

Determinants of Overweight/Obesity among Filipino Adolescents: 2018 Expanded National Nutrition Survey

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The prevalence of overweight and obesity among children and adolescents has been increasing worldwide. In the Philippines, the prevalence of adolescent overweight/obesity showed an increasing trend – from 4.9% in 2003 to 9.2% in 2015 and 11.6% in 2018. Obesity increases the risk of cardiovascular diseases, diabetes, some cancers, and other non-communicable diseases. This study aimed to identify major potential determinants of overweight/obesity among Filipino adolescents from the Food and Nutrition Research Institute’s Expanded National Nutrition Survey (ENNS). Univariate and multivariate analyses of the 2018 ENNS were done and included socio-demographic, socio-economic, clinical, and dietary data as potential determinants of adolescent overweight/obesity. Findings revealed that 12.0% of Filipino adolescents were overweight/obese. The odds of being overweight/obese was 75% (OR: 1.75; CI = 1.42–2.15; $p < 0.001$) higher with energy intake above requirements and 45% (OR: 1.45; CI = 1.25–1.67; $p < 0.001$) higher with protein intake above requirement. The risk of becoming overweight/obese in adolescents was higher among 10–12 yr old (OR: 1.61; CI = 1.23–2.10; $p = 0.002$), from households with less than five members (OR: 1.60; CI = 1.27–2.02; $p = 0.001$), living in urban areas (OR: 1.30; CI = 1.13–1.51; $p = 0.001$), from the richest wealth quintile (OR: 3.49; CI = 2.40–5.06; $p < 0.001$), whose households were food secure (OR 1.46; CI = 1.20–1.79; $p = 0.001$), and those household heads with at least college level of education (OR 1.56; CI = 1.15–2.13; $p = 0.008$), and who were physically inactive (OR: 1.41; CI = 1.08–1.84; $p = 0.016$). The dramatic rise in the prevalence trend of overweight/obesity among Filipino adolescents calls for integrated efforts of both the public and private sectors to focus on policies that would influence the promotion and support of overweight/obesity prevention. These findings may also serve as basis and inputs in modifying eating behaviors and the importance of increasing physical activity targeting the richest quintile in urban areas to help curb the overweight/obesity among adolescents.

Keywords: diet, Filipino adolescent, lifestyle, obesity, overweight, Philippines

INTRODUCTION

Adolescent obesity has been an increasing public health concern across the globe (WHO 2021; UNICEF 2022). As in any life stage group, obesity in adolescents has a

significant impact on both physical and physiological health. Reilly *et al.* (2003) identified short-term and long-term effects that may manifest from childhood – including psychological consequences such as lower self-esteem, increased risk of developing cardiovascular diseases (CVDs), as well as other clinical consequences such as

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asthma, type 1 diabetes, low-grade systemic inflammation, increased serum C-reactive protein concentration, and even abnormalities of the foot structure.

Adolescence is a significant period of human growth and maturation and represents the transition between life as a child and life as an adult. Around 1.2 billion people, or one in six of the world's population, are adolescents aged 10–19 yr old (WHO 2018a). In the Philippines, adolescents comprise 30% of the population. Achievement of optimum growth during this period is of utmost importance in maintaining good health thereafter (Goyal and Chavan 1993).

The World Health Organization (WHO) (2018b) reported that the prevalence of overweight/obesity among adolescents globally has risen from 4% in 1975 to 18% in 2016, or in a span of 41 yr. In the Philippines, based on the 2003–2018 National Nutrition Surveys (NNSs) of the Department of Science and Technology–Food and Nutrition Research Institute (DOST-FNRI), adolescent overweight/obesity has increased from 4.9% in 2003 to 11.6% in 2018 (DOST-FNRI 2020).

Studies in the Philippines that identify the risk factors associated with overweight/obesity among adolescents, particularly using national representative samples, are limited; available studies were on non-pregnant/non-lactating women of reproductive age (WRA) (Goyena *et al.* 2017) and adults (Duante *et al.* 2019). Household and individual characteristics – including socio-economic status, size of household, food available in the household (Lee *et al.* 2019), energy and protein intake (Duante *et al.* 2019), and age (Goyena *et al.* 2017; Duante *et al.* 2019), as well as lifestyle, genetics, and medical conditions (CDC 2020) – were determinants of overweight and obesity that were identified in these studies. Identifying major determinants of overweight/obesity among Filipino adolescents is likewise important to help authorities identify and develop strategies and programs to curb the rising malady.

This study was carried out to identify the determinants of overweight/obesity among Filipino adolescents aged 10–19 yr old using data from the 2018 Expanded NNS (ENNS). Specifically, the study sought [1] to determine the prevalence of overweight/obesity among adolescents by household socio-economic characteristics (including wealth, food security, size, household head work, educational status, and urban-rural location) and individual characteristics (including age, gender, dietary intake, and lifestyle factors), and [2] to determine the factors affecting overweight/obesity among adolescents (10–19 yr old).

MATERIALS AND METHODS

Study Design and Participant Selection

The study utilized data collected in the 2018 ENNS, which was a cross-sectional household-based survey (DOST-FNRI 2020). The 2018 ENNS employed the 2013 Master Sample of the Philippine Statistics Authority (PSA), which used replicated sampling wherein a replicate was composed of at least five provinces or highly urbanized cities (HUCs) (PSA n/d). The 2018 ENNS included eight replicates, hence 40 provinces and HUCs for a nationally representative sample. One province (Sulu) was not covered due to the peace and order situation. The final sample for this study included 16,217 adolescents, 10–19 yr old, who had complete anthropometry, dietary, demographic, and lifestyle data.

Study Variables

Dependent variable: overweight/obesity. Adolescent overweight/obesity, which is the abnormal or excessive accumulation of fat, was determined using body mass index (BMI), calculated as weight in kilograms (kg) divided by the square of the height in meters (kg/m²) and classified using the WHO Growth Reference Standards (WHO 2007). The overweight had a BMI z-score of +1, whereas the obese had BMI z-score of +2. Adolescents with BMI z-score of < +1 to –2 had normal nutritional status. For adolescents aged 19.08–19.99 yr old (229–239 mo), BMI was categorized according to the WHO cut-off standards of 25.0–29.99 kg/m² to define overweight and ≥ 30.00 kg/m² to define obesity (WHO 1995).

Independent variables. Independent variables or the potential determinants of adolescent overweight/obesity were selected from variables available in the 2018 ENNS. These included household and individual-level characteristics.

Household characteristics included household wealth status, household food security, household size, household head educational attainment, household head work status, and location of residence as urban or rural. Household wealth status was assessed in the ENNS using principal component analysis wherein proxy measures of wealth included type of housing materials on the floor, roof and wall; household water access; toilet facility; and household ownership of any appliances (television, radio, refrigerator, *etc.*), vehicles (car, bicycle, *etc.*) and electricity connection (DOST-FNRI 2016). The household wealth index was categorized into five quintiles: poorest, poor, middle, rich, and richest. For household food security, the ENNS applied the household food insecurity access scale or HFIAS (Coates *et al.* 2007). Household food security/insecurity was categorized into four levels: food secure and mildly, moderately, and

severely food insecure. However, in the analysis, mildly, moderately, and severely food insecure were merged into the food insecure group. Household size was categorized as having either < 5 or ≥ 5 members. Household head educational attainment was categorized into four: no grade completed, at least elementary level, at least high school level, and at least college level. Household head work status was categorized as either not employed or employed. The location of residence as rural or urban was based on NSCB Resolution No. 9, Series of 2003 (PSA 2003).

The individual-level variables were gender (male and female), age in years (10–12, 13–15, and 16–19 yr old), dietary intake (energy and protein intake), and lifestyle-related characteristics (physical activity, smoking, and alcohol consumption). The ages of the adolescents were grouped based on the 2015 Philippine dietary reference intakes or PDRI (DOST-FNRI 2015a).

Dietary intake was collected using two non-consecutive 24-h food recalls and processed using the individual dietary evaluation system (DOST-FNRI 2015b). Energy and protein adequacy was evaluated using the 2015 PDRI (DOST-FNRI 2015a). Energy and protein were categorized as above the recommended energy intake (REI) or estimated average requirement (EAR), respectively, and meeting or below the REI or EAR.

Lifestyle factors were physical activity, smoking, and alcohol consumption statuses. Physical activity was assessed as either active or inactive based on the WHO global reference list of 100 care health indicators (WHO 2015). For adolescents, inactive physical activity referred to engaging in less than 60 min of moderate- to vigorous-intensity physical activity per day. Smoking status – including the use of commercial/manufactured/hand-rolled cigarettes, cigars, and tobacco pipes – was categorized as either current smoker, former smoker, or never smoker based on the WHO STEPS surveillance manual (WHO 2017). Alcohol consumption was either lifetime abstainer, former drinker, or current drinker based on the WHO Global status report on alcohol and health (WHO 2014).

Data collection was done through face-to-face interviews using an interview guide and structured questionnaire *via* the electronic data collection system developed and validated by the DOST-FNRI (2012).

Data Processing and Analysis

Overweight and obesity were combined to ensure adequate size for the analysis. Descriptive statistics generated included frequencies and means to describe the adolescents in the study. Pearson's chi-squared (χ^2) test was used to compare the proportion of overweight/obese adolescents by characteristic. Logistic regression analysis – both univariate and multivariable linear regression

analyses – was done to identify the independent factors of overweight/obesity among adolescents. All variables were analyzed in univariate regression analysis, and only significant factors were considered in multivariable regression analysis. The detection of multicollinearity between variables was done by checking the extremely high values of standard errors. Independent variables with multicollinearity were excluded from the analysis. All statistical tests were done at a 5% level of significance.

All analyses were performed using Stata Version 15.0. Sampling weights were computed based on the product of the base weighting non-response adjustment and post-stratified calibration/adjustment based on the population counts obtained from the PSA. Survey weights were applied in all datasets and calculations to represent national estimates through the complex survey design.

Ethical Considerations

The protocol for the study, involving secondary data analysis, was approved by the FNRI Institutional Ethics Review Committee (FIERC) of the DOST on 31 Jul 2017, with Protocol Code FIERC-2017-07. It was also reviewed and given technical clearance by the PSA. Informed consent was obtained from participants prior to actual data collection of the ENNS (DOST-FNRI 2020).

RESULTS

Characteristics of the Filipino Overweight/Obese Adolescents

Table 1 summarizes the demographic and household socio-economic characteristics of adolescents that were studied. More than half of 16,217 adolescents were female (50.1%) and in the age bracket of 16–19 yr old (35.0%). Most of the adolescents are from rural area (53.8%) and came from a family with more than five members (74.8%). More than 20% of adolescents were from the middle and poor wealth quintiles with 21.6 and 21.5%, respectively. Three in every five (62.2%) adolescents belonged to food insecure households. In addition, the majority of the adolescents (85.8%) had household heads that are employed, and less than half of the adolescents (45.0%) had household heads who attained at least the high school level. For selected lifestyle-related factors, most of the adolescents were physically inactive (76.0%) and abstained from smoking (92.1%) and in alcohol drinking (73.6%).

The prevalence of undernourished, normal weight, and overweight/obesity among adolescents by demographic and household socio-economic characteristics are presented in Table 2. Of 16,217 adolescents from the ENNS with complete data, 12% were overweight or obese, 75.5%

Table 1. Socio-demographic and socio-economic characteristics of adolescents, 10–19 yr old: Philippines, 2018 (n = 16,217).

Socio-demographic and socio-economic characteristics	Total sample size (n)	%	95% confidence interval	
			LL	UL
<u>Adolescent characteristics</u>				
Philippines	16,217	14.7	14.6	14.7
Sex				
Male	8,200	49.9	49.3	50.5
Female	8,017	50.1	49.5	50.7
Age group				
10–12 yr old	5,657	33.7	33.0	34.5
13–15 yr old	5,250	31.2	30.4	32.1
16–19 yr old	5,310	35.0	34.1	35.9
<u>Household characteristics</u>				
Household size				
< 5 members	3,650	25.2	23.6	26.8
≥ 5 members	12,567	74.8	73.2	76.4
Type of residence				
Urban	5,215	46.2	44.0	48.4
Rural	11,002	53.8	51.6	56.0
Wealth quintile				
Poorest	4,303	20.4	19.6	21.3
Poor	4,125	21.5	20.3	22.8
Middle	3,252	21.6	20.2	23.0
Rich	2,593	20.5	19.4	21.6
Richest	1,944	16.0	14.7	17.4
Food security				
Food secure	5,380	37.8	36.0	39.5
Food insecure	10,837	62.2	60.5	64.0
Household head educational attainment				
No grade completed	554	2.8	2.4	3.2
At least elementary level	6,230	34.6	33.3	36.0
At least high school level *	6,778	45.0	42.9	47.2
At least college level **	2,655	17.6	16.0	19.4
Household head work status				
Not employed	2,144	14.2	13.1	15.4
Employed	14,073	85.8	84.6	86.9
<u>Selected lifestyle-related risk factors</u>				
Physical activity				
Physical inactive ^{1a}	12,212	76.0	74.4	77.5
Physical active ^{1b}	4,005	24.0	22.5	25.6
Smoking status				
Abstainer ^{2a}	15,108	92.1	91.0	93.0
Current ^{2b}	623	4.6	4.0	5.4

Table 1 Cont.

Socio-demographic and socio-economic characteristics	Total sample size (n)	%	95% confidence interval	
			LL	UL
Former ^{2c}	486	3.3	2.8	3.8
Alcohol status				
Abstainer ^{3a}	12,210	73.6	72.2	75.0
Current ^{3b}	2,696	18.0	16.7	19.3
Former ^{3c}	1,311	8.4	7.7	9.1

Notes:

*Including post-secondary non-tertiary and short-cycle tertiary

**Including master's and doctorate level education or equivalent education

^{1a}A person doing less than 60 min of moderate- to vigorous-intensity physical activity per day

^{1b}A person engaged in moderate-to-vigorous-intensity physical activity at least 60 min daily on all seven days of the week

^{2a}Never smokers – those individuals who have never smoked at all

^{2b}Former smokers – those who have ever smoked in the past year prior to the survey whether on a daily basis or an aggregate lifetime consumption of at least 100 cigarettes but not daily

^{2c}Current smokers – those who smoke during the time of survey either on a daily basis (at least one cigarette a day) or on regular/ occasional smoking, those who do not smoke daily but who smoke at least weekly, or those who smoke less often than weekly

^{3a}Lifetime abstainers – those who have never consumed alcohol

^{3b}Current drinkers – those who were currently consuming alcohol during the survey period

had normal weight, and 12.5% were undernourished. The distribution of overweight/obese was not different by gender (12.6% males and 11.4% females), higher in the younger 10–12 yr old adolescents (15.0% vs. 10.9% in 13–15 yr old and 10.0% in 16–19 yr old), in households with less than five members (17.0% vs. 10.3%), and in urban areas (16.2% vs. 8.3%). Households in the richest quintile and were food secure had higher proportions of overweight/obese adolescents (23.2 and 18.5%, respectively) and lower among the poor/poorest and with food insecurity. Furthermore, those household heads with at least a college level of education and those who were not employed had higher proportions of overweight/obese adolescents (20.3 and 13.8%, respectively). With regard to the lifestyle characteristics, the majority were physically inactive (13.1%), never smokers (12.4%), and former alcohol consumers (16.0%). Alcohol consumption was not associated with the prevalence of overweight/obesity among adolescents.

The proportion of adolescents aged 10–12 and 13–15 yr old with energy intake of more than 100% REI was higher among the overweight/obese; whereas among the 16–19 yr old, the proportion was higher among adolescents with normal weight ($p < 0.001$). Meanwhile, the overweight/obese adolescents had a higher proportion with more than 100% EAR for protein compared with the undernourished and those with normal weight ($p < 0.001$) in all age groups (Table 3).

Factors Associated with Overweight/Obesity among Adolescents

The odds of being overweight/obese among adolescents based on characteristics – including energy and protein intake, age group, household size, location of residence, wealth, food security, physical activity, and household head educational attainment – are shown in Table 5. The results of the univariate analysis are presented in Table 4.

Controlling for the odds that may be contributed by the other characteristics, the likelihood of being overweight/obese among adolescents was 1.75 times higher with energy intake of more than 100% REI and 1.45 times higher with protein intake of more than 100% EAR. Increased odds of being overweight/obese were also shown among 10–12 yr old (OR: 1.61) and belonging to households with size < 5 members (OR: 1.60), in urban areas (OR: 1.30), with higher wealth (OR: 1.45–3.49), among the physically inactive (OR: 1.41), whose households were food secure (OR: 1.46), and those household heads with at least college level of education (OR: 1.56).

DISCUSSION

There have been concerns about the increasing prevalence of overweight/obesity in the younger age groups (both children and adolescents) and the early onset of non-communicable diseases (including diabetes, high blood pressure, strokes, and heart disease) (Raj and Kumar 2010; Sahoo *et al.* 2015). Globally, the prevalence of obesity among children and adolescents has increased

Table 2. Prevalence of undernourished, normal weight, and overweight/obesity among adolescent by socio-demographic and socio-economic characteristics: Philippines, 2018 (n = 16,217).

Socio-demographic and socio-economic characteristics	Total sample size (n)	Undernourished			Normal weight			Overweight/Obese			p-value
		%	95% confidence interval		%	95% confidence interval		%	95% confidence interval		
			LL	UL		LL	UL		LL	UL	
<u>Adolescent characteristics</u>											
Philippines	16,217	12.5	11.6	13.5	75.5	74.5	76.5	12.0	11.2	12.9	
Sex											
Male	8,200	14.9	13.7	16.1	72.6	71.5	73.7	12.6	11.5	13.7	< 0.001*
Female	8,017	10.2	9.2	11.3	78.4	76.5	80.1	11.4	10.1	12.8	
Age group											
10–12 yr old	5,657	13.8	12.6	15.1	71.2	69.1	73.1	15.0	13.3	16.9	< 0.001*
13–15 yr old	5,250	11.3	9.7	13.2	77.7	75.7	79.7	10.9	9.5	12.5	
16–19 yr old	5,310	12.4	11.2	13.7	77.7	75.3	79.9	10.0	8.4	11.8	
<u>Household characteristics</u>											
Household size											
< 5 members	3,650	11.0	9.1	13.3	72.0	69.5	74.3	17.0	14.3	20.1	< 0.001*
≥ 5 members	12,567	13.0	12.1	14.0	76.7	75.3	78.0	10.3	9.4	11.2	
Type of residence											
Urban	5,215	10.7	9.7	11.9	73.0	71.4	74.6	16.2	15.0	17.6	< 0.001*
Rural	11,002	14.0	13.0	15.2	77.6	76.0	79.2	8.3	7.3	9.5	
Wealth quintile											
Poorest	4,303	14.0	12.7	15.5	82.3	80.6	83.8	3.7	3.0	4.5	< 0.001*
Poor	4,125	15.9	13.6	18.4	77.6	74.9	80.1	6.5	4.7	9.0	
Middle	3,252	11.9	10.0	14.1	75.8	72.8	78.5	12.3	9.9	15.3	
Rich	2,593	11.8	10.4	13.4	71.4	68.5	74.1	16.8	14.4	19.5	
Richest	1,944	7.8	5.8	10.4	69.0	65.8	72.0	23.2	19.9	26.9	
Food security											
Food secure	5,380	10.6	9.4	12.0	70.9	68.7	73.1	18.5	16.7	20.3	< 0.001*
Food insecure	10,837	13.7	12.3	15.3	78.3	76.3	80.1	8.0	7.2	9.0	
Household head educational attainment											
No grade completed	554	11.2	6.8	17.7	82.5	76.9	86.9	6.4	3.5	11.2	< 0.001*
At least elementary level	6,230	14.4	12.7	16.2	79.0	76.8	80.9	6.7	5.2	8.5	
At least high school level	6,778	12.2	11.0	13.5	74.7	72.9	76.4	13.2	11.7	14.8	
At least college level	2,655	10.0	7.5	13.1	69.7	65.7	73.5	20.3	16.8	24.4	
Household head work status											
Not employed	2,144	11.2	8.9	13.9	75.0	71.3	78.3	13.8	11.6	16.4	< 0.001*
Employed	14,073	12.7	11.9	13.6	75.6	74.7	76.4	11.7	10.9	12.5	

Table 2. Cont.

Socio-demographic and socio-economic characteristics	Total sample size (n)	Undernourished			Normal weight			Overweight/Obese			p-value
		%	95% confidence interval		%	95% confidence interval		%	95% confidence interval		
			LL	UL		LL	UL		LL	UL	
<u>Selected lifestyle-related risk factors</u>											
Physical activity											
Physically inactive	12,212	12.3	11.2	13.4	74.6	73.3	75.9	13.1	11.9	14.4	< 0.001*
Physically active	4,005	13.3	11.2	15.7	78.3	75.3	81.0	8.5	7.1	10.1	
Smoking status											
Abstainer	15,108	12.6	11.7	13.5	75.1	74.1	76.0	12.4	11.5	13.2	< 0.001*
Current	623	12.7	9.0	17.7	79.7	72.1	85.6	7.6	3.7	14.8	
Former	486	11.4	7.4	17.1	81.3	74.8	86.5	7.3	4.4	11.9	
Alcohol status											
Abstainer	12,210	13.1	12.0	14.2	75.3	74.0	76.7	11.6	10.7	12.6	< 0.001*
Current	2,696	11.0	9.4	12.9	77.3	74.0	80.2	11.7	9.4	14.5	
Former	1,311	11.0	9.2	13.1	73.0	68.4	77.2	16.0	12.9	19.6	

*Significantly different across categorical variables at $p < 0.05$ using Pearson's chi-squared test (test of proportion)

Table 3. Proportion of adolescents, 10–19 yr old with undernourished, normal weight, and overweight/obese by energy and protein adequacy: Philippines, 2018.

Variables	Undernourished			Normal weight			Overweight/Obese			p-value
	%	95% confidence interval		%	95% confidence interval		%	95% confidence interval		
		LL	UL		LL	UL		LL	UL	
<u>Among 10–12 yr old</u>										
Energy adequacy										
% with > 100% REI	7.1	4.1	12.0	12.0	10.6	13.7	32.0	23.3	42.1	< 0.001*
Protein adequacy										
% with > 100% EAR	53.9	47.5	60.2	62.6	61.1	64.1	85.8	82.5	88.6	< 0.001*
<u>Among 13–15 yr old</u>										
Energy adequacy										
% with > 100% REI	9.5	6.0	14.8	11.4	9.7	13.5	22.0	14.7	31.7	< 0.001*
Protein adequacy										
% with > 100% EAR	44.1	34.7	54.0	48.8	45.5	52.0	70.4	63.4	76.6	< 0.001*
<u>Among 16–19 yr old</u>										
Energy adequacy										
% with > 100% REI	13.2	9.5	18.0	32.0	23.3	42.1	19.5	13.2	27.8	0.002*
Protein adequacy										
% with > 100% EAR	47.2	41.8	52.6	45.1	42.5	47.7	52.1	44.2	59.9	< 0.001*

*Significantly different across categorical variables at $p < 0.05$ using Pearson's chi-squared test (test of proportion)

substantially over the last decade. In the Philippines, based on NNS and ENNS, overweight/obesity among adolescents has more than doubled in a span of 15 yr (2003–2018).

As shown from the analysis of the 2018 ENNS, total energy and protein intake above the requirement increased the odds of being overweight/obese. In the study of del Mar Bibiloni *et al.* (2015), the authors noted that overweight/obese Italian adolescents consumed more energy from proteins, particularly more animal than plant proteins, compared to their normal-weight counterparts, and the proportion of overweight/obese increased many-fold with increasing protein-energy intake. A closer examination of the diet patterns and food choices of the overweight/obese *versus* those with undernourished and normal weight may help ascertain the role of diet and nutrition.

Physical inactivity was also observed to increase the odds of being overweight/obese with an odds ratio of 1.41. Globally, more than 80% of school-going adolescents did not meet the current recommendations of at least one hour of physical activity per day – including 85% of girls and 78% of boys (WHO 2019). Moreover, four out of five (80.8%) Filipino adolescents were found to be insufficiently physically active (DOST-FNRI 2020). In this study, younger adolescents, *i.e.* aged 10–12 yr old, were 1.61 more likely to be overweight/obese than 16–19 yr old. Additionally, those adolescents (13–15 yr old) were 1.16 more likely to be overweight/obese, although not significant. According to Sember *et al.* (2020), the time spent on physical activity declines during adolescence. The younger children, including pre-teens, are less likely to engage in outdoor activities than their older teenage peers and are more conscious of their body image (Miranda *et al.* 2014; Sember *et al.* 2020; Dixit *et al.* 2011).

The odds of being overweight/obese was 1.30 if the adolescent lived in an urban *versus* rural area. Various studies in Southeast Asia have also reported increased odds of living in urban environments – from 1.34 in Malaysia, 2.68 in Thailand, 3.66 in Indonesia, and 4.16 in Vietnam and Laos (Angkurawaranon *et al.* 2014). The urban environment, with the lure of marketing and accessibility of establishments that offer highly processed and energy-dense foods (Nurwanti *et al.* 2019; Hong *et al.* 2018; Rojroongwasinkul *et al.* 2013) and loss of green spaces that otherwise may be used for recreation and physical activity, has positive effects on overweight/obesity (del Mar Bibiloni *et al.* 2015).

The dynamic of increased odds from household wealth and related indicators of improved socio-economic status is related to food availability and access, overconsumption, as well as urbanicity. In most low- and middle-income

countries, the prevalence of overweight and obesity was higher among wealthier individuals than among poorer ones (Templin *et al.* 2019). Bishwajit (2017) also explained that the higher household wealth is correlated with the increase of being overweight and obese among adolescents and young adults. Furthermore, in 2010, study findings in Harvard T.H. Chan School of Public Health mentioned that households in higher-income groups were more likely to have fat diets than lower-income households. Cultural norms were also observed in developing countries and may favor overweight and obese adolescents and young adults among wealthier households, as richer households are less likely to engage in regular physical labor than poor households. Moreover, higher household income and smaller household size have been reported to be associated with higher purchasing power and food affordability (Herforth and Ahmed 2015).

Adolescents with household heads who obtained higher educational attainment were more likely to be overweight/obese compared to those with household heads with lower education attainment. These households were more likely to reside in urban areas for employment, have more resources because of job opportunities, and be exposed to an unhealthy lifestyle. These results were observed in other studies like the that of Muthuri *et al.* (2016), wherein they reported that Kenyan children whose fathers had higher education were more overweight. Education is important in terms of making choices when it comes to resource allocation. Similarly, regions in Turkey were observed to have an increased rate of obesity as the educational status of parents increased, more specific to the mother's educational status (Huseyin Eker *et al.* 2017).

Another significant factor associated with adolescent overweight/obesity is food security. The study of Dubois *et al.* (2011) in Jamaica reported that food insecurity was associated with decreased odds of being overweight or obese. Children who lived in food-insecure households had significantly lower odds (OR: 0.65, 95% CI = 0.4–0.9) of being overweight, in comparison to those living in food-secure households (Dubois *et al.* 2011). However, other studies reported that food insecurity and obesity coexist in low-income children and adolescents (Gundersen *et al.* 2008; Tester *et al.* 2020).

STRENGTH AND LIMITATIONS

To the knowledge of the researchers, this is the first study in the Philippines that investigated the factors associated with overweight/obesity among adolescents using a nationally-representative sample. A few previous studies mostly investigated the factors dealing with overweight and obesity among adults and children; however, this current study further investigates the factors linked to

Table 4. Univariate analysis of factors affecting overweight/obesity among adolescents, 10–19 yr old: Philippines, 2018.

Factors	Odds ratio	SE	t	p-value	95% confidence interval		F-statistic	Prob > F
					LL	UL		
Sex							1.80	0.200
Constant	0.13	0.01	-32.79	< 0.001	0.11	0.15		
Male	1.12	0.09	1.34	0.20	0.94	1.33		
Female	Reference							
Age group							10.93	0.001*
Constant	0.11	0.01	-24.22	< 0.001	0.09	0.13		
10–12 yr old	1.60	0.19	4.03	0.00	1.25	2.05		
13–15 yr old	1.11	0.15	0.78	0.45	0.84	1.47		
16–19 yr old	Reference							
Household size							25.18	0.001*
Constant	0.11	0.01	-48.20	< 0.001	0.10	0.13		
< 5 members	1.79	0.21	5.02	< 0.001	1.40	2.29		
≥ 5 members	Reference							
Wealth quintile							40.12	< 0.001*
Constant	0.04	0.00	-33.09	< 0.001	0.03	0.05		
Poorest	Reference							
Poor	1.81	0.32	3.38	0.00	1.25	2.64		
Middle	3.65	0.52	9.15	< 0.001	2.70	4.93		
Rich	5.23	0.79	10.91	< 0.001	3.79	7.23		
Richest	7.83	1.25	12.87	< 0.001	5.57	11.01		
Type of residence							82.24	< 0.001*
Constant	0.09	0.01	-34.54	< 0.001	0.08	0.11		
Rural	Reference							
Urban	2.13	0.18	9.07	< 0.001	1.78	2.55		
Food security							106.43	< 0.001*
Constant	0.09	0.01	-41.15	< 0.001	0.08	0.10		
Food secure	2.59	0.24	10.32	< 0.001	2.13	3.15		
Food insecure	Reference							
Household head educational attainment							20.57	< 0.001*
Constant	0.07	0.01	-21.49	0.00	0.06	0.09		
No grade completed	0.95	0.33	-0.14	0.89	0.46	1.98		
At least elementary level	Reference							
At least high school level	2.12	0.33	4.88	0.00	1.53	2.94		
At least college level	3.57	0.60	7.60	0.00	2.50	5.10		
Household head work status							4.43	0.053
Constant	0.16	0.01	-19.74	0.00	0.13	0.20		
Not employed	Reference							
Employed	0.82	0.08	-2.10	0.05	0.68	1.00		

Table 4. Cont.

Factors	Odds ratio	SE	t	p-value	95% confidence interval		F-statistic	Prob > F
					LL	UL		
Physical activity							14.54	0.002*
Constant	0.09	0.01	-26.37	< 0.001	0.08	0.11		
Physically inactive	1.63	0.21	3.81	0.00	1.24	2.14		
Physically active	Reference							
Smoking status							4.75	0.027*
Constant	0.08	0.03	-7.13	< 0.001	0.04	0.17		
Abstainer	1.72	0.61	1.53	0.15	0.81	3.68		
Current	0.96	0.45	-0.08	0.94	0.36	2.59		
Former	Reference							
Alcohol status							4.52	0.031*
Constant	0.13	0.02	-17.44	< 0.001	0.10	0.17		
Abstainer	0.99	0.13	-0.08	0.94	0.75	1.31		
Current	1.43	0.22	2.31	0.04	1.03	2.00		
Former	Reference							
Intake above energy requirement							126.26	< 0.001*
Constant	0.12	0.00	-55.63	< 0.001	0.11	0.12		
No	Reference							
Yes	2.55	0.21	11.24	< 0.001	2.14	3.05		
Intake above protein requirement							189.39	< 0.001*
Constant	0.08	0.00	-42.14	< 0.001	0.07	0.09		
No	Reference							
Yes	2.38	0.15	13.76	< 0.001	2.08	2.72		

*Significant at $p < 0.05$

Table 5. Multivariate analysis of factors affecting overweight/obesity among adolescents 10–19 yr old: Philippines, 2018.

Factors	Odds ratio	SE	t	p-value	95% confidence interval	
					LL	UL
Constant term	0.01	0.00	-19.6	< 0.001	0.01	0.02
Intake above energy requirement						
No	Reference					
Yes	1.75	0.17	5.8	< 0.001*	1.42	2.15
Intake above protein requirement						
No	Reference					
Yes	1.45	0.10	5.5	< 0.001*	1.25	1.67
Age group						
10–12 yr old	1.61	0.20	3.8	0.002*	1.23	2.10
13–15 yr old	1.16	0.15	1.1	0.273	0.88	1.53
16–19 yr old	Reference					
Household size						
< 5 members	1.60	0.17	4.3	0.001*	1.27	2.02
≥ 5 members	Reference					

Table 5. Cont.

Factors	Odds ratio	SE	t	p-value	95% confidence interval	
					LL	UL
Type of residence						
Rural	Reference					
Urban	1.30	0.09	4.0	0.001*	1.13	1.51
Wealth quintile						
Poorest	Reference					
Poor	1.45	0.25	2.2	0.046*	1.01	2.09
Middle	2.47	0.34	6.5	< 0.001*	1.83	3.32
Rich	2.99	0.48	6.9	< 0.001*	2.13	4.20
Richest	3.49	0.61	7.2	< 0.001*	2.40	5.06
Food security						
Food secure	1.46	0.14	4.0	0.001*	1.20	1.79
Food insecure	Reference					
Physical activity						
Physically inactive	1.41	0.18	2.7	0.016*	1.08	1.84
Physically active	Reference					
Household head educational attainment						
No grade completed	1.32	0.50	0.7	0.479	0.59	2.97
At least elementary level	Reference					
At least high school level	1.36	0.22	1.9	0.075	0.97	1.91
At least college level	1.56	0.23	3.1	0.008*	1.15	2.13

*Significant at $p < 0.05$

overweight/obesity and discovered to be consistent with the findings of other international studies as well. Another strength of this study is that it focuses on the determinants that specifically target the possible root cause of overweight/obesity among Filipino adolescents, which is driven by a variety of factors that can be addressed using a multi-sectoral approach.

There may be other determinants not accounted for in this study – such as medical illness, emotional issues/ depression, medical conditions, Cushing’s disease, polycystic ovary syndrome (PCOS) (CDC 2020), and even genetic factors; this is because the data may not be included and covered in the ENNS. The role of genetics in the sequelae obesity has been explored in some studies. Some studies have found that BMI is 25–40% heritable (Anderson and Butcher 2006). Emotional issues, depression, and anxiety can both be associated with overeating, poor food choices, and a more sedentary lifestyle (Holland 2020). Some hormone problems, which are associated with a decreased metabolic rate that can contribute to overweight and obesity, are hypothyroidism (Sanyal and Raychaudhuri 2016), PCOS (Rosenberg 2019), and Cushing's Syndrome (Ferrau and Korbonits

2015). Another limitation of the study is the use of 24-h food recall method, which relies on respondent’s memory and is prone to respondents’ bias that could lead to the under- or overestimation of foods consumed (FAO 2018), which could affect the analysis of potential factors of overweight/obesity among the study population.

CONCLUSION AND RECOMMENDATIONS

This study was carried out to identify factors that were associated with overweight and obesity in the country – particularly among adolescents – and, in doing so, help authorities, partners, and other stakeholders discern programs and strategies to address the malady. The factors associated with overweight/obesity identified in this study were found to be consistent with the results of other bodies of work. It is particularly notable that higher socioeconomic status, residence in urban areas, higher educational status of household head, physical inactivity, and food intake exceeding requirement pose an increased likelihood of being overweight/obese. It

is deemed as a challenge for public policymakers and program and intervention formulators to plan for efficient programs to address the overweight/obesity among adolescents. Individual-level interventions that promote nutrition guidelines for healthy diets, limit the intake of total fats and sugars, and increase consumption of fruit and vegetables may be implemented through schools and social media. At the societal level, the food industry could reduce the salt content of processed food, ensure healthy and nutritious choices, restrict the marketing of foods high in sugars, salts, and fats, and ensure the availability of healthy food choices with regular physical activity. Children and adolescents should be physically active for at least 60 min of moderate-to vigorous-intensive daily physical activity such as sports and walking. There is a need for more open or designated spaces for recreational and physical activities. In addition, the Republic Act No. 10963 or the TRAIN Law, which taxes sweetened beverages, must be fully implemented.

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