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ORIGINAL ARTICLE

Neighborhood socioeconomic status and self-rated health in Israel: the Israel National Health Interview Survey

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Abstract
Objectives To explore neighborhood socioeconomic status (NSES) differentials in self-rated health (SRH) in Israel.
Methods Study sample included 6296 Jewish participants in the Israeli National Health Interview Survey of 2007–2008. Neighborhoods were assigned socioeconomic scores by the Central Bureau of Statistics, incorporating 16 demographic and socioeconomic measures using a 20-point scale. Generalized estimating equation models with a multinomial distribution assessed the relative cumulative odds for decreasing SRH by quartiles of NSES, while accounting for neighborhood clustering. Base models were adjusted for age, religiosity, immigration from the former Soviet Union, education, income, and then additionally for employment, living in the periphery and co-morbidity.
Results We found a strong association between poor SRH and living in disadvantaged neighborhoods, after adjusting for individual-level SES. The combination of living in deprived areas with below average income was associated with over twice the risk of poor SRH.
Conclusions The association between low NSES and worsening SRH, exacerbated by lower income, highlights the importance of considering socioeconomic environmental and individual conditions in targeting high-risk populations.

Keywords Socioeconomic status · Disparities · Self-rated health · Neighborhood · International

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Introduction

There is substantial international evidence that lower socioeconomic status (SES) is associated with poor health. Data from several countries have confirmed this association with individual-level measures of SES, considering populations in the United States, European and Asian countries (Semyonov et al. 2013; Alvarez-Galvez et al. 2013; Vathesatogkit et al. 2014; Costa-Font and Hernández-Quevedo 2012). Neighborhood socioeconomic disparities in health have also been well established in several countries, indicating worse health outcomes for those living in disadvantaged neighborhoods, independent of individual socioeconomic means (Pickett and Pearl 2001).

Socioeconomic disparities in health have been documented in Israel as well (Jaffe and Manor 2009), although few studies have explored associations between neighborhood SES and health in Israel, and those considered only limited population samples of patients with heart disease (Gerber et al. 2010, 2011; Koren et al. 2012). Neighborhood conditions may influence health in a number of ways including a lack of physical resources such as recreational facilities (Gordon-Larsen et al. 2006; Powell et al. 2006),

increased exposure to violence and stressful life events (Attar et al. 1994), and decreased access to health care (Kirby and Kaneda 2005). Israel's Central Bureau of Statistics has developed a composite index to assess neighborhood SES for small geographical units, each representing approximately 2000 inhabitants. The first such score was calculated based on the 1995 National Census and new scores have recently been assigned based on the 2008 National Census. The current study utilizes this score to assess neighborhood SES in an Israeli population sample.

Our measure of health in this analysis consists of self-rated health (SRH). While subjective, SRH has been found a strong predictor of major health outcomes (Idler and Benyamini 1997; McGee et al. 1999). Moreover, SRH encompasses both elements of actual physiological processes, as well as an individual's perception of their health, as one author describes, "self-rated health lies at the cross roads of culture and biology (Jylhä 2009)." Bailis et al. further describe SRH as not only a measure of spontaneous health but also a measure of an individual's future health plans and goals (Bailis et al. 2003). This measure of health seems particularly relevant when examining the association between neighborhood SES and health, considering the multiple biological and psychosocial pathways potentially linking disadvantaged neighborhoods to disease. Given that one's immediate environment is likely to play a major role in self-perception and in shaping personal health goals, SRH may be an ideal measure to evaluate the link between neighborhood conditions and health. A measure of health that might additionally capture cultural perceptions of well-being is especially well-suited to the study of an Israeli population, considering its cultural diversity; 42.7 % of Israel's total population is comprised of immigrants from European, Asian, African and American countries, at least 39 % of whom arrived between 1990 and 2006 from the former Soviet Union (Central Bureau of Statistics 2009).

The main objective of this study was, thus, to explore neighborhood socioeconomic differentials in SRH among the Jewish population in Israel. Additionally, we examine how individual-level SES and immigration might interact with neighborhood SES to influence health. These analyses were limited to the Jewish population due to limited availability of geocoded data for most of the Arab participants (only 11 % of the 2217 Arab participants); future analyses will include the Arab sector when those data become available.

Methods

Study population

This study sample included participants in the second Israel National Health Interview Survey (INHIS) conducted by the Ministry of Health's Israel Center for Disease Control (ICDC) in 2007–2008. INHIS was based on the European Health Interview Survey (EUROHIS) framework initiated in 2000 by the World Health Organization Regional Office for Europe (Israel National Health Interview Survey 2012). The INHIS data included a random sample of Israeli citizens aged 21 years and older who were recruited by telephone. A sample of telephone numbers was drawn from a computerized list of subscribers of the 2 primary national telephone companies in Israel, covering an estimated 90 % of the Israeli population at that time (Central Bureau of Statistics 2007). Geographic cluster sampling was performed to ensure national representation. Of the original sample of 29,697 households, 11,906 (40.1 %) were excluded due to wrong numbers, disconnected numbers, commercial numbers and households without a resident 21 years and older. Of the remaining 17,791, a total of 10,502 respondents completed the questionnaire (response rate of 35.4 %). An additional 171 participants were excluded who were not Israeli citizens, leaving a final total of 10,331 survey participants. These data were collected within the ICDC mandate and thus additional institutional review board approval was not necessary.

Inclusion criteria

This study considered the Jewish survey participants (7867 of the eligible 10,331), with a total of 6497 who had viable geocoded information and were assigned a neighborhood socioeconomic score by the Central Bureau of Statistics (CBS). We further excluded participants missing data for the variables relevant to this study (self-rated health, $n = 48$; level of religiosity and immigration, $n = 86$, education, $n = 50$, region of residence $n = 2$, employment status, $n = 9$, and prevalence of co-morbid conditions, $n = 6$), resulting in a total sample size of $n = 6296$.

Outcome: self-rated health

INHIS participants were asked to rate their health with the following question: "What is your general health condition?" with the following response options: excellent, good, fair, poor, very poor.

Exposure: neighborhood SES

Neighborhood SES (NSES) was estimated through a composite index developed and validated by the Israel CBS (Central Bureau of Statistics 2013). The index, based on the 2008 Israel Census data, incorporates 16 socioeconomic measures, including demographic (average number of persons per household, dependency ratio, median age),

education (percent of workers in academic or managerial occupations, percent of academic degree holders ages 25–54, average years of schooling for ages 25–54), employment/benefits (percent of recipients of income support and income supplement to pensions, percent of subminimum wage earners, percent of wage and income earners above twice the average wage, percent of women ages 25–54 not in civilian labor force, percent of wage and income earners ages ≥15), and standard of living indicators (percent of household with computer and internet access, average number of bathrooms per person in household, average number of rooms per person in household, average number of vehicles at household disposal (ages ≥18 years), average monthly income per person). A full description of the estimation methods has been published (Central Bureau of Statistics 2013). The socioeconomic index classifies small geographical units (approximately 2000–5000 residents) into socioeconomic classes using a 20-point scale. This NSES score was assigned by the CBS to each person interviewed in INHIS on the basis of geocoded address at the time of the survey (2007–2008). The NSES score was then classified into quartiles to allow for non-linearity in the association between NSES and SRH: Q1 (lowest), 1–9, Q2 10–11, Q3 12–13 and Q4 14–20 (highest, and the reference group in the models). There were 1416 neighborhoods represented in this study sample, representing 120 Israeli cities or towns.

Additional covariates

We considered a number of potential confounding factors in the association between NSES and SRH. All measures were self-reported in the INHIS survey questionnaires. Individual-level SES measures included education, defined as highest degree attainment and categorized as less than high school, complete high school or vocational training and an academic degree (reference). Income was classified as less than the average income, average income, more than the average income (reference), with the average national salary defined as approximately $2500 per month. Since there were many participants missing income information, we created a category for missing income to include in the models rather than exclude such a large group of participants. Level of religiosity was included since prior research has shown that religiosity among Israeli Jews is associated with SRH (Shmueli 2007). Moreover, considering that very religious communities in Israel are often segregated into neighborhoods, this measure could be a major confounder in the relationship between NSES and SRH. Level of religiosity was classified as secular (reference; generally referring to individuals who typically do not perform religious rituals), traditional (may perform some rituals such as some Sabbath and Holiday observance), religious (follow kosher dietary restrictions, perform Holiday and Sabbath rituals/observance, regularly attend synagogue, and affiliate with a religious community), and ultra-Orthodox (adhere to all the rituals, live in more segregated communities and follow stricter codes of dress and observance). Similar classifications have been used in other studies examining religiosity and health in Israel (Shmueli 2007).

Considering other studies that have found significant health disparities between immigrants to Israel from the former Soviet Union (FSU; known henceforth as FSU immigrants) and the remaining Israeli Jewish population (Baron-Epel and Kaplan 2009, 2001), we also considered an indicator of this population in our analyses, defined as participants who immigrated from the FSU in or after 1990. This population group is the largest immigrant group in Israel since its independence in 1948, comprising of 39.3 % of immigrants in 2006 (Central Bureau of Statistics 2009) and representing over 1 million (approximately 75 % reported as Jewish) people who immigrated to Israel between 1990 and 2006 (Central Bureau of Statistics 2009; Ott et al. 2009).

Employment status was classified as unemployed, student/army service, retired, homemaker or employed (reference). Living in the southern or northern regions of the country was compared to living in the center, since these areas are considered peripheral, with constraints with regard to health and social services (Shemesh et al. 2011; Israeli Medical Association 2008). Co-morbidity was determined as having reported being diagnosed with any of the following conditions: cardiovascular disease, diabetes, asthma, chronic bronchitis/emphysema or cancer.

Analysis plan

Our initial analyses included descriptions of the measures of interest, including comparisons of the analytic sample to the INHIS Jewish sample that we excluded due to missing NSES measures, as well as other measures included in this analysis. We then fitted generalized estimating equation (GEE) models with a multinomial distribution to determine the relative cumulative odds for decreasing SRH (i.e., going from excellent to very poor) by quartiles of neighborhood SES, while accounting for correlation between participants living in the same neighborhoods. These cumulative regression models model the log of the cumulative odds at every decreasing level of self-rated health (that is, the odds of being in that or a worse category level vs. all higher health levels), as a common, single linear function of predictors plus level-specific intercepts. Considering that dichotomizing SRH disregards valuable information about the gradient levels of SRH; these models

are particularly advantageous, as they allow us to examine the associations across all 5 levels of SRH. We initially adjusted for age, level of religiosity, FSU immigration, education and income. We then adjusted for additional confounders that may also be operating as mediators, including employment status, living in the periphery and co-morbidity. We explored possible interactions between NSES and individual-level income, individual-level education, living in the periphery, FSU immigration and co-morbidity by including interaction terms in the models and stratifying the models when these interactions were statistically significant.

Results

The average age of study participants was 51.7 years (ranging from 21.0 to 98.0), 12.2 % were FSU immigrants, 53.9 % were secular and 5.3 % unemployed. Additionally, 20.8 % lived in the peripheral areas of the country, and 33.2 % reported earning an income below the national average. In terms of health, 72.9 % reported excellent or good health, and 23.6 % reported having been diagnosed with cardiovascular disease, type 2 diabetes, bronchitis or asthma (Table 1).

As shown in Table 2, living in disadvantaged neighborhoods was associated with worse self-reported health [cumulative odds ratio (OR) for decreasing self-reported health: 1.5, 95 % confidence intervals (CI) 1.3, 1.8 for the lowest NSES quartile compared to the highest], after adjusting for age, FSU immigration, level of religiosity, education and income. While NSES was significantly associated with SRH after adjusting for individual-level income and education, these individual-level SES measures remained significantly associated with SRH as well (OR 2.1, 95 % CI 1.8–2.4 for <average income vs. above average, and OR 1.5, 95 % CI 1.3–1.8 for <high school vs. ≥college). The strongest cumulative OR of worse SRH was associated with being an FSU immigrant, with a cumulative OR of 3.9 (95 % CI 3.4–4.6).

After additional adjustment for employment status, living in a peripheral area, and co-morbid conditions, the cumulative odds ratio of worse SRH was only slightly reduced to OR 1.4 (95 % CI 1.2–1.7) for the lowest neighborhood quartile compared to the highest (see Table 2). The cumulative odds ratios for income and education were also slightly weaker in this model, with employment status possible accounting for some of the income–SRH relationship. Living in the southern peripheral region was associated with worse SRH (Or 1.2, 95 % CI 1.1–1.5), and no significant risk associated with living in the North. Unemployment and FSU immigration both had the highest odds ratios of 4.0 (CI 3.1–5.0) and 4.1 (CI 3.5–4.8), respectively.

Table 1 Characteristics of the 2007–2008 Israel National Health Interview Survey (INHIS) Jewish study participants

	Analytic sample $n = 6296$[a]	Total INHIS sample $n = 7867$[b]
Age (mean; median; std)	51.7; 52.0; 16.5	51.8, 52.0, 16.4
Religiosity (%)*		
Traditional	28.2	27.3
Religious	10.0	10.4
Ultra-orthodox	7.9	7.5
Secular	53.9	54.8
Immigration from the former Soviet Union (%)*	12.2	11.4
Employment (%)*		
Unemployed	5.3	5.3
Student	4.3	3.9
Retired	25.2	24.6
Homemaker	8.2	7.8
Employed	57.0	58.4
Living in north (%)*	9.7	12.0
Living in south (%)*	11.1	11.8
Prevalent chronic disease (CVD, type 2 diabetes, bronchitis or asthma) (%)	23.6	23.4
Self-rated health*		
Excellent	38.9	40.4
Good	34.0	33.5
Fair	21.6	20.8
Poor	3.6	3.4
Very poor	1.9	1.8
Education (%)*		
<High school	17.6	17.2
High school/vocational degree	47.0	46.4
Academic degree	35.5	36.4
Income (%)*		
Below average	33.2	32.0
Average	23.6	23.4
Above average	32.2	32.2
Missing	11.0	12.4
Neighborhood socioeconomic status score (%)		
Q1 (1–9)	26.9	26.9
Q2 (10–11)	23.3	23.3
Q3 (12–13)	21.4	21.3
Q4 (14–20)	28.4	28.5

* Statistically significant difference between included and excluded group ($p < 0.05$)

[a] Excludes participants missing neighborhood SES score, self-reported health, religiosity, immigration for the former Soviet Union, employment status, education, chronic conditions and region of residence

[b] Total Jewish 2007–2008 INHIS sample; reduced sample sizes for various measures: $n = 7781$ religiosity, $n = 7842$ immigration from the former Soviet Union, $n = 7830$ employment, $n = 7794$ education, $n = 7864$ region of residence, $n = 7859$ comorbidity, $n = 7813$ self-rated health, $n = 6497$ neighborhood SES

Table 2 Cumulative odds ratios and 95 % confidence intervals for the associations between individual and neighborhood-level characteristics and self-rated health: 2007–2008 Israel National Health Interview Survey

	Model 1[a] $N = 6296$	Model 2[b] $N = 6296$
Age	1.07 (1.06–1.07)***	1.05 (1.05–1.06)***
Religiosity		
Traditional	1.14 (1.02–1.29)*	1.14 (1.01–1.29)*
Religious	1.04 (0.87–1.25)	1.04 (0.87–1.25)
Ultra-orthodox	0.43 (0.34–0.54)***	0.47 (0.37–0.59)***
Secular	Reference	Reference
Immigration from the former Soviet Union	3.91 (3.36–4.56)***	4.06 (3.46–4.77)***
Education		
<High school	1.51 (1.29–1.76)***	1.43 (1.21–1.68)***
High school/vocational degree	1.25 (1.12–1.40)***	1.22 (1.09–1.37)***
Academic degree	Reference	Reference
Income		
Below average	2.09 (1.82–2.40)***	1.79 (1.55–2.06)***
Average	1.35 (1.18–1.55)***	1.30 (1.13–1.50)***
Missing income	1.39 (1.17–1.65)***	1.29 (1.08, 1.53)**
Above average	Reference	Reference
Neighborhood socioeconomic status		
Q1 (1–9)	1.54 (1.32–1.81)***	1.42 (1.20–1.67)***
Q2 (10–11)	1.45 (1.25–1.69)***	1.39 (1.20–1.62)***
Q3 (12–13)	1.21 (1.05–1.40)**	1.19 (1.02–1.38)*
Q4 (14–20)	Reference	Reference
Employment		
Unemployed		3.96 (3.12–5.03)***
Student		0.72 (0.52–1.00)~
Retired		1.33 (1.14–1.55)***
Homemaker		1.46 (1.20–1.78)***
Employed		Reference
Living in North		1.02 (0.87–1.20)
Living in South		1.23 (1.05–1.45)*
Non-periphery		Reference
Prevalent chronic disease		3.22 (2.85–3.64)***

$\sim 0.05 \leq p < 0.01$,
* $0.01 \leq p < 0.05$,
** $0.001 \leq p < 0.01$,
*** $p < 0.001$

[a] Adjusted for age, religiosity, immigration from the former Soviet Union, education and income

[b] Additionally adjusted for employment (unemployed, student, retired, homemaker vs. employed), living in the periphery (north or south), any prevalent chronic disease (self-reported cardiovascular disease, type 2 diabetes, asthma or chronic bronchitis)

Interaction terms for income, education, living in the periphery, FSU immigration and co-morbidity yielded only statistically significant interactions for income (p value <0.0001 for NSES lowest quartile* <average income, data not shown). We, thus, stratified model 1 by the three income levels (Table 3). As shown in Table 3, while some statistical significance can been seen in cumulative odds ratios of low NSES levels compared to the highest quartile, the odds ratio is higher and more significant among those with <average income (OR 2.1, 95 % CI 1.6–2.8).

Discussion

Our study showed a strong association between poor SRH and living in disadvantaged neighborhoods, after adjusting for individual-level income, employment status and education. Our findings further indicate that the combination of living in a deprived area as well as having below average income is associated with over two times the risk of poor SRH. Thus, while income seems to have the strongest association with SRH, associations persist at the neighborhood level independent of individual socioeconomic factors.

A recent analysis conducted by Badland et al. on an Australian population shows similar findings, where low income is strongly associated with poor SRH, however, this risk is attenuated when living in more advantaged neighborhoods (Badland et al. 2013); that study also found an independent association between worse SRH and living in disadvantaged neighborhoods independent of income and education (Badland et al. 2013). While ours is the first study to examine SRH and neighborhood SES in Israel, several other studies have similarly found evidence linking

Table 3 Cumulative odds ratio of worsening self-rated health by education and neighborhood SES, stratified by low, medium and high income: 2007–2008 Israel National Health Interview Survey

	Low income (≤average) $N = 2090$	Medium income (average) $N = 1487$	High income (>average) $N = 2024$
Neighborhood socioeconomic status			
Q1 (1–9)	2.14 (1.63–2.79)***	1.41 (1.02–1.95)*	1.26 (0.95–1.68)
Q2 (10–11)	1.92 (1.45–2.53)***	1.39 (1.04–1.87)*	1.39 (1.08–1.79)*
Q3 (12–13)	1.40 (1.04–1.88)*	1.27 (0.95–1.71)	1.15 (0.91–1.45)
Q4 (14–20)	Reference	Reference	Reference

Adjusted for age, religiosity, immigration from the former Soviet Union, and education

* $0.01 \leq p < 0.05$, ** $0.001 \leq p < 0.01$, *** $p < 0.001$

poor SRH and living in disadvantaged neighborhoods in the United States and England (Brown et al. 2007; Franzini et al. 2005; Stafford et al. 2004; Verhaeghe and Tampubolon 2012).

In exploring the various pathways that might connect NSES to health, it is interesting to point out that Israel provides universal health care coverage to its approximately 8 million citizens. Our findings of persisting NSES–health disparities despite free health care are intriguing, and found in other countries with universal health care systems (Stafford et al. 2004; Pickett and Pearl 2001); these results point to a complex pathway that is not limited to the function of basic health care availability. For example, Stafford et al. compared NSES and SRH in London and Helsinki (both cities with universal health care coverage) and found the disparities greater in London. The authors suggested that these disparities were more pronounced in London due to greater socioeconomic segregation and higher income inequality (Stafford et al. 2004).

Multiple pathways have indeed been suggested in linking neighborhood disadvantage to negative health outcomes, including fewer physical resources, such as recreational facilities (Gordon-Larsen et al. 2006; Powell et al. 2006) and limited access to healthy and affordable food (Horowitz et al. 2004; Moore and Diez Roux 2006; Powell et al. 2007). In addition, individuals living in low-SES areas are more often exposed to violence and stressful life events (Attar et al. 1994), and less likely to access adequate and preventive health care (Kirby and Kaneda 2005). The few studies exploring NSES and health in Israel found that those living in disadvantaged neighborhoods are less likely to obtain necessary medical procedures and more at risk for recurring coronary heart disease events compared to those living in higher SES neighborhoods (Gerber et al. 2010; Koren et al. 2012). Indeed, Koren et al. suggest that poor Israeli neighborhoods may lack adequate qualified medical staff and specialty care (Koren et al. 2012). Considering the general dearth of medical staff and specialists in what is known as Israel's poor "periphery," (Knesset Research and Information Center 2007), the geographic isolation of disadvantaged neighborhoods is also likely to contribute to poor health.

Aside from showing an association between NSES and poor SRH, our findings indicated that this association is stronger among those with income below the national average compared to those with income above the national average. This interaction suggests that lower financial resources may exacerbate the harmful aspects of living in disadvantaged neighborhoods, while greater financial resources likely buffer the negative health influences of living in those neighborhoods. For example, a recent Israeli study showed that those with lower income decrease expenditure on fresh fruits and vegetables (Chernichovsky and Regev 2014); this trend may be magnified in poor neighborhoods with limited availability of fresh produce. Alternatively, in a neighborhood lacking medical specialists, owning a car may enable access to specialists in other neighborhoods. Future research is needed to address the specific pathways linking NSES to health and how individual means may modify this relationship.

A striking finding in this study was the strong association between FSU immigrants and SRH; this population had about 4 times the risk of poor SRH compared to the rest of the Israeli Jewish population, after adjusting for individual and NSES. In a survey on a random sample of the entire Israeli population in 2006, Baron-Epel and Kaplan also found a higher proportion of those reporting poor physical health among FSU immigrants compared to the non-immigrant Jewish population, especially among women (Baron-Epel and Kaplan 2009). Our study, however, indicates that this association cannot be explained by either individual or neighborhood SES. Limited research on the FSU immigrant population in the US and Israel suggests that cultural factors as well as alienation in the adopted country are among some of the issues that may be exacerbating health conditions (Benisovich and King 2003). Unlike the healthy immigrant effect found among immigrant populations in the United States (Singh et al.

2013), it is likely that immigrants to Israel are not subject to the same selection bias. That is, FSU immigration to Israel was a "diaspora migration", when people moved as a result of common ancestry rather than for economic reasons (Ott et al. 2009); it does not necessarily follow that those immigrants were healthier than the host population. Some studies have shown that while FSU immigrants in Israel appear healthier than Russian who never emigrated, they are still worse off compared to the host population (Ott et al. 2009). These findings suggest that other factors related to the trauma experienced before immigration, in addition to the trauma related to immigration (Osman and Walsemann 2013), may contribute to higher mortality rates observed compared to the rest of the Israeli population (Ott et al. 2009). Further research is needed to address this disparity and possible health barriers that are not captured in our measures of SES and might shed light on the high health risk in this population.

Another strong association worth noting is that of unemployment and worsening SRH, with our results showing almost 4 times the risk of worsening SRH for those unemployed, even after adjusting for education, income and NSES. Studies have found unemployment status associated with decline in physical and mental well-being, even after accounting for financial resources (McKee-Ryan et al. 2005). Moreover, perceived financial strain is thought to play a major role in this association and cannot be accounted for simply by measuring income (McKee-Ryan et al. 2005). Although not the main objective of this study, these findings suggest alternative pathways by which social factors may influence health.

The strengths of this study include the assessment of a large population-based sample and the use of a national standard neighborhood SES score, as well as the ability to examine a population with universal health care coverage. Some limitations of our analyses include the restriction to only the Jewish population in Israel. We are in the midst of preparing a parallel analysis that will incorporate Arab INHIS participants by assigning a neighborhood score that considers a larger geographical area and is thus less vulnerable to geocoding limitations that restricted the current analyses. These analyses were also restricted to SRH assessment rather than objective health data, although we describe the positive aspects of addressing SRH.

Conclusions and future implications

We found neighborhood socioeconomic health disparities in a sample of the Israeli Jewish population. The association between living in disadvantaged communities and worse self-rated health is stronger among those with lower income. These findings highlight the importance of considering socioeconomic environmental and individual conditions in targeting high-risk populations, as well as factors that may uniquely contribute to the vulnerability of immigrant populations.

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