

DOUBLE BURDEN OF MALNUTRITION IN 6–14-YEAR-OLD STUDENTS: A CROSS-SECTIONAL STUDY IN THAI NGUYEN CITY

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Abstract. The double burden of malnutrition is a significant issue that affects students' health, academic performance, and overall well-being. This study was conducted to determine the status of the double burden of malnutrition among students in Thai Nguyen city. A cross-sectional study was conducted on 1,861 children who reside in Thai Nguyen city and are between the ages of 6 to 14 years old. The criteria for assessing nutritional status in children in this study involved a combination of the 2007 World Health Organization (WHO) standards and the International Obesity Task Force's (IOTF) standards. The study revealed a concerning situation of the double burden of malnutrition among this population. The prevalence of overweight and obesity was relatively high compared to previous surveys, with approximately 28.6% of students. On the other hand, the rate of thinness was also around 12.3% among students. The rate of overweight and obesity was higher in boys compared to girls, with 34.3% of male students compared to 22.4% of female students. The rate of thinness was higher in girls compared to boys, with 15.1% of female students compared to 9.9% of male students ($P = 0.038$). There were no statistically significant differences in the prevalence of thinness, overweight, and obesity when compared between primary school and secondary school students. These findings suggest that Thai Nguyen city faces a complex nutritional challenge, with both overnutrition and undernutrition coexisting among students. By addressing the double burden of malnutrition, we can improve the overall health and well-being of the student population, setting the foundation for a healthier future generation.

Keywords: double burden of malnutrition, Thai Nguyen, 6–14-year-old students.

1. Introduction

The double burden of malnutrition is a term used to describe a phenomenon where a population experiences both undernutrition and overnutrition simultaneously. It is a growing public health concern in many countries, particularly in low- and middle-income countries that are undergoing rapid economic and social transitions [1]. Undernutrition, which includes stunting, wasting, and being underweight, remains a

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significant problem in many parts of the world, especially among children. On the other hand, overnutrition, which includes overweight, obesity, and diet-related non-communicable diseases, is also on the rise, particularly in urban areas. The double burden of malnutrition can have serious health consequences, including an increased risk of chronic diseases and impaired cognitive development, and can also have economic and social impacts [2, 3]. Addressing this complex issue requires a multi-sectoral approach that involves improving access to nutritious food, promoting healthy lifestyles, and addressing social and economic factors that contribute to malnutrition.

The double burden of malnutrition is the major public health challenge faced by many countries around the world. India is home to one of the largest populations of undernourished people in the world. According to the National Family Health Survey data (311,182 children 0-5 years old and 972,192 adults 15-54 years old), child stunting prevalence was 38% in 2016, with no gender differences in trends [4]. This is even though India is one of the world's largest food producers. By contrast, India is also grappling with a rising prevalence of obesity and other diet-related diseases due to changes in dietary patterns and lifestyle. The prevalence of overweight/obesity in adults almost doubled between 2006 and 2016 (from 10 to 21%) [4]. The United States is also facing a dual burden of undernutrition and overnutrition. While hunger and malnutrition still affect a significant number of Americans, obesity rates have reached epidemic proportions in recent years. The World Health Organization acknowledges that the US has unprecedented rates of both obesity (greater than 1/3 of all adults) and food insecurity (about 1/8 of the population) [5, 6]. Similarly, Mexico is facing a growing problem of both undernutrition and overnutrition. While poverty and food insecurity are still significant issues in many parts of the country, obesity rates have soared in recent years, 36,1% of Mexican adults had obesity (Body Mass Index, BMI \geq 30 kg/m²) [7].

Vietnam faces a double burden of malnutrition, with undernutrition and overnutrition coexisting in different parts of the country and among different segments of the population [8]. Addressing these issues will require a multifaceted approach, including promoting healthy diets and lifestyles, improving access to nutritious foods, and addressing poverty and inequality. In the last few decades, Vietnam has made significant progress in reducing the prevalence of undernutrition. However, undernutrition remains a concern in some parts of the country, particularly in rural areas and among ethnic minority populations. However, the prevalence of stunting is higher among ethnic minority children and in some rural provinces. Meanwhile, overnutrition or obesity is becoming an increasing concern in Vietnam, especially in urban areas [8, 9].

In the context of students in Vietnam, the double burden of malnutrition is a significant issue that affects their health, academic performance, and overall well-being. Undernutrition, including stunting, wasting, and micronutrient deficiencies, remains a persistent problem among Vietnamese students, particularly those from low-income families and rural areas. According to a study on 2,788 Vietnamese children aged 11-14 years old in 2018, the prevalence of overweight and obesity among students were 17.4% and 8.6%, respectively by WHO Z-score criteria [10]. A cross-sectional survey conducted in 2016 involving 2,334 children aged 6-9 from eight primary schools

revealed that the prevalence of underweight, stunting, and wasting was 8.0%, 5.1%, and 5.3%, respectively [11].

Several factors contribute to the double burden of malnutrition in Vietnamese students, including poverty, inadequate access to nutritious food, unhealthy diets, and lack of physical activity. In addition, the rapid economic development in Vietnam has led to changes in lifestyle and dietary patterns, including the adoption of Western-style diets that are high in fat, sugar, and salt. Addressing the double burden of malnutrition among students in Vietnam requires a comprehensive approach that involves multiple sectors, including education, health, agriculture, and the food industry. Some strategies that can be implemented include promoting healthy eating habits and physical activity, improving access to nutritious food, enhancing nutrition education, and strengthening food regulations and labeling.

In recent years, Thai Nguyen city, located in northern Vietnam, has experienced rapid economic growth, leading to significant changes in various aspects of its society. One notable area where this transformation is evident is in the eating habits of students. As the city has undergone urbanization, witnessed an increase in disposable income, the increasing influence of Western culture, as well as the ease of accessibility of fast-food outlets, there has been a notable shift in the way students approach food consumption. This is also a risk factor for the double burden of malnutrition in Thai Nguyen city. However, the research on this issue in Thai Nguyen city is still limited. Therefore, this study was conducted to determine the status of the double burden of malnutrition among students in Thai Nguyen city, which is the basis for further studies to raise students' awareness of nutrition, thereby helping to strike a balance between the benefits of economic development and the promotion of healthy nutritional status among the younger generation in Thai Nguyen city.

2. Content

2.1. Subjects and methods

2.1.1. Study population

The study population consisted of 1,861 children who reside in Thai Nguyen city and were between the ages of 6 to 14 years old. The study design was a cross-sectional study conducted at two schools in Thai Nguyen city (915 Giang Sang Primary and Secondary School and Hoang Van Thu Secondary School). These schools were selected by a simple random sample method.

2.1.2. Data collection

The data collection method involved measuring the height and weight of participants according to the standardized guidelines of the National Institute of Nutrition, which ensure that measurements were taken consistently and accurately across all participants. The method for measuring standing height involved the use of a stadiometer. Participants were asked to stand with their backs against the stadiometer, and the height was recorded to the nearest centimeter. For weight measurements, participants were asked to step onto a scale, which was calibrated to ensure accuracy. Weight was recorded to the nearest tenth of a kilogram. These methods were non-invasive and were not cause any discomfort or harm to participants.

2.1.3. Diagnostic criteria

The criteria for assessing nutritional status in children in this study involved a combination of the 2007 World Health Organization (WHO) standards and the International Obesity Task Force's (IOTF) standards.

According to IOTF, nutritional status was defined by specific BMI for age and gender cut points corresponded to BMI at 18 years old: thinness ($\text{BMI} < 18.5 \text{ kg/m}^2$), overweight ($25 \text{ kg/m}^2 \leq \text{BMI} < 30 \text{ kg/m}^2$), obesity ($\text{BMI} \geq 30 \text{ kg/m}^2$) [12].

According to WHO, in children aged 5-19 years old, thinness was defined by BMI-for-age Z-score $< -2\text{SD}$, overweight was defined by BMI for age $+1\text{SD} < \text{Z-score} \leq +2\text{SD}$, obesity was defined by BMI for age Z-score $> +2\text{SD}$.

To accurately assess overweight and obesity in students, we combine both criteria above. That is, a child was considered overweight or obese when both of the above criteria were satisfied.

2.1.4. Statistical analysis

The statistical analyses were done with the statistical software package SPSS16.0 (SPSS Inc., Chicago, Illinois). A variety of appropriate statistical tests for analyzing normally distributed and non-normally distributed variables was used in this study. For normally distributed variables, statistical tests included: t-test was used to compare the means of two independent groups; One-way ANOVA was used to compare the means of three or more independent groups. For non-normally distributed variables, common statistical tests included: the Mann-Whitney U test was used to compare the medians of two independent groups; the Kruskal-Wallis test was used to compare the medians of three or more independent groups. The Chi-square test was used for comparing two or more qualitative variables. *P*-values < 0.05 were considered significant.

2.2. Results and discussion

2.2.1. Characteristics of research subjects

The characteristics of the study subjects are presented in Table 1.

Table 1. Characteristics of the study subjects.

Parameter	Boys (N = 935)	Girls (N = 859)	<i>P</i> -value
Age (years) ^a	9.2 ± 2.1	9.1 ± 2.0	0.908
Weight (kg) ^a	35.6 ± 13.2	32.3 ± 10.8	<0.0001
Height (cm) ^a	136.5 ± 14.5	134.8 ± 13.8	0.014
BMI (kg/m^2) ^b	16.9 (15.2 – 20.0)	16.0 (14.6 – 18.6)	<0.0001
Height-for-age Z-score ^b	0.27 (-0.35 – 0.94)	0.23 (-0.47 – 0.77)	<0.0001
Weight-for-age Z-score ^b	0.75 (-0.24 – 1.78)	0.32 (-0.63 – 1.24)	<0.0001
BMI-for-age Z-score ^a	0.75 ± 1.53	0.23 ± 1.28	<0.0001

BMI, body mass index; *Bold values indicate a significant difference between cases and controls*; ^aData is mean ± SD, *P*-values obtained by Student T test; ^bData is median (interquartile range); *P*-values obtained by Mann-Whitney U test.

There was no difference in age among the research subjects but a statistically significant difference in certain anthropometric indicators (height, weight, BMI, height-for-age Z-score, weight-for-age Z-score, weight-for-height Z-score, and BMI-for-age Z-score) between boys and girls. These indexes were higher in boys than in girls ($P < 0.05$).

2.2.2. Nutritional status of students in Thai Nguyen

The nutritional status of students in Thai Nguyen is presented in Figure 4. The data indicates that Thai Nguyen is experiencing a double burden of malnutrition, which refers to the coexistence of 12.3% undernutrition (underweight and wasted) and 28.6% overnutrition (overweight and obesity) within a population (Figure 1A). Additionally, the rate of overweight and obesity in Thai Nguyen was 28.6%. This suggests that a considerable portion of the population was experiencing excess weight, which can lead to various health issues such as cardiovascular diseases, diabetes, and other chronic conditions.

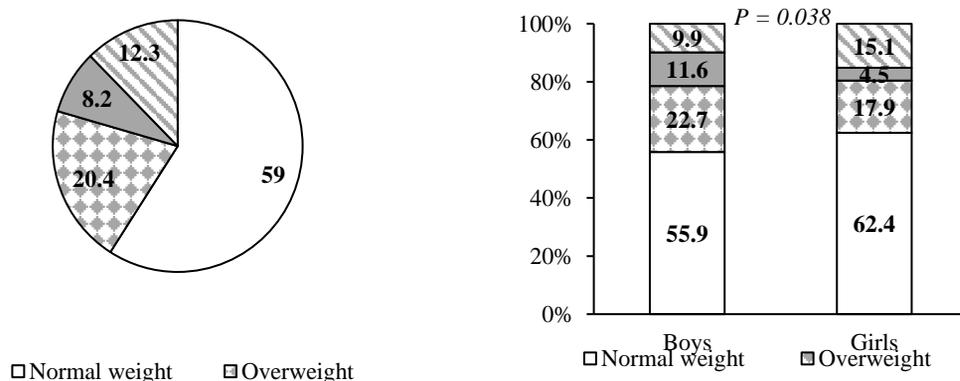


Figure 1. Nutritional status of students in Thai Nguyen (A) and compared by sex (B)
P-values obtained by Chi-square test

The study reveals an interesting gender disparity in the rates of overweight, obesity, underweight, and wasted among students in Thai Nguyen city. The findings indicated that the rate of overweight and obesity was higher in boys compared to girls, with 34.3% of male students compared to 22.4% of female students. The rate of underweight and waste was higher in girls compared to boys, with 15.1% of female students compared to 9.9% of male students ($P = 0.038$) (Figure 1B).

2.2.3. Thinness by sex and school level

The prevalence of thinness among primary school students was 12%, while among secondary school students, it was 14.3% ($P = 0.229$). However, there is a statistically significant difference in the rate of thinness when comparing between boys and girls. Accordingly, the thinness rate in primary school girls was 15%, much higher than that of boys at 9.2% ($P = 0.001$) (Figure 3).

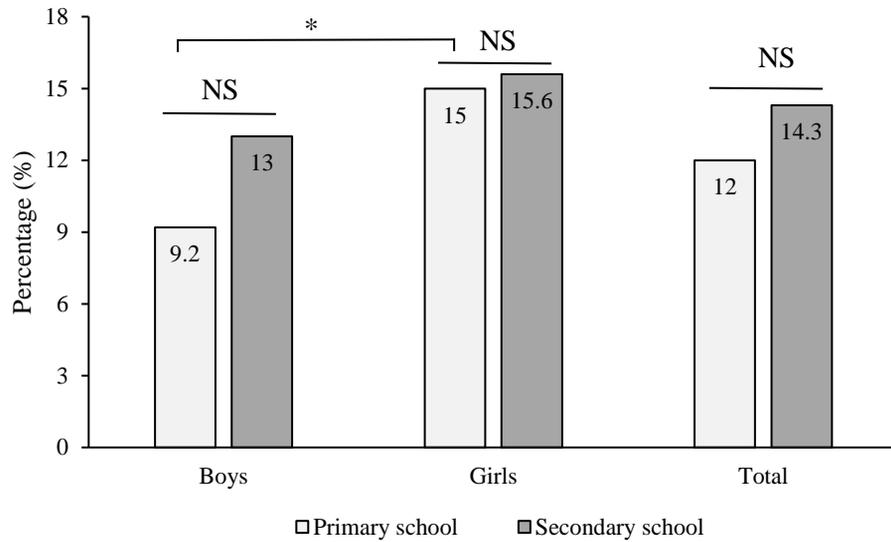


Figure 2. Thinness by sex and school level of students in Thai Nguyen
P-values obtained by Chi-square test. * $P < 0.05$; NS: Non-Significant

2.2.4. Overweight and obesity by sex and school level

Figure 3 presents the findings regarding the prevalence of overweight and obesity among students, categorized by gender and school level. It indicated that there was a tendency for a higher percentage of children with obesity among primary school students compared to secondary school students, but this difference was not statistically significant. On the other hand, there was a statistically significant difference in the prevalence of overweight and obesity in boys compared to girls ($P < 0.05$).

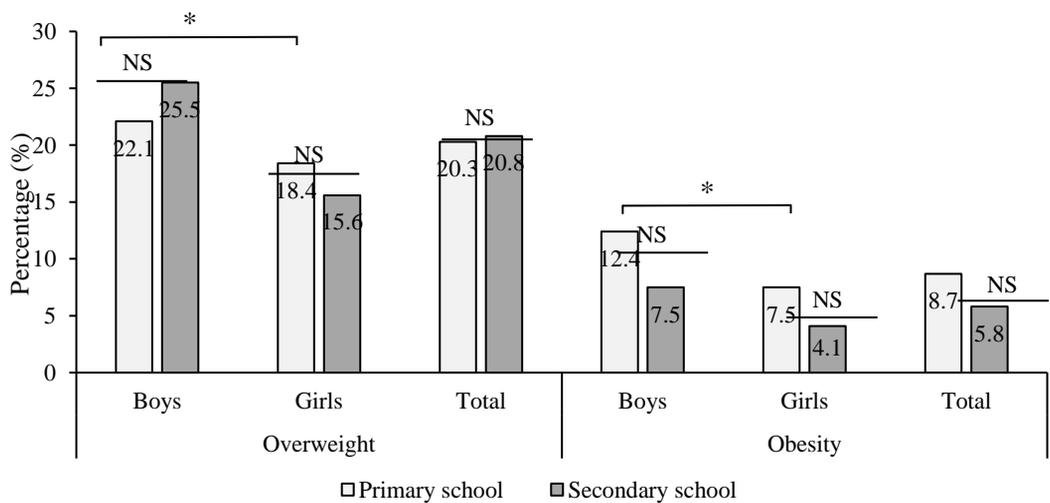


Figure 3. Overweight and obesity by sex and school level of students in Thai Nguyen
P-values obtained by Chi-square test. * $P < 0.05$; NS: Non-significant

Our study was conducted in a large city in the North of Vietnam, so the results are not generalizable to other regions of the country. A cross-sectional survey of 10,949 children (6 - 18 years old) from 30 schools in Ho Chi Minh city, in 2014 - 2015 showed that the prevalence of overnutrition was high, especially in boys of primary school age in urban areas (20-30% were overweight, 20-30% were obese, and 50% had abdominal obesity) [8]. Lower than our study, the study on children 6-10 years old in Hai Phong city showed that the proportion of overweight and obese students was 11.2% and 10.1%, respectively [13]. A cross-sectional study of 2,872 nationally representative children aged 0.5 - 11.9 years showed that, at school age (6 - 11 years old), the rates of stunting and underweight were higher than in our study (15.6% and 22.2%, respectively). The prevalence of overweight or obesity in urban children was similar to our study (29%) [14].

There are significant challenges related to the double burden of malnutrition that exist worldwide, with varying patterns across different regions. Undernutrition affects approximately one-quarter of children globally. Overweight and obesity, on the other hand, affect about 10% of children worldwide. While the rates of stunting and wasting have shown some decline over the past two decades, the prevalence of obesity has been rising, particularly in regions such as Latin America and the Caribbean, the Middle East, and Oceania. This shift towards higher obesity rates can be attributed to changes in dietary patterns, urbanization, globalization of food systems, and lifestyle changes [15].

These gender differences in nutritional status highlight the importance of considering gender-specific factors and interventions when addressing the double burden of malnutrition in Thai Nguyen city. The higher rate of overweight and obesity in men may be influenced by various factors, including differences in dietary preferences, physical activity levels, and hormonal factors. Targeted interventions for men should focus on promoting healthier eating habits, encouraging regular physical activity, and raising awareness about the risks associated with overweight and obesity. Conversely, the higher rate of underweight and malnutrition in women may be influenced by factors such as cultural norms, gender inequalities, and inadequate access to healthcare and nutrition resources. Addressing the specific needs of women, such as improving access to nutritious food, enhancing healthcare services, and promoting gender equality, can help combat underweight and malnutrition in this population.

It is crucial to design gender-sensitive interventions that take into account the unique challenges and vulnerabilities faced by both men and women in Thai Nguyen. By adopting a comprehensive and gender-specific approach, the city can work towards reducing the rates of overweight, obesity, underweight, and malnutrition, and promoting better health outcomes for all students.

The cross-sectional sample for the study in 2014 included data from 520 girls, and 459 boys aged 14 years old in Poland showed that the rates of underweight-wasted and overweight obesity were 9.4% and 15.7%, respectively. In which, the rate of underweight and waste in girls was much higher than in boys (11.1% vs. 5.9%) but the rate of overweight and obesity in girls was lower than in boys (15% vs. 18.1%) [16]. Based on data from the 2015 China Health and Nutrition Survey, a study conducted among children and adolescents aged 6 to 17 years revealed that the prevalence of

overweight and obesity was 15.43% and 11.06%, respectively, as determined by BMI-for-age Z-scores based on the WHO child growth standards [17].

A comprehensive analysis combining data from 2,416 population-based studies, involving 128.9 million participants aged 5 years and older (including 31.5 million aged 5 - 19 years) and utilizing WHO criteria, provides a comprehensive overview of the global trend of dual nutritional burden between 1975 and 2016. The global prevalence of obesity, based on age-standardized data, exhibited an increase from 0.7% (0.4 - 1.2) in 1975 to 5.6% (4.8-6.5) in 2016 among girls. For boys, the prevalence rose from 0.9% (0.5 - 1.3) in 1975 to 7.8% (6.7 - 9.1) in 2016. Conversely, the prevalence of moderate and severe underweight decreased from 9.2% (6.0-12.9) in 1975 to 8.4% (6.8 - 10.1) in 2016 among girls, and from 14.8% (10.4 - 19.5) in 1975 to 12.4% (10.3 - 14.5) in 2016 among boys. In terms of specific countries, India had the highest prevalence of moderate and severe underweight, with rates of 22.7% (16.7 - 29.6) among girls and 30.7% (23.5 - 38.0) among boys [18].

It's important to note that these global statistics provide a general overview, and the specific rates and prevalence can vary across countries, regions, and population groups. Disparities in nutrition and health outcomes can also exist within countries, with differences observed between income groups and urban/rural areas. Addressing these challenges requires a multi-faceted approach that focuses on improving access to nutritious food, promoting healthy dietary practices, enhancing nutritional education, fostering physical activity, and addressing underlying socioeconomic factors. Additionally, efforts to reduce disparities and promote equity in nutrition outcomes are crucial.

The presence of both undernutrition and overnutrition highlights the complex nutritional challenges faced by the population of Thai Nguyen. It may be attributed to various factors, including changes in dietary patterns, sedentary lifestyles, and socioeconomic factors. Addressing this double burden of malnutrition requires comprehensive strategies that focus on promoting balanced nutrition, improving access to healthy food options, enhancing nutritional education, and encouraging physical activity. These efforts should aim to address both undernutrition and overnutrition and promote overall health and well-being.

Our study has several strengths. First, researching a large sample size of 1,861 children provided a comprehensive understanding of the double burden of malnutrition in Thai Nguyen city. The large sample size enhanced the generalizability and statistical power of the study, allowing for more reliable findings. Second, the inclusion of children from Thai Nguyen city ensured that the research was specific to the local context. This increases the relevance of the findings and enables the development of targeted interventions and policies to address the double burden of malnutrition in the area. Third, focusing on children between the ages of 6 to 14 years old allowed for a deeper understanding of the long-term effects of malnutrition during critical developmental stages. This age range covers important periods of physical and cognitive growth, making the findings particularly relevant to addressing the double burden of malnutrition in this population. However, the study has some limitations. While the large sample size findings generalizability, the study may still be limited to

Thai Nguyen city and may not be representative of other regions or populations. The specific demographic, cultural, and economic characteristics of Thai Nguyen city may differ from other areas, limiting the applicability of the research findings. Besides, because the research was only conducted on 2 secondary schools, there was a possibility of selection bias. In addition, while the research focuses on the double burden of malnutrition, it may look at important contextual factors that influence nutritional outcomes. Factors such as economic status, cultural practices, food availability, and access to healthcare may interact with malnutrition and shape its prevalence and impact. Further study should consider incorporating these contextual factors to provide a more comprehensive understanding of the issue.

3. Conclusions

The study conducted on students aged 6-14 years old in Thai Nguyen city reveals a concerning situation of the double burden of malnutrition among this population. The findings indicated that the prevalence of overweight and obesity was relatively high compared to previous surveys, with approximately 28.6% of students. On the other hand, the rate of underweight and malnutrition was also around 12.3% among students. The rate of overweight and obesity was higher in boys compared to girls, with 34.3% of male students compared to 22.4% of female students. The rate of underweight and waste was higher in girls compared to boys, with 15.1% of female students compared to 9.9% of male students ($P = 0.038$). There were no statistically significant differences in the prevalence of thinness, overweight, and obesity when compared between primary school and secondary school students.

These findings suggest that Thai Nguyen city faces a complex nutritional challenge, with both overnutrition and undernutrition coexisting among the student population. These findings can inform future interventions, policies, and health promotion programs aimed at addressing the double burden of malnutrition-related concerns among students in Thai Nguyen city. By addressing the double burden of malnutrition, we can improve the overall health and well-being of the student population, setting the foundation for a healthier future generation.

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REFERENCES

- [1] Popkin, B.M., Corvalan, C. and Grummer-Strawn, L.M., 2020. Dynamics of the double burden of malnutrition and the changing nutrition reality. *The Lancet*, Vol. 395, Iss. 10217, pp. 65-74.
- [2] Wells, J.C., Sawaya, A.L., Wibaek, R., Mwangome, M., Poullas, M.S., Yajnik, C.S. and Demaio, A., 2020. The double burden of malnutrition: aetiological pathways and consequences for health. *The Lancet*, Vol. 395, Iss. 10217, pp. 75-88.

- [3] Nugent, R., Levin, C., Hale, J. and Hutchinson, B., 2020. Economic effects of the double burden of malnutrition. *The Lancet*, Vol. 395, Iss. 10218, pp. 156-164.
- [4] Nguyen, P.H., Scott, S., Headey, D., Singh, N., Tran, L.M., Menon, P. and Ruel, M.T., 2021. The double burden of malnutrition in India: Trends and inequalities (2006–2016). *Plos one*, Vol. 16, Iss. 2, pp. e0247856.
- [5] Bowers, K.S., Francis, E. and Kraschnewski, J.L., 2018. The dual burden of malnutrition in the United States and the role of non-profit organizations. *Preventive medicine reports*, Vol. 12, pp. 294-297.
- [6] World Health Organization, Obesity and overweight, <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight> (accessed May 19, 2023).
- [7] Barquera, S. and Rivera, J.A., 2020. Obesity in Mexico: rapid epidemiological transition and food industry interference in health policies. *The Lancet Diabetes & Endocrinology*, Vol. 8, Iss. 9, pp. 746-747.
- [8] Mai, T.M.T., Pham, N.O., Tran, T.M.H., Baker, P., Gallegos, D., Do, T.N.D., van der Pols, J.C. and Jordan, S.J., 2020. The double burden of malnutrition in Vietnamese school-aged children and adolescents: a rapid shift over a decade in Ho Chi Minh City. *European Journal of Clinical Nutrition*, Vol. 74, Iss. 10, pp. 1448-1456.
- [9] Khan, N.C. and Khoi, H.H., 2008. The double burden of malnutrition: the Vietnamese perspective. *Asia Pacific Journal of clinical nutrition*, Vol. 17, Iss.1, pp. 116-118.
- [10] Phan, H.D., Nguyen, T.N.P., Bui, P.L., Pham, T.T., Doan, T.V., Nguyen, D.T. and Van Minh, H., 2020. Overweight and obesity among Vietnamese school-aged children: National prevalence estimates based on the World Health Organization and International Obesity Task Force definition. *PloS one*, Vol. 15, Iss. 10, p. e0240459.
- [11] Hoang, N.T., Orellana, L., Le, T.D., Gibson, R.S., Worsley, A.F., Sinclair, A.J. and Szymlek-Gay, E.A., 2018. Anthropometric status among 6–9-year-old school children in rural areas in Hai Phong City, Vietnam. *Nutrients*, 10(10), p. 1431.
- [12] Cole, T.J. and Lobstein, T., 2012. Extended international (IOTF) body mass index cut-offs for thinness, overweight, and obesity. *Pediatric obesity*, Vol. 7, Iss. 4, pp. 284-294.
- [13] Ngan, H.T.D., Tuyen, L.D., Van Phu, P. and Nambiar, S., 2018. Childhood overweight and obesity amongst primary school children in Hai Phong City, Vietnam. *Asia Pacific Journal of Clinical Nutrition*, Vol. 27, Iss. 2, pp. 399-405.
- [14] Le Nguyen, B.K., Le Thi, H., Thuy, N.T., Huu, C.N., Do, T.T., Deurenberg, P. and Khouw, I., 2013. The double burden of undernutrition and overnutrition in Vietnam in 2011: results of the SEANUTS study in 0· 5–11-year-old children. *British Journal of Nutrition*, Vol. 110, Iss. S3, pp. S45-S56.
- [15] Winichagoon, P. and Margetts, B.M., 2017. The double burden of malnutrition in low-and middle-income countries. *Energy Balance and Obesity*. International Agency for Research on Cancer.

- [16] Kantanista, A. and Osinski, W., 2014. Underweight in 14 to 16-year-old girls and boys: prevalence and associations with physical activity and sedentary activities. *Annals of Agricultural and Environmental Medicine*, Vol. 21, Iss. 1, pp. 114-119.
- [17] Hu, X., Jiang, H., Wang, H., Zhang, B., Zhang, J., Jia, X., Wang, L., Wang, Z. and Ding, G., 2021. The intraindividual double burden of malnutrition in Chinese children and adolescents aged 6–17 Years: evidence from the China Health and nutrition survey 2015. *Nutrients*, Vol. 13, Iss. 9, p. 3097.
- [18] Abarca-Gómez, L., Abdeen, Z.A., Hamid, Z.A., Abu-Rmeileh, N.M., Acosta-Cazares, B., Acuin, C., Adams, R.J., Aekplakorn, W., Afsana, K., Aguilar-Salinas, C.A. and Agyemang, C., 2017. Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128.9 million children, adolescents, and adults. *The Lancet*, Vol. 390, Iss. 10113, pp. 2627-2642.