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Demographic and Food Insecurity Factors Linked to Adolescent Overweight in Thailand: A Binary Logistic Regression Analysis

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ABSTRACT
Overweight among adolescents in Thailand is a growing public health concern, influenced by demographic and socioeconomic factors. Food insecurity further complicates this issue through the food insecurity–obesity paradox, where limited access to nutritious food coexists with excess weight. However, nationally representative evidence on this relationship remains limited. This study examined the association between demographic characteristics (sex, age, and school grade) and food insecurity with overweight among Thai adolescents using data from the 2021 Global School-based Student Health Survey (GSHS). This study employed a cross-sectional design using secondary data. A total of 4,510 students aged 13–17 years were included, with an overall overweight prevalence of 19.07%. Logistic regression showed that boys had lower odds of overweight than girls (OR = 0.709, 95% CI: 0.705–0.714). Age was significantly associated with overweight, with the highest risk observed among adolescents aged 15–16 years (OR = 1.972 and 2.202). Lower school grades were associated with reduced odds compared to grade 12. Food insecurity was positively associated with overweight (OR = 1.509, 95% CI: 1.480–1.537). These findings highlight the complex interplay of demographic and contextual factors. Targeted interventions addressing age, gender, school level, and food insecurity are essential to reduce adolescent overweight in Thailand.

Keywords: Adolescent Overweight, Thailand, Demographic Factors, Food Insecurity, Logistic Regression

INTRODUCTION
Across Thai adolescents (roughly ages 10–19, with many studies focusing on 12–18 or similar school-age ranges), overweight prevalence has been repeatedly documented in the single-digit to low-teens range, with variation by definition (BMI cut-points), age group, gender, and urban-rural setting. Nationally representative data using established international references (IOTF, WHO, or WPRO) consistently show that overweight/obesity constitutes a non-trivial but heterogeneous burden among Thai youth, and that boys tend to have higher overweight prevalence than girls in several Thai samples, though some subnational studies report differing patterns (Sirirassamee et al., 2018; Sabri et al., 2022).

Several demographic factors are repeatedly associated with overweight among adolescents, including sex, age, urban vs rural residence, and household socioeconomic status (SES). In many Thai samples, males show higher overweight prevalence than females, though patterns vary by age band and setting. Age is typically inversely related to overweight within adolescence, with younger adolescents often at higher risk in some cohorts although risk levels may shift as age increases. Overall,

demographic factors interact with regional context, dietary patterns, and physical activity levels to shape overweight risk among Thai adolescents (Sritart et al., 2022; Ochola et al., 2023; Zhou et al., 2025).

The relationship between food insecurity and overweight/obesity among Thai adolescents is nuanced and emerges from a mix of national school surveys, rural-urban studies, and regional analyses. Across settings, food insecurity can coexist with overweight/obesity in adolescence, reflecting the malnutrition obesity paradox observed in Southeast Asia and other LMIC contexts. Several Thai studies indicate that overweight/obesity increases alongside indicators of dietary transition and food insecurity in certain subgroups, while others show weaker or context-specific associations. Methodological heterogeneity different BMI cutoffs (IOTF, WHO, WPRO), age bands, and urbanicity can influence observed links between food insecurity and weight status. Overall, the evidence supports a co-occurrence pattern in Thai adolescents, with stronger associations in urban, higher-SES, or transitioning contexts and potential gender and regional variation (Niemeier and Fitzpatrick, 2019; Sritart et al., 2022; Pengpid & Peltzer, 2024; Roșioară et al., 2025).

There is limited empirical evidence linking household food insecurity to overweight among Thai adolescents using nationally comparable school-based survey data. Existing studies often examine these issues separately rather than within a unified analytical framework. Many GSHS-based studies in Southeast Asia report descriptive prevalence or simple bivariate associations. Thus, the objective of this study was to examine the association between demographic characteristics and food insecurity with overweight among adolescents in Thailand using data from the Global School-based Student Health Survey (GSHS). Specifically, the study aimed to identify whether demographic factors such as sex, age, and school level, as well as experiences of food insecurity, are significantly associated with the likelihood of being overweight among Thai adolescents through binary logistic regression analysis.

METHODS

Study Design and Settings

This study analyzed data from the 2021 Global School-based Student Health Survey (GSHS) in Thailand, which was the third time the survey had been conducted in the country. The survey targeted adolescents aged 13–17 years in grades 7–12 and used a two-stage sampling method: schools were selected based on size, and then classes within those schools were randomly chosen. Participation was voluntary, and confidentiality was assured, with school names and locations excluded from the public dataset. The survey achieved strong participation, with a 92% school response rate, a 90% student response rate, and an overall response rate of 83%. After cleaning the data and addressing missing values using a listwise deletion approach, the final sample included 4,510 students. Students completed self-administered questionnaires during class, covering a wide range of health-related topics such as alcohol and substance use, diet, mental health, physical activity, sexual behavior, tobacco use, and experiences of violence. The survey was coordinated by Thailand's Ministry of Public Health with technical support from the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC), ensuring both methodological rigor and operational feasibility (World Health Organization, 2023).

Variables

In the 2021 Thailand GSHS, several demographic and contextual variables were measured using straightforward survey questions. Age was assessed by asking students "How old are you?" with response options ranging from 11 years or younger to 18 years or older. School grade was measured through the question "In what grade are you?" with options from Grade 7 to Grade 12. We focused on adolescents aged 13–17 years because this age band corresponds to the Global School-based Student Health Survey (GSHS) sampling frame in Thailand, which targets secondary school students in grades 7–12. This narrower age range ensures comparability with national survey data while still capturing the critical mid-adolescent period. Gender was determined

by asking "What is your sex?" with two response categories: male or female. Finally, food insecurity was captured by asking about the percentage of students who reported going hungry most of the time or always in the past 30 days because there was not enough food at home, with responses coded as yes or no. In this study, overweight was defined using the WHO BMI-for-age growth reference, consistent with the Global School-based Student Health Survey (GSHS) methodology. These simple, direct questions enabled the survey to collect consistent demographic information while also identifying important social determinants of health among adolescents.

Data Analysis

In this study, the analysis was carried out step by step to explore how demographic factors and food insecurity were linked to overweight among Thai adolescents. First, univariate analysis was used to describe the basic characteristics of the students, such as age, grade, gender, and food insecurity status. Then, bivariate analysis examined the relationship between overweight and each factor one at a time. Finally, multivariate analysis applied binary logistic regression to assess the independent effect of each variable while controlling for others, with the findings reported as odds ratios (ORs) and confidence intervals (CIs). Model selection for the multivariate analysis was conducted through a backward elimination procedure. This approach ensured that the results were both clear and statistically reliable.

Ethical Consideration

This study used data from the Global School-based Student Health Survey (GSHS) Thailand 2021, which had already been collected by the Ministry of Public Health and Ministry of Education with national-level ethical approval. Participation was voluntary, with informed consent from parents and assent from students when required. All responses were anonymous, and no identifying information was collected, ensuring confidentiality and protecting participants. Because the survey involved adolescents, special care was taken to make the questions appropriate and sensitive, especially those about health behaviors such as substance use, sexual activity, and mental health. For this secondary analysis, only de-identified, publicly available data were used, and there was no direct contact with students. This secondary analysis posed minimal risk to participants. However, the study acknowledges

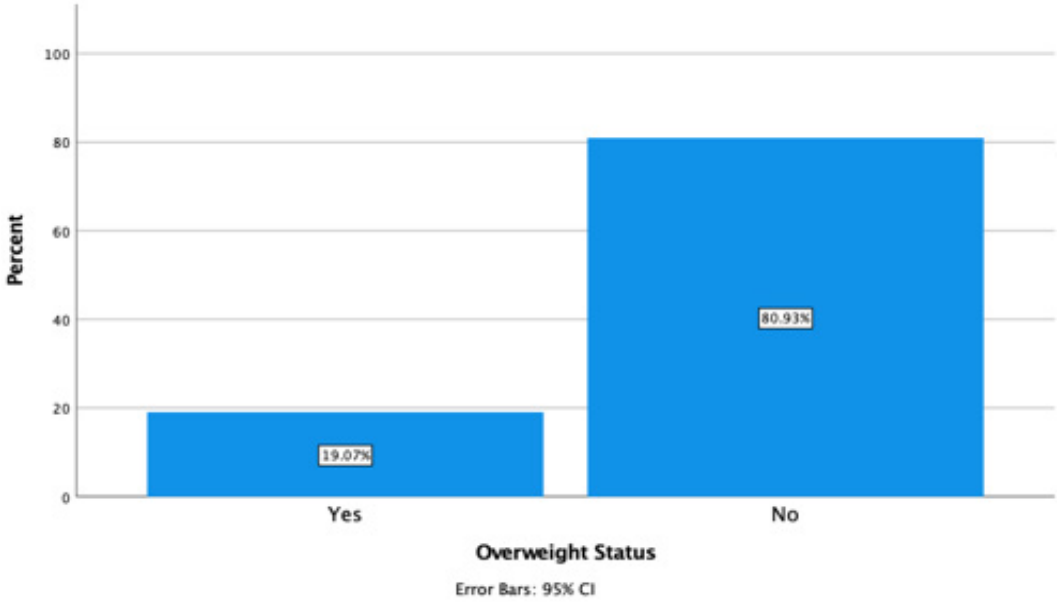

Figure 1
Percentage Distribution of Overweight Status among Adolescents in Thailand

several limitations, such as the school-based sampling design and reliance on self-reported answers, which may affect the way the findings are interpreted.

RESULT AND DISCUSSION

The bar chart (Figure 1) illustrates the percentage distribution of overweight status among adolescents. The results show that 19.07% of adolescents are overweight, while the majority, 80.93%, are not overweight. The inclusion of 95% confidence intervals (CI) around each bar indicates that the estimates are statistically reliable.

Table 1 presents the frequency distribution of respondent characteristics among overweight adolescents in Thailand. The data show that overweight status was almost equally distributed between boys (49.90%) and girls (50.10%). However, among those without overweight, girls accounted for a larger proportion (59.70%) compared to boys (40.30%), and this difference was statistically significant ($p < 0.001$). Age distribution revealed that overweight prevalence peaked at 13 years old (30.60%), followed by 15 years (20.20%) and 14 years (17.10%), while younger adolescents aged 11 years or younger

Table 1
Frequency Distribution of Adolescent Respondent Characteristics in Thailand, Categorized by Overweight and Non-overweight Status (N: 4,510)

Variables	Overweight (n: 860)		No overweight (n: 3,650)		p-value
	n	%	n	%	
Demographic status					
Sex					
Boys	429	49.90%	1470	40.30%	<0.001
Girls	431	50.10%	2180	59.70%	
Age					
11 years old or younger	2	0.20%	3	0.10%	<0.001
12 years old	49	5.70%	132	3.60%	
13 years old	263	30.60%	839	23.00%	
14 years old	147	17.10%	601	16.50%	
15 years old	174	20.20%	810	22.20%	
16 years old	85	9.90%	443	12.10%	
17 years old	56	6.50%	385	10.50%	
18 years old or older	84	9.80%	437	12.00%	
School class					
7th grade	321	37.30%	1,021	28.00%	<0.001
8th grade	139	16.20%	558	15.30%	
9th grade	187	21.70%	857	23.50%	
10th grade	76	8.80%	383	10.50%	
11th grade	59	6.90%	365	10.00%	
12th grade	78	9.10%	466	12.80%	
Food insecurity					
Yes	21	2.40%	135	3.70%	0.087
No	839	97.60%	3,515	96.30%	

Sources: Processed Secondary Data

(0.20%) and 12 years (5.70%) showed much lower prevalence. These differences across age groups were also significant ($p < 0.001$). Overall, the findings suggest that sex and age are strongly associated with overweight status, with boys and adolescents in the early to mid-teen years being more likely to experience overweight compared to their peers.

Table 2 presents the binary logistic regression analysis of demographic factors and food insecurity associated with overweight among adolescents in Thailand. The results show that boys had lower odds of being overweight compared to girls (OR = 0.709, 95% CI: 0.705–0.714, $p < 0.001$). Age was significantly associated with overweight status. Compared to adolescents aged 18 years or older, those aged 15 years (OR = 1.972, 95% CI: 1.922–2.023, $p < 0.001$) and 16 years (OR = 2.202, 95% CI: 2.150–2.256, $p < 0.001$) had the highest odds of being overweight. Adolescents aged 14 years (OR = 1.325, 95% CI: 1.290–1.361, $p < 0.001$) and 13 years (OR = 1.020, 95% CI: 0.991–1.050, $p < 0.005$) also showed elevated risks, while those aged 11 years or younger (OR = 0.313, 95% CI: 0.287–0.341, $p < 0.001$) and 12 years (OR = 0.707, 95% CI: 0.684–0.730, $p < 0.001$) had significantly lower odds. School grade was inversely associated with overweight status when compared to 12th grade. For example, adolescents in 7th grade (OR = 0.563, 95% CI: 0.547–0.580, $p < 0.001$), 8th grade (OR = 0.594, 95% CI: 0.578–0.610, $p < 0.001$), 9th grade (OR = 0.445, 95% CI: 0.434–0.457, $p < 0.001$), and 10th grade (OR = 0.392, 95% CI: 0.383–0.402, $p < 0.001$) all had reduced odds of overweight. Even 11th grade (OR = 0.712, 95% CI: 0.698–0.726, $p = 0.002$)

Table 2
Binary Logistic Regression Analysis of Demographic Factors and Food Insecurity Associated with Overweight Among Adolescents in Thailand

Variable	Boys			p-value
	OR	95% CI		
		Lower	Upper	
Demographic status				
Sex				
Boys	0.709	0.705	0.714	<0.001
Age (ref 18 years old or older)				
11 years old or younger	0.313	0.287	0.341	<0.001
12 years old	0.707	0.684	0.73	<0.001
13 years old	1.020	0.991	1.050	<0.005
14 years old	1.325	1.29	1.361	<0.001
15 years old	1.972	1.922	2.023	<0.001
16 years old	2.202	2.150	2.256	<0.001
17 years old	1.570	1.540	1.601	0.016
School class (ref: 12th grade)				
7th grade	0.563	0.547	0.58	<0.001
8th grade	0.594	0.578	0.61	<0.001
9th grade	0.445	0.434	0.457	<0.001
10th grade	0.392	0.383	0.402	<0.001
11th grade	0.712	0.698	0.726	0.002
Food insecurity (ref: No)				
Yes	1.509	1.480	1.537	<0.001

Sources: Processed Secondary Data

showed lower odds compared to 12th grade. Finally, food insecurity was paradoxically associated with overweight. Adolescents reporting food insecurity had significantly higher odds of being overweight (OR = 1.509, 95% CI: 1.480–1.537, $p < 0.001$).

Age within adolescence is a consistently important modifier of overweight risk in Thailand, reflecting developmental, behavioral, and environmental changes that occur as children transition from late childhood into early and mid-adolescence. Across Thai studies, younger adolescents often show different overweight patterns than older adolescents, with some cohorts showing higher risk earlier in adolescence and others showing rising risk into late adolescence as exposure to obesogenic environments accumulates. Methodological choices (BMI cutoffs, age bands, school-based vs. population-based designs) influence the observed age-related gradients, underscoring the need for standardized age-range reporting when comparing studies. In Thai samples, younger adolescents sometimes exhibit different prevalence levels compared with older adolescents, consistent with a maturation- and behavior-driven shift in risk (Ding et al., 2021; Pengpid & Peltzer, 2024). Previous studies in Thailand have reported that boys tend to have higher overweight prevalence than girls, though some subnational studies report differing patterns(Sirirassamee, et al., 2018; Sabri et al., 2022). In our adjusted analysis, however, boys showed lower odds of overweight compared to girls, suggesting that crude prevalence patterns may be influenced by confounding factors such as age and school grade. This highlights the importance of considering demographic and contextual variables when interpreting gender differences in adolescent overweight.

Across global and regional literature, including evidence relevant to Thailand, food insecurity (FI) and overweight/obesity often co-occur in adolescence, a pattern termed the food insecurity-obesity paradox. In Thai contexts, several nationally representative and subnational studies imply that FI can be associated with higher odds of overweight among adolescents, though findings are heterogeneous and context-specific (Dewi et al., 2020; Abera et al., 2023). The observed association is influenced by how FI is measured (household vs child-level FI), the BMI cutoffs and age bands used, urbanization and SES, and gender. Some Thai and regional studies report stronger FI–overweight signals in urban transitioning settings and among girls or specific regions, while others show null or weaker associations, underscoring the need for longitudinal designs and harmonized measures (Niemeier and Fitzpatrick, 2019).

Mechanisms proposed in the broader literature include reliance on inexpensive, energy-dense foods when resources are constrained, cyclic hunger leading to compensatory overeating, and stress-related eating patterns. This "FI–obesity paradox" has been observed across LMICs and in adolescence, with variation by gender, age, and setting. In Thailand, rapid dietary transition and urban food environments can amplify these mechanisms in susceptible subgroups, aligning with regional patterns of the double burden nutrition in youth. Nationally representative Thai data show rising overweight/obesity among adolescents alongside changing FI dynamics linked to economic conditions and school feeding policies. While direct FI–overweight estimates for Thai adolescents are not uniformly published in a single large cohort, cross-national Thai studies embedded in GSHS-era datasets have documented co-occurring overweight/obesity and indicators of FI or hunger in adolescents, and reported that FI interacts with urbanization and SES to shape weight outcomes (Niemeier and Fitzpatrick, 2019; Dewi *et al.*, 2020; Pengpid and Peltzer, 2024).

Overweight among Thai adolescents shows different patterns depending on gender and school level. Studies often find that boys have a higher prevalence of overweight than girls, but this difference changes across age groups and grade levels. Biological factors like puberty and body composition, behavioral changes such as diet choices and physical activity, and sociocultural influences like body image expectations all play a role in shaping these patterns. School-level factors also matter: higher grades often bring more independence, exposure to cafeterias, and less structured physical activity, which can affect boys and girls

differently. In addition, differences between urban and rural schools, socioeconomic status, and the reach of school-based health programs can further influence overweight risk. These findings highlight the importance of looking at overweight by both gender and grade level, and suggest that interventions should be tailored to specific age groups, school contexts, and gender-related needs to be most effective (Ganbold et al., 2019; Dewi et al., 2020; Lee et al., 2020; Abera et al., 2023; Pengpid and Peltzer, 2024).

Limitation of the Study

This study used data from the Global School-based Student Health Survey (GSHS) Thailand 2021, which provides valuable national and international insights but also has some limitations. Because the survey was conducted only among students, adolescents who were not in school were excluded, even though they may face higher health risks. The survey relied on self-reported questionnaires, which can lead to errors or biased answers, especially on sensitive topics like substance use, sexual activity, or mental health. In addition, the survey was cross-sectional, meaning it captured information at one point in time and cannot show cause-and-effect relationships. External factors, such as the COVID-19 pandemic, may also have influenced responses, making comparisons with earlier surveys more difficult. Finally, cultural and language differences could affect how questions were understood, possibly leading to underreporting of certain behaviors. Despite these limitations, the survey remains an important tool for monitoring adolescent health in Thailand and contributes to global evidence. A further limitation is that food insecurity was assessed using a single severe-hunger item from the GSHS. This measure does not account for milder or multidimensional aspects of food insecurity (e.g., anxiety about food supply, reduced dietary diversity), which may also influence adolescent weight outcomes. Schools should implement nutrition-focused programs that combine healthy meal provision, food security monitoring, and education to address the food insecurity–overweight paradox among adolescents.

CONCLUSION

In conclusion, this study shows that age, gender, school level, and food insecurity are all important factors linked to overweight among Thai adolescents. Boys and younger adolescents in early to mid-teen years were more likely to be overweight compared to girls and older students, while those in higher grades (especially Grade 12) showed greater risk than lower grades. A striking finding was the food insecurity–overweight paradox, where adolescents reporting hunger also had higher odds of being overweight, reflecting broader patterns seen in Southeast Asia. These results highlight the complex interplay of biological, behavioral, and social factors shaping adolescent health. While the survey's school-based design and reliance on self-reported data limit causal interpretation, the findings provide valuable evidence for policymakers and educators. Tailored interventions that consider gender differences, age stages, school environments, and food insecurity contexts are essential to effectively address overweight among Thai adolescents and to guide future public health strategies.

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