, 0.77]
Compressed mud					0.859+	[0.72, 1.03]	0.862	[0.72, 1.03]
Compressed cement bricks/concrete blocks/slab					0.789	[0.49, 1.26]	0.759	[0.47, 1.23]
Cement blocks					0.116***	[0.07, 0.18]	0.098***	[0.06, 0.16]
Iron sheets/asbestos/cardboard/wood/grass					0.757	[0.48, 1.20]	0.784	[0.49, 1.24]
Pole and dagga/mud					0.757*	[0.61, 0.95]	0.780*	[0.62, 0.98]
Type of Materials Used for Floor (House)								
Concrete					1	[1, 1]	1	[1, 1]
Cement					0.612***	[0.51, 0.74]	0.582***	[0.48, 0.70]
Brick					1.428	[0.84, 2.44]	1.379	[0.80, 2.36]
Tiles					2.433*	[1.05, 5.63]	1.842	[0.75, 4.51]
Mud					0.590***	[0.49, 0.71]	0.561***	[0.46, 0.68]
Other					0.573	[0.27, 1.23]	0.533	[0.25, 1.15]
Don't know					0.291***	[0.16, 0.54]	0.276***	[0.15, 0.51]
Main Source of Water								
Directly from river/lake/stream/dam/rainwater					1	[1, 1]	1	[1, 1]
Unprotected well					0.809**	[0.71, 0.92]	0.809**	[0.71, 0.92]
Protected well					1.073	[0.92, 1.26]	1.041	[0.89, 1.22]
Borehole					1.175*	[1.03, 1.34]	1.175*	[1.03, 1.34]
Unprotected spring					0.901	[0.70, 1.17]	0.899	[0.69, 1.17]
Public tap					2.521***	[1.70, 3.72]	2.493***	[1.68, 3.70]
Own tap					2.724***	[1.57, 4.72]	2.720***	[1.56, 4.76]
Other taps (nearby building)/water kiosk/bought					1.237	[0.80, 1.92]	1.303	[0.84, 2.02]

(Continued on following page)

TABLE 3 | (*Continued*) Fixed and random effects result in the association of Wellbeing of rural older people with the individual and community-contextual factors in Zambia (2015 Living Conditions Monitoring Survey, Zambia).

Characteristics	Model 0		Model I		Model II		Model III	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Energy Used for Cooking								
Collected firewood					1	[1, 1]	1	[1, 1]
Purchased firewood					3.625***	[2.75, 4.77]	3.349***	[2.54, 4.43]
Charcoal own product					1.359**	[1.12, 1.64]	1.376***	[1.14, 1.67]
Charcoal purchased					1.137	[0.97, 1.33]	1.074	[0.96, 1.26]
Electricity					0.425**	[0.24, 0.75]	0.281***	[0.15, 0.51]
Energy Used for Lighting								
Kerosine/paraffin/diesel					1	[1, 1]	1	[1, 1]
Electricity					0.827	[0.52, 1.34]	0.83	[0.51, 1.36]
Solar panel					0.535***	[0.40, 0.72]	0.527***	[0.39, 0.71]
Candle					0.564***	[0.42, 0.76]	0.572***	[0.43, 0.77]
Open fire					0.453***	[0.32, 0.63]	0.438***	[0.31, 0.62]
Torch					0.440***	[0.34, 0.57]	0.450***	[0.34, 0.59]
None					0.443***	[0.31, 0.64]	0.448***	[0.31, 0.65]
Other					0.333***	[0.24, 0.47]	0.317***	[0.22, 0.45]
Type of Toilet Facility								
Own flush toilet inside/outside household					1	[1, 1]	1	[1, 1]
Own pit latrine with slab					0.423**	[0.23, 0.78]	0.380**	[0.21, 0.71]
Communal pit latrine with slab					0.395**	[0.21, 0.75]	0.384**	[0.20, 0.74]
Neighbours/another HH pit latrine with slab					0.229***	[0.10, 0.50]	0.200***	[0.09, 0.44]
Own pit latrine without a slab					0.348***	[0.19, 0.64]	0.320***	[0.17, 0.59]
Communal pit latrine without a slab					0.167***	[0.09, 0.32]	0.153***	[0.08, 0.30]
Pit latrine without a slab					0.321***	[0.17, 0.60]	0.295***	[0.16, 0.56]
None					0.305***	[0.16, 0.59]	0.269***	[0.14, 0.52]
Other					0.348**	[0.18, 0.67]	0.316***	[0.16, 0.61]
Intercept	0.377***	[0.31, 0.46]	0.387***	[0.31, 0.49]	4.99***	[1.91, 13.04]	6.507***	[2.43, 17.41]
Random Effects								
Variance	0.658	[0.44, 0.98]	0.6502	[0.44, 0.97]	0.5504	[0.37, 0.83]	0.5657	[0.38, 0.85]
ICC (%)	16.7	[0.12, 0.23]	16.5	[0.12, 0.23/]	14.3	[0.10, 0.20]	14.7	[0.10, 0.21]
PCV (%)			1.2		16.4		14	
Model Statistics								
Log Likelihood	−8671.1		−8613.8		−8264.2		−8239.3	
AIC	17346.2		17243.7		16640.4		16602.5	
N	14,531		14,531		14,432		14,432	

Exponentiated coefficients; 95% confidence intervals in brackets $^{+}p < 0.1$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

individual-level and contextual-level factors. This further suggests that other unmeasured or unobserved rural community characteristics may influence the wellbeing of older people. Although there are other unobserved rural community characteristics, the PCV of 14% indicates that the random effects (individual and contextual factors) included in the model account for the substantial portions of the variability in the wellbeing of older adults in rural communities. Therefore, unpacking the multilevel structure of the data is important to understand the context-specific nuances that influence the wellbeing of older adults in rural communities.

DISCUSSION

We aimed to identify individual and community-contextual level factors associated with the wellbeing of older adults above 50 years in rural settings. We established that both individual and community-contextual factors dynamically interact to influence rural settings that foster or hinder the wellbeing of older people. These findings align with other studies on rural ageing that suggest that rural settings are contested spaces for ageing and are created through active and passive interactions between diverse older adults, community members, rural organisations and the policy/programmatic architecture [14]. The study highlights that educational attainment at the nexus of access to adequate housing, the appropriate type of materials to construct housing, and access to water and energy for cooking create contested spaces. By identifying these spaces through the generation of evidence, possible opportunities are opened for policy and practical interventions that could be beneficial for ageing individuals and their communities.

At the individual level, higher education attainment among older adults was associated with better wellbeing. A population and development review argues that education attainment over the life course is a paramount driver for many social, economic and health outcomes [39]. Another study on the impact of education attainment on older people's wellbeing found that each additional year of education attainment improved the wellbeing of older persons [40], also in terms of their social, economic and health outcomes [41]. Others have shown a

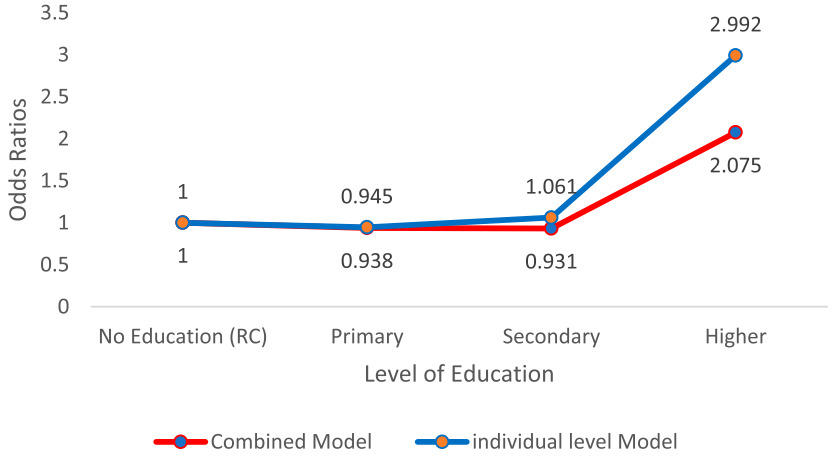


FIGURE 3 | Distribution of odds ratios for older people's wellbeing and level of education (2015 Living Conditions Monitoring Survey, Zambia).

qualitative increase in older people's cognitive health, self-confidence, and life satisfaction with educational attainment [42]. The level of education has been argued to directly enhance the quality of social engagement and social interaction, which results in more opportunities for the formation of stronger social networks including connections with peers [43]—contributing to wellbeing.

Level of education correlates strongly with better job prospects, personal empowerment, and income. Better income in older age can reduce stress and contribute to general wellbeing. Importantly, education attainment can enhance health literacy and improve the ability to access, understand and use information to make informed health decisions for wellbeing. Although the results of this analysis have shown that the prevalence of illness or injury among older adults negates the gains in wellbeing, studies have indicated that older adults with higher levels of education have better health outcomes than their less-educated peers [41]. Education can facilitate and shape the wellbeing of older adults and is a key driver for attaining a demographic dividend and the SDGs. Education is a key mechanism to prepare for old age, especially when complemented by community-contextual factors such as social support, access to healthcare and a better socioeconomic status [27].

At the community-contextual level, the contested spaces for the wellbeing of older adults were associated with the available community resources, such as type housing, access to water, sanitation, and energy for cooking. The interactions with these (or lack of) resources, directly or indirectly shape the setting within which older adults age. Access to housing provides a sense of safety and increases the desire to age in a specific place [44]. The results have shown that older people with access to improved housing experienced better wellbeing than those who live in traditional huts. The results are consistent with the research reported in other studies, which argued that rural communities have distinctive challenges associated with infrastructure, specifically, and decent housing improves the general wellbeing of older people [15, 31].

The WHO further emphasises that housing protects people from hazards and promotes good health and wellbeing [36, 37]. However, another study in Zambia argues that the challenge related to housing dates to Zambia's pre-independence times, and 80% of the national housing stock is in informal and unplanned settlements and made of poor materials not resistant to withstand an array of climatic and weather conditions [45]. The results also indicate that housing conditions in rural communities significantly impact individual older people and community wellbeing. Studies on health and housing have demonstrated that housing can affect various aspects of health, mental wellbeing, and overall quality of life [46].

According to the results, older adults living in improved houses with access to piped water and energy for cooking (such as sufficient income to buy charcoal) experienced better wellbeing than counterparts in poor housing with related conditions. The interaction of housing conditions, access to water and energy for cooking and lighting in rural settings directly influences older people's wellbeing. Generally, most rural areas in Zambia face challenges concerning access to energy for cooking and lighting [24]. The results show that older people who purchased firewood or had charcoal for cooking had better wellbeing than older people in rural areas who collected firewood for cooking, given distances and weight. Access to water and sanitation services (toilets) remains a key wellbeing factor. Findings showed that older people in rural areas with access to either a borehole, public tap or a tap on their property have better wellbeing compared to older individuals who have to collect water directly from the source (e.g. river, lake, dam, rainwater). A possible explanation is that older people must walk long distances to the source of water, as a study by Koff confirmed, but also that many of them cannot carry heavy loads due to their frailty [15, 31, 47, 48].

In terms of a critical realist approach [49], it could be posited that the factors that support the wellbeing of older adults are obscured within the contextual causal relationship, as evidenced by the interaction of individual and rural community-contextual characteristics [50]. Thus, it is asserted that there is a need to move beyond a simplistic focus on older peoples' observable

individualistic characteristics towards a more complex understanding by integrating "real" world community-contextual effects, evidenced in this study. The monolithic clustering and characterisation of older people based on the binary/blanket categorisation of communities as rural and/or urban are likely to obscure a true reflection of the wellbeing of older adults. Consequently, the analysis of older adults' wellbeing should consider the specific characteristics of individuals at the interface of the particular rural context.

The findings suggest that the community-contextual factors of wellbeing are diverse and dynamic. As such, the emergence of any external influence could threaten elements that support contested spaces beneficial for the wellbeing of older adults. For example, the COVID-19 pandemic of 2020 negatively affected the elements that create a favourable setting for the wellbeing of older people, such as loss of income, inadequate food, challenges to access healthcare, and exacerbated isolation due to restricted movements [51, 52]. The 2021 Socio-economic Impact Assessment Survey of COVID-19 on Households in Zambia (SEIA) highlights how COVID-19 altered mechanisms for the wellbeing of older adults. Thus, any efforts that do not consider the variability of community-contextual characteristics in understanding what influences the wellbeing of older adults may not generate optimal outcomes.

The stark reality is that only about a third of rural older adults in this study experienced wellbeing. It is therefore imperative to highlight the identified factors that facilitate wellbeing with a clear and critical realist approach to structure attainable interventions that may otherwise be obscured in the reductionism and clustering of the challenges in rural communities. This implies that the factors that support the wellbeing of older people in rural communities should be looked at with a three-tier approach by focusing on what is *prevailing* in rural communities, the underpinning factors i*nfluencing* the prevailing factors, and how they *interface* with the prevailing wellbeing of older adults.

Conclusion

This study adds compelling evidence to the studies about rural ageing in SSA on the influence of individual factors (education attainment) and community-contextual factors (access to improved housing, piped water, having own energy sources for cooking such as charcoal or income to buy firewood) on the wellbeing of older people in rural communities. These results underscore the need to address educational disparities and improve access to basic community resources to promote the wellbeing of older populations in rural communities. Furthermore, this analysis has policy-making and pragmatic implications. To this end, the 2022 African Union Strategic Policy Framework and Plan of Action on Ageing (AUPFPAA) calls for strategic investment across the life course (in this case, education) to enhance capacities and wellbeing in older age that can benefit both older and younger people [53]. This might, in turn, foster the attainment of a demographic dividend as the population ages. These results also inform a call for direct investment in rural infrastructure such as housing, water access, and energy (cooking, lighting). Amalgamated efforts are needed to negotiate and address the contested spaces for rural ageing by valuing the participation and needs of current cohorts of older citizens and, to that end, also investing in future generations through education. It emphasises the call for a life course approach to wellbeing in later life through education, as well as the need to ensure that older people's physical environments are good or friendly places to age.

The limitations in terms of the dataset are acknowledged on two levels: the use of the 2015 data may have presented some inadequacies due to it being dated and potential changes might have occurred, resulting in changes in the context; the data were also collected to measure the general wellbeing of the population. This focus may have missed salient aspects unique to older adults. Nevertheless, the results point to a non-monolithic analysis of what shapes the wellbeing of older adults by interfacing individual and community-contextual level factors. The multi-level analysis has demonstrated the need to decrypt factors of wellbeing often obscured in the monolithic analysis of individual or community-contextual level factors separately. This is because the monolithic approach might risk not recognising the diverse, dynamic and complex interface of individual and community-contextual factors for the wellbeing of older adults. Further research is required to explore additional determinants of wellbeing, specifically human and social capital, and the development and impact of specific community-context interventions to support the wellbeing of older people in rural settings.

DATA AVAILABILITY STATEMENT

Data are available at the Zambia Statistics Agency (https://www.zamstats.gov.zm) for public use upon a data request through the Statistician-General.

ETHICS STATEMENT

Ethics approval was not required for this study, as it is a secondary data analysis of existing survey data (LCMS). However, permission to use the data was sought, and the study was conducted under the ethics number NWU-01152-22-A7.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

CONFLICT OF INTEREST

The authors declare that they do not have any conflicts of interest.

REFERENCES

1. Poulin LIL, Skinner MW, Hanlon N. Rural Gerontological Health: Emergent Questions for Research, Policy and Practice. *Soc Sci Med* (2020) 258:113065. doi:10.1016/j.socscimed.2020.113065
2. Orpin P, Van Der Ploeg W, Walker J, Boyer K, Carroll M. Supporting Rural Ageing Well: How Important Is the Rural? In: 13th National Rural Health Conference; 24-27 May 2015. Darwin: National Rural Health Alliance Organising Group (2014). p. 1–9.
3. Nyirenda M, Sukazi S, Buthelezi C, Hanass-Hancock J. "A Frightening Experience, Especially at Our Age": Examining the Neglect and Abuse of Older Persons in HIV Prevention and Care Programs. *Front Public Health* (2023) 11:1061339. doi:10.3389/fpubh.2023.1061339
4. United Nations Department of Economic and Social Affairs. *Overview of Demographic Ageing in Africa* (2016). Available from: https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/unpd_ws201607_demographic_trends_in_africa_yk.pdf (Accessed November 22, 2023).
5. Hoffman J. Ageing in Africa as the Youngest Region: Research-Policy Emergence. *J Popul Ageing* (2022) 15:879–83. doi:10.1007/s12062-022-09407-0
6. United Nations Economic Commission for Africa. *The State of Older People in Africa -2007: Regional Review and Appraisal of the Madrid International Plan of Action on Ageing* (2007). Available from: https://www.un.org/esa/socdev/ageing/documents/regional_review/Africa2007.pdf (Accessed November 10, 2023).
7. United Nations Department of Economic and Social Affairs. *World Population Prospects* (2022). Available from: https://doi.org/10.18356/9789210014380c009 (Accessed August 27, 2023).
8. United States Census Bureau. *Why Study Aging in Africa, the Region With the World's Youngest Population?* (2022). Available from: https://www.census.gov/library/stories/2022/04/why-study-aging-in-africa-region-with-worlds-youngest-population.html (Accessed July 15, 2023).
9. Solanki G, Kelly G, Cornell J, Daviaud E, Geffen L. Population Ageing in South Africa: Trends, Impact, and Challenges for the Health Sector. *S Afr Health Rev* (2019) 2019:175–82.
10. Central Statistical Office. *2010 Census of Population and Housing; Population and Demographic Projections 2011 – 2035* (2013). Available from: https://www.zamstats.gov.zm.
11. Zambia Statistics Agency. *2022 Census of Population and Housing Preliminary Report* (2022). Available from: https://www.zamstats.gov.zm.
12. Zambia Statistics Agency. *Highlights of the 2022 Poverty Assessment in Zambia* (2022). Available from: https://www.zamstats.gov.zm.
13. United Nations Department of Economic and Social Affairs. *World Social Report 2023: Leaving No One Behind in an Ageing World* (2023). Available from: https://doi.org/10.18356/9789210019682 (Accessed November 16, 2023).
14. Skinner MW, Winterton R. Interrogating the Contested Spaces of Rural Aging: Implications for Research, Policy, and Practice. *Gerontologist* (2018) 58:15–25. doi:10.1093/geront/gnx094
15. Koff TH. Aging in Place: Rural Issues. *J Am Soc Aging* (1992) 16:53–5.
16. World Health Organization. *UN Decade of Healthy Ageing: Plan of Action* (2020). Available from: https://www.who.int/ageing/decade-of-healthy-ageing.
17. Smalls BL, Gibson A, Lacy ME, Pope CN, Pope ND, Rhodus EK, et al. Improving Health and Well-Being in Aging Rural America Through the Social Determinants Framework. *Journals Gerontol Soc Sci* (2023) 78:1185–91. doi:10.1093/geronb/gbad032
18. Keyes CLM. Social Well-Being. *Soc Psychol Q* (1998) 61:121. doi:10.2307/2787065
19. The United Nations Economic Commission for Europe. *Older Persons in Rural and Remote Areas: Policy Brief on Ageing No.18* (2017). Available from: https://www.unece.org/fileadmin/DAM/pau/age/Policy_briefs/ECE-WG1-25.pdf.
20. Keating N. *Rural Ageing: A Good Place to Grow Old?* 1st ed. Bristol: Bristol University Press (2008). doi:10.2307/j.ctt9qgmzc
21. Hoffman J, Roos V. Postcolonial Perspectives on Rural Ageing in (South) Africa. In: Skinner M, Winterton R, Walsh K, editors. *Rural Gerontology*. 1st ed. London: Routledge (2020). p. 223–36. doi:10.4324/9781003019435-23
22. Aboderin I, Ferreira M. Linking Ageing to Development Agendas in Sub-Saharan Africa: Challenges and Approaches. *J Popul Ageing* (2008) 1:51–73. doi:10.1007/s12062-009-9002-8
23. Fakoya OA, McCorry NK, Donnelly M. Loneliness and Social Isolation Interventions for Older Adults: A Scoping Review of Reviews. *BMC Public Health* (2020) 20:129–14. doi:10.1186/s12889-020-8251-6
24. Central Statistical Office. *Living Conditions Monitoring Survey (LCMS)*. Lusaka: Central Statistical Office (2015). Available from: http://www.zamstats.gov.zm/report/Lcms/2006-2010LCMSReportFinalOutput.pdf.
25. World Bank. *Zambia Tackles Core Development Challenges* (2016). Available from: https://www.worldbank.org/en/results/2016/10/24/zambia-tackles-core-development-challenges (Accessed May 4, 2023).
26. Bosch-Farré C, Malagón-Aguilera MC, Ballester-Ferrando D, Bertran-Noguer C, Bonmatí-Tomàs A, Gelabert-Vilella S, et al. Healthy Ageing in Place: Enablers and Barriers From the Perspective of the Elderly. A Qualitative Study. *Int J Environ Res Public Health* (2020) 17:6451–23. doi:10.3390/ijerph17186451
27. Sixsmith J, Makita M, Menezes D, Cranwell M, Chau I, Smith M, et al. Enhancing Community Participation Through Age-Friendly Ecosystems: A Rapid Realist Review. *Geriatrics* (2023) 8:52. doi:10.3390/geriatrics8030052
28. Kabelenga I. Previous Lifestyles and Neglect in Old Age: Perceptions and Conceptions of Community Leaders in Zambia 1. *Postmodernism Probl* (2020) 2020:100–24.
29. Kabelenga I. *Elder Abuse in Rural and Urban Zambia; Interview-Study With Community Leaders*. Doctoral Thesis. Lapland: University of Lapland (2018).
30. HelpAge International. *A Social Pension in Zambia Perceptions of the Cash Transfer Pilot in Katete* (2011). Available from: www.pension-watch.net.
31. Chirwa M, Kalinda R. Challenges of the Elderly in Zambia. A Systematic Review Study. *Eur Sci J* (2016) 12:351. doi:10.19044/esj.2016.v12n2p351
32. Keating N, Phillips J. A Critical Human Ecology Perspective on Rural Ageing. In: Keating N, editor. *Rural Ageing*. Bristol: Bristol University Press (2008). p. 1–10. doi:10.2307/j.ctt9qgmzc.6
33. Skinner M, Winterton R, Walsh K. *Rural Gerontology: Towards Critical Perspectives on Rural Ageing*. 1st ed. London: Routledge (2020). doi:10.4324/9781003019435
34. Suzman R, Beard JR, Boerma T, Chatterji S. Health in an Ageing World: What Do We Know? *The Lancet* (2015) 385:484–6. doi:10.1016/S0140-6736(14)61597-X
35. Aboderin I, Beard J. Older People's Health in Sub-Saharan Africa. *The Lancet* (2015) 385:e9–11. doi:10.1016/S0140-6736(14)61602-0
36. United Nations. *Political Declaration and Madrid International Plan of Action on Ageing: Second World Assembly on Ageing, Madrid Spain* (2002). Available from: https://www.un.org/esa/socdev/documents/ageing/MIPAA/political-declaration-en.pdf (Accessed October 20, 2023).
37. World Health Organization. *Global Age-Friendly Cities: A Guide*. Community Health (2007). Available from: http://www.who.int/ageing/publications/Global_age_friendly_cities_Guide_English.pdf.
38. Bressoux P. Using Multilevel Models Is Not Just a Matter of Statistical Adjustment—Illustrations in the Educational Field. *Annee Psychologique* (2020) 120:5–38. doi:10.3917/anpsy1.201.0005
39. Lutz W. Education Will Be at the Heart of 21st-Century Demography. *Vienna Yearb Popul Res* (2010) 8:9–16. doi:10.1553/populationyearbook2010s9
40. Merriam SB, Kee Y. Promoting Community Wellbeing: The Case for Lifelong Learning for Older Adults. *Adult Edu Q* (2014) 64:128–44. doi:10.1177/0741713613513633
41. Raghupathi V, Raghupathi W. The Influence of Education on Health: An Empirical Assessment of OECD Countries for the Period 1995–2015. *Arch Public Health* (2020) 78:20. doi:10.1186/s13690-020-00402-5
42. Noble C, Medin D, Quail Z, Young C, Carter M. How Does Participation in Formal Education or Learning for Older People Affect Wellbeing and Cognition? A Systematic Literature Review and Meta-Analysis. *Gerontol Geriatr Med* (2021) 7:2333721420986027. doi:10.1177/2333721420986027
43. Andersson MA. Higher Education, Bigger Networks? Differences by Family Socioeconomic Background and Network Measures. *Socius* (2018) 4:237802311879721. doi:10.1177/2378023118797217
44. Wiles JL, Leibing A, Guberman N, Reeve J, Allen RES. The Meaning of "Aging in Place" to Older People. *Gerontologist* (2012) 52:357–66. doi:10.1093/GERONT/GNR098

45. Richard Z, Shuichi O. Urbanization, Housing Problems and Residential Land Conflicts in Zambia. *Jpn J Hum Geogr (Jimbun Chiri)* (2017) 69:73–86. doi:10.4200/jjhg.69.01_073
46. World Health Organization. *Health Principles of Housing* (1989). Available from: https://apps.who.int/iris/handle/10665/39847 (Accessed August 7, 2023).
47. Mshamu S, Peerawaranun P, Kahabuka C, Deen J, Tusting L, Lindsay SW, et al. Old Age Is Associated With Decreased Wealth in Rural Villages in Mtwara, Tanzania: Findings From a Cross-Sectional Survey. *Trop Med Int Health* (2020) 25:1441–9. doi:10.1111/tmi.13496
48. Hove J, D'Ambruoso L, Mabetha D, Var der Merwe M, Byass P, Kahn K, et al. 'Water Is Life': Developing Community Participation for Clean Water in Rural South Africa. *BMJ Glob Health* (2019) 4:e001377–13. doi:10.1136/bmjgh-2018-001377
49. Bhaskar R. *Reclaiming Reality: A Critical Introduction to Contemporary Philosophy*. London: Routledge (2010).
50. Lawani A. Critical Realism: What You Should Know and How to Apply it. *Qual Res J* (2021) 21:320–33. doi:10.1108/QRJ-08-2020-0101
51. United Nations Conference on Trade and Development. *The Economic and Social Impact of COVID-19 in Zambia*. UNCTAD (2022). Available from: https://unctad.org/publication/economic-and-social-impact-covid-19-zambia (Accessed August 27, 2023).
52. Mathew N, Deborah I, Karonga T, Rumbidzai C. The Impact of COVID-19 Lockdown in a Developing Country: Narratives of Self-Employed Women in Ndola, Zambia. *Health Care Women Int* (2020) 41:1370–83. doi:10.1080/07399332.2020.1823983
53. African Union. *Strategic Policy Framework and Plan of Action on Ageing. Fourth Session of the Specialised Technical Committee on Social Development*. Addis Ababa: Labour & Employment (2022). p. 1–46.

International Journal of Public Health
ORIGINAL ARTICLE
published: 13 March 2024
doi: 10.3389/ijph.2024.1606572

Multidimensional Deprivations and Associated Factors Among Older Adults in Urban Geographies of Nigeria: Implications for Poor Health Outcomes in Later Life

Jacob Wale Mobolaji *

Department of Demography and Social Statistics, Obafemi Awolowo University, Ile-Ife, Nigeria

Objectives: Many urban-dwelling older Nigerians are multidimensionally deprived and are unable to meet their daily financial, nutritional, and healthcare needs. This has implications for their health outcomes, yet it has been under-researched. This study assessed the multidimensional deprivation index (MDI) of urban-dwelling older Nigerians and the associated factors.

Methods: The study analysed a weighted sample of 5,225 older persons aged ≥60 years from Nigeria's Demographic and Health Survey, 2018. MDI was estimated, and associations were examined using a multilevel multinomial logistic regression model.

Results: Nationally, 75% of the older persons were multidimensionally deprived, with 27% severely deprived. Women (36%) were more severely deprived than men (20%). Those in the Northern regions (38%–40%) were the most deprived. Higher MD risk was associated with female gender and older ages ≥70–79 years. Conversely, lower risk was associated with households headed by family and residence in educated communities. Community variation accounts for 10.4% and 35.9% of the MD and severe MD risks, respectively.

Conclusion: This study suggests socioeconomic interventions that address gender disparities and target highly deprived regions, with consideration for individual and community characteristics.

Keywords: older adults, multidimensional deprivation, poverty, standard of living, socioeconomic status, multilevel analysis

OPEN ACCESS

Edited by:
Stephen Ojiambo Wandera, Makerere University, Uganda

Reviewed by:
Patricio Valenzuela, University of the Andes, Chile, Chile
One reviewer who chose to remain anonymous

***Correspondence**
Jacob Wale Mobolaji,
mobolawale@gmail.com,
jmobolaji@oauife.edu.ng

This Original Article is part of the IJPH Special Issue "Ageing and Health in Sub-Sahara Africa"

Received: *01 September 2023*
Accepted: *28 February 2024*
Published: *13 March 2024*

Citation:
Mobolaji JW (2024) Multidimensional Deprivations and Associated Factors Among Older Adults in Urban Geographies of Nigeria: Implications for Poor Health Outcomes in Later Life. Int J Public Health 69:1606572. doi: 10.3389/ijph.2024.1606572

INTRODUCTION

Old age is characterized by emerging needs and difficulties due to decreasing physical functioning and health deterioration. In Nigeria, the population of older adults is rapidly rising with the associated health challenges [1, 2]. In the next 10 years, the proportion of the population moving into the older age group will be very alarming. The Nigerian government recently approved the first national policy on older people [3], however, the evidence and content provided left more to be desired. Evidence suggests that about 70% of the older Nigerians are vulnerable and poor [4], with the inability to meet their daily financial, nutritional, and healthcare needs; yet little is known about the complexities and dimensions of their poverty and vulnerability. Multiple and co-existing

deprivations in the socioeconomic and healthcare resources accentuate the risk of poor health outcomes and lower life expectancy in later life.

The concept of multidimensional deprivation aims at capturing poverty, otherwise referred to as deprivation, in all its forms as conceived in the sustainable development goal (SDG) 1 [5]. The concept relates to the measures of household deprivations in multiple dimensions and their corresponding indicators which include health (measured by child death and nutritional status), education (years of formal education, and child's school enrolments) and standard of living (sanitation, water, floor, household assets, cooking fuel, electricity) [6–8]. While the multidimensional approach has been adapted to different population sub-groups across the world, especially children and older people [9–12], little has been done in Nigeria. The few multidimensional poverty studies in Nigeria have either focused on the general household or children, with little/no research attention to older adults.

Existing evidence shows that residents of urban settings are socioeconomically better than those in rural geographies [13, 14]. However, there are unassessed disparities and nuances in urban settings. Urban geographies in many developing countries, especially in Nigeria, are susceptible to alarming crime rates, poverty, high cost of living, environmental hazards and socioeconomic inequalities [15–17]. Poverty in the urban setting is linked to the worsening environmental degradation and poor socioeconomic infrastructure coupled with poor governance and institutional deficiencies [18–21]. This study argues that the socioeconomic condition of older urban residents, especially vulnerable older adults residing in slums, is worse than rural dwellers. Although growing old and maintaining wellbeing and resilience in such settings could be challenging, research evidence teasing out the dimensions and intensity of poverty realities of the older residents is lacking in Nigeria. This study examines the extent of multidimensional deprivations and associated factors among older people in Nigeria. The findings from this study will serve as a policy guide for improving the welfare and wellbeing of older people in the country.

METHODS

Data Sources and Sample Design

The study employed secondary analysis of household members' data from Nigerian Demographic and Health Surveys (DHS), 2018. The household version of NDHS is nationally representative and contains demographic, socioeconomic and health information about individuals in the selected households. A stratified two-stage cluster design was used to select households from 904 clusters. A detailed description of the sample design of the survey was already published elsewhere [22]. Information on individual socio-demographic characteristics and household living conditions of a weighted sample of 5,225 older members of the household aged 60 years and above were extracted and used for this study. The sample was weighted to correct the possible sampling errors during the data collection.

Variables and Measures

The multidimensional deprivation index (MDI), the outcome variable for this study, was measured using five dimensions: health, education, standard of living, information and communication, and empowerment. The five dimensions were computed from 15 indicators including the experience of functional limitations; level of education; official language literacy; sources of drinking water; type of toilet facilities regarded as sanitation; type of cooking fuel; access to electricity; type of housing materials; access to sources of information such as television and radio sets; access to means of communication such as mobile phone or landlines; ownership of agricultural land, livestock or farm animals; access to means of mobility; and access to a bank account. Existing studies have used different dimensions and indicators for different population sub-groups. For instance, most authors have used dimensions like disability, standard of living, education and housing burden [9–12]. The Nigerian National Multidimensional Poverty Index 2021 used education, unemployment, health in terms of nutrition food security and time to healthcare, and living standard and poverty. However, the data is not publicly available at the time of this study. The dimensions and indicators used in this study were adapted from the existing studies identified above and based on data availability.

Each of the indicators was assigned a weight within its corresponding dimension, while all dimensions d were given equal relative weight w. The multidimensional deprivation (MD) score m for ith respondent is the weighted sum of all deprivations such that

$$m_i = \sum_{j=1}^{d} w_{ij} = 1 \quad (1)$$

Deprivation score which lies between zero and one (0–1) was assigned to each respondent. As the number of deprivations increases, the score of the respondent increases to a maximum of 1 which indicates extreme deprivation, while zero represents no deprivation. Please see the details of the variables, measures and corresponding weights in **Table 1**. Although scholars have used different weighting strategies including multiple cluster analysis [23] and composite scoring of 1 for the deprived and 0 for non-deprived persons in each indicator [12], this study used the latter approach which is the most popularly used weighting method in measuring multidimensional deprivations.

A deprivation threshold (t) also referred to as the cut-off value which is the percentage of the indicators in which a respondent is deprived was set, such that persons below the t are considered not deprived at the t dimension. Persons who are deprived in 20% of the 15 indicators are deprived at $t = 1$; those that were deprived in 40% of the indicators are deprived at $t = 2$; and deprivations in 60%, 80% and 100% of the indicators are deprived at $t = 3$, $t = 4$ and $t = 5$, respectively. A cut-off value of 40% ($t = 2$) was regarded as MD in this study. Though some studies have used a cut-off point of $t = 1$ for MD, the choice of cut-off $t = 2$ was based on the high poverty level in the country. Available evidence suggests that raising the cut-off point helps to adjust for the poverty level in poverty-tolerant contexts of low- and middle-income countries (LMIC) [11].

TABLE 1 | Dimensions, indicators and measurements of multidimensional deprivation index (Nigeria, 2023).

Dimensions	Indicators	Deprivation descriptions	Weights	Total weights
Health	Functional limitations	[a]Has difficulty in any of seeing, hearing, walking, talking, memory, dressing self	1/5	1/5
Education	Level of education	Has not completed at least primary school	1/10	1/5
	Official language literacy	Does not understand English (official) language	1/10	
Living standard	Drinking water	Unimproved water	1/25	1/5
	Sanitation	Unimproved sanitation	1/25	
	Cooking fuel	unimproved cooking fuel	1/25	
	Electricity	No electricity	1/25	
	housing	Unimproved floor/roof/wall	1/25	
Information, Communication and Companionship	Information	No access to radio or TV	1/15	1/5
	Communication	No access to telephone	1/15	
	Companionship	Living alone	1/15	
Empowerment	Ownership of agricultural land, livestock, farm animals, cattle/cow/bulls/donkeys	[b]Has less than 1 ha of land or zero horse/camel/donkey or less than 2 cattle/cow/bulls or less than 8 goats/sheep/pigs or less than 30 poultry birds	1/15	1/5
	Mobility	[b]Has no car/truck or bike/scooter or animal-drawn cart or boat with a motor, motorized tricycle	1/15	
	Bank account	No bank account	1/15	

[a]*Difficulty in any of the listed items means deprivation.*
[b]*Ownership of any of the listed items is not deprived.*

Overall, multidimensionally deprived persons were identified from the MDI. Persons who were deprived in less than 20% of the indicators were categorised as not deprived; individuals who were deprived in 20%–39.9% of the indicators were categorised as being vulnerable to MD; while persons deprived in 40%–59.9% of the indicators were referred to as being multidimensionally deprived; and those that were deprived in ≥60% of the indicators were categorised as having severe MD. For inferential statistical tests and multivariable analysis, the MD levels were recoded into three: no MD (merging not deprived with vulnerable to MD) with code = 0, multidimensionally deprived (code = 1) and severe MD (code = 2).

The independent variables are the individual socio-demographic, household and community characteristics of the respondents. The sociodemographic characteristics include age, sex, marital status, sex and age of their household head. The community variables include community level of education and poverty level (each categorised as low, medium and high), and region of residence. The community variables were generated from the existing variables, except the region of residence.

Data Analysis

The data for this study was analysed in two sections using Stata version 15.1 software. The first section addressed the estimates of the multidimensional deprivation index while the second section focused on the predictors of multidimensional deprivation among older adults in Nigeria using the multilevel multinomial logistic regression model.

Multidimensional Deprivation Estimates

The multidimensional deprivation measures including the headcount ratio (H), intensity (I), relative shares of MD, and the adjusted headcount ratio (R_0) as well as their gender and regional disparities were estimated and presented in **Tables 2–4**. According to Alkire and Foster [8], the headcount ratio H indicating the proportion of respondents with multiple deprivations is given by

$$H = \frac{p}{n} \tag{2}$$

Where p is the number of respondents who are multidimensionally deprived. This is the incidence of MD in the population while n is the total population. In this study, the headcount ratio of multidimensionally deprived older persons was estimated using the above formula, expressed in percentages and presented at various cut-off values. The H of older Nigerians were estimated for those who were vulnerable to multidimensional deprivation (t = 1); multidimensionally deprived (t = 2); and those with severe multidimensional deprivation (t ≥ 3). The estimates were also obtained by gender and region of residence.

In addition, the Intensity I of multidimensional deprivation which is the average share of deprivation among the poor is another measure of MD, based on Alkire and Foster's formula

$$I = \frac{\sum_{i=1}^{n} m_i(t)}{d \times p} \tag{3}$$

Where m is the weighted sum of the MD score as indicated in Eq. **1**; t is the chosen MD threshold, d is the total number of dimensions being considered and p represents the incidence of deprivation at the target threshold as shown in Eq. **2**. The formula in Eq. **3** above was used to estimate the intensity of MD among older persons in Nigeria at national and subnational levels and by gender.

The adjusted headcount ratio R_o was also estimated for various levels of multidimensional deprivation among older Nigerians. The R_o was obtained by the product of the headcount ratio and intensity of MD, as shown in Eq. **4** below.

$$R_0 = H\,X\,I \tag{4}$$

Furthermore, the relative share of each multidimensional deprivation of each of the dimensions was also estimated at both national and subnational levels, and by gender.

Multilevel Multinomial Logistic Regression Model

The associated factors of multidimensional deprivation were examined using multilevel multinomial logistic regression (MMLR), encompassing both fixed-effect and random effects models. The outcome of an MMLR consists of *k* categories indexed using positive integers *1, 2, 3, . . . , k*. Given the Generalized Bernoulli distribution of the outcome variable (multidimensional deprivation: no MD [k = 1], multidimensionally deprived [k = 2] and severe MD [k ≥ 3]) in this study, the probability of observing each category *k* is denoted as πk. Taking "k = 1" as the reference category to establish a baseline against which other categories are compared, the model comprises K − 1 equations that analyse and contrast the odds of exhibiting the category *k* instead of the reference category.

The MMLR model is a mixed Generalized Linear Model (GLM) with linear predictors [24], generally given by Eq. **5** below

$$\gamma_{ij} = \alpha^k + \beta^{k\prime} x_{ij} + \xi_j^{\,k} + \delta_{ij}^{\,k} \tag{5}$$

and multinomial logit link of

$$q\left(Y_{ij} = k \mid x_{ij}, \xi_{ij}, \delta_{ij}\right) = \frac{e^{\gamma_{ij}k}}{1 + \sum_{l=2}^{K} e^{\gamma_{ij}l}} \tag{6}$$

Where $k = 1, 2, \ldots, K$ represent the categories of the outcome variable (multidimensional deprivation); $j = 1, 2, \ldots, J$ represent the cluster (community) and $i = 1, 2, \ldots, n_j$ represent the respondents of the *jth* cluster.

Incorporating multilevel modelling into the multinomial logistic regression in **Eqs 5**, **6** allows variability in the probabilities of experiencing the *k* category across individuals. In each of the sub-equations, a random effect, represented by a varying intercept, is introduced. As described by Koster and McElreath [25], this varying intercept enables individuals to have either increased or decreased odds of being observed in category k relative to the reference category. The log-odds of ith individual experiencing other categories of K relative to the reference category is given as

$$log\left(\frac{\gamma_{1ij}}{\gamma_{0ij}}\right) = \alpha_{1ij} + u_{1i} \tag{7}$$

$$log\left(\frac{\gamma_{2ij}}{\gamma_{0ij}}\right) = \alpha_{2ij} + u_{2i} \tag{8}$$

$$\begin{bmatrix} u_{1i} \\ u_{2i} \end{bmatrix} \sim \text{Normal}\,(0, \pi_u)\text{: } \pi_{u=} \begin{bmatrix} \sigma^2_{u1} \\ \sigma_{u1,2}\ \sigma^2_{u1,2} \end{bmatrix}$$

$$\gamma_0 + \gamma_1 + \gamma_2 = 1 \tag{9}$$

Where α_{1ij} and α_{2ij} are the intercepts that distinguish the second category in **Eq. 7** and third category in **Eq. 8** from the reference category, while u_{1i} and u_{2i} denote the individual-level random effects. These random effects are assumed to follow a multivariate normal distribution with zero means and a consistent 2 × 2 variance-covariance matrix. For brevity, only the intercept and random effects equations are presented. The sum of the proportion of individuals experiencing each k category equals 1 as shown in Eq. **9**.

The above analytical approach was implemented by incorporating the logit link function of the GLM via the *gsem* Stata command. The analysis comprised four distinct nested models, including the empty model (comprising solely the outcome variable), model 1 (constructed solely with individual-level variables), model 2 (constructed solely with community-level variables), and model 3 (incorporating both individual and community-level variables). The optimal model selection for final result interpretation was determined through log-likelihood and Akaike's information criteria.

The adjusted Relative Risk Ratio (RRR) with a 95% Confidence Interval (CI) was reported, and variables demonstrating a *p*-value of less than 0.05 in the multivariable analysis were identified as significant predictors of multidimensional deprivation (both for MD and severe MD). In random-effects analysis, the between-community variations in multidimensional deprivation were assessed using the Variance Partition Coefficient (VPC) otherwise referred to as Intraclass Correlation Coefficient (ICC) and Proportional Change in Variance (PCV). These measures provided insights into the extent of variation attributed to communities in the context of multidimensional deprivations.

Meanwhile, a multicollinearity test was conducted among explanatory variables using the Variance Inflation Factor (VIF). The results indicated the absence of multicollinearity, with VIF values ranging from 1.01 to 4.85 and a mean VIF of 2.35, except for a category of community-level poverty (VIF = 5.34). The recommended threshold for multicollinearity is a value greater than 5 to 10 [26, 27].

RESULTS

The results in **Table 2** show the unweighted and weighted distribution of older persons selected for this study. Based on the weighted sample, more than half of them were males (55.1%) and 60–69 years old (58.1%). Although nearly two-thirds were married, a substantial proportion of them were widowed (32.6%). At least three-quarters of the respondents were household heads. A higher proportion of the total weighted sample was selected from the South West (33.4%) and South East (23.7%) while North East (7.3%) and North Central (9.4%) were the least represented.

Based on the estimate of the multidimensional deprivation index of older persons in Nigeria, over 75% of older Nigerians living in urban areas are multidimensionally deprived, with 27% classified as being in severe multidimensional deprivation (**Table 3**). An additional 23% of the people, about 2 million older persons, were vulnerable to multidimensional deprivation.

TABLE 2 | Unweighted and weighted distribution of the respondents (Nigeria, 2023).

Sociodemographic characteristics	Unweighted sample		Weighted sample	
	n	%	n	%
Age group				
<70	2,805	57.6	3,037	58.1
70–79	1,429	29.4	1,535	29.4
80+	633	13.0	653	12.5
Sex				
Male	2,638	54.2	2,877	55.1
Female	2,229	45.8	2,348	44.9
Marital Status				
Single	26	0.5	26	0.5
Married	3,131	64.3	3,416	65.4
Divorced	79	1.6	77	1.5
Widowed	1,631	33.5	1706	32.6
Household head				
Self (respondent)	3,716	76.3	3,961	75.8
Someone else	1,151	23.7	1,264	24.2
Region of residence				
North Central	610	12.5	492	9.4
North East	359	7.4	382	7.3
North West	641	13.2	784	15.0
South East	1,307	26.8	1,241	23.7
South South	569	11.7	583	11.2
South West	1,381	28.4	1743	33.4
Total	4,867	100.0	5,225	100.0

TABLE 3 | Multidimensional deprivation index among older adults (Nigeria, 2023).

Cut off points	Overall			Male			Female		
	R_0	H	I	R_0	H	I	R_0	H	I
Vulnerable to MD (t = 1)	0.072	22.7	31.9	0.083	26.4	31.6	0.058	17.8	32.5
MD (t = 2)	0.244	48.8	49.9	0.250	50.6	49.5	0.228	45.3	50.4
Severe MD (t = 3)	0.184	26.6	69.4	0.137	20.0	68.5	0.253	36.1	70.1

Note: MD, multidimensional deprivation; vulnerable to MD: respondents deprived in 20%–39.9% of the indicators; MD: deprived in 40%–59% of the indicators; severe MD: deprived in ≥60% of the indicators; H multidimensional headcount ratio at each cut-off point; I intensity of deprivation among the poor; R_0 Adjusted headcount ratio (multiplication of H and I).

The intensity of deprivation, which is the average poverty score among the multidimensionally deprived, indicates that the severely deprived people are deprived in over 69% of the indicators while the multidimensionally deprived had an average of 50% deprivation score. The MDI, which is the proportion of the population that is multidimensionally deprived adjusted by the intensity of the deprivation, is 0.244 while for those severely deprived is 0.184.

More specifically, the majority of the older persons lived in unimproved houses (83%), with no access to electricity (77%), drinking unimproved water (71%), illiterate of the national official language of communication (76%), had no means of mobility (66%) with health challenge (60%). Just about half (52%) had below secondary education. Less than half of the respondents were deprived of other indicators (result not shown).

There are wide gender inequalities in multidimensional poverty levels in Nigeria. For instance, while only 20% of the older men were severely deprived with the intensity of 68%, over 36% of their women counterparts had the same severity of deprivation. Thus, the MDI for women (0.253) was almost double that of men (0.137).

The subnational decomposition of the analysis indicates that the share of older persons multidimensionally deprived in at least 40% of the indicators (t = 2) in some regions was higher than the national rate, especially the North East (86%) and the North West (80%) (**Table 4**). It was lowest in the South-South (66%). Those with severe multidimensional deprivations were highest in the two Northern regions–North East (40%) and North West (38%) and lowest in the South-South (17%) and South West (23%). In addition to the huge share of the urban-dwelling older persons in multidimensional deprivations, about 20%–22% are still vulnerable to deprivation across the regions, except the North East with the least (14%) and South-South with the highest (30%).

Across the regions, severe multidimensional deprivations were higher among older women than men. In the North East and North West in particular, about half of the women, 52% and 50% respectively, were severely deprived compared to men, 34% and 32% respectively. In the North Central and South

TABLE 4 | Subnational decomposition of multidimensional deprivations among older adults (Nigeria, 2023).

	Overall			Male			Female		
Cut off points	**R_0**	**P%**	**I%**	**R_0**	**P%**	**I%**	**R_0**	**P%**	**I%**
North Central									
Vulnerable to MD	0.069	21.8	31.6	0.132	27.3	48.2	0.080	14.6	54.7
MD	0.250	50.3	49.8	0.277	50.6	54.8	0.294	50	58.7
Severe MD	0.181	25.9	69.9	0.131	18.9	69.1	0.247	35	70.5
North East									
Vulnerable to MD	0.046	13.9	32.8	0.001	16.3	0.538	0.057	9.6	59
MD	0.231	45.7	50.5	0.287	49.5	57.9	0.237	38.4	61.8
Severe MD	0.278	40.1	69.4	0.233	33.8	69	0.363	52	69.8
North West									
Vulnerable to MD	0.062	19.6	31.5	0.116	22.5	51.5	0.079	13.5	58.2
MD	0.208	41.7	49.8	0.253	44.0	57.6	0.228	36.7	62
Severe MD	0.263	37.9	69.4	0.222	32.3	68.6	0.351	49.8	70.4
South East									
Vulnerable to MD	0.068	21	32.5	0.128	26.1	48.9	0.090	16.4	55
MD	0.246	48.8	50.4	0.281	51.0	55.1	0.278	46.8	59.4
Severe MD	0.197	28.2	69.9	0.133	19.4	68.6	0.255	36.2	70.5
South South									
Vulnerable to MD	0.092	29.5	31.1	0.139	31.9	43.6	0.134	26.9	49.9
MD	0.238	48.9	48.7	0.266	53.0	50.2	0.255	44.6	57.1
Severe MD	0.116	17.0	68.3	0.055	8.2	67.4	0.180	26.3	68.6
South West									
Vulnerable to MD	0.079	24.8	32	0.139	29.8	46.6	0.104	19.6	53.2
MD	0.249	50	49.7	0.286	53.6	53.4	0.268	46.1	58.2
Severe MD	0.161	23.3	69.2	0.094	13.9	67.6	0.233	33.3	69.9

Note: MD, multidimensional deprivation; vulnerable to MD: respondents deprived in 20%–39.9% of the indicators; MD: deprived in 40%–59% of the indicators; severe MD: deprived in ≥60% of the indicators; P proportion considered multidimensionally deprived at each cut-off point; I intensity of deprivation among the poor; R_0 Adjusted headcount ratio (multiplication of P and I).

East, the proportion of severely deprived women almost doubled that of men. Though women in the South-South and South West are not as severely deprived as their counterparts in other regions, the gender disparity is highest in the two regions, with over 150% and 220% higher share among women than men. However, more men are vulnerable to multidimensional deprivation than women.

Generally, of the five domains of deprivations, health (26.4%), education (25.1%) and living standard (22.2%) contributed the largest share to the multidimensional deprivations of older persons in Nigeria (**Table 5**). At the sub-national level, education had the largest share of multidimensional deprivation in the North East (30.3%) and North West (31.0%), while health had the largest share in the South-South (35.7%). Deprivation in information/communication was the least across the regions except in the South-South where education was the least in the arrays of older persons' deprivations. From a gender perspective, overall, males were deprived most in health (29.4%) while women were deprived most in education (26.5%). This gender pattern is reflected at the sub-national level, except in the South-South where older males (38.2%) and females (32.8%) were more deprived of health than in any other dimension, and in the North West where both males (31.0%) and females (31.1%) were deprived most in education.

The results in **Table 6** indicate the multilevel multinomial logistic regression estimates of individual-level and community-level factors associated with the risk of multidimensional deprivation among older persons in urban areas of Nigeria. The fixed-effect results indicate that respondents' age, sex, and household headship were associated with their risk of multidimensional deprivation. For instance, the relative risk ratio (RRR) of being multidimensionally deprived was higher by 90%–143% for females (RRR = 1.90; $p < 0.001$; 95% C.I. = 1.56–2.31) compared to males, and for respondents of age 70–79 (RRR = 1.35; $p < 0.01$; 95% C.I. = 1.14–1.60) and age 80 or above (RRR = 2.43; $p < 0.001$; 95% C.I. = 1.83–3.24) compare to their counterparts below age 70 years (Model 1). However, the risk was about 30% lower for older persons living in households headed by someone else (RRR = 0.70; $p < 0.001$; 95% C.I. = 0.55–0.89) relative to older adults who were themselves the household heads. The associations were consistent when adjusted for other factors in Model 3. The associations between the individual-level factors and risk of severe MD were similar to those of MD. In addition, the gender of the household head was such that older persons living in female-headed households had a lower risk of severe MD, relative to their counterparts living in male-headed households.

The result of the association between MD and community-level variables indicates that higher community-level education is significantly associated with a lower risk of MD and Severe MD in Models 2. As the community education level goes from low to high, the risk decreases. Also, the region of residence is a

TABLE 5 | Contribution of each domain to multidimensional deprivation index (R_0) at national and subnational levels and by gender (Nigeria, 2023).

	Health (%)	Education (%)	Living standard (%)	Information/Communication (%)	Empowerment (%)	Total (%)
Overall						
Nigeria	26.4	25.1	22.2	9.5	16.8	100.0
Regions						
North Central	27.3	25.4	21.2	10.9	15.3	100.0
North East	25.9	30.3	18.7	9.8	15.4	100.0
North West	24.9	31.0	17.8	11.2	15.1	100.0
South East	25.4	25.2	20.3	7.8	21.3	100.0
South South	35.7	9.2	27.5	10.5	17.1	100.0
South West	25.3	25.0	25.6	9.3	14.8	100.0
Male						
Nigeria	29.4	23.7	23.0	8.3	15.6	100.0
Regions						
North Central	31.0	23.2	22.1	9.8	14.0	100.0
North East	28.1	28.9	19.5	9.4	14.0	100.0
North West	24.5	31.0	17.1	11.6	15.8	100.0
South East	28.6	22.9	21.6	6.9	20.0	100.0
South South	38.2	6.4	30.0	9.3	16.1	100.0
South West	30.8	23.1	25.8	7.3	13.0	100.0
Female						
Nigeria	23.5	26.5	21.3	10.7	18.0	100.0
Regions						
North Central	23.2	26.6	20.4	13.0	16.8	100.0
North East	26.9	31.0	17.3	9.9	15.0	100.0
North West	24.5	31.1	18.3	11.2	14.9	100.0
South East	23.3	27.0	18.6	8.8	22.4	100.0
South South	32.8	12.9	24.0	12.1	18.1	100.0
South West	19.8	28.2	23.0	12.2	16.7	

significant community-level factor contributing to the risk of MD among older persons in Nigeria. In Model 2, different regions show different risk levels. For instance, individuals from the South West and North East regions have a significantly higher risk of MD compared to the reference group (South-South). However, when adjusted for other factors in Model 3, only the North East showed a consistent association. For severe MD, all the regions except North Central had a higher risk compared to the reference group. The result was consistent and also included the North Central when adjusted for other factors in Model 3.

The result of the random effect indicated the variances attributable to the different nested levels in the model. The empty model which contains no explanatory variable indicated that between-communities variation, expressed as VPC, associated with the risk of severe MD (27.7%) was larger than between-community variation associated with the risk of MD (9.6%), and this gap was consistent across individual and community levels. The result further indicated that intra-community variation associated with the risk of MD and severe MD was estimated at 18.4% and 33.0% respectively (Model 2), and when adjusted for other factors was estimated at 10.4% and 35.9% respectively (Model 3). These results indicated that community-level factors account for a large proportion of the variation in the risk of multidimensional deprivations and severe multidimensional deprivations.

DISCUSSION

Older people in low- and middle-income (LMIC) settings like Nigeria are increasingly at higher risk of poverty compared to other population groups. This is partly due to the prevailing economic crisis in the country. This study examines the level of MD and associated factors among older people in urban geographies of Nigeria. The findings from this study serve as a reference for developing community-based interventions to improve the welfare and wellbeing of older people in urban areas of the country.

The results presented in this study provide valuable insights into the MD experienced by older adults in the urban setting of LMIC, taking Nigeria as a case study. The findings reveal an alarming level of headcount MD among this population, with over 75% being multidimensionally deprived among which 27% were severely deprived. The rate among older persons implies that approximately seven million urban-dwelling older persons in Nigeria are experiencing severe deprivation across multiple dimensions. An additional 23% of older persons were vulnerable to multidimensional deprivation. This poses a big challenge to the wellbeing and quality of life of older people, indicating the extent of the problem and the need for urgent attention and targeted interventions to address various domains of deprivation. This level of MD is higher than the rate reported

TABLE 6 | Multilevel multinomial logistic regression of predictors of multidimensional deprivation among older persons in urban areas (Nigeria, 2023).

	(Empty model) (outcome variable only)		Model 1 (Individual variables)		Model 2 (Community variables)		Model 3 (Full model)	
	MD	**Severe MD**	**MD**	**Severe MD**	**MD**	**Severe MD**	**MD**	**Severe MD**
Fixed effects			RRR (95% C.I.)	RRR (95% C.I.)	RRR (95% C.I.)	RRR (95% C.I.)	RRR (95% C.I.)	RRR (95% C.I.)
Sex								
Male [RC]			1.00	1.00			1.00	1.00
Female			1.90 (1.56–2.31)***	5.70 (4.53–7.18)***			1.90 (1.57–2.32)***	6.18 (4.91–7.78)***
Age group								
<70 [RC]			1.00	1.00			1.00	1.00
70–79			1.35 (1.14–1.60)**	2.13 (1.73–2.61)***			1.35 (1.14–1.61)**	2.15 (1.75–2.64)***
80+			2.43 (1.83–3.24)***	6.59 (4.81–9.01)***			2.45 (1.84–3.26)***	6.85 (5.01–9.36)***
Marital Status								
Non-widows [RC,b]			1.00	1.00			1.00	1.00
Widows			0.97 (0.57–1.67)	0.63 (0.34–1.16)			0.96 (0.56–1.65)	0.57 (0.31–1.06)
Household size			0.94 (0.79–1.11)	0.85 (0.69–1.04)			0.94 (0.80–1.11)	0.84 (0.68–1.03)
Household head								
Self [RC]			1.00	1.00			1.00	1.00
someone else			0.70 (0.55–0.89)**	0.40 (0.30–0.52)***			0.70 (0.55–0.89)**	0.37 (0.28–0.50)***
Sex of household head								
Male [RC]			1.00	1.00			1.00	1.00
Female			0.84 (0.71–1.00)	0.67 (0.54–0.83)***			0.88 (0.73–1.05)	0.80 (0.65–1.00)[a]
Community-level education								
Low [RC]					1.00	1.00	1.00	1.00
Middle					0.61 (0.41–0.90)[a]	0.40 (0.25–0.63)***	0.59 (0.40–0.88)[a]	0.37 (0.23–0.60)***
High					0.50 (0.33–0.76)**	0.21 (0.12–0.35)***	0.51 (0.33–0.80)**	0.24 (0.14–0.41)***
Community-poverty								
High [RC]					1.00	1.00	1.00	1.00
Middle					0.98 (0.65–1.48)	1.35 (0.81–2.24)	1.00 (0.63–1.58)	1.23 (0.71–2.13)
Low					1.02 (0.66–1.57)	1.01 (0.59–1.74)	1.11 (0.67–1.84)	1.15 (0.62–2.12)
Region of residence								
South-South [RC]					1.00	1.00	1.00	1.00
South West					1.33 (1.01–1.76)[a]	1.90 (1.27–2.83)**	1.32 (0.99–1.76)	1.85 (1.23–2.79)**
South East					1.31 (0.97–1.77)	1.69 (1.10–2.58)[a]	1.35 (0.99–1.84)	1.86 (1.21–2.87)**
North Central					1.33 (0.95–1.86)	1.56 (0.97–2.50)	1.34 (0.95–1.90)	1.62 (1.00–2.63)[a]
North East					1.92 (1.23–2.99)**	3.18 (181–5.58)***	2.23 (1.41–3.52)**	5.34 (3.00–9.51)***
North West					1.18 (0.83–1.69)	2.27 (1.41–3.67)**	1.30 (0.90–1.87)	3.32 (2.03–5.44)***
Random effects								
Variance (SE)	0.35 (0.076)	1.26 (0.168)	0.37 (0.078)	1.01 (0.159)	0.28 (0.069)	0.75 (0.127)	0.31 (0.073)	0.71 (0.131)
VPC (%)	9.6	27.7	10.1	23.5	7.8	18.6	8.6	17.8
Explained variation—PCV (%)	Ref	Ref	5.7	15.2	18.4	33.0	10.4	35.9

[a]$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; *SE: standard error, VPC: variance partition coefficient, PCV: proportional change in variance, RC: reference category.*

by the National Bureau of Statistics (NBS) for under-five children (70%), the highest rate among population groups in Nigeria [28]. It is also far higher than the prevalence in high-income countries like the United States [12] with a 12% prevalence, and some developing countries like Iran with a 59% prevalence [29]. Of all the dimensions considered, health (26%), education (25%) and standard of living (22%) contributed the largest share to the MD. The contributions of these indicators align with the 2015 AgeWatch index in which Nigeria was ranked one of the lowest globally in health index, level of education and socioeconomic situations of older persons [30].

The headcount and intensity of MD provide a more comprehensive insight into the condition of older persons in Nigeria, unlike other studies which have utilised only income or socioeconomic status to measure poverty among older people [4]. The intensity of deprivation among the severely deprived individuals, with an average deprivation score of over 69% of the indicators and among the multidimensionally deprived group, with an average deprivation score of 50%, is particularly of serious concern. It underscores the comprehensive nature of the deprivation experienced and reinforces the need for multifaceted interventions that address various dimensions of the deprivation simultaneously. Though a few existing studies in Nigeria have delved into poverty among older people [4, 31], none has indicated the extent of poverty among the poor, as revealed in this study.

The study also reveals significant gender inequalities in multidimensional poverty levels among older adults in Nigeria. Women, in particular, face higher levels of severe deprivation compared to men, with the MDI for women almost double that of men. This disparity reflects women's limited access to education, lower levels of participation in household economic and health decision-making, and limited access to employment opportunities [22]. The gender disparity is evident across various regions, with Northern women experiencing the worst condition of severe MD. This highlights the need for gender-sensitive interventions to address the specific challenges faced by older women in accessing resources and opportunities.

Furthermore, this study finds that living in a household headed by someone else, especially by a family member, protects older persons from MD. Although being a household head could give older persons some authority over household members and resource allocation [32], this benefit is conditional on the availability of resources, the extent of affinity, sense of responsibility and reciprocity, and the functional ability of the household head. Thus, older persons living in households headed by a younger, economically active and financially buoyant family member are more likely to have access to information, communication and companionship, healthcare support and quality living standards, compared with those with otherwise living arrangements. However, if the household is headed by the spouse, it may not benefit some older women who are economically vulnerable and marginalised in household headship and resource sharing in a patriarchal society [33, 34].

The subnational decomposition analysis provides further valuable insights into the regional disparities in multidimensional deprivation. The North East and North West regions exhibit higher rates of deprivation, with a significant proportion experiencing severe deprivation. The two regions have often shown the worst case of many socioeconomic and health indicators including the level of education, healthcare service utilisations, unemployment, multidimensional deprivations in general and sub-groups of the population [22, 28, 35]. The situation in Northern regions may also be linked to the women's low level of education, restriction in some public spaces and economic activities, and culturally laden norms that limit women's economic and social power in the regions [36]. On the other hand, the South-South region, though with a lower level of headcount MD, reports the highest vulnerability to multidimensional deprivation. These regional variations emphasize the importance of tailoring interventions to address the unique challenges and context of each region, considering factors such as socioeconomic conditions, healthcare infrastructure, and cultural factors.

The multilevel regression analysis identifies individual-level and community-level factors associated with the risk of multidimensional deprivation among urban-dwelling older persons in Nigeria. This study found that the age of the respondents was a major individual-level factor influencing the risk of multidimensional deprivation. In particular, older persons, especially women, face a higher risk of multidimensional deprivations. This finding may be because individuals at advanced ages are more vulnerable to poverty due to their reduced participation in economic activities coupled with caregivers' financial incapacity [37, 38] and poor socioeconomic conditions in the country [39]. However, the finding contrasts the that of Dhongde [40] who linked lower multidimensional deprivation to older age. This disparity may be because Dhongde's evidence was based on a high-income context.

The study, however, found that those living in communities with high levels of education experience a lower risk of deprivation. These findings underscore the importance of not only considering individual characteristics but also recognizing the broader context of the community when addressing health outcomes. This has implications for designing interventions and policies that aim to reduce the prevalence of severe MD. Meaning impact could be achieved when community-level factors are given the necessary focus.

Potential Health Implications

The findings of this study have significant health implications. The huge proportion of multidimensional deprivations suggests that a significant portion of older adults lack access to essential elements of wellbeing, including health services, education, standard living conditions, and social support. Specifically, individuals with deprivation in the health domain, for instance, are liable to functional limitations which can be worsened in the absence of relevant support [40]. This potentially increases older people's risk of hospitalisation and health expenditure. A similar implication is inferable for education, as more than half of older persons are uneducated and will be susceptible to adverse health outcomes associated with a low level of education. Also, living arrangements, access to information and communication devices are key indicators of information and communication in this study. Older persons living alone are at risk of loneliness and depression [41]. In the same vein,

lack of access to information, either from radio, television or mobile phones, results in a lack of access to health information which has implications for older persons who need regular healthcare services. Poor standard of living puts older people at risk of exposure to infectious diseases amidst their declining immunity.

The gender disparities also stress the need for gender- and situation-specific interventions to improve the health and overall wellbeing of older adults, especially women, in urban areas. Furthermore, from a community-level point of view, structural inequalities need to be addressed to enhance the health outcomes of older populations, promote equitable access to healthcare, and improve their overall quality of life.

Limitations to the Study

The study utilized a cross-sectional design, which limits its ability to establish causal relationships. Longitudinal data would be necessary to better understand the dynamics of multidimensional deprivation over time. Besides, variables and measures in this study were adapted to the extent of data availability; thus, it might not fully capture all dimensions of multidimensional deprivation that could be relevant to the older population. However, the dimensions and indicators used are comprehensive and arguably cover the major socioeconomic and health concerns of older persons. The construction of the multidimensional deprivation index involved assigning weights to indicators. Though different weighting methods could lead to different conclusions, I do not envisage any major difference in the conclusions. Also, the choice of a cut-off value (40%) to define multidimensional deprivation was based on considerations for poverty levels tolerable in an LMIC context, but different cut-off points could yield different estimates of deprivation. However, divergent estimates do not in any way invalidate the estimate of this study, as long as it is interpreted within its premised assumptions. This study focused on urban areas, which might limit the generalizability of the findings to rural settings or other countries with different contexts and socioeconomic conditions.

Conclusion

This study indicates an alarming prevalence of multidimensional deprivations among urban-dwelling older adults in Nigeria, though gender disparities are evident, with women more severely deprived. It highlights that the deprivations were driven, not only by individual factors but also by community-level factors, including education and region of residence. The findings of this study underscore the urgent need for comprehensive and targeted policy interventions to address the multidimensional deprivation faced by older adults in urban Nigeria. These interventions should prioritize addressing gender disparities, targeting regions with high deprivation rates, and considering individual and community characteristics. By addressing the underlying determinants of multidimensional deprivation and promoting health equity, policymakers and stakeholders can work towards improving the wellbeing and quality of life for older adults in urban Nigeria.

ETHICS STATEMENT

This study involves humans and utilized secondary data of the Demographic and Health Survey (DHS) program being coordinated by ICF International. To utilize the data for this study, written approval was obtained from ICF International. The DHS protocol was approved by the National Health Research Ethics Committee of Nigeria (NHREC) and the ICF Institutional Review Board (IRB). The survey was conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in the survey, and IRB-approved protocol for the DHS public-use datasets do not in any way identify the participating respondents, households, or sample communities.

AUTHOR CONTRIBUTIONS

JM is the sole author of this manuscript from conceptualization to method, analysis, results, discussion and conclusion.

FUNDING

This study did not receive any direct funding from any source. However, the author acknowledges the support of the Consortium for Advanced Research Training in Africa (CARTA). CARTA is jointly led by the African Population and Health Research Center and the University of the Witwatersrand and funded by the Carnegie Corporation of New York (Grant No. G-19-57145), Sida (Grant No: 54100113), Uppsala Monitoring Centre, Norwegian Agency for Development Cooperation (Norad), and by the Wellcome Trust [reference no. 107768/Z/15/Z] and the UK Foreign, Commonwealth & Development Office with support from the Developing Excellence in Leadership, Training and Science in Africa (DELTAS Africa) programme.

CONFLICT OF INTEREST

The author declares that they do not have any conflicts of interest.

REFERENCES

1. Ottong J. *Population, Age and Sex Distribution: Population of Nigeria* (2012). Available from: https://www.onlinenigeria.com/links/adv.asp?blurb¼549 (Accessed September 27, 2022).
2. United Nations. *Population Ageing 2006*. New York, NY: Department of Economics and Social Affairs. Population Division. ST/ESA/SER.A/251 (2006). Available from: https://www.un.org/esa/socdev/ageing/documents/ageing2006chart.pdf (Accessed September 27, 2022).
3. Federal Government of Nigeria. *FG Approves National Policy on Ageing for Older Persons in Nigeria* (2021). Available from: https://fmic.gov.ng/fg-approves-national-policy-on-ageing-for-older-persons-in-nigeria/#:~:text=Theapprovalwasgivenon,%2Cself-fulfillmentanddignity (Accessed February 11, 2021).
4. Adisa O. Why Are Some Older Persons Economically Vulnerable and Others Not ? The Role of Socio-Demographic Factors and Economic Resources in the

Nigerian Context. *Aeing Int* (2019) 44:202–22. doi:10.1007/s12126-019-09348-8
5. United Nations. *Transforming Our World: The 2030 Agenda for Sustainable Development*. New York: Department of Economic and Social Affairs Population Division, United Nations (2015). A/RES/70/1. Available from: https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf (Accessed September 27, 2022).
6. Alkire S, Kanagaratman U, Suppa N. The Global Multidimensional Poverty Index (MPI) 2021: 2018 Revision. In: *OPHI MPI Methodological Note 51*. Oxford, United Kingdom: Oxford Poverty and Human Development Initiative, University of Oxford (2021).
7. United Nations Development Programme, Oxford Poverty and Human Development Initiative. *Charting Pathways Out of Multidimensional Poverty: Achieving the SDGs*. Oxford, United Kingdom: United Nations Development Programme (2020). Available from: http://hdr.undp.org/sites/default/files/2020_mpi_report_en.pdf (Accessed February 20, 2023).
8. Alkire S, Foster J. Counting and Multidimensional Poverty Measurement. *J Public Econ* (2011) 95(7–8):476–87. doi:10.1016/j.jpubeco.2010.11.006
9. Hu Y, Han H, Liu P. Reducing Multidimensional Poverty of Elderly: The Role of the New Rural Pension Scheme in China. *Discret Dyn Nat Soc* (2022) 2022: 1–16. doi:10.1155/2022/4533075
10. Ku I, Kim CO. Decomposition Analyses of the Trend in Poverty Among Older Adults: The Case of South Korea. *Journals Gerontol - Ser B Psychol Sci Soc Sci* (2020) 75(3):684–93. doi:10.1093/geronb/gby047
11. Yun S, Ko K. *Multidimensional Elderly Poverty index*. Sejong City, Korea: Korea Institute for Health and Social Affairs (2018). Hanguk Pogon Sahoe Yonguwon Available from: http://www.kihasa.re.kr (Accessed February 26, 2023).
12. Dhongde S. Assessing Multidimensional Deprivation Among the Elderly in the USA. In: White R, editor. *Measuring Multidimensional Poverty and Deprivation, Global Perspectives on Wealth and Distribution*. Cham: Palgrave Macmillan (2017). p. 255–70.
13. Norris P. *Making Democratic Governance Work: How Regimes Shape Prosperity, Welfare, and Peace*. England, United Kingdom: Cambridge Univ Press (2012). doi:10.1017/CBO9781139061902
14. Mcferson HM. Poverty Among Women in Sub-Saharan Africa: A Review of Selected Issues. *J Int Womens Stud* (2010) 11(4):50–72. Available from: http://vc.bridgew.edu/jiws/vol11/iss4/4 (Accessed November 14, 2023).
15. Akinyemi AI, Mobolaji JW, Abe JO, Ibrahim E, Ikuteyijo O. Women Deprivation Index and Family Planning Utilisation in Urban Geography of West African Countries. *Front Glob Women's Heal* (2021) 2(6):656062. doi:10.3389/fgwh.2021.656062
16. Momoh J, Opaluwah A, Albeera H. Challenges Facing Nigeria's Urban Environment: The Abuja Case. *J Sustain Dev Africa* (2018) 20(2):34–49.
17. Akinyemi AI, Ikuteyijo OO, Mobolaji JW, Erinfolami T, Adebayo SO. Socioeconomic Inequalities and Family Planning Utilization Among Female Adolescents in Urban Slums in Nigeria. *Front Glob Women's Heal* (2022) 3: 838977. doi:10.3389/fgwh.2022.838977
18. Cities Alliance. *Connecting Systems of Secondary Cities*. Brussels: Cities Alliance/UNOPS (2019). Available from: https://www.citiesalliance.org/sites/default/files/2019-07/CA_ConnectingSystems_Web_FINAL%281%29_0.pdf (Accessed May 26, 2021).
19. Turgel I, Bozhko L. Secondary Cities in Emerging Market Countries: New Trends and Challenges. In: 5th International Multidisciplinary Scientific Conference on Social Sciences and Arts SGEM; 23 - 26 October, 2018; Florence, Italy (2018). p. 191–6.
20. Cities Alliance. *Secondary Cities Are a Vital Part of National and Regional Economic Development*. Brussels, Belgium: Cities Alliance (2014).
21. South African Cities Network. *Secondary Cities in South Africa: The Start of a Conversation Background Report*. South Africa (2012). Available from: http://sacitiesnetwork.co.za/wp-content/uploads/2014/07/secondary_cities_in_south_africa_with_more_detail.pdf (Accessed May 26, 2021).
22. National Population Commission (NPC) [Nigeria] and ICF. *Nigeria Demographic and Health Survey 2018*. Abuja, Nigeria, and Rockville, Maryland, USA: NPC and ICF (2019).
23. Adetola A, Olufemi P. Determinants of Child Poverty in Rural Nigeria: A. *Glob J Hum Soc Sci Arts Humanit* (2012) 12(12):1–17.
24. Grilli L, Rampichini C. A Multilevel Multinomial Logit Model for the Analysis of Graduates' Skills. *Stat Methods Appl* (2007) 16(3):381–93. doi:10.1007/s10260-006-0039-z
25. Koster J, McElreath R. Multinomial Analysis of Behavior: Statistical Methods. *Behav Ecol Sociobiol* (2017) 71(9):138. doi:10.1007/s00265-017-2363-8
26. Aragaw A, Azene A, Workie M. Poisson Logit Hurdle Model With Associated Factors of Perinatal Mortality in Ethiopia. *J Big Data* (2022) 9(16):16. doi:10.1186/s40537-022-00567-6
27. Kim J. Multicollinearity and Misleading Statistical Results. *Korean J Anesthesiol* (2019) 72(6):558–69. doi:10.4097/kja.19087
28. National Bureau of Statistics. *Nigeria Multidimensional Poverty index* (2022). p. 2022.
29. Alkire S, Basakha M, Mohaqeqi Kamal SH. Multidimensional Poverty Index: A Multilevel Analysis of Deprivation Among Iranian Older Adults. *Ageing Soc* (2022) 2022:337–56. doi:10.1017/s0144686x2200023x
30. HelpAge International. *Global AgeWatch Index 2015: Insight Report*. London: HelpAge International (2015). Available from: https://www.helpage.org (Accessed March 20, 2018).
31. Eme Ichoku H, Fonta W, Thiede M. Socioeconomic Gradients in Self-Rated Health: A Developing Country Case Study of Enugu State, Nigeria. *Econ Chang Restruct* (2011) 44(3):179–202. doi:10.1007/s10644-010-9098-0
32. Mobolaji J, Akinyemi AI. Complementary Support in Later Life: Investigating the Gender Disparities in Patterns and Determinants Among Older Adults in South-Western Nigeria. *BMC Geriatr* (2022) 25:704–9. doi:10.1186/s12877-022-03393-w
33. Omowumi BE, Taiwo PA, Olaotan SY. Old People's Well-Being in a Total Institution and the Imperative of New Policy Directives. *Afr J Psychol Stud Soc Issues* (2016) 19(2):12–27.
34. Bloom DE, Jimenez E, Rosenberg L. *Social Protection of Older People*. USA: Havard university (2011). (PGDA Working Paper No. 83). Available from: http://www.hsph.harvard.edu/pgda/working.htm (Accessed September 6, 2023).
35. Okoli C, Hajizadeh M, Rahman MM, Khanam R. Geographical and Socioeconomic Inequalities in the Utilization of Maternal Healthcare Services in Nigeria: 2003-2017. *BMC Health Serv Res* (2020) 20(1):849. doi:10.1186/s12913-020-05700-w
36. Ogbe A. The Travails of Women and Girls in Northern Nigeria: A Human Rights Issue. *SSRN Electron J* (2020) 11:1–14. doi:10.18192/potentia.v11i0.4662
37. Akinyemi A, Akinlo A. Unmet Needs for Care and Support for the Elderly in Nigeria: Gaps in Experiences and Expectations of the Aged in Ilesa, South-West Nigeria. *Niger J Sociol Anthropol Spec Ed Ageing Niger* (2014) 12(1): 28–43. doi:10.36108/njsa/4102/12(0120)
38. Aboderin I. Decline in Material Family Support for Older People in Urban Ghana, Africa: Understanding Processes and Causes of Change. *J Gerontol Soc Sci* (2004) 59B(3):S128–37. doi:10.1093/geronb/59.3.s128
39. Oladele Akinbode S, Elizabeth Ojediran F. Multidimensional Poverty Among Households in Southwest Nigeria. *J Econ Dev* (2018) 48–67. doi:10.33301/jed-p-2018-20-01-03
40. Dhongde S. Multidimensional Economic Deprivation During the Coronavirus Pandemic: Early Evidence From the United States. *PLoS One* (2020) 15(12): e0244130. doi:10.1371/journal.pone.0244130
41. Mushtaq R, Shoib S, Shah T, Mushtaq S. Relationship Between Loneliness, Psychiatric Disorders and Physical Health? A Review on the Psychological Aspects of Loneliness. *J Clin Diagn Res* (2014) 8(9):WE01–WE4. doi:10.7860/JCDR/2014/10077.4828

International Journal of Public Health
ORIGINAL ARTICLE
published: 19 June 2024
doi: 10.3389/ijph.2024.1606499

Exposure to Adversity and its Impact on Later Life Cognitive, Mental, and Physical Health

Elyse A. Jennings[1], Sumaya Mall[2], Darina T. Bassil[1] and Kathleen Kahn[3]*

[1]Center for Population and Development Studies, Harvard T.H. Chan School of Public Health, Boston, MA, United States, [2]Division of Epidemiology and Biostatistics, School of Public Health, University of the Witwatersrand, Johannesburg, South Africa, [3]MRC/Wits Rural Public Health and Health Transitions Research Unit (Agincourt), School of Public Health, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa

Objectives: We aimed to assess later-life health responses to childhood and lifetime adversity in a cohort of rural, Black South African adults.

Methods: We performed ordinary least squares regression using two waves of data from Health and Aging in Africa: A Longitudinal Study of an INDEPTH Community in South Africa (HAALSI) to estimate a decline in cognitive, mental, and physical health over approximately 3 years. Our analytic sample consisted of 1,993 women and 1,496 men.

Results: Associations between several types of adversity and health outcomes point to declines in health. At the same time, many adverse experiences are associated with improvements in cognitive, mental, and physical health in later life. The direction of the association varied by type of exposure, health outcome, and gender.

Conclusion: In populations exposed to many adversities during life, specific adverse experiences may sometimes be associated with greater improvements (and not just greater decline) in health in later life. Further research is needed to unpack the mechanisms at play in these populations.

Keywords: middle and late adulthood, South Africa, adverse experiences, adverse childhood experiences, cognitive health, mental health, physical health

OPEN ACCESS

Edited by:
Andrea Madarasova Geckova, University of Pavol Jozef Šafárik, Slovakia

Reviewed by:
Two reviewers who chose to remain anonymous

****Correspondence***
Elyse A. Jennings,
ejennings@hsph.harvard.edu

This Original Article is part of the IJPH Special Issue "Ageing and Health in Sub-Sahara Africa"

Received: *10 August 2023*
Accepted: *29 May 2024*
Published: *19 June 2024*

Citation:
Jennings EA, Mall S, Bassil DT and Kahn K (2024) Exposure to Adversity and its Impact on Later Life Cognitive, Mental, and Physical Health. Int J Public Health 69:1606499. doi: 10.3389/ijph.2024.1606499

INTRODUCTION

The events and experiences that individuals encounter throughout their lives can have a profound impact on their health and wellbeing [1–5]. Evidence suggests that adverse experiences in childhood are linked to several health outcomes in adulthood, such as cardiovascular disease and premature mortality [6, 7]. Adverse experiences into adulthood also have the potential to affect health in later life [8, 9]. Existing research typically focuses on Western and high income populations, thereby limiting our understanding of the effects of adverse experiences in different cultural contexts and among populations with relatively limited resources.

In this study, we focused on a population of rural Black South Africans and examine the association between adversity—both during childhood and across the life course—and the rate of decline in cognitive, mental, and physical health in later adulthood. We investigate the impact of specific domains of adverse experiences and exposures: adverse experiences in the childhood home, the experience of having a spouse or child with a drug or alcohol addiction, exposure to violence (both in combat and non-combat), the experience of assault, and exposure to natural disasters.

Importantly, this research sheds light on these associations in a population that was affected by structural racism under apartheid for much of its life, and still experiences significant poverty. These experiences, in themselves, have been linked to poor health outcomes in multiple settings, including the United States [10–12]. In the population we focus on there is a high burden of morbidity and mortality [13, 14]. Uncovering associations between specific adverse exposures and health outcomes will offer insight into the extent to which adversity may impact this burden.

Extensive research has documented the significance of adverse experiences and exposures across the lifecourse for health outcomes [5, 9, 15, 16]. Adversity experienced during childhood can negatively affect mental health, cardiovascular disease, morbidity, and the risk of mortality in adulthood [5–7, 15–17]. For example, there is evidence that mental health disorders play an important mediating role in the association between various adverse childhood experiences and cardiovascular outcomes [18], and that greater exposure to childhood adversity may increase the risk of heart failure [17]. Adversity has also been linked to greater depressive symptoms [19, 20]. Other research has suggested that children from homes with more parental turmoil are at greater risk of poor academic and behavioral outcomes [21], which in turn may affect cognitive and mental health. However, existing studies often find null associations between childhood adversity and cognition in later life [5, 22–24]. Mechanisms through which adversity in childhood may impact health in later life include prolonged stress on the body, brain development, and other biological mechanisms that have the potential to affect social and emotional development, as well [7]. Therefore, we might expect to see worse mental and physical health outcomes in later life in individuals exposed to adversity in their childhood, and either worse or similar cognitive health when compared with those who did not experience the same adversity.

As people enter adulthood, their experiences and exposures to new adverse events can also have long-term impacts. Exposure to adversity across the life course has the potential to profoundly impact cognitive, mental, and physical health [8, 9, 25–29]. For example, having a close relative who is addicted to drugs or alcohol has been found to have lasting effects on an individual's emotional well-being, often through stress and family strain [30, 31]. Witnessing violence or being physically or sexually assaulted can result in prolonged stress, and has been linked to poor mental and physical health outcomes [32–38]. Natural disasters—adversity that is experienced by a community—can also affect the mental and physical well-being of individuals by disrupting social processes and limiting access to medication or health care [9, 25, 29, 39]. The evidence for the impacts of adversity on cognitive outcomes is more mixed [40–42], and these impacts may vary depending on the type of adversity experienced, the timing of the exposure, and the cognitive domains under investigation [41, 43]. Proposed mechanistic pathways linking lifetime adversity to cognition include stress-induced effects on brain structures and depression [20, 44].

Responses to trauma may differ according to gender [9, 45–47]. For example, studies have found that women may be less resilient than men after exposure to a natural disasters [9, 48], and that women may suffer more and for longer than men after adverse experiences [45]. Evidence suggests that women tend to have internalized responses to adverse exposures, whereas men exhibit externalized responses more often [46], which may have the potential to differentially affect which aspects of health are impacted in later life. Women and men may also differ in their access to support that can help protect against the negative consequences of adversity—women have often been found to have larger social networks than men [49, 50], although evidence from South Africa suggests that men have relatively large social networks [51].

We expect that each adverse experience/exposure will be associated with an accelerated decline in cognitive, mental, and physical health for both men and women in this population. Given past findings, we expect the strongest associations for mental health decline, and weaker associations for cognitive decline [5, 9, 18, 22–24, 34]. As responses to trauma may be inextricably linked to gender, we empirically tested these expectations separately for women and men.

Our investigation revealed mixed findings, with certain adverse experiences and exposures associated with improvements in health, while others were found to be associated with the expected decline in health. These mixed results are apparent for both women and men. The unique lifetime experiences of this population may have led to greater resilience and the effective development of coping mechanisms in the face of the adversities we analyzed. At the same time, many adverse events are associated with a decline in cognitive, mental, and/or physical health, pointing to the importance of understanding mechanisms for intervention.

METHODS

The study area for this investigation was a cluster of villages in and near Agincourt, South Africa: a rural, low-income area in the Bushbuckridge sub-district of Mpumalanga Province in north-eastern South Africa. Agincourt is located in an area of forced racial segregation during apartheid, where Black South Africans belonging to the Shangaan ethnic group were forcibly moved [52, 53]. Mpumalanga is the second most homogeneous province in South Africa, with over 90% of residents identifying as Black African [54]. The Agincourt area is also home to many former Mozambican refugees, the older of whom are likely to have been exposed to combat violence during the years of civil war in Mozambique (1976–1992). While South Africa is one of the more economically advanced countries in the region, much of the population of Agincourt is poor [55].

Data

We used data from Health and Aging in Africa: A Longitudinal Study of an International Network for the Demographic Evaluation of Populations and Their Health (INDEPTH) Community in South Africa (HAALSI). The HAALSI study is a population-based survey that aims to characterize a cohort of men and women aged 40 years and older in rural South Africa with respect to health and aging [55]. Participants were sampled from the Agincourt Health and socio-Demographic Surveillance System (Agincourt HDSS) in

Mpumalanga province [56]. The identified sampling frame consisted of 8,974 women and 3,901 men who were aged 40 years or older as of 1 July 2014 and who had resided continuously in the study area for the 12 months prior to the 2013 Agincourt census. Using gender-specific sampling fractions to ensure a gender-balanced cohort, 6,281 participants were randomly selected to participate in HAALSI.

Baseline (wave 1) interviews were completed between November 2014 and November 2015, with a total of 5,059 respondents (response rate of 85.9% among eligible individuals). Wave 2 interviews were conducted between October 2018 and November 2019 with all living members of the 5,059 individual cohort (response rate of 94%; n = 4,176). Wave 3 interviews were conducted between July 2021 and March 2022 among living members of the original cohort (response rate of 93%; n = 3,707). In wave 2, all respondents were administered a life history module that included questions about childhood and lifetime adversity. Our investigation focused on responses to these life history items to predict the decline in health between waves 2 and 3. Estimates of change over this short period of approximately three years are likely conservative.

Measures

Dependent Variables

To assess the decline in cognitive health between waves 2 and 3, we developed a composite measure to indicate a decline in cognitive function. In each wave, we summed the total immediate recall of 10 words over three trials (up to 10 points per trial), delayed recall of these 10 words (up to 10 points), and orientation (correctly stating the year, month, day, and name of the current South African president; up to 4 points) [57]. The total score in each wave totaled a maximum of 44 points. We then coded the measure of cognitive decline by subtracting the composite score in wave 3 from the wave 2 score.

Next, we coded a measure to indicate a decline in mental health between waves 2 and 3 using the 20-item Center for Epidemiologic Studies Depression (CES-D) scale [58]. The scale included items asking how often the respondents had experienced different depressive symptoms in the previous week (e.g., felt bothered, had poor appetite, had trouble concentrating, etc.). Response options included "rarely or none of the time (less than 1 day)," "some or little of the time (1-2 days)," "occasionally or a moderate amount of time (3-4 days)," and "most or all of the time (5–7 days)." Following other studies, these options were coded from 0 to 3 and then summed to produce a score of 0-60 at each wave [59]. We then coded a measure to indicate a decline in mental health (i.e., an increase in depressive symptoms) by subtracting the CES-D score at wave 2 from the score at wave 3.

Finally, we estimated the decline in physical health between waves 2 and 3. For each wave, we coded a measure of the sum of activities of daily living (ADLs) that the respondents reported having difficulty with (i.e., walking, bathing, eating, getting out of bed, and using the toilet). To measure the decline in physical health (i.e., an increase in physical limitations), we subtracted the sum of reported difficulties in up to five ADLs at wave 2 from the sum of the same at wave 3.

Independent Variables

We coded a series of measures to indicate lifetime exposure to adverse events or experiences from the wave 2 survey. We grouped items where appropriate, according to the results of factor analyses. First, a measure of exposure to adverse family experiences in childhood was coded as 1 if the respondents reported experiencing at least one of the following before the age of 16: parents arguing or fighting often; parents drinking excessively, taking drugs, or having mental health problems; or the respondents being physically abused by their parents. If the respondents reported none of these experiences, the value was set to 0.

A measure indicating whether the respondents ever had a spouse, partner, or child who was addicted to drugs or alcohol was coded 1 if yes and 0 if no.

Next, we coded two measures to indicate exposure to violence. The first measure indicates exposure to violence other than in combat, and was coded 1 if the respondents reported ever witnessing an accident or violent act in which someone was killed or seriously wounded other than in combat or in the military, and 0 if not. The second was a measure indicating exposure to violence in military or combat, coded as 1 if the respondents ever fired a weapon in combat, were shot at, or witnessed someone being seriously injured or killed in war or military action, and coded 0 if not.

A measure of experience of assault indicates the respondents' direct experience of ever having been the victim of a serious physical attack or assault, or ever having been the victim of sexual assault. If the respondents experienced either type of assault they received a code of 1; if not, the value was set to 0.

Finally, a measure indicating the respondents' exposure to natural disasters was coded as 1 if they reported having ever experienced a major flood, fire, earthquake, or other natural disasters, and 0 if they reported that they did not.

Covariates

We also controlled for a series of variables that may impact the relationship between childhood exposures and adult health. First, we controlled for family background with binary measures of whether the respondents reported that their parents were in a union when they were born and whether their father attended school. We also controlled for a measure indicating whether the respondents were born outside South Africa. Next, we controlled for the respondents' reports of their childhood health, coded as 1 if they reported poor, fair, or good health, 2 if they reported very good health, and 3 if they reported excellent health in childhood.

Next, we controlled for the respondents' (continuous) age at wave 1. We also controlled for a series of three dummy variables to indicate their educational attainment, coded 1 if they had not completed any formal education, 2 if they had some or completed primary education, or 3 if they had some secondary education or higher at wave 1. We also controlled for respondents' employment status at wave 2, coded as four dummy variables to indicate: (1) employed, (2) homemaker (translated to be understood as "home manager"), if they did not report being employed, (3) retired, if they did not report being employed or a

TABLE 1 | Analytic sample characteristics from Health and Aging in Africa: A Longitudinal Study of an International Network for the Demographic Evaluation of Populations and Their Health (INDEPTH) Community in South Africa (HAALSI) (Agincourt, South Africa. 2014–2022).

	Women	Men	Difference between women and men
	Mean/proportion (SD)	Mean/proportion (SD)	
Dependent variables (change between waves 2 and 3, standardized)			
Decline in cognitive health	−0.03 (0.99)	0.04 (1.01)	0.07 ***
Decline in mental health	−0.03 (0.83)	0.04 (1.20)	0.07 ***
Decline in physical health	−0.02 (0.93)	0.03 (1.09)	0.05***
Independent variables (wave 2)			
Adverse family experiences in childhood	0.24	0.22	−0.02 ***
Ever had a spouse, partner or child who was an addict	0.10	0.04	−0.06 ***
Exposure to violence (non-combat)	0.14	0.23	0.09 ***
Exposure to violence (combat)	0.09	0.16	0.07 ***
Experience of assault	0.06	0.09	0.03 ***
Exposure to natural disaster	0.42	0.43	0.01 *
Covariates			
Parents not in union at birth	0.07	0.07	0.001
Father attended school	0.27	0.24	−0.03 ***
Born outside of South Africa	0.32	0.29	−0.03 ***
Childhood health	1.89 (0.80)	1.94 (0.80)	0.05 ***
Age (wave 1)	60.43 (12.21)	60.32 (11.70)	−0.11
Education (wave 1)			
No formal education	0.48	0.38	−0.10 ***
Some/completed primary school	0.34	0.37	0.03 ***
Some/completed secondary or higher education	0.18	0.25	0.07 ***
Employment status (wave 2)			
Not working	0.83	0.70	−0.13 ***
Employed	0.14	0.21	0.07 ***
Retired	0.03	0.09	0.06 ***
Marital status (wave 2)			
Married or living with a partner	0.33	0.63	0.30 ***
Never married/single	0.05	0.11	0.06 ***
Separated or divorced	0.12	0.13	0.01 +
Widowed	0.50	0.13	−0.37 ***
Married more than once (wave 2)	0.12	0.39	0.27 ***
Number of children (wave 1)	4.53 (2.05)	4.73 (2.26)	0.20 ***
Household wealth index (wave 2)	3.03 (1.44)	3.01 (1.41)	−0.02
Frequency of social support (wave 2)	11.56 (7.59)	11.30 (7.44)	−0.26 **
CES-D (wave 2)	15.06 (9.44)	13.72 (9.39)	−1.34 ***
Ever had a stroke (wave 2)	0.02	0.02	0.001

N = 1,751 women and 1,263 men for decline in cognitive function; N = 1,780 women and 1,282 men for decline in mental health; and N = 1,947 women and 1,452 men for decline in physical health. N = 1,981 women and 1,486 for all independent variables and covariates.
CES-D, Center for Epidemiologic Studies Depression Scale.

home manager, or (4) not working, if they did not report that they were any of the above statuses.

We then controlled for the respondents' marital status at the time of the wave 2 survey, with a series of dummy variables indicating whether the respondents were (1) never married, (2) married or living with a partner, (3) separated or divorced, or (4) widowed. Additionally, we controlled for a measure indicating whether the respondents reported having been married more than once at wave 2. We also controlled for the number of children the respondents had at wave 1, which was top-coded at 8 children.

Next, we controlled for household wealth and the frequency of social support, both at wave 2. Households were ranked according to principal component analysis scores for household ownership of items such as televisions, refrigerators, livestock, and vehicles in addition to housing characteristics, type of water, and sanitation facilities [60]. The ranking was then coded into quintiles to indicate the household wealth index. The frequency of social support was coded as the average approximate number of days per month that the respondents reported receiving emotional, physical, and/or informational support from any of up to seven named social contacts.

Finally, in models predicting a decline in cognitive and physical health, we control for depressive symptoms at wave 2 using the 20-item CES-D scale, as described above. We also control for self-reported diagnosis (ever) with stroke in models predicting a decline in physical health, coded as 1 if the respondents reported having ever had a stroke at wave 2, and 0 if not.

Analysis

We used ordinary least squares (OLS) regression to estimate declines in cognitive, mental, and physical health. We standardized the dependent variables (health outcomes) to

TABLE 2 | Ordinary least squares regression predicting decline in cognitive, mental, and physical health among women (Agincourt, South Africa. 2014–2022).

	Model 1 decline in cognitive health	Model 2 decline in mental health	Model 3 decline in physical health
Intercept	−0.51 *** (0.06)	−0.06 (0.05)	−0.89 *** (0.06)
Independent variables			
Adverse family experiences in childhood	−0.20 *** (0.02)	0.004 (0.02)	−0.02 (0.02)
Ever had a spouse, partner or child who was an addict	−0.06 * (0.03)	−0.10 *** (0.02)	0.03 (0.03)
Exposure to violence (non-combat)	0.16 *** (0.02)	−0.07 *** (0.02)	−0.10 *** (0.02)
Exposure to violence (combat)	−0.11 *** (0.03)	0.12 *** (0.02)	0.10 *** (0.03)
Experience of assault	−0.05 (0.03)	0.16 *** (0.03)	0.04 (0.03)
Exposure to natural disaster	−0.07 *** (0.02)	−0.001 (0.01)	−0.03 + (0.02)
Covariates			
Parents not in union at birth	0.11 *** (0.03)	0.09 *** (0.02)	−0.09 ** (0.03)
Father attended school	0.04 * (0.02)	−0.01 (0.01)	0.03 (0.02)
Born outside of South Africa	−0.001 (0.02)	−0.04 * (0.02)	0.16 *** (0.02)
Childhood health	0.05 *** (0.01)	−0.03 *** (0.01)	−0.01 (0.01)
Age	0.004 *** (0.001)	0.002 *** (0.001)	0.02 *** (0.001)
Education (Ref: No formal education)			
Some/completed primary school	0.22 *** (0.02)	0.10 *** (0.02)	−0.06 ** (0.02)
Some/completed secondary or higher education	0.35 *** (0.03)	−0.05 * (0.02)	0.11 *** (0.03)
Employment status (Ref: Not working)			
Employed	−0.10 *** (0.02)	0.20 *** (0.02)	0.06 * (0.02)
Retired	−0.64 *** (0.05)	−0.04 (0.04)	−0.17 *** (0.05)
Marital status (Ref: Married or living with a partner)			
Never married/single	0.10 ** (0.04)	0.07 * (0.03)	0.04 (0.04)
Separated or divorced	0.02 (0.03)	−0.09 *** (0.02)	−0.08 ** (0.03)
Widowed	−0.01 (0.02)	−0.05 ** (0.01)	−0.03 + (0.02)
Married more than once	−0.14 *** (0.02)	0.02 (0.02)	0.16 *** (0.02)
Number of children	−0.003 (0.004)	−0.01 * (0.003)	−0.02 *** (0.004)
Household wealth index	0.02 *** (0.01)	−0.02 *** (0.01)	0.003 (0.01)
Frequency of social support	−0.002 + (0.001)	0.001 + (0.001)	0.004 *** (0.001)
CESD at wave 2	0.003 *** (0.001)		−0.01 *** (0.001)
Ever had a stroke			−0.02 (0.05)
N	*1, 751*	*1,780*	*1,947*

Models weighted for mortality. Beta coefficients with standard errors in parentheses.
Two-tailed tests, + p< *.10,* *p < *.05,* **p < *.01,* ***p < *.001.*

allow for greater comparability across models. We used multiple imputations for missing values on any of the independent and covariate measures in our analyses to retain the full sample of respondents who completed the waves 2 and 3 surveys and have no missing information on the outcome measures. This resulted in a base analytic sample of 1,981 women and 1,486 men, which was restricted in each model based on missing data on the respective outcome measure (see **Table 1**). We applied inverse probability weights to our models to account for mortality between waves 1 and 3.

RESULTS

Table 1 displays the means, or proportions, for all variables in our models in addition to their standard deviation (for non-binary variables). The last column indicates the gender difference and whether these differences are significant. These descriptive statistics indicate that women experienced significantly less decline in their cognitive, mental, and physical health between waves than men. There were also significant gender differences across exposures. Nearly a quarter of women (24%) and 22% of men faced adverse family experiences in childhood. Ten percent of women and only 4% of men reported ever having a spouse, partner, or child who was an addict. Fourteen percent of women and 23% of men reported exposure to non-combat violence, while 9% of women and 16% of men reported exposure to violence in combat. Six percent of women and 9% of men reported experiencing assault. Finally, 42% of women and 43% of men reported exposure to natural disasters. Notably, 32% of women and 29% of men reported being born outside of South Africa; the majority of these individuals are likely to be Mozambican immigrants who entered the country as refugees.

Table 2 displays the results of OLS regressions estimating the decline in each health outcome among women. Results from Model 1 suggest that childhood adverse family experiences, ever having a spouse, partner or child who was an addict, ever having been exposed to combat violence, and ever having been exposed to natural disasters were each associated with greater improvement in cognitive health between waves ($\beta = -0.20$ at $p < .001$; $\beta = -0.06$ at $p < .05$; $\beta = -0.11$ at $p < .001$; and $\beta = -0.07$ at $p < .001$, respectively). On the other hand, exposure to non-combat violence was associated with a decline in cognitive

TABLE 3 | Ordinary least squares regression predicting decline in cognitive, mental, and physical health among men (Agincourt, South Africa. 2014–2022).

	Model 1 decline in cognitive health	Model 2 decline in mental health	Model 3 decline in physical health
Intercept	−0.43 *** (0.08)	0.19 * (0.08)	−0.10 (0.08)
Independent variables			
Adverse family experiences in childhood	−0.11 *** (0.02)	0.01 (0.03)	−0.02 (0.03)
Ever had a spouse, partner or child who was an addict	−0.02 (0.05)	−0.14 * (0.06)	−0.01 (0.05)
Exposure to violence (not combat)	0.15 *** (0.02)	0.06 * (0.03)	−0.10 *** (0.03)
Exposure to violence (combat)	0.17 *** (0.03)	−0.14 *** (0.03)	0.08 * (0.03)
Experience of assault	−0.02 (0.03)	0.29 *** (0.04)	0.01 (0.04)
Exposure to natural disaster	−0.06 ** (0.02)	−0.12 *** (0.02)	−0.03 (0.02)
Covariates			
Parents not in union at birth	0.14 *** (0.04)	−0.03 (0.04)	−0.13 *** (0.04)
Father attended school	−0.07 ** (0.02)	−0.07 ** (0.03)	0.10 *** (0.03)
Born outside of South Africa	−0.06 * (0.02)	0.004 (0.03)	0.003 (0.02)
Childhood health	0.11 *** (0.01)	0.002 (0.01)	−0.01 (0.01)
Age	0.001 (0.001)	−0.01 *** (0.001)	0.004 *** (0.001)
Education (Ref: No formal education)			
Some/completed primary school	0.18 *** (0.02)	−0.06 * (0.03)	−0.10 *** (0.02)
Some/completed secondary or higher education	0.28 *** (0.03)	−0.01 (0.03)	−0.11 *** (0.03)
Employment status (Ref: Not working)			
Employed	−0.07 ** (0.03)	0.09 ** (0.03)	0.02 (0.03)
Retired	−0.44 *** (0.03)	0.26 *** (0.04)	0.17 *** (0.04)
Marital status (Ref: Married or living with a partner)			
Never married/single	0.09 * (0.03)	−0.13 *** (0.04)	0.13 *** (0.03)
Separated or divorced	−0.06 * (0.03)	0.17 *** (0.03)	0.21 *** (0.03)
Widowed	−0.03 (0.03)	0.05 (0.03)	0.12 *** (0.03)
Married more than once	−0.04 + (0.02)	0.08 *** (0.02)	−0.12 *** (0.02)
Number of children	0.01 * (0.004)	−0.01 + (0.01)	0.02 *** (0.01)
Household wealth index	0.02 ** (0.01)	0.02 ** (0.01)	−0.03 *** (0.01)
Frequency of social support	0.002 + (0.001)	0.01 *** (0.001)	0.002 + (0.001)
CESD at wave 2	0.002 + (0.001)		−0.01 *** (0.001)
Ever had a stroke			−0.57 *** (0.06)
N	*1,263*	*1,282*	*1,452*

Models weighted for mortality. Beta coefficients with standard errors in parentheses.
Two-tailed tests, + p< *.10,* *p < *.05,* **p < *.01,* ***p < *.001.*

function (β = 0.16 at $p < .001$). The experience of assault was not significantly associated with a decline in cognitive health among women.

Model 2 indicates that ever having a spouse, partner, or child who was an addict was associated with an improvement in women's mental health between waves (β = −0.10 at $p < .001$), as was exposure to non-combat violence (β = −0.07, at $p < .001$). Exposure to violence in combat and experience of assault were each associated with a decline in mental health (β = 0.12 at $p < .001$ and β = 0.16 at $p < .001$, respectively). Adverse family experiences in childhood and exposure to natural disasters were not significantly associated with decline in mental health among women.

In Model 3 of **Table 2**, we found that exposure to non-combat violence and exposure to natural disasters were each associated with improved physical health between waves (−0.10 at $p < .001$, and −0.03 at $p < .10$, respectively) among women. Exposure to violence in combat was associated with a decline in physical health (0.10 at $p < .001$). Adverse family experiences in childhood, ever having had a spouse, partner or child who was an addict, and experience of assault were not significantly associated with decline in physical health among women.

Table 3 estimates these associations among men. Results from Model 1 suggest that adverse family experiences in childhood and exposure to a natural disaster were each associated with an improvement in men's cognitive health between waves (−0.11 at $p < .001$ and −0.06 at $p < .01$, respectively). Exposure to violence, both combat and non-combat, was associated with a decline in men's cognitive health (0.15 at $p < .001$ and 0.17 at $p < .001$, respectively). Ever having a spouse, partner, or child who was an addict and ever experiencing assault were not significantly associated with men's cognitive health.

Model 2 of **Table 3** shows that ever having a spouse, partner, or child who was an addict, exposure to violence in combat, and exposure to a natural disasters were associated with greater improvements in men's mental health (−0.14 at $p < .05$, −0.14 at $p < .001$, and −0.12 at $p < .001$, respectively). Exposure to non-combat violence and experience of assault, on the other hand, were associated with a decline in mental health between waves (0.06 at $p < .05$ and 0.29 at $p < .001$, respectively). Adverse family experiences in childhood were not significantly associated with a decline in mental health among men.

In Model 3 of **Table 3**, we found that exposure to non-combat violence was associated with improved physical health among men (−0.10 at $p < .0001$). Exposure to violence in combat, on the other hand, was associated with a decline in men's physical health (0.08 at $p < .05$). The other experiences and exposures in the model were not significantly associated with physical health among men.

In order to directly assess gender differences in the association of adverse exposures and experiences with health outcomes, we tested these same models with gender interactions (see **Supplemental Table S1**). These results indicated that exposure to violence in combat had significantly different associations with each of the three health outcomes by gender; adverse family experiences in childhood had significantly different associations with cognitive health by gender; and exposure to non-combat violence, experience of assault, and exposure to natural disasters had significantly different associations with mental health by gender.

We performed a sensitivity analysis to assess whether survivor bias might subtly impact our results. We tested the associations for 40–49-year-olds (the least selective for survivor bias) and for those aged 75+ (the most selective) to assess the severity of this bias, and we found mixed evidence. In some cases, adversity was associated with null results or improvements in health for the older group more than the younger group (which would indicate survivor bias), and in other cases adversity was associated with greater declines in health for this group than for the younger group (see **Supplemental Tables S2–S5**). It is important to keep in mind that healthier people are more likely to have survived long enough to be selected into our analytic sample, but this selection does not appear to impact our results in a consistent direction.

DISCUSSION

This investigation focused on understanding how adverse experiences and exposures in childhood and throughout life might be associated with the rate of decline in cognitive, mental, and physical health over a period of approximately 3 years in a cohort of middle-aged and older rural Black South Africans. We expected that each adverse experience and exposure would be associated with a decline in health outcomes, although the association may be weaker than in high-income populations. While we did find that some adverse exposures were associated with declines in certain health outcomes, we also found that some of the adverse exposures that we investigated were associated with an improvement in certain measures of health. Furthermore, these associations sometimes differed by gender. These findings are mixed with respect to our expectations and comparability with past research.

Our findings on how exposure to violence in combat and the experience of assault are associated with health outcomes complement existing research. For example, Axinn et al (2023) found, that exposure to civil violence in 7 countries that experienced civil violence since WWII, was associated with a higher risk of mental disorders in the long term [28]. Similarly, in a study of U.S.-based WWII and Korean War veterans, Elder and Chipp (1989) found that heavy combat veterans were at higher risk for emotional and behavioral problems, compared with noncombat and light combat veterans [8]. Interestingly, this study found that those exposed to heavier combat exhibited greater resilience. Our results also suggest a decline in health in response to exposure to combat violence: This exposure was associated with a decline in women's mental and physical health, and in men's cognitive and physical health. Other health outcomes, on the other hand, point toward improvements in health as a response to this exposure: women exposed to combat violence experienced improved cognitive health and men exposed to this type of violence experienced improved mental health.

Previous studies have found that intimate partner violence (IPV) leads to worse mental health outcomes, especially for women [34–36]. Similarly, in our study, we found that the experience of assault was associated with worse mental health outcomes for both men and women. Therefore, the experience of assault may have a similar negative impact on mental health across settings. On the other hand, in contrast to this literature, our supplementary analyses found that the decline in men's mental health is significantly greater than the decline in women's mental health in response to having experienced assault. This may, in part, be due to measurement: our measure of experience of assault may include not only IPV but also serious physical attacks, which could impact men more severely than women.

Our findings for the other exposures we investigated did not align as well with existing research. For example, childhood adversity and trauma have been linked to a higher risk of mortality [7], mood disorders [2], and cardiovascular and heart disease [6, 17, 18]. On the other hand, studies—including those of a subset of the adults in our sample—have found that childhood adversity has null associations with cognitive health [5, 22–24]. In contrast to each of these previous studies, our analyses revealed significant associations with (improved) cognitive health, but not with mental or physical health. The significant results in our investigation may reflect our focus on changes in health over a three-year period, rather than a cross-sectional measure of cognitive health or a measure of change over a longer period.

Past studies—involving populations in Singapore, Mexico, England, Australia, and Italy—have found that having family members with addiction can lead to poor health outcomes, operating through mechanisms such as stress and family strain [30, 31]. Our investigation revealed the opposite: women who have experienced having a family member with addiction were observed to have improved cognitive health, and both men and women who endured this experience were observed to have improved mental health.

Research on the health impacts of exposure to non-combat violence has tended to focus on mental health, and findings have largely indicated a negative association [32, 33]. Our investigation found more mixed results: men exposed to non-combat violence were found to experience a decline in mental health, but their female counterparts were found to experience improved mental

health. Additionally, we found that this exposure may lead to improved physical health, but decreased cognitive health for both men and women.

Existing studies of the health impacts of exposure to natural disasters have also tended to focus on mental health, finding that this exposure is a risk factor for poor mental health [9, 61]. In our investigation, we found null results for the association between this exposure and women's mental health, but evidence that exposure to natural disasters may lead to improved mental health for men. We also found evidence of improved cognitive health for women and men exposed to natural disasters, and improved physical health for women. These findings are contrary to expectations based on existing research and suggest that resilience may be strong in the HAALSI cohort.

The improvements in health that we found in response to adversity are likely an artifact of the unique disadvantages faced by this population. Exposure to adversity can foster the development of resilience mechanisms and result in improved coping mechanisms [62], which can lead to improved health, particularly if observed over a specific period of time. The majority of the adults in our sample experienced apartheid, while the others experienced the Mozambican civil war before entering South Africa as refugees. This background of adversity, compounded with the specific experiences and exposures we have assessed in this investigation, may have led to hyper-resilience.

Exposure to adversity may enhance coping mechanisms that operate through psychological, biological, behavioral, and/or social processes [9, 62]. For example, people exposed to adversity may cope by ensuring that they have supportive social networks [63, 64], and it is possible that social networks are more responsive in this setting than in others [31]. People may also adopt healthier behaviors as a coping mechanism [62], which could result in improved physical health. Adversity may also trigger changes in stress hormone levels, and alter neural pathways that are related to resilience [65–67], which could have a positive impact on cognitive health. Each of these possible mechanisms, in conjunction with individual differences, genetic predispositions, and socioeconomic factors, may mitigate the negative impact of adversity and promote resilience. Further research is needed to identify and disentangle whether these and/or other mechanisms are at play.

Our results suggest that gender may play an important role in how individuals respond to different types of adversity. The gender differences we found were not always in the same direction, which highlights the complicated gendered processes that underlie these associations. In some cases, these gender differences may be the result of different circumstances and opportunities for exposure [68]. For example, in the case of responses to exposure to combat violence—which we found to be associated with significantly worse cognitive and physical health outcomes for men than for women, but worse mental health outcomes for women than for men (see **Supplemental Table S1**)—it is important to keep in mind that women are less likely than men to be engaged in combat and more likely to witness it. These unique circumstances may result in different cognitive, mental, and physical processes for women than for men.

Even when women and men have similar exposures, associations with health outcomes may differ due to different biological and/or social mechanisms. For example, women may respond more severely to traumatic experiences [69], and men may respond more through externalized symptoms [46]. These gendered processes may help to explain why we see better health outcomes for men in some cases, such as in our finding that women's mental health is more negatively impacted by exposure to natural disaster than men's mental health—a finding that is aligned with results from previous work [9, 48]. On the other hand, women may be better positioned to rely on social support than men, and their social networks may be larger [64, 70]. These different social mechanisms may help explain why we see relatively better outcomes for women in some cases, such as in their mental health responses to non-combat violence and experiences of assault. In fact, some evidence suggests that women may exhibit resilience and post-traumatic growth in response to adversity [71, 72]. Future work would benefit from examining how the mechanisms connecting adversity to health may differ by gender in this setting.

Our expectation that health decline would be most apparent in mental health [5, 9, 23], and least apparent in cognitive health [5, 9, 18, 22–24, 34] was not supported. Mental health was significantly associated with a few of the experiences and exposures that we investigated, but in many cases the association pointed toward improved mental health. Cognitive health was significantly associated with many of the experiences and exposures we investigated, but often in the direction of improved cognitive health. These findings, often in contrast to existing research, further reflect the unique experiences and possible resilience of rural Black South African populations.

This study had limitations that need to be considered. One important limitation is the generalizability of these results. In situating our results within the broader literature, it is apparent that this population is sometimes unique in its health responses to adversity. HAALSI is a population-based sample from the Agincourt Health and socio-Demographic Surveillance System (HDSS) in Mpumalanga province [56], which is nested within INDEPTH [73] and the South African Population Research Infrastructure Network (SAPRIN) [74]–larger research networks in sub-Saharan Africa, that allow for comparisons and extrapolation both within and beyond South Africa. Analytical work has demonstrated similarities in demographic structure and health status across rural commuties in sub-Saharan Africa [74], indicating that our findings are likely to be generalizable to other rural, resource-limited areas in the region.

Concerns about survivor bias are a second important limitation that applies to all studies, and especially to studies of aging like this one. The sensitivity analyses that we performed did not eliminate this concern. Those who have survived long enough to be selected for the sample may have characteristics that protect them against rapid health decline, which would make our estimates of decline more conservative. Third, we focused on changes in health over approximately

three years, which limited the amount of change we were able to observe. Nonetheless, this three-year period is valuable in that it offered a snapshot of changes in health and a sense of differences across individuals in the rate of health decline. Fourth, we were unable to identify the timing of many of the experiences and exposures that we investigated. Future research would benefit from survey measures that more accurately capture the timing and severity of exposure to adversity. Finally, these analyses do not account for other possible confounders, such as genetic predisposition and community support systems, and must be interpreted with this limitation in mind.

In conclusion, this investigation has offered important insights into the associations between adversity and health outcomes in a cohort of aging adults living in an economically disadvantaged rural setting in South Africa. While we did find evidence of declining health in response to adverse exposures in some cases, our results shed light on the possibility that exposure to adversity may sometimes lead to greater improvements in health within specific time frames in later adulthood. Policymakers and researchers would benefit from future work that unpacks the specific mechanisms at play that can lead to either improved or worsened health in response to lifetime adversity. Although our results may not be generalizable to other settings and populations, they contribute to the literature by providing a more nuanced and comprehensive understanding of how various adverse exposures may impact different health outcomes within a population that has historically faced significant challenges.

ETHICS STATEMENT

Ethics approvals for HAALSI were obtained from the University of the Witwatersrand Human Research Ethics Committee, the Harvard T.H. Chan School of Public Health Office of Human Research Administration, and the Mpumalanga Provincial Research and Ethics Committee. Studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent was obtained from all participants prior to participation.

AUTHOR CONTRIBUTIONS

EJ performed analyses, interpreted findings, and drafted and edited all aspects of the manuscript. SM contributed guidance and interpretation of analyses and writing, especially as related to the context of rural South Africa. DB contributed guidance on data analyses, writing, and analytic interpretation, especially as related to cognitive health. KK contributed guidance on interpretation of findings, contextualization, and editing of the manuscript. All authors contributed to the article and approved the submitted version.

FUNDING

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. This work was supported by funding from the National Institute on Aging for the HAALSI Study (grant number P01 AG041710). HAALSI is nested within the Agincourt Health and Demographic Surveillance System (HDSS) site: The MRC/Wits Rural Public Health and Health Transitions Research Unit and Agincourt HDSS, a node of the South African Population Research Infrastructure Network (SAPRIN), is supported by the Department of Science and Innovation, the University of the Witwatersrand, and the Medical Research Council, South Africa, and previously by the Wellcome Trust, UK (grants 058893/Z/99/A; 069683/Z/02/Z; 085477/Z/08/Z; 085477/B/08/Z). SM is supported by a self-initiated research grant from the South African Medical Research Council (2018–2022).

CONFLICT OF INTEREST

The authors declare that they do not have any conflicts of interest.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.ssph-journal.org/articles/10.3389/ijph.2024.1606499/full#supplementary-material

REFERENCES

1. Altintas M, Bilici M. Evaluation of Childhood Trauma with Respect to Criminal Behavior, Dissociative Experiences, Adverse Family Experiences and Psychiatric Backgrounds Among Prison Inmates. *Compr Psychiatry* (2018) 82:100–7. doi:10.1016/j.comppsych.2017.12.006
2. Jansen K, Cardoso TA, Fries GR, Branco JC, Silva RA, Kauer-Sant'Anna M, et al. Childhood Trauma, Family History, and Their Association with Mood Disorders in Early Adulthood. *Acta Psychiatrica Scand* (2016) 134(4):281–6. doi:10.1111/acps.12551
3. Xie P, Wu K, Zheng Y, Guo Y, Yang Y, He J, et al. Prevalence of Childhood Trauma and Correlations between Childhood Trauma, Suicidal Ideation, and Social Support in Patients with Depression, Bipolar Disorder, and Schizophrenia in Southern China. *J Affective Disord* (2018) 228:41–8. doi:10.1016/j.jad.2017.11.011
4. Elder JGH. The Life Course as Developmental Theory. *Child Dev* (1998) 69(1): 1–12. doi:10.2307/1132065
5. Payne CF, Mall S, Kobayashi L, Kahn K, Berkman L. Life-Course Trauma and Later Life Mental, Physical, and Cognitive Health in a Postapartheid South African Population: Findings from the HAALSI Study. *J Aging Health* (2020) 32(9):1244–57. doi:10.1177/0898264320913450
6. Jakubowski KP, Cundiff JM, Matthews KA. Cumulative Childhood Adversity and Adult Cardiometabolic Disease: A Meta-Analysis. *Health Psychol* (2018) 37:701–15. doi:10.1037/hea0000637
7. Yu J, Patel RA, Haynie DL, Vidal-Ribas P, Govender T, Sundaram R, et al. Adverse Childhood Experiences and Premature Mortality through Mid-Adulthood: A Five-Decade Prospective Study. *The Lancet Reg Health - Americas* (2022) 15:100349. doi:10.1016/j.lana.2022.100349
8. Elder JGH, Clipp EC. Combat Experience and Emotional Health: Impairment and Resilience in Later Life. *J Personal* (1989) 57(2):311–41. doi:10.1111/j.1467-6494.1989.tb00485.x
9. Goldmann E, Galea S. Mental Health Consequences of Disasters. *Annu Rev Public Health* (2014) 35(1):169–83. doi:10.1146/annurev-publhealth-032013-182435

10. Harris RB, Stanley J, Cormack DM. Racism and Health in New Zealand: Prevalence over Time and Associations between Recent Experience of Racism and Health and Wellbeing Measures Using National Survey Data. *PLOS ONE* (2018) 13(5):e0196476. doi:10.1371/journal.pone.0196476
11. Pugh M, Perrin PB, Rybarczyk B, Tan J. Racism, Mental Health, Healthcare Provider Trust, and Medication Adherence Among Black Patients in Safety-Net Primary Care. *J Clin Psychol Med Settings* (2021) 28(1):181–90. doi:10.1007/s10880-020-09702-y
12. LaFave SE, Suen JJ, Seau Q, Bergman A, Fisher MC, Thorpe RJ, et al. Racism and Older Black Americans' Health: A Systematic Review. *J Urban Health* (2022) 99(1):28–54. doi:10.1007/s11524-021-00591-6
13. Kahn K, Garenne ML, Collinson MA, Tollman SM. Mortality Trends in a New South Africa: Hard to Make a Fresh Start1. *Scand J Public Health* (2007) 35(69_Suppl. l):26–34. doi:10.1080/14034950701355668
14. Kabudula CW, Tollman S, Mee P, Ngobeni S, Silaule B, Gómez-Olivé FX, et al. Two Decades of Mortality Change in Rural Northeast South Africa. *Glob Health Action* (2014) 7(1):25596. doi:10.3402/gha.v7.25596
15. LaBrenz CA, Dell PJ, Fong R, Liu V. Happily Ever after? Life Satisfaction after Childhood Exposure to Violence. *J Interpersonal Violence* (2019) 36: 0886260518820706–NP6766. doi:10.1177/0886260518820706
16. Felitti VJ, Anda RF, Nordenberg D, Williamson DF, Spitz AM, Edwards V, et al. REPRINT OF: Relationship of Childhood Abuse and Household Dysfunction to Many of the Leading Causes of Death in Adults: The Adverse Childhood Experiences (ACE) Study. *Am J Prev Med* (2019) 56(6): 774–86. doi:10.1016/j.amepre.2019.04.001
17. Liang YY, Ai S, Weng F, Feng H, Yang L, He Z, et al. Associations of Childhood Maltreatment and Genetic Risks with Incident Heart Failure in Later Life. *J Am Heart Assoc* (2022) 11(20):e026536. doi:10.1161/JAHA.122.026536
18. Deschênes SS, Kivimaki M, Schmitz N. Adverse Childhood Experiences and the Risk of Coronary Heart Disease in Adulthood: Examining Potential Psychological, Biological, and Behavioral Mediators in the Whitehall II Cohort Study. *J Am Heart Assoc* (2021) 10(10):e019013. doi:10.1161/JAHA.120.019013
19. Chapman DP, Whitfield CL, Felitti VJ, Dube SR, Edwards VJ, Anda RF. Adverse Childhood Experiences and the Risk of Depressive Disorders in Adulthood. *J Affective Disord* (2004) 82(2):217–25. doi:10.1016/j.jad.2003.12.013
20. Poole JC, Dobson KS, Pusch D. Childhood Adversity and Adult Depression: The Protective Role of Psychological Resilience. *Child Abuse Neglect* (2017) 64: 89–100. doi:10.1016/j.chiabu.2016.12.012
21. Amato PR. Children of Divorce in the 1990s: An Update of the Amato and Keith (1991) Meta-Analysis. *J Fam Psychol* (2001) 15(3):355–70. doi:10.1037//0893-3200.15.3.355
22. Audra LG, Erika M, Sarah FA, Dan MM, Rachel AW, Elizabeth RM, et al. Are Adverse Childhood Experiences Associated with Late-Life Cognitive Performance across Racial/ethnic Groups: Results from the Kaiser Healthy Aging and Diverse Life Experiences Study Baseline. *BMJ Open* (2021) 11(2): e042125. doi:10.1136/bmjopen-2020-042125
23. Kobayashi LC, Farrell MT, Payne CF, Mall S, Montana L, Wagner RG, et al. Adverse Childhood Experiences and Domain-Specific Cognitive Function in a Population-Based Study of Older Adults in Rural South Africa. *Psychol Aging* (2020) 35:818–30. doi:10.1037/pag0000552
24. O'Shea BQ, Demakakos P, Cadar D, Kobayashi LC. Adverse Childhood Experiences and Rate of Memory Decline from Mid to Later Life: Evidence from the English Longitudinal Study of Ageing. *Am J Epidemiol* (2021) 190(7): 1294–305. doi:10.1093/aje/kwab019
25. Shultz JM, Russell J, Espinel Z. Epidemiology of Tropical Cyclones: The Dynamics of Disaster, Disease, and Development. *Epidemiologic Rev* (2005) 27(1):21–35. doi:10.1093/epirev/mxi011
26. Burnam MA, Stein JA, Golding JM, Siegel JM, Sorenson SB, Forsythe AB, et al. Sexual Assault and Mental Disorders in a Community Population. *J Consulting Clin Psychol* (1988) 56(6):843–50. doi:10.1037//0022-006x.56.6.843
27. Brooks JR, Taylor RJ, Chatters LM. The Impact of Traumatic Events on Mental Health Among Older African American and Black Caribbean Adults. *J Aging Health* (2022) 34(3):390–400. doi:10.1177/08982643221086336
28. Axinn WG, Bruffaerts R, Kessler TL, Frounfelker R, Aguilar-Gaxiola S, Alonso J, et al. Findings from the World Mental Health Surveys of Civil Violence Exposure and its Association with Subsequent Onset and Persistence of Mental Disorders. *JAMA Netw Open* (2023) 6(6):e2318919–e. doi:10.1001/jamanetworkopen.2023.18919
29. Phifer JF. Psychological Distress and Somatic Symptoms after Natural Disaster: Differential Vulnerability Among Older Adults. *Psychol Aging* (1990) 5(3):412–20. doi:10.1037//0882-7974.5.3.412
30. Lee KMT, Manning V, Teoh HC, Winslow M, Lee A, Subramaniam M, et al. Stress-Coping Morbidity Among Family Members of Addiction Patients in Singapore. *Drug Alcohol Rev* (2011) 30(4):441–7. doi:10.1111/j.1465-3362.2011.00301.x
31. Orford J, Velleman R, Natera G, Templeton L, Copello A. Addiction in the Family Is a Major but Neglected Contributor to the Global burden of Adult Ill-Health. *Soc Sci Med* (2013) 78:70–7. doi:10.1016/j.socscimed.2012.11.036
32. Fowler PJ, Tompsett CJ, Braciszewski JM, Jacques-Tiura AJ, Baltes BB. Community Violence: A Meta-Analysis on the Effect of Exposure and Mental Health Outcomes of Children and Adolescents. *Dev Psychopathol* (2009) 21(1):227–59. doi:10.1017/S0954579409000145
33. Clark C, Ryan L, Kawachi I, Canner MJ, Berkman L, Wright RJ. Witnessing Community Violence in Residential Neighborhoods: A Mental Health hazard for Urban Women. *J Urban Health* (2008) 85(1):22–38. doi:10.1007/s11524-007-9229-8
34. Satcher D. Violence as a Public Health Issue. *Bull N Y Acad Med* (1995) 72(1): 46–56.
35. Bogat GA, Levendosky AA, Theran S, Von Eye A, Davidson WS. Predicting the Psychosocial Effects of Interpersonal Partner Violence (IPV):How Much Does a Woman's History of IPV Matter? *J Interpersonal Violence* (2003) 18(11): 1271–91. doi:10.1177/0886260503256657
36. Alexander PC. Childhood Trauma, Attachment, and Abuse by Multiple Partners. *Psychol Trauma Theor Res Pract Pol* (2009) 1(1):78–88. doi:10.1037/a0015254
37. Franzese RJ, Covey HC, Tucker AS, McCoy L, Menard S. Adolescent Exposure to Violence and Adult Physical and Mental Health Problems. *Child Abuse Neglect* (2014) 38(12):1955–65. doi:10.1016/j.chiabu.2014.10.017
38. Leserman J. Sexual Abuse History: Prevalence, Health Effects, Mediators, and Psychological Treatment. *Psychosomatic Med* (2005) 67(6):906–15. doi:10.1097/01.psy.0000188405.54425.20
39. Polusny MA, Ries BJ, Schultz JR, Calhoun P, Clemensen L, Johnsen IR. PTSD Symptom Clusters Associated with Physical Health and Health Care Utilization in Rural Primary Care Patients Exposed to Natural Disaster. *J Traumatic Stress* (2008) 21(1):75–82. doi:10.1002/jts.20281
40. Richards M, Wadsworth MEJ. Long Term Effects of Early Adversity on Cognitive Function. *Arch Dis Child* (2004) 89(10):922–7. doi:10.1136/adc.2003.032490
41. Künzi M, Sieber S, Joly-Burra E, Cullati S, Bauermeister S, Stringhini S, et al. Adversity Specificity and Life Period Exposure on Cognitive Aging. *Scientific Rep* (2023) 13(1):8702. doi:10.1038/s41598-023-35855-5
42. Rosnick CB, Small BJ, McEvoy CL, Borenstein AR, Mortimer JA. Negative Life Events and Cognitive Performance in a Population of Older Adults. *J Aging Health* (2007) 19(4):612–29. doi:10.1177/0898264307300975
43. Künzi M, Gheorghe DA, Kliegel M, Ballhausen N, Gallacher J, Bauermeister S. Cumulative Life Course Adversity, Mental Health, and Cognition in the UK Biobank. *Scientific Rep* (2022) 12(1):14700. doi:10.1038/s41598-022-18928-9
44. Lupien SJ, McEwen BS, Gunnar MR, Heim C. Effects of Stress throughout the Lifespan on the Brain, Behaviour and Cognition. *Nat Rev Neurosci* (2009) 10(6):434–45. doi:10.1038/nrn2639
45. Surtees PG, Wainwright NWJ. The Shackles of Misfortune: Social Adversity Assessment and Representation in a Chronic-Disease Epidemiological Setting. *Soc Sci Med* (2007) 64(1):95–111. doi:10.1016/j.socscimed.2006.08.013
46. Eaton NR, Keyes KM, Krueger RF, Balsis S, Skodol AE, Markon KE, et al. An Invariant Dimensional Liability Model of Gender Differences in Mental Disorder Prevalence: Evidence from a National Sample. *J abnormal Psychol* (2012) 121(1):282–8. doi:10.1037/a0024780
47. Lonnen E, Paskell R. Gender, Sex and Complex PTSD Clinical Presentation: A Systematic Review. *Eur J Psychotraumatology* (2024) 15(1):2320994. doi:10.1080/20008066.2024.2320994
48. Bonanno GA, Gupta S. Resilience after Disaster. In: *Mental Health and Disasters*. New York, NY, US: Cambridge University Press (2012). p. 145–60.

49. Antonucci TC, Akiyama H. An Examination of Sex Differences in Social Support Among Older Men and Women. *Sex Roles* (1987) 17(11):737–49. doi:10.1007/bf00287685
50. Carr D, Bodnar-Deren S. Gender, Aging and Widowhood. In: Uhlenberg P, editor. *International Handbook of Population Aging*. Dordrecht: Springer Netherlands (2009). p. 705–28.
51. Jennings EA, Mkhwanazi N, Berkman L. Receipt of Emotional Support Among Rural South African Adults. *Ageing Soc* (2020) 40(5):1039–63. doi:10.1017/s0144686x18001526
52. Blalock CL. Labor Migration and Employment in Post-Apartheid Rural South Africa. *Sociol Graduate Theses Dissertations* (2014).
53. Dugard J. South Africa's Independent Homelands: An Exercise in Denationalization. *Denver J Int L Pol* (1980) 10(1):11–36.
54. Statistics South Africa. *Provincial Profile Mpumalanga: Community Survey 2016*. Pretoria: Statistics South Africa (2018). Contract No.: Report 03-01-13.
55. Gómez-Olivé FX, Montana L, Wagner RG, Kabudula CW, Rohr JK, Kahn K, et al. Cohort Profile: Health and Ageing in Africa: A Longitudinal Study of an INDEPTH Community in South Africa (HAALSI). *Int J Epidemiol* (2018) 47(3):689–90j. doi:10.1093/ije/dyx247
56. Kahn K, Collinson MA, Gómez-Olivé FX, Mokoena O, Twine R, Mee P, et al. Profile: Agincourt Health and Socio-Demographic Surveillance System. *Int J Epidemiol* (2012) 41(4):988–1001. doi:10.1093/ije/dys115
57. Kobayashi LC, Farrell MT, Langa KM, Mahlalela N, Wagner RG, Berkman LF. Incidence of Cognitive Impairment during Aging in Rural South Africa: Evidence from HAALSI, 2014 to 2019. *Neuroepidemiology* (2021) 55(2): 100–8. doi:10.1159/000513276
58. Vilagut G, Forero CG, Barbaglia G, Alonso J. Screening for Depression in the General Population with the Center for Epidemiologic Studies Depression (CES-D): A Systematic Review with Meta-Analysis. *PLoS One* (2016) 11(5): e0155431. doi:10.1371/journal.pone.0155431
59. Miller AP, Kintu M, Kiene SM. Challenges in Measuring Depression Among Ugandan Fisherfolk: A Psychometric Assessment of the Luganda Version of the Center for Epidemiologic Studies Depression Scale (CES-D). *BMC Psychiatry* (2020) 20(1):45. doi:10.1186/s12888-020-2463-2
60. Riumallo-Herl C, Canning D, Kabudula C. Health Inequalities in the South African Elderly: The Importance of the Measure of Social-Economic Status. *The J Econ Ageing* (2019) 14:100191. doi:10.1016/j.jeoa.2019.01.005
61. Ahern M, Kovats RS, Wilkinson P, Few R, Matthies F. Global Health Impacts of Floods: Epidemiologic Evidence. *Epidemiologic Rev* (2005) 27(1):36–46. doi:10.1093/epirev/mxi004
62. Henson C, Truchot D, Canevello A. Factors that Hinder post-Traumatic Growth: A Systematic Review. *Encephale* (2022) 48(5):560–2. doi:10.1016/j.encep.2022.02.001
63. Glei DA, Landau DA, Goldman N, Chuang Y-L, Rodríguez G, Weinstein M. Participating in Social Activities Helps Preserve Cognitive Function: An Analysis of a Longitudinal, Population-Based Study of the Elderly. *Int J Epidemiol* (2005) 34(4):864–71. doi:10.1093/ije/dyi049
64. Seery MD, Holman EA, Silver RC. Whatever Does Not Kill Us: Cumulative Lifetime Adversity, Vulnerability, and Resilience. *J Personal Soc Psychol* (2010) 99(6):1025–41. doi:10.1037/a0021344
65. Gee DG. Early Adversity and Development: Parsing Heterogeneity and Identifying Pathways of Risk and Resilience. *Am J Psychiatry* (2021) 178(11):998–1013. doi:10.1176/appi.ajp.2021.21090944
66. Osório C, Probert T, Jones E, Young AH, Robbins I. Adapting to Stress: Understanding the Neurobiology of Resilience. *Behav Med* (2017) 43(4): 307–22. doi:10.1080/08964289.2016.1170661
67. de Kloet ER. About Stress Hormones and Resilience to Psychopathology. *J Neuroendocrinol* (2008) 20(6):885–92. doi:10.1111/j.1365-2826.2008.01707.x
68. Smyth I, Sweetman C. Introduction: Gender and Resilience. *Gend Dev* (2015) 23(3):405–14. doi:10.1080/13552074.2015.1113769
69. Jin Y, Xu J, Liu D. The Relationship between post Traumatic Stress Disorder and post Traumatic Growth: Gender Differences in PTG and PTSD Subgroups. *Soc Psychiatry Psychiatr Epidemiol* (2014) 49(12):1903–10. doi:10.1007/s00127-014-0865-5
70. Glei DA, Landau DA, Goldman N, Chuang YL, Rodríguez G, Weinstein M. Participating in Social Activities Helps Preserve Cognitive Function: An Analysis of a Longitudinal, Population-Based Study of the Elderly. *Int J Epidemiol* (2005) 34(4):864–71. doi:10.1093/ije/dyi049
71. Lenette C, Brough M, Cox L. Everyday Resilience: Narratives of Single Refugee Women with Children. *Qual Soc Work* (2012) 12(5):637–53. doi:10.1177/1473325012449684
72. Morrill EF, Brewer NT, O'Neill SC, Lillie SE, Dees EC, Carey LA, et al. The Interaction of post-Traumatic Growth and post-Traumatic Stress Symptoms in Predicting Depressive Symptoms and Quality of Life. *Psycho-Oncology* (2008) 17(9):948–53. doi:10.1002/pon.1313
73. Sankoh O, Herbst AJ, Juvekar S, Tollman S, Byass P, Tanner M. INDEPTH Launches a Data Repository and INDEPTHStats. *Lancet Glob Health* (2013) 1(2):e69. doi:10.1016/S2214-109X(13)70034-2
74. Collinson MA, Mudzana T, Mutevedzi T, Kahn K, Maimela E, Gómez-Olivé FX, et al. Cohort Profile: South African Population Research Infrastructure Network (SAPRIN). *Int J Epidemiol* (2021) 51(4):e206–e216. doi:10.1093/ije/dyab261

International Journal of Public Health
ORIGINAL ARTICLE
published: 26 June 2024
doi: 10.3389/ijph.2024.1606387

OPEN ACCESS

Edited by:
Tobias Vogt,
Population Research Centre,
University of Groningen, Netherlands

Reviewed by:
Mkhululi Wami,
International Baccalaureate (IBO),
Netherlands
One reviewer who chose to remain anonymous

***Correspondence**
Stefan Kohler,
stefan.kohler@uni-heidelberg.de

†ORCID:
Stefan Kohler
orcid.org/0000-0003-1365-7506
Till Bärnighausen
orcid.org/0000-0002-4182-4212
Patrick Kazonda
orcid.org/0000-0003-0215-433X
Germana H. Leyna
orcid.org/0000-0001-7016-544X
Julia Lohmann
orcid.org/0000-0003-4136-9296
Japhet Killewo
orcid.org/0000-0001-6998-6750
Julia K. Rohr
orcid.org/0000-0002-1180-8764
Laura-Marie Stieglitz
orcid.org/0000-0002-0780-9246
Nicolas Paul
orcid.org/0000-0003-2228-3980

This Original Article is part of the IJPH Special Issue "Ageing and Health in Sub-Sahara Africa"

Received: *10 July 2023*
Accepted: *10 June 2024*
Published: *26 June 2024*

Citation:
Kohler S, Bärnighausen T, Kazonda P, Leyna GH, Lohmann J, Killewo J, Rohr JK, Stieglitz L-M and Paul N (2024) Chronic Conditions and Multimorbidity Among Middle-Aged and Elderly Peri-Urban Dwellers in Dar es Salaam, Tanzania. Int J Public Health 69:1606387. doi: 10.3389/ijph.2024.1606387

Chronic Conditions and Multimorbidity Among Middle-Aged and Elderly Peri-Urban Dwellers in Dar es Salaam, Tanzania

***Stefan Kohler*[1,2*†], *Till Bärnighausen*[1†], *Patrick Kazonda*[3†], *Germana H. Leyna*[4†], *Julia Lohmann*[1,5†], *Japhet Killewo*[4†], *Julia K. Rohr*[6†], *Laura-Marie Stieglitz*[1†] *and Nicolas Paul*[1†]**

[1]Heidelberg Institute of Global Health, Faculty of Medicine and University Hospital, Heidelberg University, Heidelberg, Germany, [2]Institute of Social Medicine, Epidemiology and Health Economics, Charité – Universitatsmedizin Berlin, Corporate Member of Freie Universitat Berlin and Humboldt-Universitat zu Berlin, Berlin, Germany, [3]Dar es Salaam Urban Cohort Study, Dar es Salaam, Tanzania, [4]Department of Epidemiology and Biostatistics, Muhimbili University of Health and Allied Sciences, Dar es Salaam, Tanzania, [5]Department of Global Health and Development, London School of Hygiene and Tropical Medicine, London, United Kingdom, [6]Harvard Center for Population and Development Studies, Harvard University, Cambridge, MA, United States

Objectives: Chronic conditions and multimorbidity affect care needs and prevention opportunities.

Methods: We studied 2,246 men and women aged ≥40 years within the Dar es Salaam Urban Cohort Study from June 2017 to July 2018. Seventeen chronic conditions were assessed based on self-report, body and blood pressure measurement, blood tests, and screening instruments.

Results: Hypertension (51.3%), anemia (34.1%), obesity (32.2%), diabetes (31.6%), depressive symptoms (31.5%), low grip strength (21.2%), and ischemic heart disease (11.9%) were widespread. Multimorbidity was common (73.7%). Women had higher odds of obesity, ischemic heart disease, and high cholesterol (adjusted OR: 2.08–4.16) and lower odds of underweight, low grip strength, alcohol problems, and smoking (adjusted OR: 0.04–0.45). Ten years of age were associated with higher odds of low grip strength, cognitive problems, hypertension, kidney disease, chronic cough, diabetes, high cholesterol, ischemic heart disease, and multimorbidity (adjusted OR: 1.21–1.81) and lower odds of HIV infection (adjusted OR: 0.51).

Conclusion: We found a higher prevalence of multimorbidity than previously estimated for middle-aged and elderly people in sub-Saharan Africa. The chronic conditions underlying multimorbidity differed by sex.

Keywords: chronic conditions, infectious diseases, middle-aged, multimorbidity, non-communicable diseases, older adults, sub-Saharan Africa, Tanzania

INTRODUCTION

Sub-Saharan Africa has been experiencing an epidemiological transition with a shift in the disease burden from infectious diseases to non-communicable diseases [1–3]. Health systems in this region face the challenge to care for rising levels of non-communicable diseases, still high levels of infectious diseases, and combinations thereof [1, 2]. Aggravating this health system challenge, the population aged ≥65 years in Africa has been predicted to grow from 48 million in 2021 to 569 million in 2100 [4, 5].

In a meta-analysis of 39 studies on low-income and middle-income countries, including 15 studies of five different datasets from sub-Saharan African countries, the estimated pooled prevalence of multimorbidity of non-communicable diseases was 36.4% (95% CI: 32.2–40.6) with a large variation from 0.7% to 81.3% between studies. The prevalence of multimorbidity of non-communicable diseases tended to be higher for the aged, women, people who were well-off, and urban dwellers [6]. Another meta-analysis of multimorbidity of communicable and non-communicable conditions estimated a pooled prevalence of 37.2% (95% CI: 34.9–39.4) globally based on 126 studies from 54 countries and 28.2% (95% CI: 15.6–40.8) for sub-Saharan Africa based on 10 studies [7]. The study conjectured that the low pooled prevalence estimated for sub-Saharan Africa could result from high levels of undiagnosed chronic illness [7].

Previous studies assessing the prevalence of multimorbidity in sub-Saharan Africa were often conducted in South Africa [6–10]. South Africa is one of the few upper middle income countries in the region and maintained an average upper middle income level since 2004 [11]. Studies in Tanzania reported a prevalence of multimorbidity of 25.3% [12], 61.1% [13], and 73.8% (95% CI: 71.2–76.3) for women only [14] among ≥40-year-olds assessing eight, 13, and 15 chronic conditions, respectively, in the same population as this study. A study among ≥60-year-olds in rural Tanzania found a multimorbidity prevalence of 26.1% (95% CI: 16.7–35.4) based on self-report of chronic conditions and 67.3% (95% CI: 57.0–77.5) based on clinical assessment, screening tools, and blood pressure measurement [15]. Another study in Tanzania and Uganda reported a multimorbidity prevalence of 25.6% among people living with HIV, diabetes, and/or hypertension [16]. None of these previous studies of multimorbidity in sub-Sahara Africa reported the prevalence of multimorbidity and underlying conditions by sex and age.

In this study, we evaluated 17 communicable and non-communicable health conditions among ≥40-year-old men and women living in two peri-urban wards of Dar es Salaam, Tanzania. First, we estimated the prevalence of chronic conditions and multimorbidity. Second, we assessed the relationships of chronic conditions and multimorbidity with sex and age.

METHODS

Study Design and Setting

Tanzania transitioned from a low-income country to a lower middle-income country in 2019 based on the estimated gross national income *per capita* [11]. Dar es Salaam is Tanzania's largest city and among its wealthier regions. We conducted a cross-sectional study between June 2017 and July 2018 among the peri-urban dwellers living in the Ukonga and Gongolamboto wards of Dar es Salaam. The neighboring Ukonga and Gongolamboto wards are located about 20 km from the city center, were densely populated, and had a mixture of well-built houses and mud houses. Most households had a toilet and about half had electricity [17]. The study was part of the "Health and Aging in Africa: Longitudinal Studies in Three INDEPTH Communities" (HAALSI) project [18].

Study Population

We randomly selected a sex-stratified sample of 4,850 individuals (2,450 men and 2,400 women) aged ≥40 years from the 2016 Dar es Salaam Health and Demographic Surveillance System, which is also known as the Dar es Salaam Urban Cohort Study (DUCS) [17]. Half of the study sample was randomly selected for additional point-of-care blood tests. Of the individuals selected for the study, 2,299 (744 men and 1,555 women) agreed to participate in a survey and non-invasive health measurement; 1,024 (318 men and 706 women) agreed to undergo additional blood testing. Reasons for non-participation in the survey and non-invasive measurements included unsuccessful attempts to reach a selected participant at home and lack of time to participate. Reasons for not agreeing to blood testing included concerns about confidentiality, the invasiveness of the requested procedures, and religious reasons.

After removing records with missing socioeconomic characteristics, the final study sample comprised up to 2,246 participants for the survey and non-invasive measurements and up to 1,014 participants for blood testing. The analyzed study sample underrepresented men (718 of 2,246; 32.0%) in comparison to the 2016 DUCS population aged ≥40 years (9,067 of 16,898, 54.7%; $p < 0.001$). In the sex-stratified study sample, the share of men aged 40–54 years was lower and the share of men aged ≥55 years was higher than in the 2016 DUCS population ($p < 0.001$). The shares of women aged 40–44 years, 50–54 years, or 70–74 years were lower and the shares of women aged 45–49 years or 55–70 years were higher in the study sample than in the 2016 DUCS population ($p = 0.002$) (**Supplementary Table S1**; **Supplementary Figures S1, S2**).

Data Collection

Field researchers visited study participants at home to conduct a computer-assisted personal interview, take body measurements, and measure blood pressure. The personal interviews included adapted versions of pre-existing screening instruments for chronic conditions. Body measurements included height, weight, and grip strength of the dominant hand. A finger-prick blood sample was taken from a subgroup of the study participants and point-of-care blood tests were performed. The CareSens Blood Glucose Monitoring System and the HemoCue Hemoglobin 201+ Analyser were used for point-of-care blood testing.

Assessment of Chronic Conditions

Self-Report of Chronic Conditions

Ischemic heart disease, hypercholesterolemia, stroke, smoking status, chronic cough (no tuberculosis [TB]), kidney disease, HIV,

and tuberculosis were identified by self-reporting either a diagnosis or ever receiving treatment for the respective condition. Diabetes and hypertension were identified either by a self-report of current treatment or by measurement (**Supplementary Table S2**).

Measurement of Chronic Conditions

Anemia, diabetes, hypertension, obesity, and underweight were defined based on thresholds for hemoglobin (<12 mg/dL for women and <13 mg/dL for men), blood glucose (≥200 mg/dL at any time, fasting blood glucose ≥126 mg/dL, or on diabetes treatment), blood pressure (systolic pressure ≥140 mmHg, diastolic pressure ≥90 mmHg, or on antihypertensive treatment), and the body mass index (>30 kg/m^2 and <18.5 kg/m^2), respectively. The hemoglobin threshold was adjusted for smoking (+0.3 mg/dL) and African origin (−1 mg/dL) [19, 20]. Hand grip strength <27 kg for men and <16 kg for women was categorized as low and indicative of sarcopenia [21] (**Supplementary Table S2**).

Screening of Chronic Conditions

Ischemic heart disease included a self-reported past diagnosis or screening positive for symptoms of angina pectoris, which were assessed using a modified Rose Angina Questionnaire [22, 23]. Depressive symptoms were assessed using the 10-item Center of Epidemiologic Studies Depression Scale (cut-off score ≥10) [24, 25]. Signs of alcoholism were assessed using the Cut, Annoyed, Guilty, and Eye (CAGE) questionnaire (cut-off score ≥2) [26]. Signs of cognitive problems were assessed using recall tests (cut-off score ≤1.5 SD of sample mean), which we adapted from the United States Health and Retirement Study [27, 28], or self-rated memory (rated as fair or poor) if recall tests were incomplete (**Supplementary Table S2**).

Multimorbidity

Multimorbidity was defined as being affected by ≥2 chronic conditions. As anemia and diabetes were only assessed in a subsample of study participants, we assessed multimorbidity based on either 17 or 15 chronic conditions. The multimorbidity measure based on 17 chronic conditions was the primary multimorbidity outcome assessed. It was only available in the subsample of study participants selected for blood testing. The multimorbidity measure based on 15 chronic conditions excluded anemia and diabetes and was thus available for the full study sample. Both multimorbidity measures were treated as missing data when data on one or more chronic conditions was missing.

Data Analysis

Characteristics of the study participants were summarized using descriptive statistics. We report the median and interquartile range (IQR) for continuous variables and the number and percentage of observations in a category for categorical variables. Statistical differences between male and female study participants were assessed using the Wilcoxon rank-sum test for continuous variables and the Pearson's χ^2 test for categorical variables. The sample prevalence for each chronic condition and multimorbidity was estimated as a proportion with logit-transformed confidence intervals. Tests on the equality of proportions used large-sample statistics. Tetrachoric correlation was used to analyze pairwise correlations between chronic conditions and multimorbidity. For each sex, the relationships of chronic conditions and multimorbidity with age were assessed using point biserial correlation and Epanechnikov kernel-weighted local polynomial regression graphs. The relationships of chronic conditions and multimorbidity with sex and age were further assessed using univariable and multivariable logistic regressions. The multivariable regressions included sex and age together and adjusted for religion, marital status, number of children, literacy, formal education, work status, availability of food, and the location of the dwelling. We rescaled age to 10-year increments to better reflect longer term developments in the regression results. Odds ratios of age (ORs) therefore express changes per 10 years. Standard errors were estimated using the Huber-White sandwich estimator. Statistical significance was assumed for $p < 0.05$. All analyses were conducted in Stata/SE 18.5.

Ethical Considerations

The institutional review boards of the Muhimbili University of Health and Allied Sciences in Tanzania (2015-04-22/AEC/Vol.IX/82) and the Harvard T.H. Chan School of Public Health in the United States (14-4282) approved the study. Participants gave written informed consent to participate in the study before interviews and, where applicable, again before blood collection and testing.

RESULTS

Sample Characteristics

Our study sample of 2,246 participants aged ≥40 years included 32.0% men and 68.0% women. About half of the study participants (48.3%) were 40–49 years old and about one-quarter (27.0%) were 50–59 years old. About one-quarter (24.7%) had reached or surpassed the retirement age of 60 years. Almost all study participants (98.9%) were of Tanzanian origin. About half (54.4%) stated to be Muslim and about half (45.6%) to be Christian. Being married or cohabitant (70.8%) and having children (97.1%) was common. Most study participants could read and/or write (83.8%) and attended less than 7 years or no formal education (77.6%). Almost half (48.8%) of the study participants experienced food insecurity at home due to a lack of money at least once in the past year (**Table 1**).

Women had a median age of 49 years (IQR: 43–57) and were younger than men who had a median age of 54 years (IQR: 46–63; $p < 0.001$). Men were more often than women married or cohabitant, had ≥3 children, any literacy, or attended formal education (all $p \leq 0.002$). Women were more often than men working as homemaker or otherwise and were affected by food insecurity in the past year

TABLE 1 | Sociodemographic characteristics and health status of ≥40-year-old study participants (Dar es Salaam, Tanzania, 2024).

	Total	Male	Female	*p*
	N ≤ 2,246	N ≤ 718	N ≤ 1,528	
Socioeconomic characteristics				
Age (years)	50 (44–59)	54 (46–63)	49 (43–57)	<0.001
Age group (40–49 years)	1,084 (48.3)	276 (38.4)	808 (52.9)	<0.001
50–59 years	607 (27.0)	199 (27.7)	408 (26.7)	
60–69 years	368 (16.4)	157 (21.9)	211 (13.8)	
≥70 years	187 (8.3)	86 (12.0)	101 (6.6)	
Country of origin (Tanzania)	2,222 (98.9)	709 (98.7)	1,513 (99.0)	0.56
Other	24 (1.1)	9 (1.3)	15 (1.0)	
Religion (Islam)	1,215 (54.1)	384 (53.5)	831 (54.4)	0.69
Christianity	1,031 (45.9)	334 (46.5)	697 (45.6)	
Marital status (married or cohabitant)	1,591 (70.8)	629 (87.6)	962 (63.0)	<0.001
Widowed	389 (17.3)	42 (5.8)	347 (22.7)	
Never married or separated	266 (11.8)	47 (6.5)	219 (14.3)	
Number of children (none)	65 (2.9)	15 (2.1)	50 (3.3)	0.002
1–2	505 (22.5)	133 (18.5)	372 (24.3)	
≥3	1,676 (74.6)	570 (79.4)	1,106 (72.4)	
Can read and/or write	1882 (83.8)	659 (91.8)	1,223 (80.0)	
Formal education (0–6 years)	1742 (77.6)	487 (67.8)	1,255 (82.1)	<0.001
7–10 years	111 (4.9)	55 (7.7)	56 (3.7)	
≥10 years	393 (17.5)	176 (24.5)	217 (14.2)	
Work status (homemaker)	768 (34.2)	91 (12.7)	677 (44.3)	<0.001
Working	1,041 (46.3)	417 (58.1)	624 (40.8)	
Not working	437 (19.5)	210 (29.2)	227 (14.9)	
No food in house, past year (never)	1,150 (51.2)	415 (57.8)	735 (48.1)	<0.001
Rarely (once or twice)	637 (28.4)	190 (26.5)	447 (29.3)	
Sometimes (3–10 times)	173 (7.7)	42 (5.8)	131 (8.6)	
Often (>10 times)	286 (12.7)	71 (9.9)	215 (14.1)	
Ward and area (Ukonga, Markaz)	119 (5.3)	30 (4.2)	89 (5.8)	0.48
Ukonga, Mazizini	384 (17.1)	119 (16.6)	265 (17.3)	
Ukonga, Mongolandege	213 (9.5)	69 (9.6)	144 (9.4)	
Ukonga, Mwembe Madafu	528 (23.5)	184 (25.6)	344 (22.5)	
Gongolamboto, Gongolamboto	290 (12.9)	97 (13.5)	193 (12.6)	
Gongolamboto, Guluka Kwalala	216 (9.6)	68 (9.5)	148 (9.7)	
Gongolamboto, Ulongoni	496 (22.1)	151 (21.0)	345 (22.6)	
Health status				
Health today (good or very good), N = 2,244	850 (37.9)	312 (43.5)	538 (35.3)	<0.001
Moderate	1,171 (52.2)	338 (47.1)	833 (54.6)	
Bad or very bad	223 (9.9)	68 (9.5)	155 (10.2)	
Limitations in activities of daily living, N = 2,233	377 (16.9)	92 (12.9)	285 (18.7)	<0.001

N = 2,246 unless noted otherwise. Median (IQR) or n (%).

(both $p < 0.001$). Similar portions of men (9.5%) and women (10.2%) reported a bad or very bad health status on the study day, but good or very good health was more frequently reported by men (43.5%) than women (35.3%; $p < 0.001$). Fewer men than women reported one or more limitations in activities of daily living (12.9% versus 18.7%; $p < 0.001$).

Prevalence of Chronic Conditions and Multimorbidity Across Sexes and Age Groups

Among the ≥40-year-old study participants, 93.9% (95% CI: 92.1–95.3) had one or more chronic conditions. The prevalence of multimorbidity was 73.7% (95% CI: 70.7–76.4) when anemia and diabetes were considered. The prevalence of multimorbidity without anemia and diabetes was 58.5% (95% CI: 56.3–60.6). Between half and every 10th study participant screened positive for one or more of the seven most common chronic conditions. These were hypertension (51.3%, 95% CI: 49.2–53.4), anemia (34.1%, 95% CI: 31.2–37.2), obesity (32.2%, 95% CI: 30.3–34.2), diabetes (31.6%, 95% CI: 28.7–34.5), depressive symptoms (31.5%, 95% CI: 29.6–33.5), low grip strength (21.2%, 95% CI: 19.5–23.0), and ischemic heart disease (11.9%, 95% CI: 10.6–13.3). Signs of alcohol problems were found in 7.7% (95% CI: 6.7–8.9), signs of cognitive problems in 6.6% (95% CI: 5.6–7.7), and HIV infection in 5.1% (95% CI: 4.2–6.1) of the study participants. The seven least prevalent chronic conditions, which affected every 20th or fewer study participants, were high cholesterol (5.0%, 95% CI: 4.2–6.0), tuberculosis (4.8%, 95% CI: 4.0–5.8), stroke (4.8%, 95% CI: 4.0–5.8), current smoking (4.5%, 95% CI: 3.7–5.4), underweight (4.3%, 95% CI: 3.5–5.2), chronic cough (3.3%, 95% CI: 2.6–4.1), and kidney disease (2.9%, 95% CI: 2.3–3.6) (**Table 2**; **Supplementary Table S3**).

TABLE 2 | Prevalence of chronic conditions and multimorbidity among ≥40-year-old study participants (Dar es Salaam, Tanzania, 2024).

Chronic condition	All	Men	Women	*p*	40–59 years	≥60 years	*p*
Hypertension, N = 2,184	51.3 (49.2–53.4)	54.7 (51.0–58.4)	49.7 (47.1–52.2)	0.027	45.2 (42.8–47.6)	69.9 (65.9–73.6)	<0.001
Anemia, N = 984	34.1 (31.2–37.2)	29.1 (24.2–34.5)	36.4 (32.8–40.0)	0.027	33.6 (30.3–37.1)	35.7 (29.9–42.0)	0.562
Obesity, N = 2,141	32.2 (30.3–34.2)	16.1 (13.5–19.0)	39.8 (37.3–42.4)	<0.001	34.3 (32.0–36.6)	25.8 (22.2–29.7)	<0.001
Diabetes, N = 985	31.6 (28.7–34.5)	33.8 (28.6–39.4)	30.6 (27.3–34.2)	0.325	29.8 (26.7–33.2)	36.9 (31.0–43.2)	0.040
Depressive symptoms, N = 2,220	31.5 (29.6–33.5)	29.6 (26.4–33.1)	32.4 (30.1–34.8)	0.192	30.3 (28.1–32.5)	35.5 (31.6–39.7)	0.023
Low grip strength, N = 2,100	21.2 (19.5–23.0)	33.2 (29.8–36.9)	15.6 (13.8–17.5)	<0.001	15.5 (13.8–17.4)	39.2 (35.1–43.6)	<0.001
Ischemic heart disease, N = 2,239	11.9 (10.6–13.3)	6.6 (5.0–8.6)	14.4 (12.8–16.3)	<0.001	10.6 (9.2–12.2)	15.9 (13.1–19.2)	0.001
Signs of alcohol problems, N = 2,234	7.7 (6.7–8.9)	13.0 (10.7–15.7)	5.3 (4.2–6.5)	<0.001	8.1 (6.9–9.5)	6.8 (4.9–9.2)	0.324
Signs of cognitive problems, N = 2,243	6.6 (5.6–7.7)	5.6 (4.1–7.5)	7.0 (5.8–8.4)	0.201	3.4 (2.7–4.4)	16.1 (13.2–19.4)	<0.001
HIV, N = 2,228	5.1 (4.2–6.1)	1.8 (1.1–3.1)	6.6 (5.4–7.9)	<0.001	6.1 (5.0–7.3)	2.0 (1.1–3.6)	<0.001
High cholesterol, N = 2,231	5.0 (4.2–6.0)	3.7 (2.5–5.3)	5.7 (4.6–6.9)	0.044	4.7 (3.8–5.8)	6.0 (4.3–8.4)	0.212
Tuberculosis, N = 2,235	4.8 (4.0–5.8)	4.1 (2.8–5.8)	5.2 (4.2–6.4)	0.244	4.9 (4.0–6.1)	4.6 (3.1–6.7)	0.734
Stroke, N = 2,238	4.8 (4.0–5.8)	4.5 (3.2–6.3)	5.0 (4.0–6.2)	0.603	4.2 (3.3–5.2)	6.9 (5.0–9.3)	0.009
Current smoking, N = 2,234	4.5 (3.7–5.4)	12.2 (10.0–14.8)	0.9 (0.5–1.5)	<0.001	4.1 (3.2–5.1)	5.7 (4.0–8.0)	0.121
Underweight, N = 2,141	4.3 (3.5–5.2)	5.4 (3.9–7.4)	3.7 (2.9–4.8)	0.070	3.6 (2.8–4.7)	6.2 (4.4–8.6)	0.012
Chronic cough (no TB), N = 2,233	3.3 (2.6–4.1)	2.5 (1.6–4.0)	3.6 (2.8–4.7)	0.175	2.7 (2.1–3.6)	4.9 (3.4–7.1)	0.012
Kidney disease, N = 2,231	2.9 (2.3–3.6)	2.1 (1.3–3.5)	3.2 (2.4–4.2)	0.140	2.4 (1.7–3.2)	4.4 (3.0–6.5)	0.014
Multimorbidity (17), N = 915	73.7 (70.7–76.4)	72.2 (66.6–77.3)	74.3 (70.7–77.5)	0.523	70.7 (67.3–74.0)	83.7 (78.0–88.1)	<0.001
Multimorbidity (15), N = 2027	58.5 (56.3–60.6)	56.3 (52.5–60.1)	59.5 (56.9–62.1)	0.178	53.5 (51.0–56.0)	74.9 (70.8–78.6)	<0.001
N	915–2,243	270–717	645–1,526		707–1,689	208–554	

% (#–#) = prevalence (95% logit-transformed confidence intervals), (#) = number of chronic conditions used to assess multimorbidity, TB, tuberculosis. p-*value for test of equality of proportion between groups.*

Prevalence of Chronic Conditions and Multimorbidity by Sex and Age

The prevalence of multimorbidity was similar among men and women irrespectively of whether multimorbidity was assessed based on 17 or 15 chronic conditions. However, the prevalence of the underlying chronic conditions differed between men and women. Hypertension, low grip strength, signs of alcohol problems, and current smoking were more prevalent among men. More prevalent among women were anemia, obesity, signs of ischemic heart disease, HIV, and high cholesterol (all $p \leq 0.044$). The prevalence of multimorbidity was higher among the study participants of or over the retirement age of 60 years (70.7%, 95% CI: 67.3–74.0 versus 83.7%, 95% CI: 78.0–88.1; $p < 0.001$ with 17 chronic conditions and 53.5%, 95% CI: 51.0–56.0 versus 74.9%, 95% CI: 70.8–78.6; $p < 0.001$ with 15 chronic conditions). Across sexes, this increase was driven by a higher prevalence of hypertension, diabetes, depressive symptoms, low grip strength, ischemic heart disease, signs of cognitive problems, stroke, underweight, chronic cough, and kidney disease at older age ($p \leq 0.040$). Only obesity and HIV were less prevalent in the ≥60-year-olds compared to younger participants ($p < 0.001$) (**Table 2**; **Figure 1**; **Supplementary Figures S3, S4**).

Correlation Between Chronic Conditions and Multimorbidity

Pairwise correlations between chronic conditions were often insignificant or low (Tetrachoric correlation r < 0.30). Correlations between chronic conditions and multimorbidity were mostly moderate (r = 0.30–0.50) or strong (r ≥ 0.50). The strongest positive correlations between individual chronic conditions were between signs of alcohol problems and current smoking (r = 0.42), depressive symptoms and ischemic heart disease (r = 0.41), high cholesterol and kidney disease (r = 0.39), obesity and high cholesterol (r = 0.38), HIV and tuberculosis (r = 0.35), current smoking and kidney disease (r = 0.35), hypertension and high cholesterol (r = 0.32), stroke and kidney disease (r = 0.32), tuberculosis and underweight (r = 0.31), signs of alcohol problems and chronic cough (r = 0.30), and smoking and underweight (r = 0.30). The strongest positive correlations (r ≥ 0.50) between individual chronic condition and multimorbidity (based on 17 chronic conditions) occurred for high cholesterol, chronic cough, and kidney disease (all r = 1), ischemic heart disease (r = 0.69), hypertension (r = 0.60), obesity, depressive symptoms (both r = 0.57), and diabetes (r = 0.50) (**Table 3**).

Association of Chronic Conditions and Multimorbidity With Sex and Age

In univariable regressions, women had higher odds than men for HIV (OR = 3.77, 95% CI: 2.10–6.77), obesity (OR = 3.46, 95% CI: 2.75–4.35), ischemic heart disease (OR = 2.40, 95% CI: 1.73–3.33), high cholesterol (OR = 1.58, 95% CI: 1.01–2.47), and anemia (OR = 1.39, 95% CI: 1.04–1.87). Women had lower odds than men for current smoking (OR = 0.06, 95% CI: 0.03–0.11), signs of alcohol problems (OR = 0.37, 95% CI: 0.27–0.51), low grip strength (OR = 0.37, 95% CI: 0.30–0.46), and hypertension (OR = 0.82, 95% CI: 0.68–0.98) (**Table 4** column 1).

Older age (per 10 years) was associated with higher odds of signs of cognitive problems (OR = 2.33, 95% CI: 2.02–2.68), low grip strength (OR = 1.99, 95% CI: 1.80–2.20), hypertension (OR = 1.66, 95% CI: 1.51–1.82), underweight (OR = 1.32, 95% CI: 1.09–1.60), chronic cough (no TB) (OR = 1.32, 95% CI:

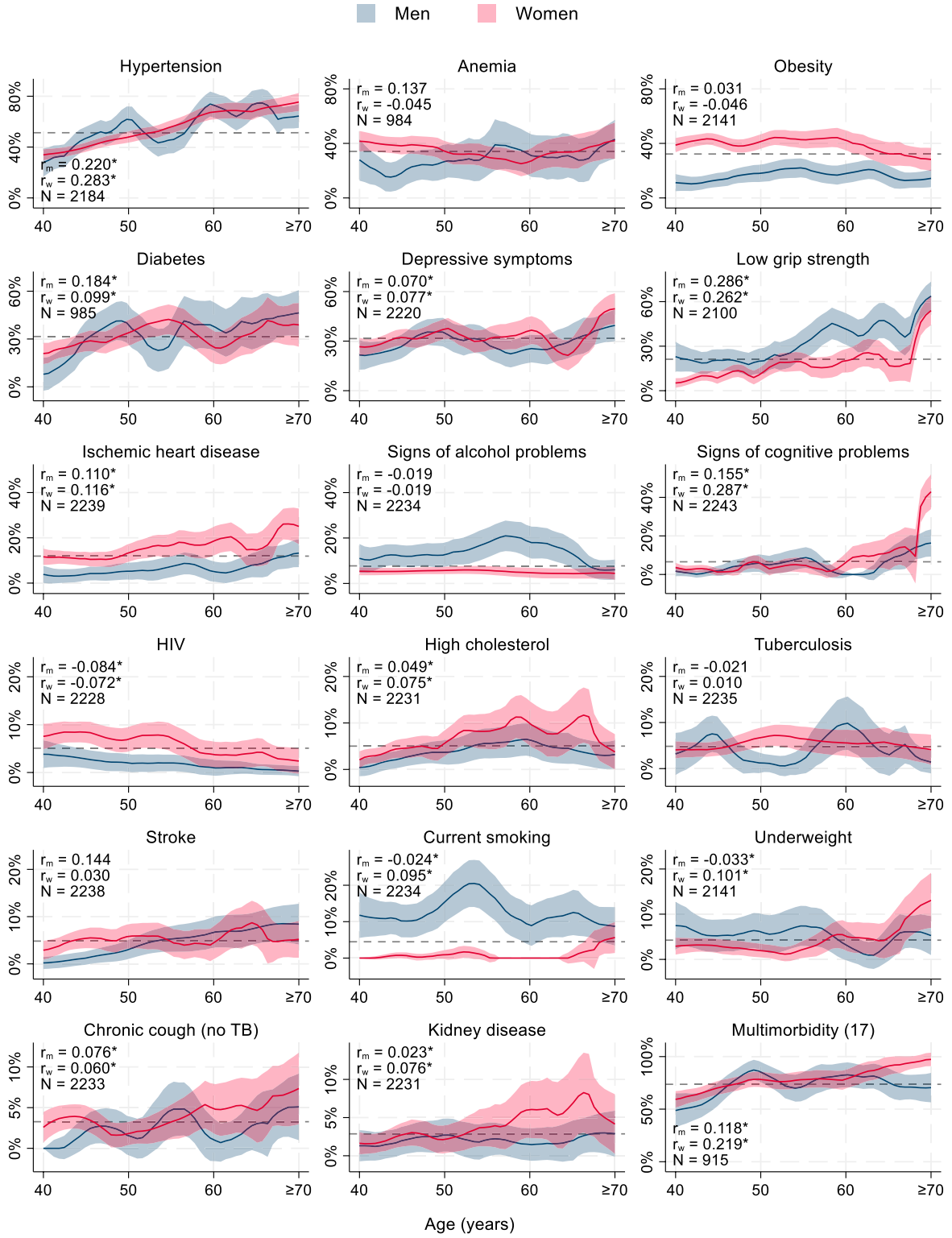


FIGURE 1 | Prevalence of chronic conditions and multimorbidity among ≥40-year-old study participants (Dar es Salaam, Tanzania, 2024) *$p < 0.05$. r = point biserial correlation coefficient of chronic condition and age, m = men, w = women, N = number of observations, dashed line = average prevalence across ages and sexes (#) = number of chronic conditions used to assess multimorbidity, TB = tuberculosis. Epanechnikov kernel-weighted local polynomial regression with 95% confidence intervals. Scale of *y*-axis differs across graphs.

TABLE 3 | Pairwise correlations between chronic conditions and multimorbidity among ≥40-year-old study participants (Dar es Salaam, Tanzania, 2024).

	Hypertension	Anemia	Obesity	Diabetes	Depressive symptoms	Low grip strength	Ischemic heart disease	Signs of alcohol problems	Signs of cognitive problems	HIV	High cholesterol	Tuberculosis	Stroke	Current smoking	Underweight	Chronic cough (no TB)	Kidney disease	Multimorbidity (17)	Multimorbidity (15)
Hypertension	1	–0.17*	0.22*				0.17*				0.32*							0.6*	0.64*
Anemia	–0.17*	1	–0.15*			0.14*				0.25*			0.19*					0.49*	
Obesity	0.22*	–0.15*	1			–0.29*	0.22*				0.38*	–0.24*		–0.35*	–1*	0.24*		0.57*	0.62*
Diabetes	0.06	0.002	0.08	1														0.50*	
Depressive symptoms	0.02	0.09	0.06	–0.02	1	–0.14*	0.41*					0.26*						0.57*	0.57*
Low grip strength	0.05	0.14*	–0.29*	0.11	–0.14*	1			0.28*									0.34*	0.36*
Ischemic heart disease	0.17*	0.14	0.22*	0.04	0.41*	0.06	1		0.27*		0.24*	0.26*	0.22*				0.27*	0.69*	0.69*
Signs of alcohol problems	0.05	0.03	0.09	0.04	–0.11	0.11	0.01	1						0.42*		0.30*		0.46*	0.51*
Signs of cognitive problems	0.07	0.15	–0.07	0.14	0.16	0.28*	0.27*	–0.09	1									0.39*	0.48*
HIV	–0.14	0.25*	–0.09	0.03	0.07	–0.003	0.01	0.15	0.01	1		0.35*						0.47*	0.45*
High cholesterol	0.32*	–0.15	0.38*	0.09	–0.06	–0.09	0.24*	–0.03	–1	0.20	1						0.39*	1*	0.63*
Tuberculosis	–0.05	0.12	–0.24*	–0.17	0.26*	–0.0007	0.26*	–0.27	0.22	0.35*	0.03	1			0.31*			0.44*	0.59*
Stroke	0.06	0.19*	–0.13	0.16	–0.01	0.15	0.22*	0.16	0.06	0.15	0.14	–0.14	1				0.32*	0.42*	0.38*
Current smoking	0.06	0.14	–0.35*	0.03	–0.07	0.07	–0.08	0.42*	–0.06	–0.0008	–1	0.13	–1	1	0.30*		0.35*	0.39*	0.43*
Underweight	–0.12	0.20	–1*	–0.18	0.05	0.16	0.03	0.11	0.22	0.21	–1	0.31*	0.08	0.30*	1				0.30*
Chronic cough (no TB)	0.19	–0.11	0.24*	0.19	0.02	0.10	0.02	0.30*	0.28	–1	–0.08	–1	0.13	0	–1	1		1*	1*
Kidney disease	0.16	0.02	–0.04	–0.01	0.18	0.14	0.27*	–0.16	0.16	0.07	0.39*	0.21	0.32*	0.35*	0.02	0.23	1	1*	1*
Multimorbidity (17)	0.60*	0.49*	0.57*	0.50*	0.57*	0.34*	0.69*	0.46*	0.39*	0.47*	1*	0.44*	0.42*	0.39*	0.22	1*	1*	1	1*
Multimorbidity (15)	0.64*		0.62*		0.57*	0.36*	0.69*	0.51*	0.48*	0.45*	0.63*	0.59*	0.38*	0.43*	0.30*	1*	1*	1*	1

N = 915–2,243. *p < 0.05. *R = tetrachoric correlation coefficient, (#) = number of chronic conditions used to assess multimorbidity, TB, tuberculosis. Only significant correlations are displayed in the upper right panel.*

TABLE 4 | Relationships of chronic conditions with age and sex among ≥40-year-old study participants (Dar es Salaam, Tanzania, 2024).

Chronic condition	Univariable regressions	Univariable regressions	Multivariable regressions	
	Female	Age (10 years)	Female	Age (10 years)
Hypertension, N = 2,184	0.82 (0.68–0.98)*	1.66 (1.51–1.82)*	0.86 (0.69–1.07)	1.52 (1.36–1.70)*
Anemia, N = 984	1.39 (1.04–1.87)*	1.03 (0.91–1.17)	1.35 (0.96–1.90)	0.98 (0.84–1.14)
Obesity, N = 2,141	3.46 (2.75–4.35)*	0.85 (0.78–0.92)*	4.16 (3.23–5.36)*	0.94 (0.85–1.05)
Diabetes, N = 985	0.86 (0.65–1.16)	1.27 (1.12–1.43)*	0.97 (0.69–1.38)	1.25 (1.07–1.46)*
Depressive symptoms, N = 2,220	1.14 (0.94–1.38)	1.17 (1.08–1.27)*	1.15 (0.90–1.46)	1.03 (0.92–1.15)
Low grip strength, N = 2,100	0.37 (0.30–0.46)*	1.99 (1.80–2.20)*	0.33 (0.25–0.44)*	1.81 (1.59–2.05)*
Ischemic heart disease, N = 2,216	2.40 (1.73–3.33)*	1.26 (1.13–1.40)*	3.08 (2.10–4.53)*	1.21 (1.05–1.39)*
Signs of alcohol problems, N = 2,234	0.37 (0.27–0.51)*	0.99 (0.87–1.13)	0.33 (0.23–0.49)*	0.89 (0.74–1.08)
Signs of cognitive problems, N = 2,243	1.28 (0.88–1.86)	2.33 (2.02–2.68)*	0.99 (0.59–1.66)	1.69 (1.40–2.03)*
HIV, N = 2,228	3.77 (2.10–6.77)*	0.62 (0.50–0.76)*	1.89 (0.99–3.61)	0.51 (0.39–0.68)*
High cholesterol, N = 2,208	1.58 (1.01–2.47)*	1.18 (1.05–1.34)*	2.08 (1.26–3.44)*	1.24 (1.01–1.51)*
Tuberculosis, N = 2,235	1.29 (0.84–2.00)	0.95 (0.81–1.11)	1.40 (0.85–2.32)	0.81 (0.65–1.01)
Stroke, N = 2,238	1.12 (0.73–1.71)	1.22 (1.06–1.41)*	1.11 (0.69–1.80)	1.10 (0.91–1.32)
Current smoking, N = 2,234	0.06 (0.03–0.11)*	1.30 (1.11–1.51)*	0.04 (0.02–0.07)*	1.16 (0.94–1.43)
Underweight, N = 2,120	0.67 (0.44–1.04)	1.32 (1.09–1.60)*	0.45 (0.27–0.76)*	1.12 (0.87–1.44)
Chronic cough (no TB), N = 2,233	1.45 (0.84–2.49)	1.32 (1.09–1.59)*	1.48 (0.79–2.79)	1.27 (1.00–1.60)*
Kidney disease, N = 2,166	1.55 (0.86–2.78)	1.26 (1.06–1.51)*	1.87 (0.94–3.73)	1.34 (1.01–1.79)*
Multimorbidity (17), N = 915	1.11 (0.81–1.53)	1.57 (1.31–1.89)*	1.07 (0.74–1.54)	1.39 (1.11–1.75)*
Multimorbidity (15), N = 2027	1.14 (0.94–1.38)	1.71 (1.54–1.90)*	1.26 (1.00–1.58)*	1.54 (1.35–1.75)*
Pseudo R^2	0.0003–0.169	0.000008–0.148	0.031–0.250	

*p < 0.05. OR (#–#) = odds ratio (95% confidence interval), (#) = number of chronic conditions used to assess multimorbidity, TB, tuberculosis. The multivariable regressions included sex and age and adjusted for religion, marital status, number of children, literacy, formal education, work status, availability of food, and the area of the dwelling.

1.09–1.59), current smoking (OR = 1.30, 95% CI: 1.11–1.51), diabetes (OR = 1.27, 95% CI: 1.12–1.43), ischemic heart disease (OR = 1.26, 95% CI: 1.13–1.40), kidney disease (OR = 1.26, 95% CI: 1.06–1.51), stroke (OR = 1.22, 95% CI: 1.06–1.41), high cholesterol (OR = 1.18, 95% CI: 1.05–1.34), depressive symptoms (OR = 1.17, 95% CI: 1.08–1.27), and multimorbidity (OR = 1.57, 95% CI: 1.31–1.89 based on 17 chronic conditions, or OR = 1.71, 95% CI: 1.54–1.90 based on 15 chronic conditions). Older age was associated with lower odds of HIV (OR = 0.62, 95% CI: 0.50–0.76) and obesity (OR = 0.85, 95% CI: 0.78–0.92) (**Table 4** column 2).

In multivariable regressions which included sex, age, and other socioeconomic characteristics, women had higher odds than men for obesity (adjusted OR = 4.16, 95% CI: 3.23–5.36), ischemic heart disease (adjusted OR = 3.08, 95% CI: 2.10–4.53), high cholesterol (adjusted OR = 2.08, 95% CI: 1.26–3.44), and multimorbidity based on 15 chronic conditions (adjusted OR = 1.26, 95% CI: 1.00–1.58). Women had lower odds than men for underweight (adjusted OR = 0.45, 95% CI: 0.27–0.76), low grip strength (adjusted OR = 0.33, 95% CI: 0.25–0.44), signs of alcohol problems (adjusted OR = 0.33, 95% CI: 0.23–0.49), and smoking (adjusted OR = 0.04, 95% CI: 0.02–0.07). Older age was associated with higher odds (per 10 years) of low grip strength (adjusted OR = 1.81, 95% CI: 1.59–2.05), signs of cognitive problems (adjusted OR = 1.69, 95% CI: 1.40–2.03), hypertension (adjusted OR = 1.52, 95% CI: 1.36–1.70), kidney disease (adjusted OR = 1.34, 95% CI: 1.01–1.79), chronic cough (no TB) (adjusted OR = 1.27, 95% CI: 1.00–1.60), diabetes (adjusted OR = 1.25, 95% CI: 1.07–1.46), high cholesterol (adjusted OR = 1.24, 95% CI: 1.01–1.51), ischemic heart disease (adjusted OR = 1.21, 95% CI: 1.05–1.39), and multimorbidity (adjusted OR = 1.39, 95% CI: 1.11–1.75 based on 17 chronic conditions and adjusted OR = 1.54, 95% CI: 1.35–1.75 based on 15 chronic conditions). Older age (per 10 years) was associated with lower odds of HIV (adjusted OR = 0.51, 95% CI: 0.39–0.68). Sex ceased to be associated with HIV, anemia, and hypertension after adjusting for age and other socioeconomic characteristics. In turn, women had lower odds of underweight and higher odds of multimorbidity (based on 15 chronic conditions without anemia and diabetes) after adjusting for age and other socioeconomic characteristics. Age ceased to be associated with underweight, smoking, stroke, depressive symptoms, and obesity after adjusting for sex and other socioeconomic characteristics (**Table 4** columns 3–4).

DISCUSSION

Main Findings of This Study

Multimorbidity based on 17 chronic conditions affected 73.7% of the ≥40-year-old study participants living in the peri-urban Ukonga and Gongolamboto wards of Dar es Salaam. Multimorbidity was associated with age and 83.7% of the ≥60-year-old study participants had multiple chronic conditions. After adjusting for other socioeconomic characteristics, women had higher odds of obesity, ischemic heart disease, and high cholesterol and they had lower odds of underweight, low grip strength, alcohol problems, and smoking. Age was associated with higher adjusted odds of low grip strength, cognitive problems, hypertension, kidney disease chronic cough, diabetes, high cholesterol, ischemic heart disease, and multimorbidity and with lower adjusted odds of HIV infection.

What Is Already Known

Previous estimates of multimorbidity of non-communicable diseases in low-income countries in sub-Saharan Africa were variable and mostly lower than our estimates [6–9]. A cross-sectional, population-based study in rural and urban Malawi reported that 1%–4% of men and 4%–7% of women had combinations of hypertension, diabetes, and obesity [29]. A cross-country study using the World Health Surveys (WHS) reported a prevalence of multimorbidity of 3.6% in Ghana, 4.2% in Kenya, 6.3% in Burkina Faso, and 7.9% in Namibia [30]. A cross-sectional study among adults in Botswana estimated a multimorbidity prevalence of 5.4% [31]. The Study on global AGEing and adult health (SAGE) reported 22% multimorbidity in a population-based sample from Ghana [32]. A cross-sectional study among community-dwelling people aged ≥60 in Burkina Faso found a multimorbidity prevalence of 65% [33]. Another study reported a 17.8% prevalence of non-communicable chronic diseases among ≥18-year-old hospital patients in Ethiopia [34].

Considering both communicable and non-communicable diseases, multimorbidity was estimated in 28.7% of the people living in two urban slums in Nairobi [35], in 15.3% of adults living with HIV in Zimbabwe [36], in 38.8% of patients of an urban clinic in Ghana [37], in 59.1% of elderly hospital patients in Ethiopia [38], and in 49% of elderly hospital patients in Nigeria [39]. A cross-country study of adults in six urban and rural centers in Ghana, Burkina Faso, Kenya, and South Africa reported a multimorbidity prevalence of 20.2%–51.7% among men and 24.1%–64.9% among women [10]. A previous study in five rural villages in northern Tanzania in 2017 found a prevalence of multimorbidity of 26.1% when chronic conditions were self-reported and 67.3% when chronic conditions were assessed through clinician diagnosis, screening tools, and blood pressure measurement [15]. A study among people living with HIV, diabetes, and/or hypertension in Tanzania or Uganda reported a multimorbidity prevalence of 25.6% [16].

Previous studies of the same sample of ≥40-year-old people in peri-urban Dar es Salaam reported a multimorbidity prevalence of 25.3% [12], 61.1% [13], and 73.8% (95% CI: 71.2–76.3) for women only [14]. Differences in multimorbidity estimates in the same sample result from assessing fewer chronic conditions (8, 13, and 15, respectively) and/or using only self-report [12] in the assessment of chronic conditions. Across studies, older adults were consistently more likely to have multimorbidity [12, 14, 29–37]. Several previous studies further reported that women were more likely multimorbid than man [12, 29–32, 35–37].

What This Study Adds

Multimorbidity has been called a priority for global health research [40]. A recent systematic review and meta-analysis estimated a pooled multimorbidity prevalence of 28.2% (95% CI: 15.6–40.8) in sub-Saharan Africa and conjectured that this low estimate could indicate high levels of undiagnosed chronic illness in this region [7]. We studied multimorbidity in a ≥40-year-old population based on assessing either 17 or 15 chronic conditions through a combination of self-report, measurement, and screening instruments. We estimated a prevalence of multimorbidity that is higher than previous estimates for sub-Saharan Africa and among the highest estimates that have been reported for low-income and middle-income countries [6]. Our estimate is consistent with a suspected large gap in diagnosing multimorbidity. Even more, finding 70.7% multimorbidity among the 40–59-year-old study participants and 83.7% multimorbidity among the ≥60-year-old study participants suggests that already most middle-aged people living in peri-urban Dar es Salaam and similar settings might benefit from a broad health assessment and subsequent care for multiple health conditions. Our findings further indicate that a broad assessment of chronic conditions can help detect different patterns of multimorbidity, as the chronic conditions determining multimorbidity differ between men and women. For instance, we estimated an association between multimorbidity and being a woman only when multimorbidity was assesses based on 15 chronic conditions without anemia and diabetes.

Practical Implications

Past studies have identified gaps in the preparedness of health facilities in Tanzania to treat non-communicable diseases such as hypertension and diabetes [41, 42]. A community-based survey from South Africa indicated that 93% of participants who screened positive for diabetes and 58% who screened positive for hypertension had unmet health needs [43]. We found hypertension and diabetes to be the most common and fourth most common chronic conditions, respectively. The study at hand further indicates that multiple chronic conditions are likely to be present among peri-urban dwellers in Tanzania aged ≥40-years. These findings underscore the scale of the challenge to develop care structures for multiple chronic conditions, especially for multiple non-communicable diseases, and broad health assessments for aging people in sub-Saharan Africa.

Approaches to caring for multiple chronic conditions may entail the integration of health programs for single diseases. A study, which piloted integrated HIV, diabetes, and hypertension care in ten health facilities offering primary care in Dar es Salaam and Kampala, has concluded that integrated management of chronic diseases is a feasible strategy [44]. A systematic review and meta-analysis on the effectiveness of integrated chronic care models in sub-Saharan Africa found positive effects on systolic blood pressure and mixed results for other health outcomes [45]. Expanding integrated care programs seems needed globally and continues to require addressing knowledge gaps, for instance, on joint care for communicable and non-communicable diseases [46], the costs of multimorbidity in low- and middle income countries [47], and the components making integrated care for multiple chronic conditions effective and cost-effective in Tanzania and other sub-Saharan African countries.

Strengths and Limitations

Strengths of this study include, first, that a wide range of chronic conditions was assessed in a general population. Second, we emphasized sensitivity in our assessment of chronic conditions by combining measurement, screening instruments, and self-report of chronic conditions. Third, we assessed multimorbidity and underlying chronic conditions by sex and age. Limitations of this study include, first, that the screening instruments have not been validated in our study population. Second, we used different approaches to assess chronic conditions, namely, self-reporting, screening instruments, and measurement. Seven chronic conditions

were based only on self-report, which can be more prone to errors and bias than the use of screening instruments or measurement. Third, we used lifetime measures to assess the presence of chronic conditions. It is possible that certain conditions were no longer present at the time of data collection. Fourth, our study is likely affected by a selection bias, as only 2,299 of the randomly selected 4,840 individuals participated in the study and only 1,024 of 2,420 selected individuals agreed to undergo blood testing. Men were included less often than women in the study. People with few chronic conditions, who worked further away, or with severe comorbidities might have been less likely to participate in the study. We aimed to account for selective participation and non-responses by stratifying descriptive analyses by sex and age and by adjusting for sex, age, and other socioeconomic characteristics in the regression analyses. Fifth, it remains unknown how the prevalence of chronic conditions in the Dar es Salaam Urban Cohort Study (DUCS) population, from which we sampled, compares to other peri-urban or urban populations in Tanzania and elsewhere. Sixth, the study was conducted in 2017/18. The COVID-19 pandemic and other factors could have caused changes in the prevalence of chronic conditions. Seventh, multiple comparisons may have inflated the number of significant findings. Finally, the cross-sectional study design was not suitable to assess causal relationships.

Conclusion

The comprehensive assessment of chronic conditions and multimorbidity in this study suggests that multiple chronic conditions affect most middle-aged and elderly people in Tanzania. The prevalence of multimorbidity among ≥40-year-old peri-urban dwellers was higher than estimates for sub-Saharan Africa from previous studies. The estimated multimorbidity prevalence of 73.7% suggests a substantial need for the care and prevention of multimorbidity and chronic conditions in Tanzania. Sex and age differences in the prevalence of chronic conditions indicate that women and men have different causes of multimorbidity across the age spectrum that might require different screening, treatment, and preventive care.

DATA AVAILABILITY STATEMENT

The data and code supporting the findings of this study are openly available in Harvard Dataverse at https://doi.org/10.7910/DVN/9EH23J and heiDATA at https://doi.org/10.11588/data/VVKWZK, respectively.

ETHICS STATEMENT

The study was approved by the Muhimbili University of Health and Allied Sciences in Tanzania (2015-04-22/AEC/Vol.IX/82) and the Harvard T. H. Chan School of Public Health in the United States (14-4282). The study was conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

SK conducted the data analysis. SK and NP wrote the manuscript. TB, JK, and JKR acquired funding for data collection. GHL, PK, and JK led study implementation activities. All authors contributed intellectual content to the article and approved the submitted version.

FUNDING

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. Research reported in this publication was supported by the National Institute on Aging of the National Institutes of Health under Award Number P30AG024409.

CONFLICT OF INTEREST

The authors declare that they do not have any conflicts of interest.

ACKNOWLEDGMENTS

The authors acknowledge financial support for the publishing fee by Heidelberg University. LMS further acknowledges support by the Else Kröner-Fresenius-Stiftung within the Heidelberg Graduate School of Global Health.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.ssph-journal.org/articles/10.3389/ijph.2024.1606387/full#supplementary-material

REFERENCES

1. GBD 2019 Diseases and Injuries Collaborators. Global Burden of 369 Diseases and Injuries in 204 Countries and Territories, 1990-2019: A Systematic Analysis for the Global Burden of Disease Study 2019. *Lancet* (2020) 396(10258):1204–22. doi:10.1016/S0140-6736(20)30925-9
2. Li Z, Shi J, Wang M, Jin Y, Zheng ZJ. Temporal Trends in the Burden of Non-Communicable Diseases in Countries With the Highest Malaria Burden, 1990-2019: Evaluating the Double Burden of Non-Communicable and Communicable Diseases in Epidemiological Transition. *Glob Health* (2022) 18(1):90. doi:10.1186/s12992-022-00882-w
3. Gouda HN, Charlson F, Sorsdshl K, Ahmadzada S, Ferrari AJ, Erskine H, et al. Burden of Non-Communicable Diseases in Sub-Saharan Africa, 1990–2017: Results from the Global Burden of Disease Study 2017. *Lancet Glob Health* (2019) 7(10):e1375–e1387.
4. Reuter A, Bärnighausen T, Kohler S. Global Ageing and Health. In: Bloom DE, Sousa-Poza A, Sunde U, editors. *The Routledge Handbook of the Economics of Ageing*. London: Routledge (2023). p. 657–70.
5. United Nations. *Department of Economic and Social Affairs Population Division, World Population Prospects 2022* (2023). Available from: https://population.un.org/wpp/ (Accessed June 15, 2024).
6. Asogwa OA, Boateng D, Marzà-Florensa A, Peters S, Levitt N, van Olmen J, et al. Multimorbidity of Non-Communicable Diseases in Low-Income and

Middle-Income Countries: A Systematic Review and Meta-Analysis. *BMJ Open* (2022) 12(1):e049133. doi:10.1136/bmjopen-2021-049133
7. Chowdhury SR, Chandra Das D, Sunna TC, Beyene J, Hossain A. Global and Regional Prevalence of Multimorbidity in the Adult Population in Community Settings: A Systematic Review and Meta-Analysis. *eClinicalMedicine* (2023) 57: 101860. doi:10.1016/j.eclinm.2023.101860
8. Roomaney RA, van Wyk B, Turawa EB, Pillay-van Wyk V. Multimorbidity in South Africa: Asystematic Review of Prevalence Studies. *BMJ Open* (2021) 11(10):e048676. doi:10.1136/bmjopen-2021-048676
9. Ho IS, Azcoaga-Lorenzo A, Akbari A, Davies J, Hodgins P, Khunti K, et al. Variation in the Estimated Prevalence of Multimorbidity: Systematic Review and Meta-Analysis of 193 International Studies. *BMJ Open* (2022) 12(4): e057017. doi:10.1136/bmjopen-2021-057017
10. Micklesfield LK, Munthali R, Agongo G, Asiki G, Boua P, Choma SS, et al. Identifying the Prevalence and Correlates of Multimorbidity in Middle-Aged Men and Women: A Cross-Sectional Population-Based Study in Four African Countries. *BMJ Open* (2023) 13(3):e067788. doi:10.1136/bmjopen-2022-067788
11. World Bank. *World Development Indicators: The World by Income and Region* (2024). Available from: https://datatopics.worldbank.org/world-development-indicators/the-world-by-income-and-region.html (Accessed June 15, 2024).
12. Tomita A, Leyna GH, Kim HY, Moodley Y, Mpolya E, Mogeni P, et al. Patterns of Multimorbidity and Their Association With Hospitalisation: A Population-Based Study of Older Adults in Urban Tanzania. *Age Ageing* (2021) 50(4): 1349–60. doi:10.1093/ageing/afab046
13. Stieglitz L-M, Adams LB, Bärnighausen T, Berghöfer A, Kazonda P, Killewo J, et al. Depressive Symptoms and Their Association With Age, Chronic Conditions and Health Status Among Middle-Aged and Elderly People in Peri-Urban Tanzania. *Cambridge Prisms: Glob Ment Health* (2023) 10:e27. doi:10.1017/gmh.2023.17
14. Stieglitz LM, Bärnighausen T, Leyna GH, Kazonda P, Killewo J, Rohr JK, et al. Patterns of Comorbidity and Multimorbidity Among Middle-Aged and Elderly Women in Peri-Urban Tanzania. *J Multimorbidity Comorbidity* (2022) 12:26335565221076254. doi:10.1177/26335565221076254
15. Lewis EG, Gray WK, Walker R, Urasa S, Witham M, Dotchin C. Multimorbidity and Its Socio-Economic Associations in Community-Dwelling Older Adults in Rural Tanzania; a Cross-Sectional Study. *BMC Public Health* (2022) 22(1):1918. doi:10.1186/s12889-022-14340-0
16. Shiri T, Birungi J, Garrib AV, Kivuyo SL, Namakoola I, Mghamba J, et al. Patient and Health Provider Costs of Integrated HIV, Diabetes and Hypertension Ambulatory Health Services in Low-Income Settings - an Empirical Socio-Economic Cohort Study in Tanzania and Uganda. *BMC Med* (2021) 19(1):230. doi:10.1186/s12916-021-02094-2
17. Leyna GH, Berkman LF, Njelekela MA, Kazonda P, Irema K, Fawzi W, et al. Profile: The Dar Es Salaam Health and Demographic Surveillance System (Dar Es Salaam HDSS). *Int J Epidemiol* (2017) 46(3):801–8. doi:10.1093/ije/dyw324
18. HAALSI. *Health and Aging in Africa: A Longitudinal Study in South Africa* (2023). Available from: https://haalsi.org/ (Accessed June 15, 2024).
19. Sullivan KM, Mei Z, Grummer-Strawn L, Parvanta I. Haemoglobin Adjustments to Define Anaemia. *Trop Med Int Health* (2008) 13(10): 1267–71. doi:10.1111/j.1365-3156.2008.02143.x
20. World Health Organization. *Haemoglobin Concentrations for the Diagnosis of Anaemia and Assessment of Severity. Vitamin and Mineral Nutrition Information System*. Geneva: World Health Organization (2011).
21. Cruz-Jentoft AJ, Bahat G, Bauer J, Boirie Y, Bruyère O, Cederholm T, et al. Sarcopenia: Revised European Consensus on Definition and Diagnosis. *Age Ageing* (2019) 48(1):601–31. doi:10.1093/ageing/afz046
22. Rose GA. The Diagnosis of Ischaemic Heart Pain and Intermittent Claudication in Field Surveys. *Bull World Health Organ* (1962) 27:645–58.
23. Rose G, McCartney P, Reid DD. Self-Administration of a Questionnaire on Chest Pain and Intermittent Claudication. *Br J Prev Soc Med* (1977) 31(1): 42–8. doi:10.1136/jech.31.1.42
24. Radloff LS. The CES-D Scale: A Self-Report Depression Scale for Research in the General Population. *Appl Psychol Meas* (1977) 1(3):385–401. doi:10.1177/014662167700100306
25. Andresen EM, Malmgren JA, Carter WB, Patrick DL. Screening for Depression in Well Older Adults: Evaluation of a Short Form of the CES-D. *Am J Prev Med* (1994) 10(2):77–84. doi:10.1016/s0749-3797(18)30622-6
26. Ewing JA. Detecting Alcoholism: The CAGE Questionnaire. *JAMA* (1984) 252(14):1905–7. doi:10.1001/jama.252.14.1905
27. Kobayashi LC, Glymour MM, Kahn K, Payne CF, Wagner RG, Montana L, et al. Childhood Deprivation and Later-Life Cognitive Function in a Population-Based Study of Older Rural South Africans. *Soc Sci Med* (2017) 190:20–8. doi:10.1016/j.socscimed.2017.08.009
28. Kobayashi LC, Mateen FJ, Montana L, Wagner RG, Kahn K, Tollman SM, et al. Cognitive Function and Impairment in Older, Rural South African Adults: Evidence From "Health and Aging in Africa: A Longitudinal Study of an INDEPTH Community in Rural South Africa. *Neuroepidemiology* (2019) 52(1-2):32–40. doi:10.1159/000493483
29. Price AJ, Crampin AC, Amberbir A, Kayuni-Chihana N, Musicha C, Tafatatha T, et al. Prevalence of Obesity, Hypertension, and Diabetes, and Cascade of Care in Sub-Saharan Africa: A Cross-Sectional, Population-Based Study in Rural and Urban Malawi. *Lancet Diabetes Endocrinol* (2018) 6(3):208–22. doi:10.1016/S2213-8587(17)30432-1
30. Afshar S, Roderick PJ, Kowal P, Dimitrov BD, Hill AG. Multimorbidity and the Inequalities of Global Ageing: A Cross-Sectional Study of 28 Countries Using the World Health Surveys. *BMC Public Health* (2015) 15(1):776. doi:10.1186/s12889-015-2008-7
31. Keetile M, Navaneetham K, Letamo G. Prevalence and Correlates of Multimorbidity Among Adults in Botswana: A Cross-Sectional Study. *PLoS One* (2020) 15(9):e0239334. doi:10.1371/journal.pone.0239334
32. Arokiasamy P, Uttamacharya U, Jain K, Biritwum RB, Yawson AE, Wu F, et al. The Impact of Multimorbidity on Adult Physical and Mental Health in Low- and Middle-Income Countries: What Does the Study on Global Ageing and Adult Health (SAGE) Reveal? *BMC Med* (2015) 13(1):178. doi:10.1186/s12916-015-0402-8
33. Hien H, Berthé A, Drabo MK, Meda N, Konaté B, Tou F, et al. Prevalence and Patterns of Multimorbidity Among the Elderly in Burkina Faso: Cross-Sectional Study. *Trop Med Int Health* (2014) 19(11):1328–33. doi:10.1111/tmi.12377
34. Woldesemayat EM, Kassa A, Gari T, Dangisso MH. Chronic Diseases Multi-Morbidity Among Adult Patients at Hawassa University Comprehensive Specialized Hospital. *BMC Public Health* (2018) 18(1):352. doi:10.1186/s12889-018-5264-5
35. Mohamed SF, Haregu TN, Uthman OA, Khayeka-Wandabwa C, Muthuri SK, Asiki G, et al. Multimorbidity From Chronic Conditions Among Adults in Urban Slums: The AWI-Gen Nairobi Site Study Findings. *Glob Heart* (2021) 16:6. doi:10.5334/gh.771
36. Magodoro IM, Esterhuizen TM, Chivese T. A Cross-Sectional, Facility Based Study of Comorbid Non-Communicable Diseases Among Adults Living With HIV Infection in Zimbabwe. *BMC Res Notes* (2016) 9(1):379. doi:10.1186/s13104-016-2187-z
37. Nimako BA, Baiden F, Sackey SO, Binka F. Multimorbidity of Chronic Diseases Among Adult Patients Presenting to an Inner-City Clinic in Ghana. *Glob Health* (2013) 9:61. doi:10.1186/1744-8603-9-61
38. Bhagavathula AS, Seid MA, Adane A, Gebreyohannes EA, Brkic J, Fialová D. Prevalence and Determinants of Multimorbidity, Polypharmacy, and Potentially Inappropriate Medication Use in the Older Outpatients: Findings From EuroAgeism H2020 ESR7 Project in Ethiopia. *Pharmaceuticals* (2021) 14(9):844. doi:10.3390/ph14090844
39. Nwani PO, Isah A. Chronic Diseases and Multimorbidity Among Elderly Patients Admitted in the Medical Wards of a Nigerian Tertiary Hospital. *J Clin Gerontol Geriatr* (2016) 7:83–6. doi:10.1016/j.jcgg.2015.10.001
40. Academy of Medical Sciences. *Multimorbidity: A Priority for Global Health Research*. United Kingdom: Academy of Medical Sciences (2018).
41. Peck R, Mghamba J, Vanobberghen F, Kavishe B, Rugarabamu V, Smeeth L, et al. Preparedness of Tanzanian Health Facilities for Outpatient Primary Care of Hypertension and Diabetes: A Cross-Sectional Survey. *Lancet Glob Health* (2014) 2(5):e285–92. doi:10.1016/S2214-109X(14)70033-6
42. Zack RM, Irema K, Kazonda P, Leyna GH, Liu E, Spiegelman D, et al. Determinants of High Blood Pressure and Barriers to Diagnosis and Treatment in Dar Es Salaam, Tanzania. *J Hypertens* (2016) 34(12):2353–64. doi:10.1097/HJH.0000000000001117
43. Singh U, Olivier S, Cuadros D, Castle A, Moosa Y, Zulu T, et al. The Met and Unmet Health Needs for HIV, Hypertension, and Diabetes in Rural KwaZulu-

Natal, South Africa: Analysis of a Cross-Sectional Multimorbidity Survey. *Lancet Glob Health* (2023) 11(9):e1372–e1382. doi:10.1016/S2214-109X(23)00239-5

44. Birungi J, Kivuyo S, Garrib A, Mugenyi L, Mutungi G, Namakoola I, et al. Integrating Health Services for HIV Infection, Diabetes and Hypertension in Sub-Saharan Africa: A Cohort Study. *BMJ Open* (2021) 11(11):e053412. doi:10.1136/bmjopen-2021-053412
45. Peter O, Agyemang C, Wao H, Wambiya E, Ng'oda M, Mwanga D, et al. Effectiveness of Integrated Chronic Care Models for Cardiometabolic Multimorbidity in Sub-Saharan Africa: A Systematic Review and Meta-Analysis. *BMJ Open* (2023) 13(6):e073652. doi:10.1136/bmjopen-2023-073652
46. Yiu KC, Rohwer A, Young T. Integration of Care for Hypertension and Diabetes: A Scoping Review Assessing the Evidence From Systematic Reviews and Evaluating Reporting. *BMC Health Serv Res* (2018) 18(1):481. doi:10.1186/s12913-018-3290-8
47. Tran PB, Kazibwe J, Nikolaidis GF, Linnosmaa I, Rijken M, van Olmen J. Costs of Multimorbidity: A Systematic Review and Meta-Analyses. *BMC Med* (2022) 20(1):234. doi:10.1186/s12916-022-02427-9

International Journal of Public Health
COMMENTARY
published: 10 October 2024
doi: 10.3389/ijph.2024.1607078

Madrid International Plan of Action on Ageing and the 2030 Agenda for Sustainable Development

*Karoline Schmid**

United Nations, New York, NY, United States

Keywords: population ageing, sustainable development, Africa, Madrid International Plan of Action on Ageing, United Nations

DEMOGRAPHIC TRENDS

Population aging is one of the most significant global trends of our era. People are living longer and reaching older ages than ever before. This shift reflects our remarkable collective achievements in enhancing living conditions for billions worldwide. Improvements in sanitation, medical treatments, access to education, family planning, and progress in gender equality and women's empowerment have all played crucial roles in the transition from high to low fertility and mortality rates. These advancements have marked the beginning of an era where rapid population growth is gradually slowing, leading to a steady increase in the proportion of older individuals in society [1].

MADRID PLAN OF ACTION AND THE 2030 AGENDA FOR SUSTAINABLE DEVELOPMENT

The United Nations has a long history of recognizing the importance of population ageing for development. The First World Assembly on Ageing convened 40 years ago in Vienna, Austria was the first global effort to comprehensively address the issues of ageing. It recognized ageing as a global phenomenon and outlined actions to improve the wellbeing and quality of life of older persons and aimed at providing opportunities for older persons to contribute to national development. The Vienna Plan of Action was the result of the World Assembly and was also endorsed by the United Nations General Assembly in 1982 [2].

The Second World Assembly on Ageing, held in Madrid, Spain in 2002, reiterated many principles from the Vienna Plan, including dignity, independence, participation, care and the elimination of discrimination and highlighted intergenerational solidarity. The Assembly concluded with the adoption of a Political Declaration and the Madrid International Plan of Action on Ageing [3] that contains an International Strategy for Action on Ageing. MIPAA provides practical assistance to policymakers in dealing with the demographic shifts in their societies and calls on all stakeholders to mainstream ageing into all national policies and development programs. The MIPAA spans a broad range of issues relevant for ageing societies, emphasizing three priority areas: older persons and development; advancing health and wellbeing into old age; and ensuring enabling and supportive environments. A critical principle to the MIPAA strategy is the bottom-up approach that involves implementing MIPAA at the local and national levels, taking local context into consideration when developing policies and programs. It also requires the active involvement and participation of various stakeholders, including older persons themselves, working on customized solutions that reflect local knowledge, customs and traditions. Of critical importance is continued

OPEN ACCESS

Edited by:
Stephen Ojiambo Wandera, Makerere University, Uganda

Correspondence
Karoline Schmid, schmidk@un.org

This Commentary is part of the IJPH Special Issue "Ageing and Health in Sub-Sahara Africa"

Received: *11 January 2024*
Accepted: *20 August 2024*
Published: *10 October 2024*

Citation:
Schmid K (2024) Madrid International Plan of Action on Ageing and the 2030 Agenda for Sustainable Development. Int J Public Health 69:1607078. doi: 10.3389/ijph.2024.1607078

monitoring and evaluation to help identify what is working, what needs adjustment and what lessons can be shared with others.

The Commission for Social Development of the United Nations Secretariat is tasked to undertake every 5 years the MIPAA review and appraisal at the global level. Governments, the United Nations system and civil society participate in a bottom-up approach to assess progress made and challenges faced in the implementation of this plan. The most recent, the fourth review and appraisal, was undertaken in 2022 in observation of the 20th anniversary of the adoption of MIPAA. This review took place against the backdrop of a devastating coronavirus disease pandemic which directly or indirectly cost the lives of over 12 million older persons in 24 months, more than half of them in lower-middle-income countries [4]. One of the most salient conclusions from the fourth review and appraisal is that great disparities exist among and within regions in the rate of implementation of the MIPAA, in the focus of countries and regions around the issue of population ageing and on what constitutes an emerging issue or an ongoing challenge in each context. The assessment further found that inadequate national institutions and institutional mechanisms as well as age-based discrimination remain a concern. Important for effective and efficient policy making and implementation are a strong knowledge base and high-quality age-disaggregated data.

The most recent review undertaken by the United Nations Economic Commission for Africa (ECA) emphasized that while Africa is the youngest continent, its older population is growing rapidly and cautioned that the gains in economic growth could be lost if Africa did not plan for its growing older populations. The review further found that only about one-third of African countries had strategies to implement the targets set in MIPAA, that these strategies needed to be aligned with the legal national frameworks and that international aid could boost the impact of government initiatives in support of older persons. The review also showed that even after 20 years since the adoption of MIPAA, older Africans are typically not supported by social and development programs. Also, the region is not adequately investing in efforts to support the rights and needs of its older population. The continent still needs to recognize that while older people have challenges, they also contribute to the continent's development. Findings further highlight that the COVID-19 pandemic has often left older people in many African countries without income, food and other forms of support [5].

As the United Nations are accelerating their efforts towards achieving the pledge to leave no one behind made when the international community adopted the 2030 Sustainable Development Agenda [6] and the related Sustainable Development Goals in 2015, the Madrid Plan of Action at 20 continues to offer a solid foundation to entice Governments to bring about the far-reaching social, economic, environmental and political changes needed to fully capture the realities of population ageing. While progress has been made towards implementing MIPAA and achieving the 2030 Sustainable Development Agenda, Governments, civil society and academia need to collaborate to take advantage of these demographic changes while at the same time preparing for the challenges population ageing poses.

The role of academia is critical for providing in-depth and inter-disciplinary research to enhance the knowledge and understanding of population ageing. Investigating and tapping into local communities that often possess valuable knowledge about the needs, preferences, and challenges of their older residents will benefit the development of better informed and more effective policies and interventions. Policies implemented in response to this historic global trend can be harnessed to uphold the pledge contained in the 2030 Agenda for Sustainable Development that no one will be left behind. Now is the time to plan for the long-term, to prepare for the challenges ahead and to take advantage of the opportunities presented.

AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

FUNDING

The author declares that no financial support was received for the research, authorship, and/or publication of this article.

AUTHOR DISCLAIMER

The views expressed herein are those of the author and do not necessarily reflect the views of the United Nations.

CONFLICT OF INTEREST

The author declares that they do not have any conflicts of interest.

REFERENCES

1. United Nations, Department of Economic and Social Affairs. *World Social Report 2023: Leaving No One Behind in an Ageing World*. ST/ESA/379. NY, United States: United Nations Fund for Population Activities, 2023 (2023). Available from: www.un.org/development/desa/pd/content/launch-world-social-report-2023.
2. United Nations. *General Assembly Resolution. Question of Aging*. NY, United States: United Nations (1982). A/RES/37/51.

3. United Nations. Political Declaration and Madrid International Plan of Action on Ageing. In: Second World Assembly on Ageing (2002). April 8–12, 2002, Madrid, Spain. Available from: https://www.un.org/esa/socdev/documents/ageing/MIPAA/political-declaration-en.pdf.
4. United Nations. *Fourth Review and Appraisal of the Madrid International Plan of Action on Ageing, 2002. Report of the Secretary General*. NY, United States: United Nations (2022). E/CN.5/2023/6.
5. United Nations Economic Commission for Africa. *Fourth Africa Regional Review on Madrid International Plan of Action Calls for Dignified Ageing for All*. NY, United States: United Nations (2022).
6. United Nations. *Transforming Our World: The 2030 Agenda for Sustainable Development*. NY, United States: United Nations (2015). A/RES/70/1.

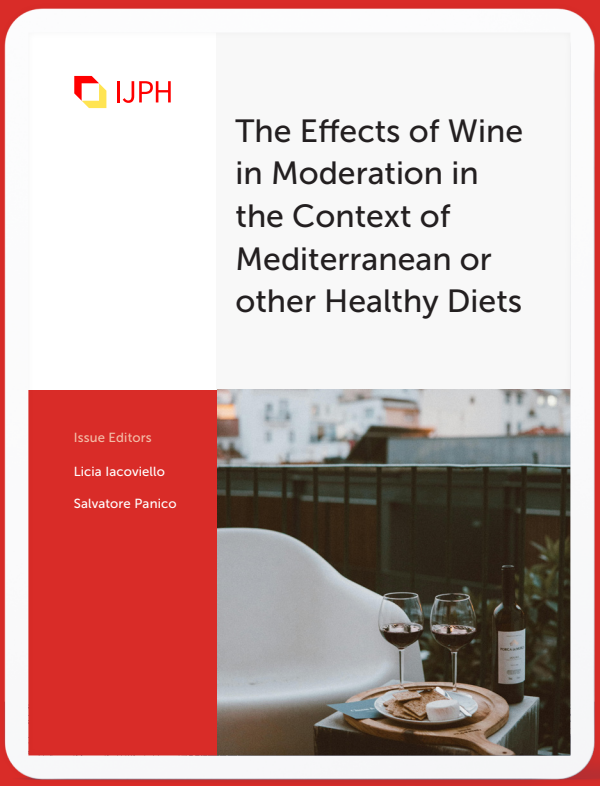
IJPH

The International Journal of Public Health (IJPH) is an independent society journal owned by the non-profit Swiss School of Public Health (SSPH+). The journal is based in a fully independent Editorial Office and operates a rigorous double blind peer review process. IJPH publishes scientific articles relevant to global public health, from different countries and cultures, and produces special issues that raise awareness and understanding of public health problems and solutions.

The Journal welcomes submissions of original research, critical and relevant reviews, methodological papers, and manuscripts that emphasize theoretical content. IJPH sometimes publishes commentaries and opinions. Special issues highlight key areas of current research.
The Editorial Board's mission is to provide a thoughtful forum for contemporary issues and challenges in global public health research and practice.

Discover more of our Special Issues

See more →



fro.ntiers.in/ijph-special-issues
frontierspartnerships.org

Contact

+41 (0) 21 510 17 40
ijph@ssph-journal.org