THE DOUBLE BURDEN OF NUTRITION AND ASSOCIATED FACTORS IN HIGH SCHOOLS STUDENTS IN LONG XUYEN CITY, AN GIANG PROVINCE

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ABSTRACT

The study was conducted to determine the double nutritional burden status among high school students and some related factors. This study was designed as a cross-sectional study with 384 high school students in Long Xuyen city, An Giang province. Students were measured weight and height by anthropometric methods and collected information, eating habits through questionnaires. The research results show that the stunting, wasting, and overweight/ obesity rate was 8.3%, 7.8%, and 6.2%, respectively. The percentage of high school students who ate fatty, snacking, and sweet foods were high, at 60.7%, 79.4% and 68.5%, respectively. The percentage of students who have a habit of eating at night after 9 pm was 22.1%. Average family income over 10 million VND/month, fatty and sweet eating habits were factors contributing to reducing the risk of stunting and wasting, but increasing the risk of being overweight/obesity.

***Keywords**: Double burden, malnutrition, overweight/obesity, high school students, Long Xuyen city - An Giang.*

I. BACKGROUND

The double nutritional burden is an increasingly prevalent public health issue in developing countries, including Vietnam [1]. In the light of the development of the economy and rapid urbanization, the nutritional status of Vietnamese youth and students is changing towards transitional nutrition. It is mean that bearing the burden of malnutrition and overweight, and obesity simultaneously [2]. School-age malnutrition leads to adverse health and cognitive effects and thus to academic achievement [3]. Meanwhile, being overweight/obese is one of the main risks of non-communicable chronic diseases such as coronary heart disease, hypertension, diabetes, cancer... [4].

Many studies have assessed nutritional status in Vietnam, focusing on target groups such as children under five years old and pregnant and lactating mothers. Nonetheless, only a small number of studies have been conducted on high school adolescents. High school students are an age that is continuing to develop physically, and this is the group that will be the mainstay and primary workforce of the country in the future. Therefore, this group of subjects needs more attention because this is the late adolescent stage, the last to develop height and improve nutritional status. [5] [6]

When assessing the status of malnutrition in high school students, the study results from Anh et al. [5] show that 6.4% of students have stunted, in which female students have stunting accounted for 6.6% higher than male students (6.1%). Meanwhile, the study of Nhung and Duong [6] shows that the percentage of 10th-grade students with stunting was more than doubled (12.7%), with the percentage of stunting in females higher than male students

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Date of receipt: 24/2/2022
Date of scientific judgment: 13/5/2022
Reviewed date: 25/5/2022

(13.0% versus 12.2%). When considering wasting malnutrition, the study by Cam et al. [7] showed that 7.59% of students aged 11 to 17 years had malnutrition, in which severe wasting was 1.85%, moderate wasting was 5.74%. This result is lower than the study of Van [8] when the rate of wasting malnutrition among high school students in Cai Nuoc district (Ca Mau province) is 25.8%. Besides the high proportion of malnutrition among high school students, the prevalence of overweight/obesity is increasing. Research results of Van [8] in Ca Mau in 2014 showed that the rate of overweight/obesity according to BMI accounted for 5.99%, while the results of Nhung and Duong [6], and Tham et al. [9] were 13.8% and 17.3%, respectively.

In An Giang, research on the nutritional status of high school students is still limited. Therefore, to facilitate the implementation of national and local strategic action plans on nutrition, this study was conducted to determine the double nutritional burden and related factors of high school students in Long Xuyen city, An Giang province. The results of this paper will provide evidence to inform the policies and practices that aim to improve status.

II. METHODS

2.1. Research subjects: Students in grades 10, 11 and 12 at high schools in Long Xuyen city, An Giang province.

2.2. Research design: A cross-sectional community-based study was conducted from September 2018 to May 2019.

2.3. Sample size: The sample size for this survey is calculated based on the formula for prevalence studies.

$$n = Z^2_{(1-\alpha/2)} \frac{p(1-p)}{d^2}$$

With the following assumptions: p-value (highest population proportion prevalence) = 50% (due to during the literature review, there were no previous studies in the area), 95% confidence interval (standard normal probability = 1.96); margin of error (d) = 0.05, z = the standard normal tabulated value, and α = level of significance. Therefore, the total sample size was 384.

2.4. Sampling: The multistage sampling technique was employed to select the study participants. First, conduct purposefully selected Long Xuyen city, An Giang province, to participate in the study. Second, of nine high schools, three schools were selected using the Simple Random Sampling Method. Then, a list of all students at these three high schools was created. Finally, high schools students were selected by using a systematic random sampling method. If a selected student refused to participate in the study, it was ignored, and the next student will be taken immediately after the student was selected in the list. Continued to select the sample until the number of students was enough, then stop.

2.5. Data collection

Data were collected through interviews by questionnaire in the combination of measuring weight and height by anthropometric methods. Weight was measured using Tanita scales with an accuracy of 0.1kg, while height was measured using UNICEF's wooden rulers.

Classification of nutritional status was determined based on the 2007 WHO Z-Score classification table for children aged 10 to 19 years, including Assessment of height-for-age Z-Score (H/A Z-Score) and assessment of the BMI Z-Score by age (BMI/A Z-Score). To be more specific, H/A Z-Score was divided into three types: Severe stunting,

Moderate stunting, and Normal nutritional status. BMI/A Z-Score was classified into five categories: Severely wasting, Moderate wasting, Normal nutritional status, Overweight, and Obesity.

2.6. Data analysis

The data were checked for completeness and consistency before entry. Then data entry and cleaning were conducted using Epi-Data 3.1 software. The H/A Z-Score and BMI/A Z-Score indicators were calculated using the WHO AnthroPlus software. All data were analyzed using SPSS 20.0 software.

2.7. Ethical issues

The research complies with regulations on research ethics. The data was collected fully, accurately, honestly, and for research purposes only. As requested by schools' authorities, school names were not disclosed, the schools were coded and the codes were not dispatched.

III. RESULTS AND DISCUSSION

Table 1. Socio-demographic characteristics of respondents (n=384)

Characteristics		Frequency	Percent
Gender	Male	169	44.0
	Female	215	56.0
Age	16	109	28.4
	17	199	51.8
	18	74	19.3
	19	2	0.5
Grade	10	118	30.7
	11	201	52.3
	12	65	16.9
Ethnicity	Kinh	372	96.9
	Others	12	3.1
Average family income per month (million VND)	≤ 5.0	51	13.3
	5.1 - 10.0	268	69.8
	10.1 - 15.0	45	11.7
	> 15.0	20	5.2

Table 1 shows that the sample selected for the study had a higher percentage of females than males (56.0% compared with 44.0%), age 17 means that grade 11 accounted for more than 50.0%. In addition, nearly 97.0% of the study population was from the Kinh ethnic group, with approximately 70% of households having an income between 5.1 and 10.0 million VND/month.

Table 2. Anthropometric indicators and nutritional status by education level and gender (Mean ± SD)

	Grade 10		Grade 11		Grade 12		Total in gender		Total
	Male	Female	Male	Female	Male	Female	Male	Female	
Height (cm)	165,7 ± 4,7**	157,9 ± 4,5**	166,8 ± 7,2**	157,2 ± 5,7**	170,4 ± 5,7**	158,5 ± 5,1**	167,0 ± 6,4**	157,6 ± 5,3**	161,8 ± 7,4
Weight (kg)	56,8 ± 10,7**	47,4 ± 5,5**	58,8 ± 11,6**	46,9 ± 7,7**	59,4 ± 6,9**	47,9 ± 6,2**	58,2 ± 10,7**	47,2 ± 6,9**	52,1 ±10,3

	Grade 10		Grade 11		Grade 12		Total in gender		Total
	Male	Female	Male	Female	Male	Female	Male	Female	
H/A Z-Score	-0.94 ± 0,66	-0,71 ± 0,70	-1,08 ± 0,92	-0,85 ± 0,85	-0,77 ± 0,77	-0,68 ± 0,77	-0,98 ± 0,82*	-0,78 ± 0,79*	-0,87 ± 0,81
BMI/A Z-Score	-0,19 ± 1,15**	-0,72 ± 0,82**	-0,25 ± 1,21**	-0,90 ± 1,02**	-0,60 ± 0,97	-0,90 ± 0,84	-0,28 ± 1,16**	-0,85 ± 0,94**	-0,60 ± 1,08

**p<0,05; **p<0,01; T test*

Table 2 shows the distribution of anthropometric indicators of high school students in this study by education level and gender. The results show that the average height, weight, H/A Z-Score and BMI/A Z-Score of high school students in Long Xuyen city were 161.8 ± 7.4; 52.1 ±10.3; -0.87 ± 0.81, and -0.60 ± 1.08, respectively. In which the height, weight and BMI/A Z-Score of male students (167.0 ± 6.4; 58.2 ± 10.7 and -0.28 ± 1.16) were higher than females, there was a statistically significant difference (p<0.01). Meanwhile, the H/A Z-Score in the group of female students (-0.78 ± 0.79) was higher than that of male students (-0.98 ± 0.82); there was a statistically significant difference (p<0.05).

The results of this study are similar to those of Nhung and Duong in Thai Nguyen [6], Hanh et al. in Ho Chi Minh City [10], and Anh et al. [5] in Hai Phong. All these studies showed that the average weight and height of male students were higher than female students.

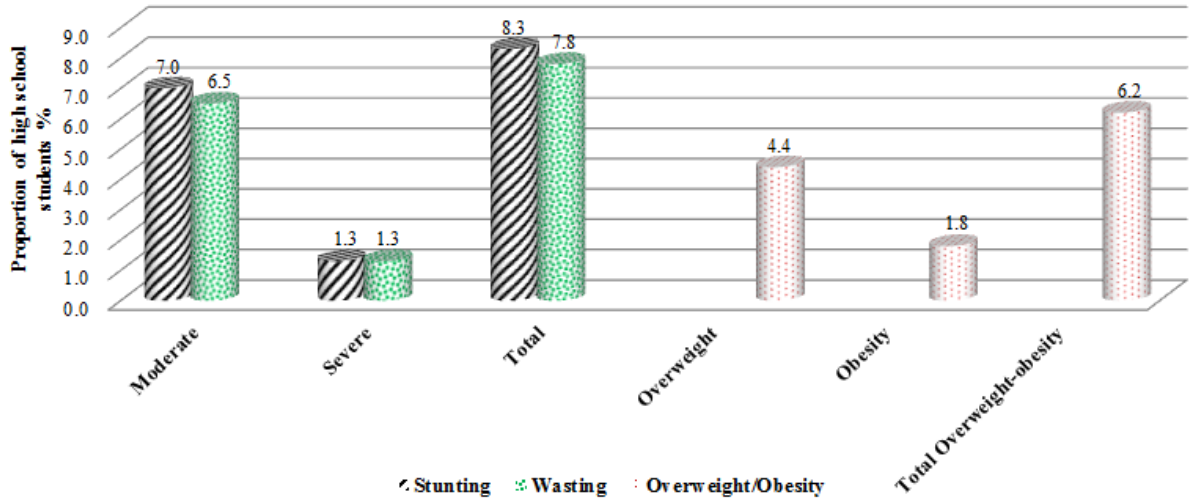

Figure 1. Distribution of nutritional status by level

Figure 1 shows the distribution of nutritional status by level among high school students in Long Xuyen city. The prevalence of stunting and moderate wasting was 7.0% and 6.5%, respectively. In addition, approximately 1.3% of students suffered from severe stunting as well as wasting. On the other hand, the percentage of students who were overweight and obese was 4.4% and 1.8%, respectively.

In this study, the percentage of students suffering from stunting is higher than that of

Anh et al. [5] in Hai Phong (8.3% compared to 6.4%). Nonetheless, this result is lower than the study of Nhung and Duong [6] in Thai Nguyen and Hanh et al. in Ho Chi Minh City [10]. The prevalence of stunting in these two studies was 12.7% and 10.7%, respectively. In addition, the percentage of wasting in this study is higher than that of Cam et al. [7], and Nhung and Duong [6], but the difference is not significant (7.59% and 6.9%, respectively). However, this result is much lower than the study of Van [8] (25.8%). The reason is that the research by Van [8] was conducted in a rural district (Cai Nuoc district, Ca Mau province). Meanwhile, other studies, including this study, were principally carried out in cities. Otherwise, the percentage of overweight/obesity in this study is 6.2%, which is much lower when compared to the study of Nhung and Duong [6], and Tham et al. [9] (13.8% and 17.3%, respectively), but higher than that of Van [8] (5.99%).

Table 3. Stunted nutritional status (height/age) of students by education level and gender

Grade	Gender	Stunted nutritional status				p
		Normal	Moderate	Severe	Total	
		n (%)	n (%)	n (%)	n (%)	
10	Male	55 (46.6)	3 (2.6)	0 (0.0)	58 (49.2)	>0.05
	Female	57 (48.3)	3 (2.5)	0 (0.0)	60 (50.8)	
	Total	112 (94.9)	6 (5.1)	0 (0.0)	118 (100.0)	
11	Male	73 (36.3)	7 (3.5)	5 (2.5)	85 (42.3)	<0.05
	Female	106 (52.7)	10 (5.0)	0 (0.0)	116 (57.7)	
	Total	179 (89.1)	17 (8.5)	5 (2.5)	201 (100.0)	
12	Male	24 (36.9)	2 (3.1)	0 (0.0)	26 (40.0)	>0.05
	Female	37 (56.9)	2 (3.1)	0 (0.0)	39 (60.0)	
	Total	61 (93.8)	4 (6.2)	0 (0.0)	65 (100.0)	

Table 3 shows the distribution of high school students' stunted nutritional status (height/age) in this study by education level and gender. The results show that moderate stunting rates between males and females are relatively equal in grades 10 and 12; there is no statistically significant difference ($p>0.05$). Nonetheless, in grade 11, the prevalence of moderate stunting among females is higher than males (5.0% compared to 3.5%), but only male students have severe stunting; there is a statistically significant difference ($p<0.05$). The percentage of severe stunting in 11th-grade male students is possible due to childhood malnutrition, genetic factors or nutritional needs in the past period only met the need for weight gain, not accommodate height growth. The result of stunting prevalence in this study is consistent with those of Nhung and Duong [6] and Anh et al. [5] when there is no statistically significant difference in the prevalence of malnutrition between the gender in grade 10 ($p>0.05$).

Table 4. Classification of nutritional status based on BMI by education level and gender of students

Grade	Gender	Nutritional status						p
		Severe wasting	Moderate wasting	Normal	Over-weight	Obesity	Total	
		n (%)	n (%)	n (%)	n (%)	n (%)	(n, %)	
10	Male	1 (0.8)	1 (0.8)	49 (41.5)	5 (4.2)	2 (1.7)	58 (49.2)	p>0.05
	Female	0 (0.0)	3 (2.5)	56 (47.5)	1 (0.8)	0 (0.0)	60 (50.8)	
	Total	1 (0.8)	4 (3.4)	105 (89.0)	6 (5.1)	2 (1.7)	118 (100.0)	
11	Male	1 (0.5)	4 (2.0)	68 (33.8)	8 (4.0)	4 (2.0)	85 (42.3)	p<0.01
	Female	2 (1.0)	14 (7.0)	98 (48.8)	1 (0.5)	1 (0.5)	116 (57.7)	
	Total	3 (1.5)	18 (9.0)	166 (82.6)	9 (4.5)	5 (2.5)	201 (100.0)	
12	Male	1 (1.5)	1 (1.5)	23 (35.4)	1 (1.6)	0 (0.0)	26 (40.0)	p>0.05
	Female	0 (0.0)	2 (3.1)	36 (55.4)	1 (1.5)	0 (0.0)	39 (60.0)	
	Total	1 (1.5)	3 (4.6)	59 (90.8)	2 (3.1)	0 (0.0)	65 (100.0)	

Table 4 shows the distribution of nutritional status of students based on BMI by education level and gender. The results show that the rate of severe wasting of male students in grades 10 and 12 is higher than that of female students (0.8% compared to 0,0%). Meanwhile, in moderate wasting, female students tend to be higher than male students. Analogous to severe wasting, the percentage of overweight/obesity in male students tends to be higher than that of females in grades 10 and 12. However, the difference in nutritional status is based on BMI indicators was no statistically significant difference between these two grades (p>0.05). Otherwise, in grade 11, there was a difference based on wasting or overweight/obesity by gender with statistically significant (p<0.01). The proportion of female students with moderate and severe wasting was higher than that of male students (7.0% and 1.0% compared to 2.0% and 0.5% respectively). In contrast, male students were more likely to be overweight/obese than female students (6.0% compared to 1.0%). This result is consistent with the study of Nhung and Duong [6] and Tham et al. [9] when the overweight/obesity rate among male students is higher than that of female students (17.9% versus 10.6% and 25.2% versus 11.1%, respectively).

Table 5. High school students' eating habits

		Frequency (n=384)	Percent
Fatty eating habit	Yes	233	60.7
	No	151	39.3
Snacking eating habit	Yes	305	79.4
	No	79	20.6
Sweet eating habit	Yes	263	68.5
	No	121	31.5
The habit of eating at night after 9 o'clock	Yes	87	22.7
	No	297	77.3

Table 5 shows the eating habits of high school students in Long Xuyen city. The results show that students who have fatty and snacking eating habits were 60.7% and 79.4%, respectively. This can be explained by the high speed of urbanization and the increasing appearance of fast food stores or sidewalk shops in Long Xuyen city in recent years, resulting in easy access for students to these foods. This reason can also lead to an increased tendency to use sweet foods, for example, cakes, milk tea.., which are frequently used with snacks or burgers in fast food stores or sidewalk shops. The result of this study demonstrates that about 68.5% of students had sweet eating habits. In addition, the percentage of high school students who have a habit of eating at night after 9 am in this study was 22.1%.

Table 6. Some factors related to nutritional status

Related factors		Stunting (%)			Wasting (%)			Overweight/obesity (%)		
		Yes	No	OR	Yes	No	OR	Yes	No	OR
Gender	Male	10.1	89.9	1.49	5.3	94.7	0.52	11.8	88.2	7.08***
	Female	7.0	93.0		9.8	90.2		1.9	98.1	
Average family income per month (million VND)	> 10	1.5	98.5	0.15*	1.5	98.5	0.16*	18.5	81.5	5.79***
	≤ 10	9.7	90.3		9.1	90.9		3.8	96.2	
Fatty eating habit	Yes	3.9	96.1	0.22***	2.1	97.9	0.11***	9.0	91.0	4.89**
	No	15.2	84.8		16.6	83.4		2.0	98.0	
Snacking eating habit	Yes	4.9	95.1	0.19***	4.3	95.7	0.16***	5.9	94.1	0.76
	No	21.5	78.5		21.5	78.5		7.6	92.4	
Sweet eating habit	Yes	4.2	95.8	0.21***	1.5	98.5	0.06***	8.0	92.0	3.41*
	No	17.4	82.6		21.5	78.5		2.5	97.5	
The habit of eating at night after 9 o'clock	Yes	8.0	92.0	0.95	2.3	97.7	0.23*	11.5	88.5	2.63*
	No	8.4	91.6		9.4	90.6		4.7	95.3	

**p<0.05; **p<0.01; ***p<0.001*

Table 6 shows some factors related to malnutrition and overweight/obesity among high school students in Long Xuyen city. Male students were 7.08 times more likely to be overweight/obese than female students regarding gender-related factors. This difference was statistically significant with p<0.001. This result is similar to the study of

Tham et al. [9] when male students have a higher risk of obesity (OR= 2.86; p < 0.01). The household economic factor reflects whether students' nutritional needs are met the requirement or not. This study shows that the group of students living in families with an average monthly income of over 10 million had a lower risk of stunting and wasting than families with an income of 10 million or less (OR 0.15 and 0.16), respectively. This difference was statistically significant with p<0.05. In contrast, the overweight/obesity rate in students with a family income of over 10 million was 5.79 times higher than the other group (p<0.001). Several factors related to students' eating habits (fatty, snacking, and sweet eating) reduced the risk of stunting and stunting (p<0.001) but also increased the risk of overweight/obesity, except for snacking habits (p>0.05). Therefore, it is necessary to strictly manage high school students' eating habits and behaviours to limit the possibility of being overweight/obese. Otherwise, the habit of eating at night after 9 pm also reduced the risk of wasting (OR=0.23; p<0.05). Nonetheless, this habit also caused an increased risk of overweight/obesity by 2.63 times (p<0.05). No association was found between the habit of eating at night after 9 pm with the stunting rate.

IV. CONCLUSION

The percentage of high school students in Long Xuyen city suffered from stunting, accounting for 8.3%, of which moderate level accounted for 7.0%, severe degree 1.3%. Likewise, the rate of wasting accounted for 7.8%, in which female students with moderate and severe wasting were higher than male students in grade 11 (7.0% and 1.0% compared to 2.0% and 0.5%) (p<0.01). Otherwise, the proportion of overweight/obesity accounted for 6.2%, of which in grade 11, male students tend to be overweight/obese higher than female students (6.0% compared to 1.0%); p<0.01). The percentage of students with fatty, snacking, and sweet eating habits was high, at 60.7%, 79.4%, and 68.5%, respectively. In addition, the proportion of students who had a habit of eating at night after 9 pm was 22.1%. Average family income over 10 million VND/month, fatty and sweet eating habits were factors contributing to reducing the risk of stunting and wasting, but increasing the risk of being overweight/ obesity.

V. RECOMMENDATIONS

Scientists, nutritionists, and local preventive medicine centres need to develop a balanced and reasonable diet to ensure an adequate supply of necessary nutrients and limit the use of fats, sweets for high school students.

Schools need to promote education and campaign to raise awareness about the adverse effects of unhealthy eating habits and behaviours on students' health.

Families need to strengthen supervision, adjust students' diets at home and limit students to eat at night after 9 pm.

The authorities need to strengthen supervision and promulgate policies to early detect students at risk of malnutrition or overweight/obesity to take timely intervention measures.

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