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ORIGINAL ARTICLE

Stunting and weight statuses of adolescents differ between public and private schools in urban Gambia

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Abstract
Objectives This study assessed the disparity in nutritional status of adolescents between public and private schools in urban Gambia.
Methods This is a school-based cross-sectional study in six private and six public upper basic schools in urban Gambia. This study recruited 491 students from public and 469 students from private schools (13–15 years of age).
Results The prevalence of stunting (WHO height-for-age $Z < -2$SD) was 13.4 % for public school students and 4.5 % for private schools. After adjustment for children's sex, age, and family socioeconomic status, the differences in prevalence of stunting and underweight were significant between public and private schools. Private school students are more likely to be overweight/obese (WHO BMI-for-age $Z > +1$SD) (OR = 2.85, 95 % CI 1.55–5.22), but less likely to be thin (BMI-for-age $Z < -2$SD) (OR = 0.61 [0.39–0.96]), compared to public school students. Children from lower income families had lower odds for overweight/obese than normal weight, compared to those from higher income families (OR = 0.34 [0.15–0.76]).
Conclusions Public and private schools in urban regions of the Gambia may face different nutritional challenges due to differences in school environment and resources.

Keywords Nutritional status · Adolescents · Anthropometry · School children

Introduction

By 2020, two-thirds of the global health burden will be attributed to chronic non-communicable diseases, which are strongly associated with poor nutrition (Chopra et al. 2002). Undernutrition is one of the most challenging public health issues, but in the recent decade, the issue of overnutrition has emerged in many developing countries (Delisle et al. 2011). The double burden of under- and overnutrition casts shadow on the populations' health and economy future. However, most nutrition initiatives in developing countries focus mainly on women at reproductive age (15–45 years old) and children under the age of five, as nutrition plays critical roles at pregnancy and the early years of life (World Health Organization 2006). Young adolescents are often regarded as healthier group, although many of them face malnutrition and non-communicable illness due to poor eating habits and inadequate exercise (Sommer 2011). Therefore, reducing undernutrition at this life stage could help preemptively break the vicious cycle of intergenerational malnutrition, chronic diseases, poor academic performance (Fiorentino et al. 2013), and poverty (World Health Organization 2006).

School system can be a good channel to regularly assess children's health and nutritional status. School can be noted

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as a universal platform for nutritional improvement for the young experiencing critical period of health. The Gambia provides nine-year compulsory education to the youth aged 7–16 years. Nevertheless, school resources usually differ between public and private schools. Private schools have better sanitary facilities and ventilation than public schools do in developing countries (Ekpo et al. 2008). In developing countries, such as the Gambia, there is no adequate nutrition education in most schools. Meanwhile, food of questionable nutritive value is sold in schools. A study in Nigeria reported that food vendors have been associated with public schools, thereby providing snacks and lunches to pupils. However, the sources of food and mode of preparations have always been a source of concern to school authorities (Ekpo et al. 2008). These environmental differences between public and private schools may contribute to disparity in nutritional status between public and private school children.

The main objective of this study is to examine the double burden of malnutrition in public and private schools in the urban Gambia, and to find out gap of the burden between the two school systems. However, students' socioeconomic status (SES) influences their choice of school (Adekoya-Sofowora et al. 2006; Omigbodun et al. 2010). Thus, this study collected children's family socioeconomic background so as to compare the nutritional status of adolescents in public and private schools after taking family SES into account.

Methods

Study population

This school-based cross-sectional study for urban adolescents (13–15 year old) was conducted in October, 2014. Aiming at this age range, children from public and private upper basic schools (equivalent to middle schools in other countries) in Region1 was sampled. Region1 covers Banjul, the capital city, and Kanifing administrative areas, the most densely populated areas in the Gambia (2559.4 people per km^2 for Banjul and 5057.5 people per km^2 for Kanifing, 2013 population estimates). Updated list of upper basic schools in Region1 was received from the Ministry of Basic and Secondary Education, the Gambia. Schools and classes were selected based on the multi-stage cluster sampling technique. At the first stage, six schools were selected from public schools and six from private schools through probability proportionate to size (PPS) sampling. At the second stage, one class was randomly selected from grades (7, 8, and 9) from each sampled school. All students in each sampled class within the age range were invited to participate. In total, 1145 students were recruited for the study, and 960 of them participated in the survey leading to 84 % response rate.

Anthropometric measurements

Anthropometric measurements were conducted by trained health workers in the field of medicine and public health at the school ground. The child's standing height in cm was measured by a stadiometer and weight in Kg measured by a Tanita BIA UM-076 body composition analyzer. These measurements were taken as the child standing, putting her/his weight evenly on both feet. All measurements were performed twice, and the average was analyzed in this study.

Measured standing height and weight of all participants were converted to sex- and age-specific *Z*-scores based on WHO and CDC growth references. As the WHO does not provide weight-for-age reference for children above 10 years old, we applied the CDC reference for underweight. The definitions are stunting, WHO height-for-age Z score < -2SD; underweight, CDC weight-for-age Z score < -2SD; thinness/severe thinness, WHO BMI-for-age < -2SD; overweight/obesity, and WHO BMI-for-age Z score $> +1$SD (Wang and Chen 2012).

Household socioeconomic and demographic status

The household socio-demographic questions were answered by the parent or guardian. The questionnaire with the parent/guardian invitation and consent forms was given to the children to carry home. The parent who agrees the child to participate in this study field and sent it back to the school. These questions include the parent's self-report education, employment, marital status, and assets at home. Family types were categorized into polygamous, monogamous, and single parent. Education level of the responding parent was categorized as primary education or less, secondary education, and tertiary or higher education. Employment status included currently employed, not employed, and self-employed. The socio-demographic questionnaires which included items for assets possession were chosen according to the DHS recommendation and references on the food vulnerability survey questionnaire (VAMU, used in the Gambia). Wealth index was constructed using the principle component analysis of the assets at home (ownership of housing/compound, car, fridge/refrigerator, computer/laptop, television, mobile phones, electricity/generator, and sofa) (Rutstein 2004). The wealthy index was divided into tertiles to define the different socio-economic status.

Data analysis

The data were entered through EpiInfo 7.1.4.0 and analyzed on SPSS version 20. Chi-square tests were performed to compare differences between private and public school children. Multiple and multinomial logistic regression analysis tested differences in the probability of undernutrition and overnutrition status between public and private schools with adjustment for potential confounders.

Ethical consideration

This study was reviewed by the research and publication committee of the University of the Gambia. It was also reviewed by the joint ethics committee of the Gambia government and Medical research council review board for approval before the exercise. Written permission to the ministry of Basic and Secondary Education and heads of schools was ensured. The consent of both the parents and the children was obtained.

Results

This study recruited 491 students from public schools and 469 from private schools. The mean age of students was 13.7 ± 0.5 years. Overall, household wealth was lower among public school students than private school students; for instance, 63.3 % of the public school students while 6.6 % of the private school students came from low income households (Table 1). As for family characteristics, 43.1 % of the students were from polygamous and 45.3 % from monogamous and 11.6 % from single parent households, while the distribution of family type differed significantly between public and private school students (p value <0.001). About one-fifth of the students were born in the rural area.

Table 2 depicts the institutional (school) disparities in double burden of under- and overnutrition among urban Gambian adolescents. The prevalence of stunting, underweight, thinness, and overweight/obese is 13.4, 28.9, 31.0, and 4.3 %, respectively, for public school students and 4.5, 10.2, 16.0, and 22.8 %, respectively, for private school students. The prevalence of stunting was higher among the younger children at age 13. Looking at the gender stratification, the prevalence of stunting, underweight, and thinness was significantly higher among boys than girls. Overweight/obese is more prevalent among girls (31.2 %) than boys (12.9 %) in general, but not statistically significant.

Multivariable logistic regression analysis revealed that public school students were three times more likely to be stunted than private school students (OR = 3.35, 95 % CI 1.66–6.74; p value = 0.001) (Table 3). Female students were less likely to be stunted than male (OR = 0.28, 95 % CI 0.17–0.47; p value = <0.001). Students from single parent household were two times more likely to be stunted than those from polygamous family backgrounds (OR = 2.75, 95 % CI 1.22–6.22; p value = 0.047). Children, whose parents were born in the urban region, are less likely to be stunted than those who migrated from the rural region of the country (OR = 0.53, 95 % CI 0.30–0.91; p value = 0.023). As for underweight, public school students were more likely to be underweight than private school students (OR = 3.06, 95 % CI 1.84–5.08; p value <0.001). Girls were less likely to be stunted than boys (OR = 0.23, 95 % CI 0.16–0.33; p value <0.001).

Multinomial logistic regression analysis depicts significant association between sociodemographic characteristics and adolescents' weight status (Table 4). After adjusting for age, sex, grade, place of birth of the child, family type, parents/guardians education, employment status, sex, and age with the reference category normal weight, the result revealed that private school students were less likely to be thin (OR = 0.61, 95 % CI 0.39–0.96; p value = 0.031), but two times more likely to be overweight/obese than to have a normal weight, compared to public school students (OR = 2.85, 95 % CI 1.55–5.22; p value = 0.001). Boys were more likely to be thin than normal weight (OR = 2.90, 95 % CI 2.08–4.06; p value <0.001) compared to female students. Children from polygamous family households were less likely to be overweight/obese than to have a normal weight compared to those from single parent households (OR = 0.43, 95 % CI 0.21–0.89; p value = 0.023). Finally, the children from low income households were less likely to be overweight/obese than to have a normal weight compared to those from high income households (OR = 0.34, 95 % CI 0.15–0.76, p value = 0.009).

Discussion

This study revealed the disparity in young adolescents' nutritional status between public and private schools in the urban Gambia. Public school students have three fold higher odds of being stunted and underweight than private school students. On the other hand, private school students are less likely to be thin than normal weight, but two times more likely to be overweight/obese than to have a normal weight, compared to public school students.

There were two major reasons for this observed disparity in nutritional status between public and private schools: students' socioeconomic background and school environmental conditions. This study shows that the differences in nutritional status between public and private schools

Table 1 Basic characteristics of students by public and private schools: Gambia, 2014

Variables	*N* (%)	Public schools ($N = 491$) *n* (%)	Private schools ($N = 469$) *n* (%)	χ^2 test: *p* value
Age				
13	259 (27.0)	102 (20.8)	157 (33.5)	
14	688 (71.7)	380 (77.4)	308 (65.7)	<0.001
15	13 (1.4)	9 (1.8)	4 (0.9)	
	Mean = 13.7, SD = 0.5	*Mean* = 13.8, SD = 0.4	*Mean* = 13.7, SD = 0.5	
Gender				
Male	406 (42.3)	195 (39.7)	211 (45.0)	0.103
Female	554 (57.7)	296 (60.3)	258 (55.0)	
Education level				
UB (grade) 7	291 (30.3)	156 (31.8)	135 (28.8)	
UB (grade) 8	309 (32.2)	156 (31.8)	153 (32.6)	0.591
UB (grade) 9	360 (37.5)	179 (36.5)	181 (38.6)	
Family type				
Polygamy	414 (43.1)	258 (52.5)	156 (33.3)	
Monogamy	435 (45.3)	180 (36.7)	255 (54.4)	<0.001
Single parent	111 (11.6)	53 (10.8)	58 (12.4)	
Child's place of birth				
Rural	178 (18.5)	99 (20.2)	79 (16.8)	0.213
Urban	782 (81.5)	392 (79.8)	390 (83.2)	
History of menarche				
Premenarche	103 (10.7)	56 (11.4)	47 (10.0)	
Postmenarche	451 (47.0)	240 (48.9)	211 (45.0)	0.249
Boys	406 (42.3)	195 (39.7)	211 (45.0)	
Ethnicity				
Mandinka	335 (34.9)	160 (32.6)	175 (37.3)	<0.001
Wolof	163 (17.0)	76 (15.5)	87 (18.6)	
Fula	182 (19.0)	128 (26.1)	54 (11.5)	
Others	280 (29.0)	127 (25.9)	153 (32.6)	
Parent's education status				
No formal education	223 (23.2)	178 (36.6)	45 (9.6)	
Primary	62 (6.5)	47 (9.6)	15 (3.2)	<0.001
Secondary	356 (37.1)	187 (38.1)	169 (36)	
Tertiary	319 (33.2)	79 (16.1)	240 (51.2)	
Parent's employment status				
Currently employed	319 (33.2)	115 (23.4)	204 (43.5)	
Self-employed	406 (42.3)	227 (46.2)	179 (38.2)	
Retired	53 (5.5)	32 (6.5)	21 (4.5)	<0.001
Unemployed/looking for job	115 (12)	81 (16.5)	34 (7.2)	
Unemployed/not looking for job	67 (7)	36 (7.3)	31 (6.6)	
Parent's age				
≤34 years	189 (19.7)	119 (24.2)	70 (14.9)	
35–49 years	492 (51.3)	239 (48.7)	253 (53.9)	0.001
≥50 years	279 (29.1)	113 (27.1	146 (31.1)	
Parent's sex				
Male	553 (57.6)	273 (55.6)	280 (59.7)	0.215
Female	407 (42.4)	218 (44.4)	189 (40.3)	

Table 1 continued

Variables	*N* (%)	Public schools (*N* = 491) *n* (%)	Private schools (*N* = 469) *n* (%)	χ^2 test: *p* value
Parent's place of origin				
Rural	358 (37.3)	187 (38.1)	171 (36.5)	0.640
Urban	602 (62.7)	304 (61.9)	298 (63.5)	
Household wealth index				
Low	342 (35.6)	311 (63.3)	31 (6.6)	
Middle	266 (27.7)	130 (26.5)	136 (29)	<0.001
High	352 (36.7)	50 (10.2)	302 (64.4)	

remained statistically significant, after family socioeconomic status was adjusted for. Thus, school environment may play a significant role in children's nutritional status. The findings are similar to studies based on 10–19 year-old children in Nigeria (Omigbodun et al. 2010) and 7–14 year-old children in Burkina Faso (Dabone et al. 2011). Possible reasons for these findings can be due to the fact that public school students are exposed to poorer school environment than private school students, such as overcrowding in classrooms and poorer sanitary equipment. Water, sanitation, and hygiene components are suggested be integrated as a part of nutrition intervention, despite barriers in the field to be removed (Teague et al. 2014). In addition, food environment in school could contribute to the nutritional differences between public and private school students as well. Food vendors have been associated with many public schools in developing countries, thereby providing snacks and lunches of questionable nutritive values. Knowledge about school food quality in African countries is scanty and requires future investigation.

Family socioeconomic status is an important factor for children's nutritional status, especially for stunting (Garcia et al. 2013; Navti et al. 2014). Findings from the current study revealed significant socioeconomic gradient in nutritional status. Association of underweight, stunting, and thinness with lower SES reflects food insecurity of the family (Belachew et al. 2013). This association is well known; as observed in other developing countries, such as Columbia (Garcia et al. 2013), South Africa (Kimani-Murage et al. 2011), Cameroon (Navti et al. 2014), and Tanzania (Muhihi et al. 2013). The association between higher SES and overweight/obesity may reflect sufficient or even superfluous food supply in richer families. In addition, children's disposable money may play a role in overnutrition. A study on Tanzanian school children found that having money to spend at school were associated with children's obesity status (Muhihi et al. 2013). A study on Senegalese school children pointed out that during school days, students tend to buy cheap foods from street food vendors, which often lack proteins and micronutrients, thereby affecting their health and nutrition (Fiorentino et al. 2013). Thus, children from higher income families would be more likely to have money to buy any kind of food at their disposal from the vendors as long as the amount of cash they carry is enough to accommodate the cost.

The results depict gender differences; prevalence of stunting, underweight, and thinness is significantly higher among boys than girls. These findings are similar to studies among school children from Nigeria (Omigbodun et al. 2010), Vietnam (Tang et al. 2007), and Brazil (Guedes et al. 2013), all of which revealed higher prevalence of stunting and underweight in boys compared to girls. Biologically, fat and muscle accumulation is a natural path during puberty (Alberga et al. 2012). For instance, a study among Indian students revealed that overweight/obesity was marginally more prevalent in the pubertal age groups (Kotian et al. 2010). Hence, as girls in general enter puberty earlier than boys do, undernourishment would be less likely found among adolescent girls than boys of the same ages.

Nevertheless, as for overnutrition, studies from Brazil (Guedes et al. 2013), South Africa (Kimani-Murage et al. 2011), and Iran (Mohammadpour-Ahranjani et al. 2004) observed higher prevalence of overweight/obesity in female than in male as this study does, but studies from Qatar (Bener 2006), China (Dong et al. 2014), and Vietnam (Tang et al. 2007) showed higher prevalence of overweight/obesity in male than in female. Possible factors for this international difference might be due to cultural/societal perceptions on ideal body image associated with gender. For instance, the society itself perceives ladies should be well nourished, thus a sign of good living (Siervo et al. 2006a). Undernourished ladies in the Gambia are classed as poor and starved. On the contrary, compared to boys, girls in Asian countries have greater weight concerns and greater intention to keep thin (Chang et al. 2013; Lee et al. 2009). These may explain the sex differences in the prevalence of thinness and overweight/obesity observed in the present study.

Table 2 Distribution of nutritional outcome between private and public school students by age, gender, and family wealth: Gambia, 2014

Variable	Stunting			Underweight			Thinness			Overweight/obese		
	Private *n* (%)[a]	Public *n* (%)	Total	Private *n* (%)	Public *n* (%)	Total	Private *n* (%)	Public *n* (%)	Total	Private *n* (%)	Public *n* (%)	Total
All	21 (4.5)	66 (13.4)	87 (9.1)	48 (10.2)	142 (28.9)	190 (19.8)	75 (16.0)	152 (31.0)	227 (23.6)	107 (22.8)	21 (4.3)	128 (13.3)
Age												
13	6 (3.8)	20 (19.6)	26 (14.6)	17 (10.8)	31 (30.4)	48 (27.0)	27 (17.2)	34 (33.3)	61 (34.3)	35 (22.3)	8 (7.8)	43 (24.1)
14–15	15 (4.8)	46 (11.8)*	61 (13.4)	31 (9.9)	111 (28.5)	142 (31.3)	48 (15.4)	118 (30.3)	166 (36.6)	72 (23.1)	13 (3.3)	85 (18.2)
Gender												
Male	15 (7.1)	46 (23.6)	61 (16.1)	30 (14.2)	100 (51.3)	130 (34.3)	45 (21.3)	94 (48.2)	139 (36.7)	45 (21.3)	4 (2.1)	49 (12.9)
Female	6 (2.3)*	20 (6.8)***	26 (10.3)	18 (7.0)*	42 (14.2)***	60 (23.7)	30 (11.6)**	58 (19.6)***	88 (34.8)	62 (24.0)	17 (5.7)	79 (31.2)
Family wealth status												
Low	1 (3.2)	49 (15.8)	50 (18.1)	4 (12.9)	101 (32.5)	105 (38.0)	7 (22.6)	103 (33.1)	110 (39.9)	2 (6.5)	9 (2.9)	11 (4.0)
Middle	5 (3.7)	13 (10.0)	18 (11.3)	13 (9.6)	32 (24.6)	45 (28.3)	23 (16.9)	39 (30.0)	62 (39.0)	25 (18.4)	9 (6.9)	34 (21.4)
High	15 (5.0)	4 (8.0)	19 (9.6)	31 (10.3)	9 (18.0)	40 (20.3)	45 (14.9)	10 (20.0)	55 (27.9)	80 (26.5)*	3 (6.0)	83 (42.1)

Fishers' exact or Chi-square test: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

[a] *n* number of children with the condition, % percent of children having the condition

Other significant factors associated with nutritional outcomes in this study are parents' place of origin, an indicator of the parent's rural–urban migration history. Children whose parents were born in the urban region were less likely to be stunted than children whose parents migrated from the rural region. This explains how globalization and urbanization can directly influence the behavior and health status of humans. The parents' exposure to urban lifestyle has a significant impact on children's nutritional outcomes. The shift from traditional food with higher fiber and carbohydrate towards diet with higher fat concentration and poor physical activity are the characteristic of urban residents (Manyanga et al. 2014; Popkin 2001; Prentice et al. 2006). Prevalence of overweight and obesity has been increasing in sub-Saharan African countries from the 1980s to the 21st century (Muthuri et al. 2014). The rapid globalization brings a brand new life and food environments in the cities, and the Westernized lifestyle may lead to greater risk of obesity (Siervo et al. 2006b). As population flocks into the cities seeking for better life condition and economic prospects, human physiology becomes maladapted to the drastic lifestyle and environmental changes from rural to urban (Siervo et al. 2006b; Wang et al. 2009). This costs an increased prevalence of overweight, obesity, and the related health outcomes (Popkin 2001; Prentice et al. 2006).

Students from single-parent households have higher risk for both stunting and overweight/obese compared to those from polygamous families. This observation was reported in other developing countries (Ntoimo and Odimegwu 2014). Literature suggested that in the sub-Sahara Africa, wives in monogamous and polygamous marriage are less likely to work than are single mothers (Elbedour et al. 2002). The association between maternal employment and children's obesity is widely observed in developed countries, because work-family time strain might reduce parental attention on children's health and weight status (Cawley and Liu 2012; Mindlin et al. 2009). Since single parent would be the household head and probably the main breadwinner of the family, the elevated odds of malnutrition among children in single-parent families may also reflect the single-parent's lower capacity of attending children's health and weight status after job (Maddah et al. 2007; Ntoimo and Odimegwu 2014). The possible link between family type to both children's under- and overnutrition in the urban Gambia and other developing countries needs public health attention.

The primary limitation of this study is that it did not include non-school attendees. Despite mandatory education system, about 15 % were not enrolled. Therefore, the generalizability of current study to all urban Gambian adolescents may be limited to those who attend upper basic

Table 3 Association between socioeconomic-demographic factors and adolescents' undernutrition status: multivariable logistic regression analysis: Gambia, 2014

Variable	*n* (%)	Stunting (HAZ < −2SD)		Underweight (WAZCDC < −2SD)	
		OR (95 % CI)	*p* value	OR (95 % CI)	*p* value
School type					
Private	469 (48.9)	1		1	
Public	491 (51.1)	3.348 (1.662–6.744)	0.001	3.059 (1.842–5.079)	<0.001
Gender					
Male	406 (42.3)	1		1	
Female	554 (57.7)	0.278 (0.166–0.466)	<0.001	0.226 (0.155–0.329)	<0.001
Age					
13±	259 (27.0)	1		1	
14–15	701 (73.0)	0.702 (0.404–1.219)	0.209	1.039 (0.679–1.589)	0.861
Education level					
UB7	291 (30.3)	1		1	
UB8	309 (32.2)	1.028 (0.572–1.847)		1.102 (0.717–1.694)	
UB9	360 (37.5)	0.720 (0.396–1.308)	0.440	0.532 (0.337–0.841)	0.003
Region/place of birth					
Rural	178 (18.5)	1		1	
Urban	782 (81.5)	0.874 (0.468–1.632)	0.672	0.881 (0.539–1.439)	0.613
Family type					
Polygamy	414 (43.1)	1		1	
Monogamy	435 (45.3)	1.413 (0.838–2.385)		0.964 (0.658–1.410)	
Single parent	111 (11.6)	2.753 (1.220–6.216)	0.047	0.732 (0.372–1.438)	0.662
Parent's age					
≤34 years	189 (19.7)	1		1	
35–49 years	492 (51.3)	0.643 (0.350–1.180)		0.936 (0.583–1.503)	
≥50 years	279 (29.1)	0.592 (0.288–1.215)	0.282	0.763 (0.438–1.329)	0.567
Parent's sex					
Male	553 (57.6)	1		1	
Female	407 (42.4)	0.553 (0.302–1.013)	0.055	0.800 (0.527–1.214)	0.294
Parent's education status					
No formal/primary	285 (29.7)	1		1	
Secondary	356 (37.1)	1.402 (0.781–2.515)		0.944 (0.614–1.452)	
Tertiary	319 (33.2)	1.144 (0.523–2.499)	0.499	0.725 (0.410–1.282)	0.509
Parent's employment status					
Currently employed	319 (33.2)	1		1	
Self-employed	115 (12.0)	1.019 (0.451–2.303)		1.014 (0.545–1.889)	
Not employed	526 (54.8)	0.947 (0.515–1.742)	0.970	1.005 (0.635–1.588)	0.999
Parent's place of origin					
Rural	358 (37.3)	1		1	
Urban	602 (62.7)	0.525 (0.301–0.914)	0.023	0.713 (0.471–1.082)	0.112
Household wealth index					
Low	342 (35.6)	1		1	
Middle	266 (27.7)	0.597 (0.311–1.145)		0.728 (0.456–1.162)	
High	352 (36.7)	0.719 (0.329–1.569)	0.297	0.694 (0.389–1.238)	0.332

The *p* values denote the significance of the whole set of the categorical dummy variables (global test)

schools. However, since upper basic school education is mandatory, the coverage of sampling frame was relatively wide. Second, this study was conducted within 1 month, while children's growth, especially body weight, fluctuates with seasons (Tomkins et al. 1986). Thus, the estimated prevalence of undernutrition and overnutrition may only

Table 4 Association between socioeconomic-demographic factors and adolescent's weight status: multinomial logistic regression analysis: Gambia, 2014

Variable	*n* (%)	Weight status			
		Thinness vs. normal weight		Overweight/obese vs. normal weight	
		BMI-for-age < -2		BMI-for-age $> +1$	
		RRR (95 % CI)	*p* value	RRR (95 % CI)	*p* value
School type					
Private	469 (48.9)	0.612 (0.392–0.957)	0.031	2.846 (1.551–5.220)	0.001
Public	491 (51.1)	1		1	
Gender					
Male	406 (42.3)	2.903 (2.077–4.057)	<0.001	0.818 (0.535–1.252)	0.355
Female	554 (57.7)	1		1	
Age					
13±	259 (27.0)	1.112 (0.758–1.631)	0.588	1.264 (0.798–2.002)	0.319
14–15	701 (73.0)	1		1	
Education level					
UB7	291 (30.3)	1.353 (0.894–2.046)	0.153	1.075 (0.650–1.779)	0.777
UB8	309 (32.2)	1.457 (0.978–2.169)	0.064	0.714 (0.427–1.193)	0.198
UB9	360 (37.5)	1		1	
Region/place of birth					
Rural	178 (18.5)	0.999 (0.633–1.578)	0.997	1.305 (0.715–2.380)	0.386
Urban	782 (81.5)	1		1	
Family type					
Polygamy	414 (43.1)	1.173 (0.653–2.106)	0.593	0.431 (0.209–0.888)	0.023
Monogamy	435 (45.3)	0.963 (0.535–1.731)	0.899	0.778 (0.400–1.513)	0.459
Single parent	111 (11.6)	1		1	
Parent's age					
$\leq$34 years	189 (19.7)	0.985 (0.591–1.639)	0.952	1.036 (0.536–2.005)	0.916
35–49 years	492 (51.3)	0.984 (0.666–1.454)	0.936	0.872 (0.540–1.406)	0.573
$\geq$50 years	279 (29.1)	1		1	
Parent's sex					
Male	553 (57.6)	1.134 (0.777–1.654)	0.515	1.715 (1.049–2.803)	0.031
Female	407 (42.4)	1		1	
Parent's education status					
No formal/primary	285 (29.7)	1.116 (0.671–1.857)	0.673	0.649 (0.322–1.308)	0.227
Secondary	356 (37.1)	1.114 (0.710–1.748)	0.638	1.018 (0.623–1.666)	0.942
Tertiary	319 (33.2)	1		1	
Parent's employment status					
Currently employed	319 (33.2)	1.028 (0.681–1.552)	0.897	0.784 (0.487–1.262)	0.317
Self-employed	115 (12.0)	1.470 (0.914–2.365)	0.112	0.556 (0.221–1.402)	0.213
Not employed	526 (54.8)	1		1	
Parent's place of origin					
Rural	358 (37.3)	1.368 (0.937–1.999)	0.105	0.951 (0.586–1.545)	0.840
Urban	602 (62.7)	1		1	
Household wealth index					
Low	342 (35.6)	1.284 (0.759–2.171)	0.352	0.342 (0.153–0.762)	0.009
Middle	266 (27.7)	1.210 (0.760–1.927)	0.421	0.740 (0.454–1.208)	0.229
High	352 (36.7)	1		1	

The reference category of weight status is normal weight

reflect the situation of the rainy months in the Gambia. Nevertheless, in terms of testing the differences in students' nutritional status between public and private school, the validity of comparison may not be affected by seasonality as long as our survey in public and private schools was conducted in the same season. Third, this is a cross-sectional study. It is uncertain whether the factors associated with malnutrition were casually a predictive or risk factors for malnutrition. Future longitudinal study is warranted to answer whether school type could prospectively affect adolescent's nutritional status. The study uses WHO and CDC references to convert the anthropometrics to determine the nutritional status. Even though this is widely used in many regions, it may not fit all populations.

Despite the limitations, this study has several strengths. First, the anthropometries were all directly measured in school. Directly measured weight status, height, and body girths are more accurate than children's self-report. Second, the response rate was as high as 84 %, indicating that the issue of self-selection might be small in this study. Third, we applied the international growth references for nutritional status, which allows international comparison.

Findings from this study can serve as a baseline guide, an evidence for policy makers to give more attention to adolescent nutrition in urban Gambia and try to promote and advocate for nutrition initiatives which will target the adolescents. Students with certain family background characteristics may have greater risks of malnutrition, and deserve nutritional assistance in school. The government should advocate for nutrition education that teaches dietary guidelines in the schools system, regulate food vendors by monitoring the quality of food being sold in schools, and devote to improving school hygiene. Regular national nutritional assessment of adolescents and pre-entry nutritional assessment at school level is necessary to keep tract of the children to know who are at risk and come up with strategies to support them.

The findings reveal that both undernutrition and overnutrition are prevalent among young Gambian adolescents, which have gender, socioeconomic, and institutional (school) disparities. Overweight/obesity was more prevalent in private schools, while stunting and thinness were more prevalent in public school. Public and private schools in urban regions of developing countries may face different challenges due to differences in school environment and resources; this issue calls for a great need in helping all students in gaining a healthy nutritional status. Children from high income household are more likely to be overweight/obese than those from low income households. Family factor is also a significant independent predictor to the children's nutritional status, where children from single-parent households were more likely to be stunted and overweight/obese than those from polygamous households. Public health measures at school level and family level are needed to reduce disparity in nutritional status between the students of public and private schools.

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Compliance with ethical standards

Conflict of interest The authors have no conflict of interests to disclose.

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