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Gender-Based Determinants of Obesity among Thai Adolescent Boys and Girls

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Abstract: Understanding the determinants that influence obesity among children and adolescents is critical to the prevention of obesity and obesity-related diseases later in life. The findings presented here broaden the understanding of obesity-related challenges by adding analyses that compare nutritional indicators among boys and girls between the ages of 11 and 16 years, by exploring the more recent literature to examine if past trends have continued or not, and by synthesizing the recent findings concerning the causes and determinants of such trends in obesity. Both data from 2005 and the more recent literature review have shown that the consumption of high calorie foods and snacks, greater screen time, body image, and depressive factors play a significant role regarding obesity during adolescence in Thailand. There continues to be a trend of increasing obesity among adolescents in Thailand, and this may be more of a concern in boys. Interviews with health professionals and parents from the 2005 study suggested that girls were more aware of their physical appearance, and there was more societal acceptance to be obese as a boy in Thailand compared to girls. These findings can inform nutritional education practices and policies.

Keywords: obesity; adolescents; Thailand; gender differences; nutrition; obesity policy

Citation: Pawloski, L.R.; Harnirattisai, T.; Vuthiarpa, S.; Curtin, K.M.; Nguyen, J.T. Gender-Based Determinants of Obesity among Thai Adolescent Boys and Girls. *Adolescents* **2023**, *3*, 457–466. https://doi.org/10.3390/adolescents3030032

Received: 15 May 2023
Revised: 17 July 2023
Accepted: 20 July 2023
Published: 28 July 2023

1. Introduction

1.1. Background

Defined by the joint WHO/FAO consultation as "the condition of the body resulting from the intake, absorption, and utilization of food as well as from factors of pathological significance", the causes of poor nutritional status are multifaceted and are often the result of social, economic, and environmental factors [1–4]. Malnutrition has traditionally been concerned with issues related to nutrient deficiencies and undernutrition. However, with rates of obesity increasing worldwide, malnutrition more commonly also reflects being overweight and obesity [5,6]. Also referred to as the nutrition transition, this epidemiological trend is defined as changes in the nutritional status and dietary intake among populations that are caused by economic, environmental, demographic, and cultural shifts. This type of transition was first documented in South America and the Caribbean and soon after in Southeast Asia [3]. Given that obesity has been linked to many chronic illnesses worldwide, it is unsurprising that rates of obesity-related illnesses are also rising in economically transitioning countries.

One age group that has been overlooked in much of the literature concerning nutritional status and the nutrition transition is adolescents [7]. In most developing countries, adolescents are faced with physiological problems resulting from nutritional stresses related to nutrient deficits. For example, Pawloski reported that Malian girls from the Segou Region

are shorter and lighter than their U.S. female counterparts. These delays in growth are due to poor nutrient intake and high-energy expenditures. However, in most economically emerging countries, the problem of overnutrition among adolescents is rising. The World Health Organization (WHO) recently announced that the number of obese children and adolescents has risen tenfold in the past four decades. As much of this growth has been documented in Asia, we will explore one region in Southeast Asia, Thailand, for which there is limited literature in recent years [8].

From data collected in 2005, Pawloski, Pakapong, and Ruchiwit reported a rise in obesity in adolescent girls in Thailand in 2008 and noted that early menarche was a predictor of obesity in adolescence [4]. While Thailand has seen a growth in obesity and chronic diseases, it still faces challenges of infectious diseases, and this dual burden challenges the ability to create appropriate obesity interventions. Thus, understanding the specific determinants of obesity within specific communities is critical to the development of effective interventions. For example, Angkurawaranon found that early life urban exposure was a risk factor for obesity and poor glucose tolerance in later adulthood in Thailand [9]. This demonstrates that determinants and factors such as age, gender, and geographic location, are critical to understanding the causes of—and means to prevent—obesity.

Soon after Thailand's economic boom, evidence of the nutrition transition and obesity among adolescents in Thailand was well documented by Pawloski et al. in 2008 and 2009 [10]. This research provided evidence from adolescents living in suburban Bangkok and showed a significant difference between boys and girls in terms of Body Mass Index (BMI)-for-age percentiles over time. Boys appeared to be gaining weight on average while girls remained closer to the 50th percentile. Further, this descriptive study showing greater prevalence of obesity among primary school girls compared to secondary school girls suggests that younger adolescents may be more greatly affected by obesity than their older counterparts [4]. This study contradicts other data at the time which found that obesity in urban areas appears to be higher in older adolescents (particularly boys) when compared to younger adolescents.

Understanding the determinants that influence obesity among children and adolescents is critical to preventing obesity and obesity-related diseases later in life. The earlier work by Pawloski did not focus on differences between boys and girls or specific determinants which might contribute to those differences. Thus, to fill this gap, the findings presented here broaden the understanding of obesity-related challenges by adding analyses that compare nutritional indicators among boys and girls between the ages of 11 and 16 years, by exploring the more recent literature to examine if past trends have continued or not, and by synthesizing the recent findings concerning the causes and determinants of such trends in obesity.

1.2. Literature Review

1.2.1. Overview of Obesity in Adolescents in Thailand

Kosulwat reported many improved demographic trends over the last three decades in Thailand including increases in life expectancy at birth and decreases in infant mortality [11]. These improvements are particularly evident in the urban industrial centers of Thailand. However, these transitions have also brought increases in obesity and overweight status which were caused by higher intakes of fat and animal protein and increased intakes of processed foods [11]. More recently, Aekplakorn et al. reported that obesity has increased in Thailand more than 2.5 times over the past 23 years, and Aekplarkorn has noted that the prevalence of being overweight/obesity in Thai adolescents and adults has increased every year since 2008 [12,13]. Such increases are thought to be associated with a rapidly increasing overall economy in Thailand. Teerawattananon and Luz reported that the obesity prevalence in Thailand may have grown at the same rate as the Thai per capita GDP which is also comparable with the growing number of the Thai population living in urban areas [14], such that in 2009, 41% of females, 28% of males, and almost 10% of Thai children were obese. Results of the 2014 survey showed that the prevalence of obesity

in males reflected the trend from previous years and rose to 33%, while the prevalence in females increased only slightly to 43%. Thailand has now become one of the countries with the highest prevalence of obesity in Asia (second only to Malaysia) [15].

While growth in the economy has contributed to the consumption of more calories and obesity in adolescents, there are other social determinants which have played a role in this transition. Some of the earlier literature by Monteiro and Victoria revealed that obesity among Thai adolescents is the result of complex interactions between behavioral and environmental cues, particularly changes in lifestyles in Thai society that tend to be more urbanized [16]. Environmental factors that may contribute to obesity include parental influences on nutrition, changes in infant nutrition after birth, not being breastfed and using formula after birth, and parental education [16]. Ajie and Campman found that trends of parental encouragement of unrestricted eating habits resulted in the consumption of large quantities of rice, milk, snacks, and beverages particularly among those who live near convenience stores [17]. Nonboonyawat et al. noted that a family history of obesity has been shown to be positively associated with being overweight or obesity among adolescents [18].

While parental influence plays a role, Ruangying and Jonjit found that adolescents with parents of different levels of education and family income have not shown significant differences regarding food consumption behavior. Food consumption value and the influence of advertisements better predicted the food consumption behavior of the adolescents in Songkhla province [19].

Overall dietary intake plays a significant role, and several recent studies have shown adolescents consuming more calories, with higher fat and carbohydrate intake and lacking fruits and vegetables [20].

1.2.2. Determinants of Obesity in Boys and Girls

The more recent literature shows obesity to be greater in boys compared to girls in Thailand. Subhaluksuksakorn et al. cited several reasons for some of these differences, including screen time, health literacy, body image, mental health, and sedentary behavior [21].

Nonboonyawat et al. showed that adolescents who spent at least 2 h watching TV, playing computer games, or using electronic devices exhibited a risk of being overweight or obese [18]. Suwanwaiphattana et al. revealed a higher level of health literacy in girls compared to males [22]. Eiamudomkan et al. demonstrated in their sample that 51.1% of adolescent participants were unsatisfied with their weight, 29.1% thought they were overweight, and 12.6% of the group opted to use a more extreme method of losing weight by fasting at least 24 h [23]. Seubsman et al. found that males had a significantly higher mean BMI (22.9) compared to females (20.9) and were more likely to be overweight and obese [24]. Further, Kongsomboon et al. demonstrated that boys, and more specifically overweight/obese boys, had higher rates of depression than girls [25]. A study by In-iw et al. demonstrated that significantly obese adolescents were shown to have poor self-image, with greater prevalence being identified in the morbidly obese group [26]. Lastly, the results from the study by Pengpid and Peltzer demonstrated that the following factors—being physically inactive, sedentary behavior, and no history of illicit drug use—were associated with obesity among boys, while these factors were not related to obesity among girls [27].

This paper will explore the following questions:

1. What are the determinants of gender differences in obesity in adolescents from suburban Bangkok.
2. What are policy and practice implications for these findings?

2. Materials and Methods

Anthropometric Data Collection Methods

The data were collected in 2004 and 2005 in Rangsit, Thailand, a peri-urban community 40 km north of Bangkok. Anthropometric data were collected from adolescent girls and

boys of ages 10–18 years. Participants were recruited from two local public primary and secondary schools. This study involved the collaboration with nurse researchers from the Faculty of Nursing, Thammasat University in Rangsit, Thailand.

Details on the data collection methods are described by Pawloski et al. [4]. To determine Body Mass Index (BMI), anthropometric indicators including heights and weights were collected. For weight measurements, a digital body fatscale (Tanita) was used, and height measurements were carried out using a field portable anthropometer (GPM Seritex Brand). All of the measurements were taken by the researcher in a clinical setting and following the methods described by Lohman et al. [28]. BMI is based on the following formula: weight/height^2 (kg/m^2).

To determine overweight and obese individuals, comparison data were chosen to serve as a reference rather than a standard. Z-scores were calculated for BMI-for-age and weight-for-age data using reference data developed by the US Centers for Disease Control (CDC) [29]. Z-scores allowed for comparisons with reference data and were calculated for weight-for-age z-scores (WAZ) and BMI-for-age z-scores (BMIZ).

Because no large reference sample was available from Thailand with which to make a comparison, these data were compared with international cut-off points for BMI-for-age developed by Cole et al. [30]. Comparison data were chosen to serve as a reference rather than a standard. This reduced the variability due to sexual dimorphism in boys and girls because each gender was compared to a relevant reference.

Descriptive statistics of body weight by gender and eating and exercise behaviors by gender are shown in Tables 1 and 2. To determine any statistically significant differences for BMI-for-age z-scores, weight-for-age z-scores, and eating/exercise behaviors between boys and girls, Chi-square and Oneway ANOVA analyses were conducted and presented in Tables 3–6. Due to the relatively small number of overweight and obese adolescents in this sample, overweight and obese individuals were collapsed into one category called overweight/obese. Thus, the dependent variable is comprised of underweight, normal weight, and overweight/obese adolescents.

Table 1. Percent distribution data of body weight by gender (n = 278).

Gender	Severely Underweight (%)	Normal Weight (%)	Overweight and Obese (%)	Total (%)
Male	3	61	23	87
Female	22	136	33	191
Total	25	197	56	278

Table 2. Descriptive data regarding eating and exercise behaviors by Gender.

Behaviors	Gender	N	Mean	SD
How many sodas do you drink per week?	Male	80	2.875	2.37271
	Female	250	2.4568	2.33454
	Total	330	2.5582	2.3471
How many serving of potato chips do you eat per week?	Male	126	3.5397	3.39565
	Female	255	1.8629	1.75024
	Total	381	2.4174	2.54253
How many snacks do you eat per day?	Male	137	2.55	1.654
	Female	266	1.8	0.998
	Total	403	2.05	1.307
How many serving of vegetables do you eat per day?	Male	140	2.6143	1.23257
	Female	261	2.3195	1.2845
	Total	401	2.4224	1.27287

Table 2. *Cont.*

Behaviors	Gender	N	Mean	SD
How many glasses of milk do you drink every day?	Male	142	2.62	2.897
	Female	263	1.83	1.413
	Total	405	2.11	2.09
How many meals per day do you eat?	Male	151	3.08	0.483
	Female	267	2.84	0.535
	Total	418	2.93	0.529
How many meals per day do you eat at home?	Male	150	2.29	0.816
	Female	266	2.02	0.684
	Total	416	2.12	0.745
How many days per week do you exercise?	Male	132	4.55	1.967
	Female	257	2.66	1.95
	Total	389	3.3	2.149
How many hours a day do you watch TV?	Male	145	3.89	2.304
	Female	265	4.06	2.041
	Total	410	4	2.136
How many hours a day do you use a computer?	Male	131	2.706	1.7594
	Female	257	1.595	2.2244
	Total	388	1.97	2.1423
How many times do you play sports per week?	Male	127	4.41	1.993
	Female	255	1.59	1.447
	Total	382	2.53	2.116
How many servings of fruit do you eat per day?	Male	136	2.11	1.494
	Female	264	1.8	1.341
	Total	400	1.91	1.401

Table 3. Entire sample ANOVA—boy and girls for BMIZ and WAZ.

Indicator	Gender	N	Mean	SD	t	*p*
BMI-for-age z-score	Male	155	0.18	1.17		
BMI-for-age z-score	Female	275	0.11	1.11		
BMI-for-age z-score	Total	430	0.13	1.13	0.37	0.55
weight-for-age z-score	Male	156	0.06	1.18		
weight-for-age z-score	Female	275	0.25	1.27		
weight-for-age z-score	Total	431	0.14	1.24	5.89	**0.02** *

* Statistical significance noted in bold.

Table 4. One-way ANOVA tables for boys and girls for WAZ broken down by age.

Age in Years	Male N	Male Mean WAZ	Male SD	Female N	Female Mean WAZ	Female SD	t	*p*
11	27	0.9	1.3	26	0.12	1.62	0.007	0.933
12	71	0.05	1.15	74	0.01	1.22	0.032	0.859
13	13	0.12	1.2	65	0.01	1.15	0.104	0.748
14	22	0.01	0.77	34	−0.6	1.02	5.85	**0.019** *
15	18	0.24	0.75	46	−0.66	1.27	7.76	**0.007** *
16	5	−0.6	0.47	30	−0.7	1.25	0.128	0.868

* Statistical Significance noted in bold.

Table 5. Relationship between gender and BMI (n = 278).

Gender	Value	df	Asymptotic Significance (2-Tailed)
Pearson Chi-square	**6.828 ***	2	0.033
Likelihood Ratio	7.524	2	0.023
Linear-by-Linear Association	6.338	1	0.012
N of Valid Cases	278		

* Statistical Significance noted in bold.

Table 6. One-way ANOVA relationships of eating and exercise behaviors by male/female.

Prompt	Groupings	Sum of Squares	df	Mean Square	T	p
How many sodas do you drink per week?	Between Groups Within Groups Total	10.599 1801.823 1812.423	1 328 329	10.599 5.493	1.93	0.166
How many serving of potato chips do you eat per week?	Between Groups Within Groups Total	237.115 2219.387 2456.502	1 379 380	237.115 5.856	40.492	**$p < 0.01$**
How many snacks do you eat per day?	Between Groups Within Groups Total	50.341 635.864 686.205	1 401 402	50.341 1.586	31.747	**$p < 0.01$**
How many serving of vegetables do you eat per day?	Between Groups Within Groups Total	7.92 640.159 648.079	1 399 400	7.92 1.604	4.937	**0.027 ***
How many glasses of milk do you drink every day?	Between Groups Within Groups Total	57.669 1706.265 1763.935	1 403 404	57.669 4.234	13.621	**$p < 0.01$**
How many meals per day do you eat?	Between Groups Within Groups Total	5.58 111.121 116.701	1 416 417	5.58 0.267	20.888	**$p < 0.01$**
How many meals per day do you eat at home?	Between Groups Within Groups Total	7.428 223.033 230.462	1 414 415	7.428 0.539	13.789	**$p < 0.01$**
How many days per week do you exercise?	Between Groups Within Groups Total	310.814 1480.595 1791.409	1 387 388	310.814 3.826	81.241	**$p < 0.01$**
How many hours a day do you watch TV?	Between Groups Within Groups Total	2.7 1864.119 1866.819	1 408 409	2.7 4.569	0.591	0.443
How many hours a day do you use a computer?	Between Groups Within Groups Total	107.112 1669.085 1776.197	1 386 387	107.112 4.324	24.771	**$p < 0.01$**
How many times do you play sports per week?	Between Groups Within Groups Total	672.89 1032.293 1705.183	1 380 381	672.89 2.717	247.699	**$p < 0.01$**
How many servings of fruit do you eat per day?	Between Groups Within Groups Total	8.579 774.155 782.734	1 398 399	8.579 1.945	4.411	**0.036 ***

* Statistical significance noted in bold.

In addition to nutritional indicators, participants were interviewed about their diet and exercise habits including food frequency questions concerning consumption of high calorie foods, such as potato chips, sodas, and snacks, and healthier options such as vegetables. Participants were asked about how often they exercised, played sports, and about their screen time.

Participants were recruited from two local public primary and secondary schools. Random sampling was not possible, as the school was not large enough to allow for it. Further, school officials required all eligible girls and boys to be able to participate. Informed consent forms were sent home to 500 girls and boys one week before data collection took

place. Only students who had informed consent forms signed and returned were eligible to participate. Data exclusion criteria included pregnancy and other outlying health factors. Human subjects' approval was granted by the George Mason University Human Subjects Review Board and the Thammasat University Faculty of Medicine Human Subjects Review Board. Participants and their parents were given assent and consent forms translated into Thai.

3. Results

Gender Differential Findings from 2005 Data

Weight-for-age z-scores (WAZ), BMI-for-age z-score data (BMIZ), and BMI classification were analyzed from a sample collected in 2005 to examine differences between males and females for ages between 11 and 16 years as well as any relationships regarding diet and energy expenditure.

For WAZ, statistically significant differences were noted for boys and girls at ages 14 and 15 for which boys were found to be statistically significantly heavier. For all ages, girls were only heavier than boys at the age of 11 years, suggesting that in older cohorts, we see boys being heavier compared to their healthy counterparts as compared to girls. The BMI-for-age z-scores did not reveal statistically significant differences between boys and girls for the entire group or for specific age cohorts. Further, Chi-squared analyses revealed significant differences between underweight, normal weight, and overweight/obese categories for boys and girls.

Descriptive results of the BMI category data are shown in Table 1 with Chi-square analysis by male/female. Statistically significant differences are noted concerning the relationship between the BMI categories and gender. For these categories, 26% of males are noted as overweight or obese, and 17% of females are noted as overweight or obese. One way ANOVA analyses looking at differences between BMI-Z scores and WAZ for boys and girls are shown in Tables 3 and 5 with Table 3 broken down by age. Statistically significant differences are only noted for WAZ, with males having higher BMI-Z and WAZ. When broken down by age, statistically significant differences for WAZ are only noted for ages 14 and 15 years, for which males have higher WAZ values. Analyses of the results concerning eating and activity behaviors are shown in Tables 2 and 4. Statistically significant differences were noted for all variables except television watching and soda consumption. For most of these variables, males consumed more, but males also responded that they played more sports and exercised more often. Lastly, males responded that they spent more time on the computer.

4. Discussion and Conclusions

This paper explores the following questions:

1. What are the determinants of gender differences in obesity in adolescents from suburban Bangkok.
2. What are policy and practice implications for these findings?

4.1. Determinants of Gender Differences

The findings from the 2005 data revealed the evidence of obesity among suburban girls and boys living in Thailand and showed that gender may have had some impact on the dietary and activity behaviors, particularly in later adolescence. Follow-up studies from the literature have revealed that there continues to be a trend of increasing obesity among adolescents in Thailand and that this may be more of a concern in boys. Interviews with health professionals and parents from the 2005 study suggested that girls were more aware of their physical appearance, and there was more societal acceptance to be obese as a boy in Thailand compared to girls.

The research suggests that the problem of being overweight and obesity affects primary school girls at higher rates than secondary school girls. One explanation is that while being exposed to the Western diet, the younger generation is also being exposed to the Western

notion of beauty, whereby thinness is equated with beauty. However, more exploration is needed to evaluate body image concerns and weight loss among older adolescent girls, and more research is needed to explore these ideas as there may be variations in different socioeconomic groups just as there are in the U.S. and other regions in the world. In the Pan-American Health Organization (PAHO) regions, for example, reports have shown that obesity is more socially accepted among wealthier men, yet not for women and, in fact, the opposite in lower socioeconomic groups [31].

Both data from 2005 and the more recent literature review have shown that the consumption of high calorie foods and snacks, greater screen time, body image, and depressive factors play a significant role regarding obesity during adolescence in Thailand. The literature also reveals that more recently there may be more of an impact regarding such behaviors in boys overall compared to girls.

4.2. Policy Implications

These findings will assist health professionals to better understand who is most at risk for obesity within this specific community in Thailand as well as understand any potential trends over time, so that more sound and effective interventions can be developed and implemented.

Future nutrition interventions could emphasize the need for children to take responsibility for their own food choices and physical activity, rather than relying on parental decision making. Special attention might be paid to boys, particularly during later adolescence, regarding screen time and the consumption of low-nutrient-dense foods, while for girls, attention might be focused on potential weight loss and body image concerns.

4.3. Limitations

This study includes a number of limitations. There is limited literature related to gender differences in nutritional status and obesity among Thai adolescents after 2005. Additionally, there may have been changes to the gender differences presented since the 2005 data were collected. Other limitations include that the analyses did not factor potential differences due to the earlier pubertal development of girls, although such findings would presume to show girls being heavier in late adolescence, and these data show boys being heavier. Lastly, these findings are exclusive to Thailand and may reflect cultural patterns not found in other countries, even among the Southeast Asian nations.

Author Contributions: Conceptualization, L.R.P., T.H. and S.V.; methodology, L.R.P.; software, J.T.N.; validation, K.M.C.; formal analysis, L.R.P.; investigation, L.R.P. and T.H.; resources, J.T.N.; data curation, L.R.P. and K.M.C.; writing—original draft, L.R.P., T.H., S.V. and K.M.C.; writing—review and editing, L.R.P., K.M.C. and J.T.N.; visualization, K.M.C. and J.T.N.; project administration, L.R.P., T.H. and S.V.; funding acquisition, L.R.P., T.H. and S.V. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Thammasat University Bualuang ASEAN Chair Professorship Grant and the U.S. Fulbright Foundation/Fulbright Thailand.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board (or Ethics Committee) of George Mason University (protocol code 4063 and 30 January 2004).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Contact the author of correspondence for access to data.

Acknowledgments: We would like to acknowledge the Thammasat University Faculty of Nursing for their support.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. WHO. *Diet, Nutrition, and the Prevention of Chronic Diseases: Report of a WHO-FAO Expert Consultation*; Joint WHO-FAO Expert Consultation; Weltgesundheitsorganisation, FAO, Eds.; WHO Technical Report Series; World Health Organization: Geneva, Switzerland, 2003; ISBN 978-92-4-120916-8.
2. Dwyer, J.T.; Bailey, R.L.; Bailey, R.L. The Concept of Nutritional Status and Its Measurement. Available online: https://www.taylorfrancis.com (accessed on 20 October 2020).
3. Jacoby, E.; Grajeda, R.; Contreras, A.; Hospedales, J. The Epidemic of Childhood Obesity in the Americas Must Be Stopped: Governmental and PAHO Leadership Are Crucial. *Int. J. Obes. Suppl.* **2013**, *3*, S15–S17. [CrossRef] [PubMed]
4. Pawloski, L.; Ruchiwit, M.; Pakapong, Y. A Cross-Sectional Examination of Growth Indicators from Thai Adolescent Girls: Evidence of Obesity among Thai Youth? *Ann. Hum. Biol.* **2008**, *35*, 378–385. [CrossRef] [PubMed]
5. Malnutrition. Available online: https://www.who.int/health-topics/malnutrition (accessed on 23 June 2023).
6. Leocádio, P.C.L.; Lopes, S.C.; Dias, R.P.; Alvarez-Leite, J.I.; Guerrant, R.L.; Malva, J.O.; Oriá, R.B. The Transition From Undernutrition to Overnutrition Under Adverse Environments and Poverty: The Risk for Chronic Diseases. *Front. Nutr.* **2021**, *8*, 676044. [CrossRef]
7. Popkin, B.M.; Ng, S.W. The Nutrition Transition to a Stage of High Obesity and Noncommunicable Disease Prevalence Dominated by Ultra-Processed Foods Is Not Inevitable. *Obes. Rev.* **2022**, *23*, e13366. [CrossRef]
8. Tenfold Increase in Childhood and Adolescent Obesity in Four Decades: New Study by Imperial College London and WHO. Available online: https://www.who.int/news/item/11-10-2017-tenfold-increase-in-childhood-and-adolescent-obesity-in-four-decades-new-study-by-imperial-college-london-and-who (accessed on 24 June 2023).
9. Angkurawaranon, C.; Wisetborisut, A.; Rerkasem, K.; Seubsman, S.; Sleigh, A.; Doyle, P.; Nitsch, D. Early Life Urban Exposure as a Risk Factor for Developing Obesity and Impaired Fasting Glucose in Later Adulthood: Results from Two Cohorts in Thailand. *BMC Public Health* **2015**, *15*, 902. [CrossRef]
10. Pawloski, L.; Kitsantas, P. Social Determinants of Overweight in Thai Adolescent Girls. *Am. J. Hum. Biol.* **2009**, *21*, 264–265.
11. Kosulwat, V. The Nutrition and Health Transition in Thailand. *Public Health Nutr.* **2002**, *5*, 183–189. [CrossRef]
12. Aekplakorn, W.; Mo-Suwan, L. Prevalence of Obesity in Thailand. *Obes. Rev. Off. J. Int. Assoc. Study Obes.* **2009**, *10*, 589–592. [CrossRef] [PubMed]
13. Siwarom, S.; Aekplakorn, W.; Pirojsakul, K.; Paksi, W.; Kessomboon, P.; Neelapaichit, N.; Chariyalertsak, S.; Assanangkornchai, S.; Taneepanichskul, S. Metabolic Syndrome in Thai Adolescents and Associated Factors: The Thai National Health Examination Survey V (NHES V). *BMC Public Health* **2021**, *21*, 678. [CrossRef] [PubMed]
14. Teerawattananon, Y.; Luz, A. *Obesity in Thailand and Its Economic Cost Estimation*; Asian Development Bank: Mandaluyong, Philippines, 2017.
15. Chan, Y.Y.; Lim, K.K.; Lim, K.H.; Teh, C.H.; Kee, C.C.; Cheong, S.M.; Khoo, Y.Y.; Baharudin, A.; Ling, M.Y.; Omar, M.A.; et al. Physical Activity and Overweight/Obesity among Malaysian Adults: Findings from the 2015 National Health and Morbidity Survey (NHMS). *BMC Public Health* **2017**, *17*, 733. [CrossRef]
16. Monteiro, P.O.A.; Victora, C.G. Rapid Growth in Infancy and Childhood and Obesity in Later Life—A Systematic Review. *Obes. Rev.* **2005**, *6*, 143–154. [CrossRef]
17. Ajie, W.N.; Chapman-Novakofski, K.M. Impact of Computer-Mediated, Obesity-Related Nutrition Education Interventions for Adolescents: A Systematic Review. *J. Adolesc. Health* **2014**, *54*, 631–645. [CrossRef]
18. Nonboonyawat, T.; Pusanasuwannasri, W.; Chanrat, N.; Wongthanavimok, N.; Tubngern, D.; Panutrakul, P.; Mungthin, M.; Nivesvivat, T.; Hatthachote, P.; Rangsin, R.; et al. Prevalence and Associates of Obesity and Overweight among School-Age Children in a Rural Community of Thailand. *J. Pediatr.* **2019**, *62*, 179–186. [CrossRef]
19. Ruangying, J.; Jorajit, S. Food Consumption Behavior of Adolescents in Songkhla Province: Synthesis of Literacy and Factors Influencing Food Consumption Behavior. *J. Lib. Arts* **2016**, *8*, 245–264.
20. Mahachoklertwattana, P. Obesity and Type 2 Diabetes in Children and Adolescents: Current Situation and Future Trends in Thailand. *Siriraj Med. J.* **2006**, *58*, 771–773.
21. Subhaluksuksakorn, P.; Sinjariyanon, W.; Pimsaran, R. Gender Difference in Underweight, Overweight and Obesity among First-Year Students of Suranaree University of Technology in 2015. *J. Med. Assoc. Thai.* **2016**, *99* (Suppl. S7), S24–S29.
22. Suwanwaiphattana, W.; Piromkraipak, J.; Nawanantawong, W.; Piromkraipak, J.; Nawanantawong, W. Health Literacy and Obesity Prevention in Junior High School: A Compared Study Between Male and Female Students. *South. Coll. Netw. J. Nurs. Public Health* **2019**, *6*, 80–90.
23. Eiamudomkan, M.; Sirirassamee, T.; Sirirassamee, B. Consumption of Vegetables, Fruits, Physical Activity, and Sedentary Behaviors in Thai Adolescents. *J. Med. Health Sci.* **2014**, *21*, 40–48.
24. Seubsman, S.; Lim, L.L.-Y.; Banwell, C.; Sripaiboonkit, N.; Kelly, M.; Bain, C.; Sleigh, A.C. Socioeconomic Status, Sex, and Obesity in a Large National Cohort of 15–87-Year-Old Open University Students in Thailand. *J. Epidemiol.* **2010**, *20*, 13–20. [CrossRef]
25. Kongsomboon, K.; Wongjitrat, N.; Chansakulporn, S.; Hutspardol, S. Nutritional Status of Students in Ongkharak District, Nakhon Nayok Province According to Age Groups and Gender: Cross Sectional Study. *J. Med. Health Sci.* **2006**, *13*, 207–216.
26. In-iw, S.; Manaboriboon, B.; Chomchai, C. A Comparison of Body-Image Perception, Health Outlook and Eating Behavior in Mildly Obese versus Moderately-to-Severely Obese Adolescents. *J. Med. Assoc. Thai.* **2010**, *93*, 429–435.

27. Pengpid, S.; Peltzer, K. Underweight and Overweight or Obesity and Associated Factors among School-Going Adolescents in Five ASEAN Countries, 2015. *Diabetes Metab. Syndr.* **2019**, *13*, 3075–3080. [CrossRef] [PubMed]
28. Lohman, T.G.; Roche, A.F.; Martorell, R. *Anthropometric Standardization Reference Manual*; Human Kinetics Books: Chicago, IL, USA, 1988; p. 90.
29. Ogden, C.L.; Fryar, C.D.; Carroll, M.D.; Flegal, K.M. Mean body weight, height, and body mass index United States 1960–2002. *Adv. Data Vital Health Stat.* **2004**, *347*, 1–20.
30. Cole, T.J.; Bellizzi, M.C.; Flegal, K.M.; Dietz, W.H. Establishing a Standard Definition for Child Overweight and Obesity Worldwide: International Survey. *BMJ* **2000**, *320*, 1240–1243. [CrossRef]
31. Peña, M.; Bacallao, J. Obesity among the Poor: An Emerging Problem in Latin America and the Caribbean. In *Obesity and Poverty. A New Public Health Challenge*; Scientific Publication-Panamerican Health Organization: Washington, DC, USA, 2004; pp. 3–10.