



ЗДРАВНО ОБРАЗОВАНИЕ

HEALTH EDUCATION

THE RELATIONSHIP OF BMI WITH DIETARY HABITS, SOCIO-ECONOMIC STATUS AND PARENTAL EDUCATION OF TEENAGERS

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Abstract: The aim of this study was to analyze the prevalence of overweight and obesity among teenagers aged 15 to 18, and to assess the relationship between body mass index and various dietary and socio-economic factors. A sample of 125 students (42, 33.6% females and 83, 66.4% males) aged 15 to 18, from two high schools in Skopje, North Macedonia, including both genders, was included in the research. Using self-assessment method, students completed a questionnaire on personal data including: (gender, body mass and height), HBSC dietary habits (fruits, vegetables, sweets, Coca-Cola or other soft drinks containing sugar), FAS socio-economic status (Does your family own a car, van or truck? Do you have your own bedroom? How many times have you been on vacation abroad in the last year? How many computers are there in your family? Do you have a dishwasher at home? How many bathrooms are there in your house?), breakfast consumption (during weekdays and weekends), as well as parental education level (primary, secondary or university). The standard descriptive method was used to show characteristics of the body mass index (BMI) of the sample as a whole and divided by gender. The association and determination of variables between BMI, dietary habits, socio-economic status and parental education level were calculated using χ^2 - chi square test analysis and linear regression. Results suggest that there is a correlation of BMI and gender $\chi^2 (2, N = 125) = 10.912, p = .004$. Teenage girls tend to have a higher prevalence of overweight and underweight compared to their male peers. There is a correlation between the frequency of breakfast consumption over 2-4 days, as well as over 5-6 days, compared with less frequent breakfast consumption during weekdays and BMI, $R^2 = .069, F (2, 122) = 4.55, p = .012$. Regular breakfast consumption on weekdays reduces the likelihood of increased BMI and may play an important role in managing body mass of teenagers. This was not statistically confirmed in relation to breakfast consumption on weekends. Findings suggest that dietary habits, regardless of the type, are not associated with the BMI of teenagers. Similarly, both family socio-economic status and parental education level do not show a statistically significant relationship with BMI. Teenage girls are more likely to be more overweight and underweight compared to their male peers. Consumption of sweets and sweet drinks 'more than once a day' dominates among teenage girls compared to boys. Breakfast consumption on weekdays,

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unlike weekends, is considered significant for managing the body mass of teenagers. A higher level of mother's education is more pronounced in overweight teenagers, followed by normal-weight and underweight teenagers, but it does not prove to be statistically significant. The analysis highlights that the socio-economic status does not show statistically significant relationship with BMI. It is suggested that girls have a different lifestyle approach to reduce the prevalence trend of both overweight and underweight. Including physical activity, its intensity, as well as the amount of food consumption in the research could clarify the relationship of these aspects with BMI.

Keywords: BMI, socio-economic status, overweight.

Introduction

The sensitive period during which the human body begins to undergo significant changes, characterized by psycho-social and physical development, which are also related to dietary habits, can have implications for both the lifestyle and well-being of teenagers. Balancing the right diet with the consumption of the necessary amount of macronutrients and micronutrients is considered crucial for proper body development and for maintaining healthy body mass. It is well known that parents can have a big influence on food choice and dietary habits of their children (Skelton et al. 2011). On the other hand, excessive food consumption, unhealthy dietary habits and lifestyle of teenagers can lead to the emergence of chronic non-communicable diseases (Swinburn et al. 2019; WHO 2020), such as: endocrine, cardiovascular and skeletal muscle diseases (Ebbeling et al. 2002). This is even more concerning when we know the fact that approximately 80% of obese children are at risk of remaining obese even in adulthood (Schwartz et al. 2014). According to OECD (2014), trends also show gender differences where males lead compared to females in China (24% vs. 16%), Hungary (28% vs. 23%), Poland (17% vs. 11%), while differences in favor of females are evident in South Africa (29% vs. 11%) and United Kingdom (26% vs. 22%). Additionally, studies show that the rise in obesity among children and teenagers is also linked to family socio-economic factors (Kansra et al. 2021; McLaren 2007), gender (Wisniewski & Chernausek 2009), ethnicity and parental education level (Datar & Chung, 2015), urban/rural residential status (Johnson & Johnson 2015), and even immigration status (Moreno et al. 2011).

On the other hand, not far from our research region, there are studies that do not confirm the consistency of the relationship between obesity and socio-demographic factors (Petrovič & Čankovič 2023).

We believe that the socio-economic status is important because it can determine not only the quality and quantity of available food, but also the access to nutritional education, which as such reflects on the health of teenagers in general. Therefore, we consider results of recent trends in the region to be particularly important. These results may also be influenced by cultural and geographical factors.

In fact, overweight and obesity appear as a problem not only among young people but are also described as an issue in adulthood. However, among younger age groups, special policy orientation in this direction is required, since small changes in their behaviour can lead to significant impact on worsening overweight throughout life, contributing to increased morbidity and early mortality (WHO 2022).

One of the research factors related to overweight and obesity may be linked to skipping breakfast. Research indicates that skipping breakfast tends to increase the likelihood of developing overweight and obesity (Wicherski et al. 2021).

This seems to be common among teenagers, especially among girls, older teenagers and those from disadvantaged families (Vereecken et al. 2009). This may be associated with their dietary habits during the day, such as excessive calorie intake during later meals, or the selection of energy-dense and nutrient-poor foods. However, findings are not always consistent and may be influenced by other factors, such as lifestyle, physical activity or metabolic changes, highlighting the need for further research to clarify these associations.

In this context, obesity and eating disorders are considered issues that affect not only individuals, but also communities and society as a whole. These issues can be closely linked to socio-economic factors, manifesting themselves in different ways across different various demographic groups.

According to Simovska (2002), the first research study on health-risk behaviours among the Macedonian population was conducted in 2002, using a questionnaire adapted to local requirements from the WHO CINDI Health Monitor, which aim was to initiate the development and implementation of a national intervention program for the prevention and control of non-communicable diseases and promotion of health in the Republic of North Macedonia. One of the most common ways of measuring the impact of these factors is using the Body Mass Index (BMI), which is a standard indicator for assessing overweight and obesity.

One of the latest studies conducted in this region revealed statistically significant associations between obesity and foods rich in carbohydrates (pasta, rice and potatoes), as well as energy drinks containing sugar, which were considered positive predictors of obesity among the young (Simoska & Jakimoska 2023).

This research aims to examine the prevalence of overweight and obesity among teenagers aged 15 to 18 by analysing the relationship between dietary habits and socio-economic factors in the capital of North Macedonia, Skopje.

Methodology

Sample

The study involved a total of 125 students (42, 33.6% females and 83, 66.4% males) from two high schools in Skopje, North Macedonia, aged 15 to 18. Students who were ill or unable to participate in physical education classes were excluded from this survey. Participation in the research was voluntary and was monitored by physical education teachers.

Procedure

Body mass index (BMI) is calculated based on students' self-reported data collected through a survey. When direct measurements are not possible, self-reported measurements provide a reliable approximate measurements for all sub-samples of classes, genders and ethnicity among teenagers (Peréz et al. 2015).

BMI is categorized as follows: underweight < 18.5, normal weight 18.5 – 24.9 and overweight over 25.

Dietary habits were collected using the international standardized questionnaire (*HBSC*) *Health Behaviour School-aged Children* (HBSC 2005/06). The questionnaire contained four questions as follows: How many times a week do you usually eat or drink: fruits, vegetables, sweets (sweets or chocolate), Coca-Cola or other soft drinks containing sugar?

The second part of the questionnaire focuses on breakfast consumption with the following questions: How many times do you usually eat breakfast (more than one glass of milk or fruit juice) during the weekdays and weekends?

The socio-economic status of respondents is described through responses to *The international Family Affluence Scale (FAS)* questionnaire (FAS 2020). The questionnaire consists of six questions: Does your family own a car, van or truck? Do you have your own bedroom? How many times have you been on vacation abroad in the last year? How many computers are there in your family? Do you have a dishwasher at home? How many bathrooms (rooms with bathroom) are there in your house?

To collect data on parental education level, students selected one of the following answers for each parent: primary, secondary or university education.

Statistical Analysis

The standard descriptive method for statistical analysis of the data was used to reflect the characteristics of the body mass index (BMI) of the sample in general and divided by gender. Bivariate analysis through the χ^2 - chi square test was used to examine the relationship of variables between BMI, nutrition and socio-economic status. The average education level (secondary and university level) of both parents was calculated to examine its correlation with BMI categories. Linear regression analysis was used to ex-

amine the impact of nutrition frequency during weekdays. A significance level of $p < .05$ was considered statistically significant. Data processing was conducted using the SPSS statistical software (version 25).

Results

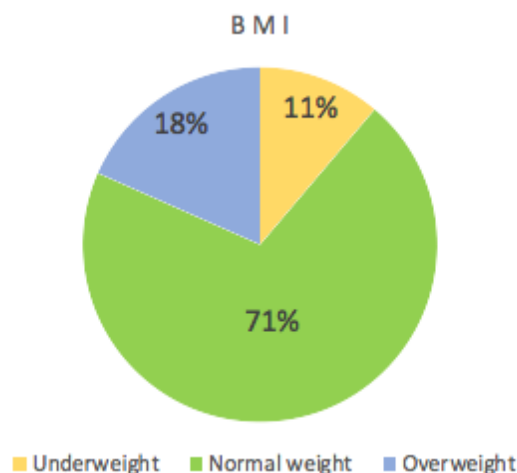


Figure 1. Body mass index of teenagers

Figure 1 shows that over two-thirds of teenagers have a normal body mass index, followed by 18% being overweight and 11% being underweight. Regarding the prevalence of obesity, there are four teenagers identified with obesity type one, while only one teenager was identified with obesity type two and three.

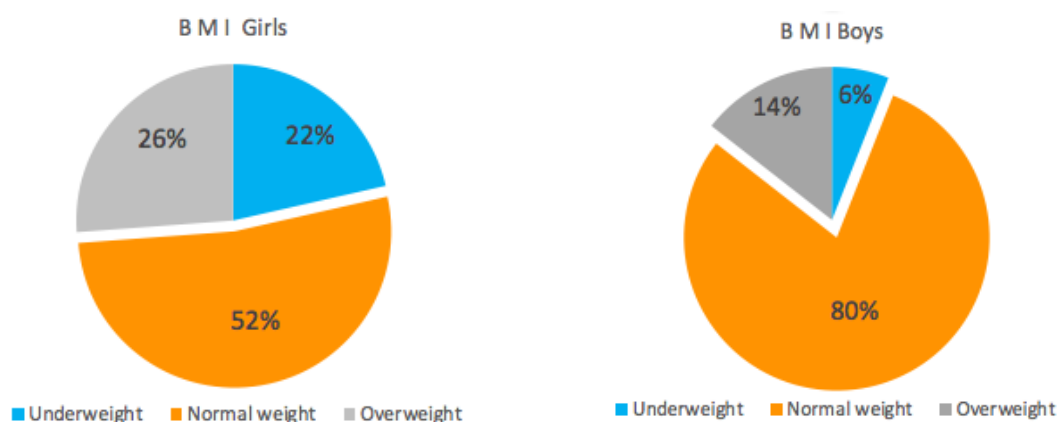


Figure 2. Body mass index and underweight and overweight prevalence divided by gender

Figure 2 clearly visualizes the dominance of underweight and overweight prevalence in teenage girls compared to their male peers. It is clear that the percentage of normal weight is lower compared to males, hence approximately half of the girls belong to an overweight or underweight body mass index. The most pronounced difference is observed in the underweight prevalence. Results show that this relationship is statistically significant, $\chi^2 (2, N = 125) = 10,912$, $p = ,004$ and suggest that there is a difference in the distribution of BMI between teenage boys and girls.

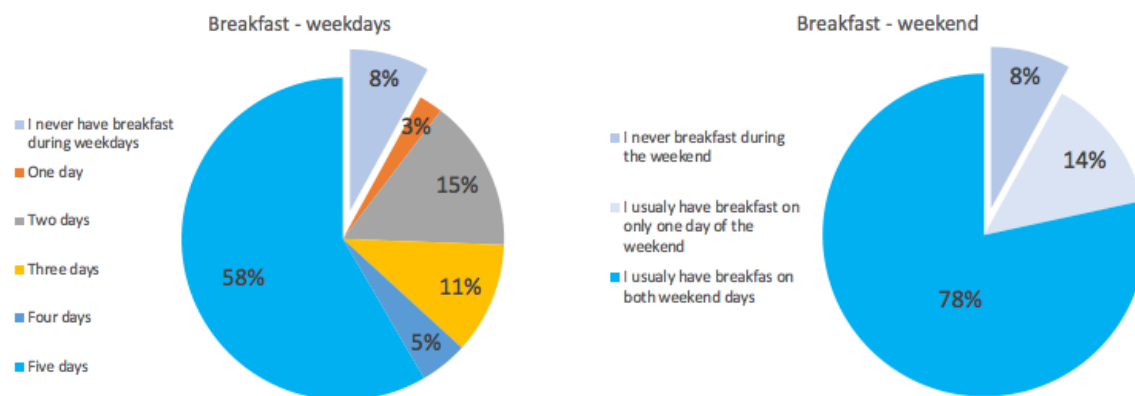


Figure 3. Breakfast consumption during weekdays and weekends

Figure 3 shows equal percentages of breakfast skipping during weekdays and weekends, each accounting for 8% in total. A downward trend of breakfast consumption during weekdays is observed, decreasing from 15% for two days of the week to 11% for three days, and further down to 5% for four days of the week.

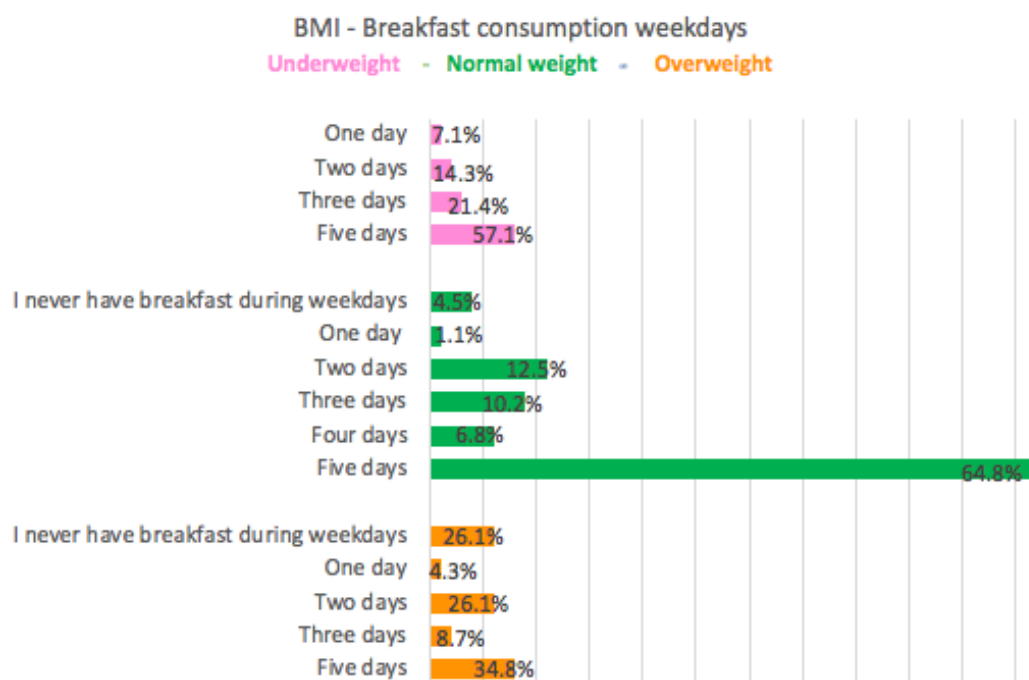


Figure 4. Breakfast consumption on weekdays in relation to body mass index (BMI)

Figure 4 shows the percentage of breakfast consumption during weekdays, excluding weekends, in relation to body mass index. Approximately 2/3 of normal-weight teenagers consume their breakfast every day of the week. There is no significant difference compared to their underweight peers (only 7.7%), while a more pronounced difference is evident among overweight teenagers (30% difference from the normal-weight, and 22.3% difference from the underweight peers).

Linear regression analysis was conducted to examine the impact of breakfast consumption frequency on BMI. The predictors, breakfast consumption 2 to 3 times per week and 4 to 5 times per week, were included as variables in the model, while consuming breakfast less than twice per week was defined as a reference group. The dependent variable BMI was previously converted into logarithm.

The model accounted for a total of 6.9% of the variance in BMI, $R^2 = .069$, $F(2, 122) = 4.55$, $p = .012$. The analysis revealed that breakfast consumption 2 to 3 times per week ($B = -.027$, $p = .02$) and 4 to 5 times per week ($B = -.021$, $p = .003$) had significant effects on teenagers' BMI. Breakfast consumption 2 to 3 times per week, as well as 4 to 5 times per week, is associated with a reduction of BMI compared to teenagers who consume breakfast less than twice a week.

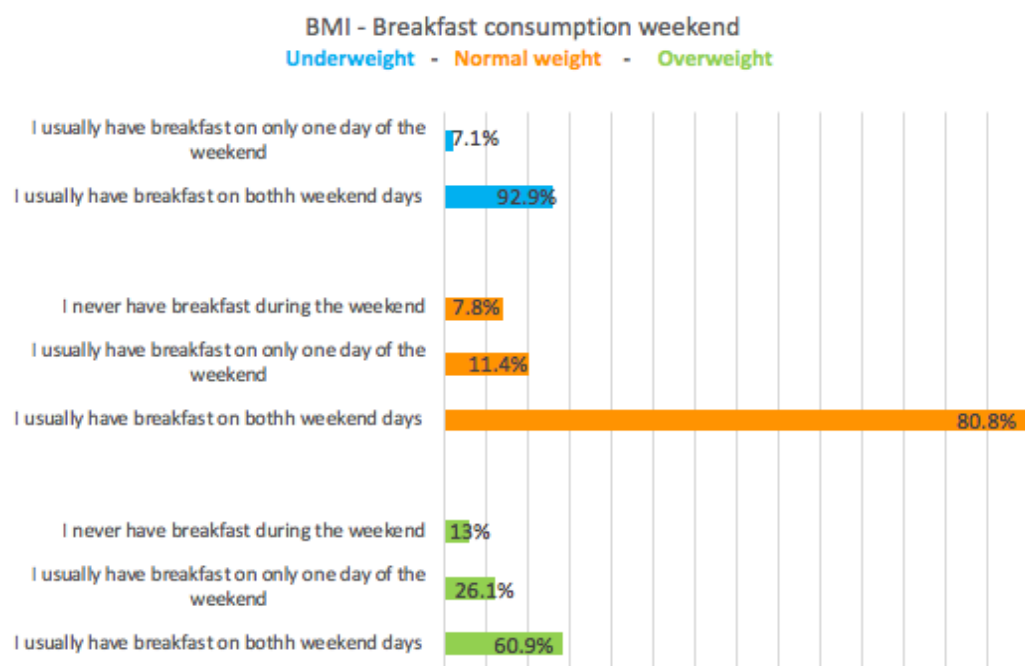


Figure 5. Breakfast consumption on weekends in relation to body mass index (BMI)

Figure 5 shows that the percentage of breakfast consumption on weekends among underweight teenager's changes compared to normal-weight and overweight teenagers. The latter consume breakfast more often than those with normal weight, and this difference is even more pronounced compared to overweight teenagers. In addition, teenagers with underweight prevalence do not spend a single weekend without consuming breakfast at least once.

Table 1. Consumption of sweets, fruits, vegetables and drinks containing sugar during the week

Food consumption	Sweets	Fruits	Vegetables	Drinks with sugar
Never	1.6%	1.6%	4.0%	8.8%
Less than once a week	7.2%	1.6%	3.2%	16.0%
Once a week	11.2%	8.0%	12.8%	16.0%
2-4 Days a week	44.0%	39.2%	25.6%	26.4%
5-6 Days a week	9.6%	9.6%	18.4%	9.6%
Once a day, every day	18.4%	24.0%	24.0%	8.0%
Every day, more than once	8.0%	16.0%	12.0%	15.2%

Table 1 shows the percentage of consumption frequency of sweets, fruits, vegetables and drinks containing sugar during the week, including weekends. For all types of food and drinks, the highest frequency appears to occur within two to four days of the week. Sweets are consumed the most, followed by fruits.

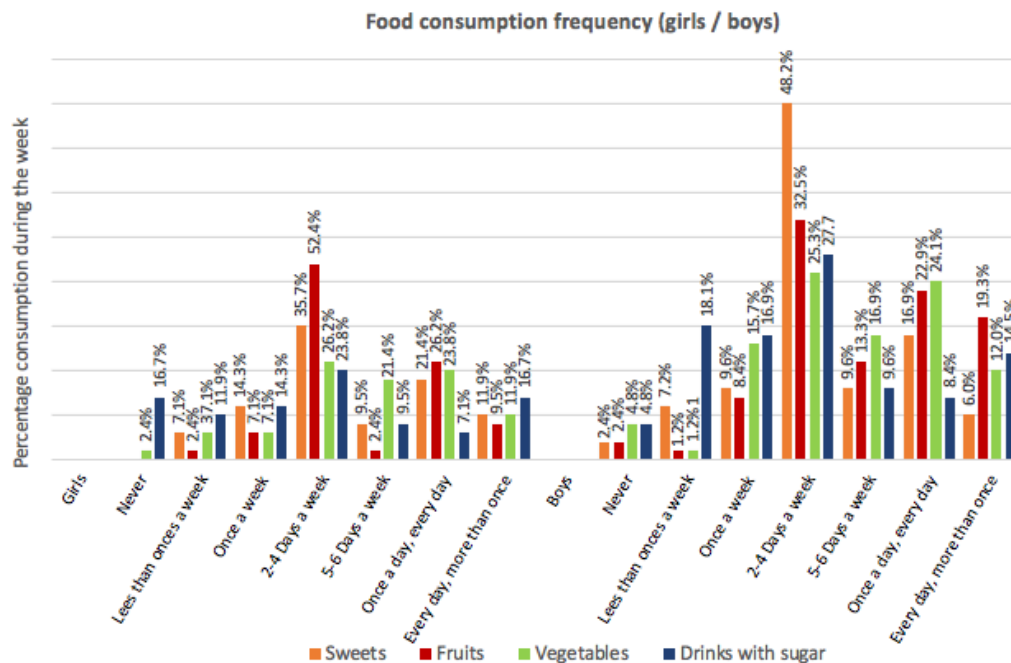


Figure 6. Consumption of sweets, fruits, vegetables and drinks containing sugar throughout the week divided by gender

Figure 6 shows reported food consumption throughout the week and weekend divided by gender. It is illustrated that the consumption of sweets and drinks containing sugar ‘more than once a day’ dominates among teenage girls compared to boys, which cannot be said for fruits, where the latter lead in percentage. A 12.5% difference in the consumption of sweets ‘two to four times a week’ is more popular among teenage boys compared to their female peers. Nonetheless, the consumption of sweets ‘more than once a day’ among girls is almost twice as high as that of boys.

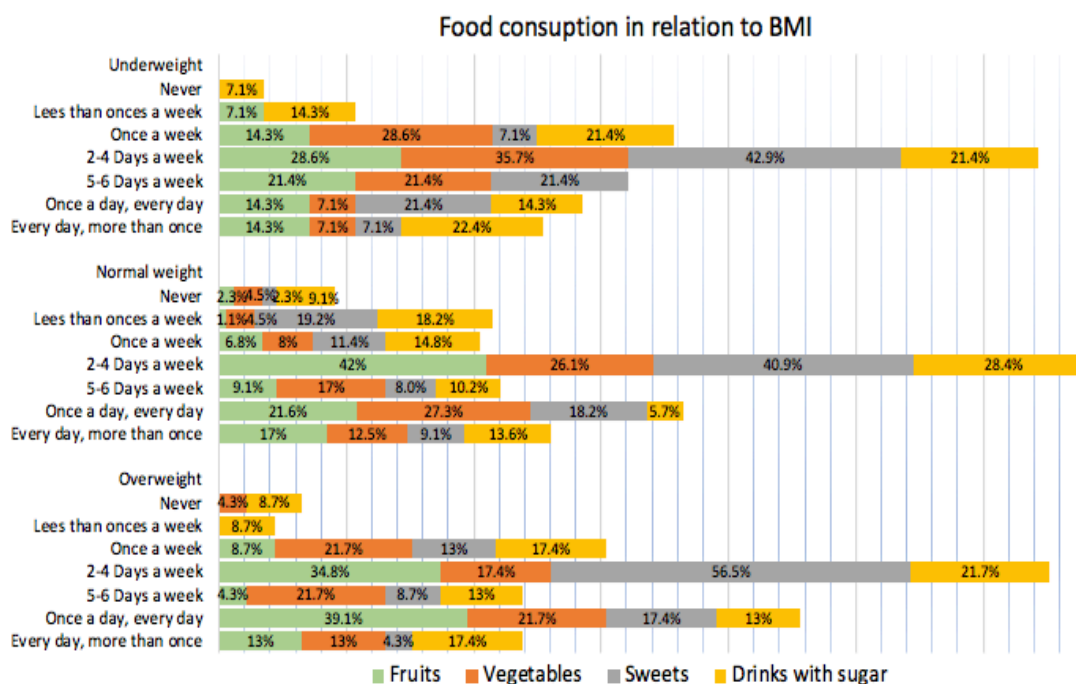


Figure 7. Relationship of BMI and consumption of sweets, fruits, vegetables and drinks containing sugar during the week

Figure 7 clearly shows that the consumption of sweets ‘two to four days a week’ is more pronounced in overweight teenagers compared to other teenagers, while underweight teenagers consume 2% more sweets within ‘two to four days a week’ than those with normal weight. The difference in the consumption of sweets and vegetables during the period from ‘two to four days a week’ is more balanced among underweight teenagers, consuming 43.9% sweets and 35.7% vegetables, representing a difference of only 7.2%, which is not observed among normal-weight or overweight teenagers. However, a statistically significant relationship between BMI categories and food consumption throughout the week was not confirmed.

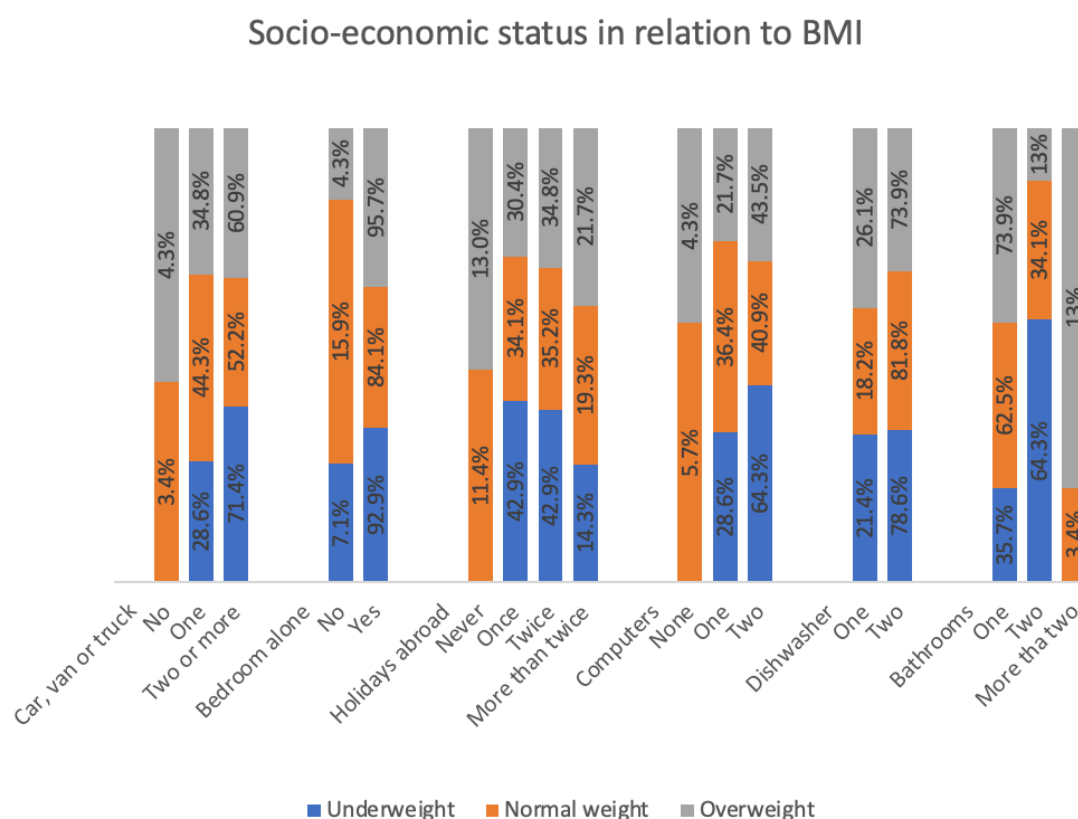


Figure 8. Relationship between socio-economic status and BMI

Figure 8 shows family socio-economic status in relation to the BMI of teenagers, where it is emphasized that those with normal body mass dominate the category of owning a dishwasher, while underweight teenagers the categories of owning vehicles and computers. However, the difference between them and overweight teenagers is smaller compared to normal-weight teenagers. Overweight teenagers dominate in categories such as: own bedroom, holidays abroad, and more than two bathrooms at home. It appears that the increased socio-economic status of the family coincides with underweight and overweight teenagers. Nonetheless, no statistically significant relationship between socio-economic status and body mass index was proven.

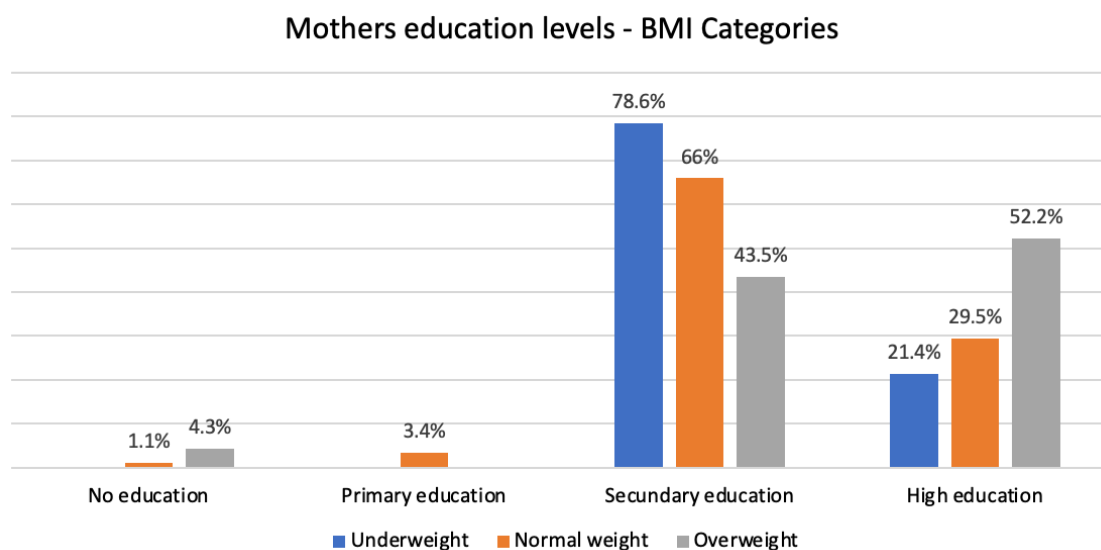


Figure 9. *Mother's education levels in relation to body mass index (BMI) of teenagers*

Figure 9 shows that more than half of the mothers of overweight teenagers have a university degree. This percentage decreases among normal-weight teenagers, where approximately 1/3 of their mothers have a university degree, and it is even lower among underweight teenagers, where mother's university education reaches just over 1/5, compared to secondary education, which constitutes 2/3, and reaches mother's highest percentage of secondary education among all teenagers.

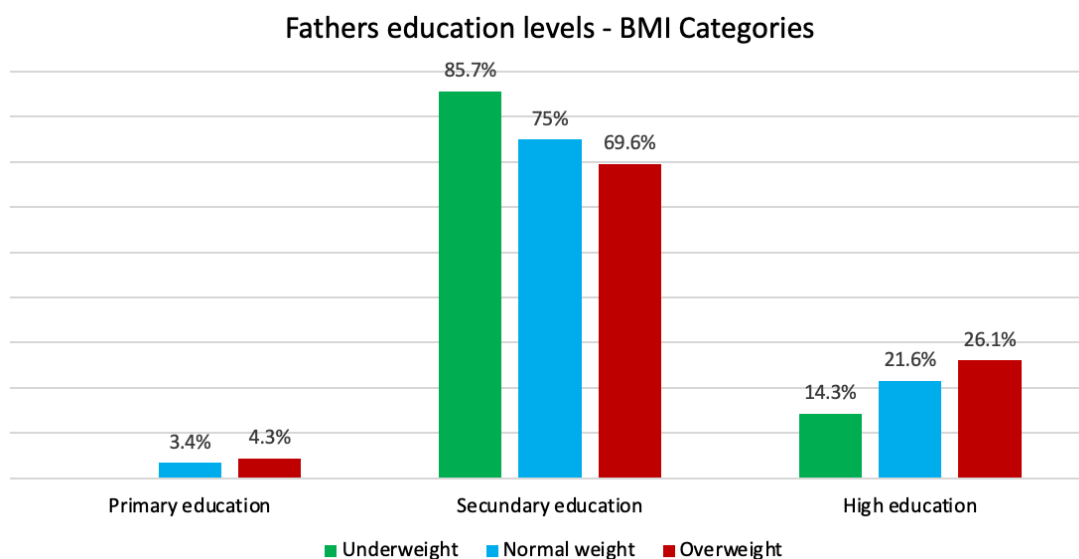


Figure 10. *Father's education levels in relation to body mass index (BMI) of teenagers*

Figure 10 shows that overweight teenagers are mostly children of fathers with a university education, although they make up only about 1/4, compared to teenagers whose fathers have completed only secondary and primary education, whereas 85.7% of the fathers of underweight teenagers have a high school degree, representing the highest percentage compared to the fathers of normal-weight and overweight teenagers.

To determine whether there is a statistically significant relationship between BMI categories and the average level of education (secondary and university) of both parents, a chi-square test was conducted, the results of which are not significant $\chi^2 (2, N = 125) = 2.571, p = .277$, and it can be concluded that there is no significant relationship between BMI and the average parental education level of teenagers.

Discussion

Since normal body mass can be considered not only an aesthetic goal of teenagers, but also a way to ensure a healthy lifestyle, the importance of which includes numerous benefits not only for the individual but also for the entire society, this contributes to the prevention of chronic diseases through regular publications of results describing the current state of these specific age groups. The results of this research highlight the difference in normal-weight girls and boys, which is quite concerning for girls because nearly half of them are either overweight or underweight. In general, normal-weight boys do not differ significantly compared to the overall percentage of the normal-weight teenagers.

Skipping breakfast is equally prevalent during weekdays and weekends at 8%. Skipping breakfast is thought to have negative effects on the circadian rhythms, such as metabolic disorders and consequences related to weight management (Gwin & Leidy, 2018). During weekdays, only 5% of the respondents consume breakfast four times a week, and this percentage increases with the decrease of breakfast consumption days. For example, 11% eat breakfast three times a week and 15% only twice a week. However, breakfast consumption among teenagers is more pronounced during weekend (78%) than on weekdays (58%), and the reasons may be related to lifestyle dynamics, as well as social activities and other extracurricular activities.

A closer look at this study reveals that normal-weight teenagers consume breakfast more often during weekdays, compared to their underweight and overweight peers. However, figures change during weekends, with underweight teenagers being the ones who consume breakfast more often, compared to their normal-weight and overweight peers. A likely reason for this could be eating breakfast on weekends together with their parents.

Regression analysis confirmed that regular breakfast consumption has an impact on reducing body mass index compared to those who consume breakfast less than twice a week. The impact appears to be statistically significant and may help control the body mass of teenagers. In addition, studies suggest that skipping breakfast is associated with elevated levels of plasma lipoproteins and fasting glucose (Ashwell & Gibson 2016), as well as with insufficient micronutrients intake (Smith et al. 2017).

The highest frequency of consumption of sweets, fruits, vegetables and drinks containing sugar is reported to occur mostly between two to four days a week. Sweets clearly lead, followed by fruits, drinks containing sugar and lastly vegetables. In terms of gender, daily consumption of sweets more than once a day among girls is approximately 50% higher than among teenage boys, while the less frequent consumption, two to four days a week, is more pronounced among boys. If we refer to the consumption of sweets in relation to BMI, it is observed that overweight teenagers consume the most on two to four days a week, compared to normal-weight and underweight teenagers. In contrast, the consumption of vegetables at the same weekly consumption frequency, two to four days a week, is the highest among underweight teenagers, followed by normal-weight and overweight teenagers. However, there is no statistically significant relationship between the frequency of food consumption and BMI. In addition, parental university education level shows a positive trend with overweight status, noted in both parents. Research from middle-income and low-income countries suggest the same tendency, where children of mothers with higher levels of education and families with higher income may show increased weight and higher probability of being overweight (Liu et al. 2016; Muthuri et al. 2016).

The research analysis indicates that the average education level of both parents does not show statistically significant correlation with BMI categories (underweight, normal-weight and overweight).

Conclusion

Teenage girls show a more pronounced tendency of being either overweight or underweight compared to their male peers. The consumption frequency of sweets, more than once a day, during the week is half as high among girls as it is among boys, while a lower frequency, two to four days a week, seems to be more preferred among boys. In relation to BMI, overweight teenagers consume the most sweets two to four days a week, while underweight teenagers consume the most vegetables over the same period. These aspects of nutrition determinants were not found to be statistically significant. Breakfast consumption shows a statistically significant association with a decrease of teenagers' BMI, which may

have an impact on body mass management, especially during their sensitive age. No statistically significant correlation was found between family socio-economic status and BMI among teenagers. The relationship between BMI and parental education appears to be inconsistent with studies suggesting that a higher level of parental education is associated with normal weight of their children. It seems that countries with low economic development display a trend in the opposite direction. The implication of other factors, such as the amount of food consumption, food composition, time of food consumption, that could potentially influence body mass index and metabolism in general among teenagers, would be necessary, considering rapid developments occurring at this age.

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