Central African Journal of Public Health
2020; 6(3): 164-172
http://www.sciencepublishinggroup.com/j/cajph
doi: 10.11648/j.cajph.20200603.18
ISSN: 2575-5773 (Print); ISSN: 2575-5781 (Online)

Prevalence and Factors Associated with Thinness and Overweight/Obesity Among Secondary School Adolescents. A Cross-sectional Study

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To cite this article:

Haddy Jallow-Badjan, Haddy Tunkara-Bah, Paul Bass, Thomas Senghore. Prevalence and Factors Associated with Thinness and Overweight/Obesity Among Secondary School Adolescents. A Cross-sectional Study. *Central African Journal of Public Health.* Vol. 6, No. 3, 2020, pp. 164-172. doi: 10.11648/j.cajph.20200603.18

Received: March 30, 2020; **Accepted**: May 3, 2020; **Published**: May 15, 2020

Abstract: Globally unhealthy lifestyle behaviors among adolescents have become a public health concern, contributing to the obesity epidemic in many parts of the world. In The Gambia, underweight has previously been considered as a significant health problem. However, in recent decades, the prevalence of overweight and obesity has been a growing concern. Thus, we aimed to investigate the prevalence and risk factors for both thinness and overweight/obesity among school going adolescence in The Gambia. Using a cross-sectional study design, 805 students (268 males, 537 females) aged 13 to 19 from schools in Western Region, The Gambia ware selected using a multi-stage sampling design. BMI-for-age z-scores were used to determine nutritional status. Multinomial logistic regressions models were used to assess the association between multiple factors and BMI-for-age status of adolescents. Our findings show that thinness and overweight/obesity were 13.69% and 7.77% respectively. Factors such as sex (female: adjusted odds ratio [aOR]=3.15, 95% confidence interval [CI]=1.43 – 6.93), mother's education (secondary: aOR=2.86, 95% CI=1.16 – 7.07), physical activity level (sufficiently active: aOR=0.48, 95% CI=0.24 – 0.95) and nighttime sleep duration (<6 hours: aOR=2.53, 95% CI=1.07 – 5.99) were significantly associated with overweight/obesity. In addition, sex (female: aOR=0.34, 95% CI=0.19–0.59) and nighttime sleep duration (<6 hours: aOR=2.92, 95% CI=1.24–6.86) were associated with thinness. The results suggest that the double burden of malnutrition exist in The Gambia and remains a major public health issue among adolescents. This, therefore, underlined the need for nutritional interventions targeting adolescents. Further research involving the entire country may be required to show the national burden.

Keywords: BMI-for-age, Thinness, Overweight/Obesity, Adolescents, The Gambia

1. Introduction

In recent decades, the health, and well-being of adolescents has attracted global attention [1]. Globally, adolescents constitute about 16% of the world's population and approximately 85% of these live in developing countries [2, 3]. The demographics are even higher in Sub-Saharan Africa (SSA) where they constitute the greatest proportion (23%) of the population [3]. The period of adolescence is a critical window when rapid changes in the health and development of an individual have important and long-lasting implication into adulthood. For instance, rapid growth accompanied by higher nutritional demands puts adolescents at great risk for malnutrition that is associated with adverse health consequences throughout their life-course [4, 5].

Many low- and middle-income countries (LMICs) that have previously been confronted with childhood

undernutrition (underweight and stunting) [6] are now facing a double burden of malnutrition (underweight and obesity) [7]. This is particularly so for adolescents [8], whose health and wellbeing have often been neglected [9]. A survey of 57 LMICs estimates the prevalence of stunting, thinness, overweight/ obesity among adolescents to be 10.2%, 5.5% and 21.4% respectively [8]. The double burden of malnutrition is a serious public health challenge [10] as poor nutritional status is associated with adverse health outcomes. In females, both underweight and obesity are associated with poor reproductive health outcome [4, 11]. Adolescent Stunting resulting from chronic undernutrition is linked to impaired cognitive development [12], delayed maturation and poor muscle strength leading to constraints in physical capacity and reduced economic productivity [12, 13]. Recent evidence has also linked adolescents underweight with adult-onset diabetes [14]. On the other hand, being overweight or obese in adolescence is associated with adverse psychosocial distress, early onset adult non-communicable diseases and an increase in long-term adult premature mortality [5, 15].

Like many developing countries, The Gambia is experiencing a demographic and nutritional transition as evident by the increase in the youthful population [16], changing lifestyle and an increasing prevalence of overweight, obesity [17, 18] and related health problems [19, 20]. The 2013 Gambia Demographic and Health Survey (GDHS) estimates that about 9.1% of adolescent women were overweight or obese. Paradoxically, underweight remains prevalent in 27% of adolescent women [21]. Certainly, these young people will become tomorrow's workforce and decision makers. Aside from the health cost, their health and wellbeing will have important implications for the future labor market [22]. Although, nutrition is accorded high priority in the socio-economic development agenda of The Gambia [23], very little emphasis is placed on adolescent's nutrition. Given the negative health consequences associated with the double burden of malnutrition, it is specifically essential to quantify the burden and examine the risk factors for adolescent malnutrition. Such information is important for policy to support interventions aimed at combating malnutrition in all its forms in this vulnerable group.

The prevalence of adolescent thinness or overweight/obesity is reported to vary across countries [8, 24, 25]. Malnutrition in adolescents has been linked to several factors both biological and environmental. Studies have shown that factors such as age, sex [26, 27], dietary habit, physical exercise [10] sleep duration and sedentary behavior [28, 29] are associated with nutritional status in adolescents. Furthermore, socioeconomic factors like parents' occupation, educational and income levels are also associated with adolescent weight status [24, 30, 31]. Although there exists a growing body of evidence on adolescent nutrition globally, very little exist in the Gambia. Thus, to address this inadequacy, we conducted a cross-sectional study to quantify the burden of malnutrition and examine the associated risk factors.

2. Methodology

2.1. Study Design and Participants

This cross-sectional study was part of a larger survey assessing the nutritional status of secondary school students in the Metropolitan Greater Banjul Area of The Gambia which accounts for 57% of the country's population [32]. The survey was conducted in December 2017 and included students from grades 10 to 12 in eight randomly selected senior secondary schools.

2.2. Sampling Procedure

To obtain a geographically representative sample, study participants were selected using a multistage stratified random sampling design. In the first stage, schools within the region were divided into four clusters, and further into private and public funded schools. A random technique was used to select one public and one private school from each cluster to make up eight schools. In each school, depending on the size of the school, two classes were randomly selected form each grade (if the school has more than one class for each grade) making a total of 48 classes. In the final stage, a list of all the students in each selected grade was used as the sampling frame to randomly select participants proportional to sex. In total, 901 students took part in the survey of which 805 were ≤19 years and were included in this analysis.

2.3. Recruitment and Data Collection

Final year undergraduate nursing students familiar with anthropometric measurements recruited the participants and collected data. To ensure consistency in the data collection procedure, all data collectors received 4 hours of training on the use of the anthropometric instruments and questionnaire administration. All data were collected in a classroom setting. In each selected grade, all sampled participants were gathered in a classroom and administered the questionnaire under the supervision of trained data collectors. To ensure confidentiality and any possibility of peer influence in answering the questionnaire, they were seated about two meters apart. Following the questionnaire administration, anthropometric measurements were taken and recorded.

2.4. Measurements

Information on sociodemographic and lifestyle characteristics were collected through a structured self-administered questionnaire based on previously published instrument and validated for use [33, 34]. The sociodemographic data included factors such as age, sex, school type, grade, number of siblings, family type, mother and father's education, and employment. The lifestyle factors consisted of physical activity, sedentary behavior,

psychosocial distress, and nighttime sleep duration. Physical activity was measured using the Physical Activity Questionnaire for Adolescents (PAQ-A), designed for assessing general levels of physical activity for students in grades 9 to 12 and approximately 13 to 19 years of age. The instrument was previously shown to have a high reliability (intraclass correlation coefficient: ICC=0.88; 95% confidence interval (CI): 0.84 - 0.91) and acceptable validity (r=0.62; p<0001) [35]. Based on previous literature [35], cut-offs were used to categorize physical activity into 'sufficiently active' and 'low active'. Sedentary behavior was determined by asking participants specific questions regarding activities during leisure time including the frequency and duration of television viewing, use of computers, video and mobile phone games, use of social media as well as other indoor games. The psychosocial distress scale of the questionnaire consists of questions that assess how often participants felt lonely, worried and could not sleep well at night, sad or hopeless to the extent of interfering in usual activity and if they had experienced any form of bullying. All responses in the case of the sedentary behavior and psychosocial distress scale were coded '0' in the case of never or none and 1, 2, 3, and 4 respectively, based on magnitude and frequency of the action. Responses were summed to obtain a final score for each participant. The median values were used as cut-offs for each variable.

Anthropometric measurements were determined using participants' weights and heights. Body weight was measured to the nearest 0.1kg using a portable SECA electronic scale (Seca gmbh & Co. kg, 22089 Hamburg, Germany / model: 874 1021659) and height measurements were taken to the nearest 0.1 cm using a portable UNICEF height measuring board. All measurements were done in accordance with the standard procedure and recorded in duplicates. Based on the US Center for Disease Control (CDC) growth charts [36], body mass index-for-age z-scores (BMIZ) were calculated using the weight and height measures. BMIZ was used to define thinness (BMIZ< -2), normal weight (-2 ≤ BMIZ ≥ +1) and Overweight/ obesity (BMIZ > +1).

2.5. Statistical Analysis

The SAS statistical Package (ver. 9.4 for Windows; SAS Institute, Cary, NC, USA) was used for all data analysis. The SAS program 'cdc-source-code.sas' [37], a program for the 2000 CDC Growth Charts was used to calculate BMIZ and percentiles. Due to the complex sampling procedure, all analysis used weighted data. The association between sociodemographic and lifestyle factors with thinness and overweight/obesity were tested in a univariate and multivariate multinomial logistic regression, with corresponding odds ratios (ORs) and 95% CI. All factors significant in the univariate model were included in the multivariate model. Statistical significance was set at p<0.05 and two-sided.

2.6. Ethical Consideration

Approval to include the participating school was sought from the Regional Education Directorate, Western Region 1 and the principals of the respective schools. Informed parental consent and child assent were obtained for all participants prior to enrollment. Final approval was granted by the University of The Gambia Research and Publication Committee and The Gambia Government/ MRC Joint Ethics Committee (Approval No: R017026)

3. Results

3.1. Sociodemographic and Lifestyle Factors of Adolescents

In total, 805 adolescents with a mean age of 16.8±1.5 years were recruited for this study. Table 1 shows the summary statistics of sociodemographic and lifestyle factors. The weighted prevalence of thinness, normal weight and overweight/obese were 13.69%, 78.54%, and 7.77% respectively. Majority of the participants were female (66.93%), had less than 16 years (89.77%), form public schools (74.66%), have 'low active' physical activity (67.44%) mild sedentary behavior (68.05%), mild psychosocial distress (61.76%) and 6 to 8 hours of nighttime sleep (47.93%).

Table 1. *Sociodemographic, lifestyle factors and BMI-for-age status of adolescents.*

Variables	Total	Weighted	
	n	n	%
Total	805	810.03	100
Weight Status			
Thinness	114	110.92	13.69
Normal weight	614	636.16	78.54
Overweight/obese	77	62.95	7.77
Sex			
Male	268	267.86	33.07
Female	537	542.17	66.93
Age, years			
< 16	666	727.19	89.77
≥ 16	139	82.84	10.23
School Type			
Private	406	205.25	25.34
Public	399	604.78	74.66
School level			
Grade 10	336	315.77	38.99

Variables	Total	Weighted	
	n	n	%
Grade 11	241	232.23	28.67
Grade 12	228	262.03	32.35
No. of siblings			
≤2	219	190.45	23.51
3-5	559	585.42	72.27
>5	27	34.16	4.22
Family type			
Nuclear	489	484.30	59.79
Extended	316	325.73	40.21
Mother's education			
No education	312	363.34	44.86
Primary	82	96.76	11.95
Secondary	235	225.54	27.84
Higher	176	124.39	15.36
Parents' Employment			
Unemployed	43	54.99	6.79
Employed	762	755.04	93.21
Physical activity level			
Low active	521	546.31	67.44
Sufficiently active	284	263.72	32.56
Sedentary behavior			
Mild	497	551.22	68.05
Severe	308	258.81	31.95
Psychosocial distress			
Mild	518	500.30	61.76
Severe	287	309.73	38.24
Sleeping duration (hrs.)			
<6	309	311.40	38.44
6 - 8	369	388.22	47.93
>8	127	110.41	13.63

BMI, Body mass index.

3.2. Factors Associated with Adolescent BMI-for-age Status

In the univariate multinomial logistic regression analysis, participants age (≥16 years, p=0.023), sex (females, p=0.021), school type (public school, p=0.009), mother's education (secondary, p=0.009 and tertiary, p=0.005, respectively) physical activity level (Sufficiently active, p=0.023) and nighttime sleep duration (<6 hours, p=0.029) were associated with overweight/obesity. In addition, sex (female, p=0.0004) and nighttime sleep duration (<6 hours, p=0.030) were associated with thinness (Table 2).

Table 3 describes the multivariate multinomial regression analysis on factors associated with adolescent BMI-for-age status. Sex (female: adjusted odds ratio [aOR]=3.15, 95% CI=1.43 – 6.93), mother's education (secondary: aOR=2.86, 95% CI=1.16 – 7.07), physical activity level (sufficiently active: aOR=0.48, 95% CI=0.24 – 0.95) and nighttime sleep duration (<6 hours: aOR=2.53, 95% CI=1.07 – 5.99) were significantly associated with overweight/obesity. In addition, sex (female: aOR=0.34, 95% CI=0.19–0.59) and nighttime sleep duration (<6 hours: aOR=2.92, 95% CI=1.24–6.86) were associated with adolescent thinness.

Table 2. *Univariate multinomial analysis of factors associated with BMI-for-age status of adolescents.*

Variables	Thinness*		Overweight/obesity*	
	OR (95% CI)	p-value[§]	OR (95% CI)	p-value[§]
Age, years				
< 16	1.00		1.00	
≥ 16	0.73 (0.28–1.88)	0.510	2.42 (1.13–5.18)	0.023
Sex				
Male	1.00		1.00	
Female	0.36 (0.21–0.63)	0.0004	2.85 (1.17–6.95)	0.021
School Type				
Private	1.00		1.00	
Public	1.07 (0.64–1.77)	0.7993	0.45 (0.25–0.82)	0.009
School level				
Grade 10	1.00		1.00	
Grade 11	1.59 (0.83–3.07)	0.165	0.82 (0.39–1.72)	0.600
Grade 12	1.73 (0.90–3.34)	0.102	0.90 (0.41–1.98)	0.786
No. of Siblings				
≤2	1.00		1.00	

Variables	Thinness*		Overweight/obesity*	
	OR (95% Cl)	*p*-value§	OR (95% Cl)	*p*-value§
3-5	0.87 (0.47–1.61)	0.647	0.69 (0.36–1.32)	0.259
>5	0.20 (0.04–1.02)	0.053	0.25 (0.04–1.40)	0.114
Family Type				
Nuclear	1.00		1.00	
Extended	1.00 (0.57–1.74)	0.986	0.86 (0.44–1.68)	0.667
Mother's Education				
No education	1.00		1.00	
Primary	0.46 (0.14–1.52)	0.204	2.04 (0.67–6.25)	0.213
Secondary	1.04 (0.54–2.01)	0.904	3.26 (1.35–7.87)	0.009
Higher	1.75 (0.85–3.61)	0.129	3.64 (1.47–9.00)	0.005
Parents' Employment				
Unemployed	1.00		1.00	
Employed	1.63 (0.40–6.68)	0.494	0.83 (0.20–3.46)	0.801
Physical activity level				
Low active	1.00		1.00	
Sufficiently active	1.16 (0.63–2.14)	0.641	0.47 (0.25–0.90)	0.023
Sedentary behavior				
Mild	1.00		1.00	
Severe	1.23 (0.70–2.17)	0.465	1.11 (0.61–2.03)	0.737
Psychosocial distress				
Mild	1.00		1.00	
Severe	0.61 (0.33–1.13)	0.113	0.93 (0.48–1.81)	0.837
Sleep duration (hours)				
	2.55 (1.10–5.92)	0.030	2.48 (1.10–5.62)	0.029
	1.00		1.00	
	1.78 (0.74–4.28)	0.201	1.50 (0.63–3.55)	0.362

*Reference in this analysis was normal weight. OR. Odds ratio; Cl, Confidence interval. §Significance at $p<0.05$.

Table 3. *Multivariate multinomial analysis of factors associated with BMI-for-age status of adolescents.*

Variables	Thinness*		Overweight/obesity*	
	OR (95% Cl)	*p*-value§	OR (95% Cl)	*p*-value§
Age, years				
< 16	1.00		1.00	
≥ 16	0.51 (0.17 - 1.52)	0.226	2.13 (0.91 – 4.98)	0.083
Sex				
Male	1.00		1.00	
Female	0.34 (0.19 – 0.59)	0.0002	3.15 (1.43 – 6.93)	0.004
School Type				
Private	1.00		1.00	
Public	1.11 (0.60 – 2.06)	0.735	0.66 (0.34 – 1.28)	0.220
Mother's Education				
No education	1.00		1.00	
Primary	0.39 (0.12 – 1.33)	0.134	1.99 (0.61 – 6.48)	0.253
Secondary	1.06 (0.53 – 2.15)	0.866	2.86 (1.16 – 7.07)	0.023
Higher	1.99 (0.85 – 4.62)	0.109	2.29 (0.83 – 6.32)	0.109
Physical activity level				
Low active	1.00		1.00	
Sufficiently active	1.30 (0.70 – 2.43)	0.403	0.48 (0.24 – 0.95)	0.035
Sleeping time (hours)				
<6	2.92 (1.24 – 6.86)	0.014	2.53 (1.07 – 5.99)	0.035
6 - 8	1.00		1.00	
>8	2.17 (0.88 – 5.34)	0.092	1.94 (0.81 – 4.68)	0.139

*Reference in this analysis was normal weight. OR. Odds ratio; Cl, Confidence interval. §Significance at $p<0.05$.

4. Discussion

Malnutrition remains a major public health problem in many developing countries contributing to the burden of diseases. Unlike overweight/obesity, thinness among adolescents is grossly understudied. Therefore, this study sought to quantify the double burden of malnutrition and investigate multiple factors associated with such a burden among school-going adolescents. Results show that thinness and overweight/obesity was prevalent at 13.69%, and 7.77%, respectively. Both sociodemographic and lifestyle factors were associated with adolescent BMI-for-age status.

Overall, about one in seven of the participants were classified as thin. Although higher than the 4.7% reported in Wolaita Sodo Town, Southern Ethiopia [24] and 5.5% estimated globally form 57 LMIC [8] it is lower than those

reported within the West African sub-region including 26.8% reported for Dakar, Senegal [38] and 29% in Ibadan, Nigeria [39]. On the other hand, 7.77% of overweight/obesity in our study was similar to 7.6% and higher than 5.0% found in the Nigerian and Ethiopian studies [24, 39], respectively, but lower than the 21.4% in the Senegalese study [38] and 15% in Accra and Kumasi, Ghana [40]. This varying prevalence may be attributed to the difference in several factors contributing to weight status, such as lifestyle and socioeconomic levels. The inconsistencies in the study design, diversity in study samples and variable age range may have also played a part.

Our finding shows that sex was significantly associated with both thinness and overweight/obesity. Females were found to be less likely than their male counterparts to be thin and more likely to be overweight/obese. A similar study of school going adolescents involving seven African countries found that males were twice more likely to be underweight than females [40]. Findings are also consistent with studies from Nigeria [39], Cameroon [41] Ethiopia [42] and Ghana [40]. The increased risk for overweight/obesity observed in females in our study may be in part the result of a gain in body fat after menarche [43], since all of our female participants have passed the age of menarche. However, contrasting findings were reported from studies in Europe [44] and China [45].

In literature, evidence on the relationship between adolescent parent's education and overweight/obesity are mixed [39, 46, 47]. While some reported an increased risk [40, 48], the reverse was reported in others [47, 49]. In our study, mother's education status was found to significantly influence overweight/obesity. Participants who reported that their mother's received formal education had a significantly increased risk for overweight/obesity compared to those whose mothers had no formal education. Two possible explanations may underline these two opposing phenomena. In the case of the positive association, educated mothers may be more likely to earn higher income that has been linked with easy accessibility to energy-dense foods and electronic devices that promote sedentary behavior increasing their risk for overweight/obesity. Conversely, maternal education may lead to greater access to knowledge of good nutritional practice. The later may apply to our results. However, this relationship may be modified by other factors and may, therefore, need clarification in further studies.

Physical activity is directly related to healthy weight status through increased energy expenditure [50]. On the other hand, evidence suggests that overweight and obese adolescent are less active [51, 52]. Consistent with other studies [53, 54] we found sufficiently active adolescents to have a decreased risk for overweight/obesity. Sleep deprivation is commonly reported in adolescents and has considerable effects on energy balance [55]. The link between sleep duration and overweight/obesity remains unclear. While some studies reported an inverse association between sleep duration and overweight/obesity [56, 57], other reported a positive association with short sleep [58, 59], yet another study reported a U-shaped association [60]. In our study, we noted that adolescents who had shorter nighttime sleep duration (<6 hours) had an increased risk for overweight/obesity, compared to those with 6 to 8 hours of sleep duration. The possible causal relationship between short nighttime sleep duration and weight gain may be through increase food intake resulting from hedonic eating [61] and increased central nervous response to unhealthy eating [62]. We noted shorter sleeping adolescents to have an increased risk for thinness. While the mechanism and pathway linking sleep duration and overweight/obesity are well documented, less is known of the mechanism linking sleep and underweight/thinness. One possible mechanism may be through the decreased secretion of sleep-inducing gut-peptides such as cholecystokinin and increase levels of wake agents such as orexin that can result from low-calorie intake [63]. A large-scale population-based study of adolescents found thin participants to have shorter nighttime sleep duration [64].

Our results must be considered in light of some limitations. Variables such as dietary intake, household wealth and family history of obesity, were not included in the analysis. Furthermore, the possibility of recall and measurement bias could not be excluded. However, the instrument was validated and data collectors were trained and supervised during the entire data collection period. Given the cross-sectional nature of the data, we cannot infer causality. Finally, the study involved school going adolescents from one region of The Gambia and therefore may not be representative of the total population of Gambian adolescents. Despite these limitations, our study provides valuable information on the situation of adolescent malnutrition in the Gambia.

5. Conclusions

Our findings show that both adolescent thinness and overweight/obesity are prevalent in the Gambia. Sex, mother's education, physical activity level and nighttime sleep duration were significantly associated with adolescent overweight/obesity, while sex and nighttime sleep was associated with thinness. Attempts at combating adolescent malnutrition in all its forms must focus on addressing the above-mentioned risk factors. The study underlines the need for nutrition policy and interventions targeting adolescents. Further studies involving the entire country may be required to show the national burden.

Competing Interests

The authors declare that they have no conflict of interest. This research did not receive any external funding.

Acknowledgements

The authors wish to acknowledge several person and organizations for their overall support throughout the study. The National nutritional Agency (NaNA) for providing anthropometric instruments, stationery and financial compensation for data collectors. The Ministry of Basic and

Secondary Education as well as principals and staff of the participating school for facilitating in the sampling and recruitment of schools. A special thanks to the parents and participating students.

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