

## Selected obesity-related dietary behaviours, body-mass index, and depressive symptoms among university students: a cross-sectional study

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### ABSTRACT

**Aims:** This study aimed to examine the associations between selected obesity-related dietary behaviours and body-mass index (BMI) and to investigate the association between BMI and depressive symptoms among university students.

**Methods:** This cross-sectional study was conducted among 632 university students aged 18-24 years in Türkiye. Data were collected using a structured questionnaire assessing sociodemographic characteristics, dietary behaviours, physical activity, and screen time. Depressive symptoms were evaluated using the Patient Health Questionnaire-9 (PHQ-9). Participants were classified according to the World Health Organization (WHO) BMI criteria. Logistic and linear regression analyses were performed.

**Results:** Higher dietary behaviour scores were associated with lower odds of belonging to the increased BMI category (OR=0.91,  $p<0.001$ ), whereas higher caloric intake from sugar-sweetened beverages was associated with increased BMI (OR=1.02,  $p<0.001$ ). Physical activity level was significantly associated with BMI ( $p=0.010$ ). No significant association was found between BMI and fruit consumption, vegetable consumption, or screen time. BMI was significantly associated with depressive symptoms ( $\beta=0.15$ ,  $p=0.004$ ).

**Conclusion:** Selected obesity-related dietary behaviours, sugar-sweetened beverage consumption, and lower physical activity levels were associated with higher BMI among university students. Furthermore, higher BMI was associated with greater depressive symptoms. These findings highlight the importance of integrated interventions targeting both healthy lifestyle behaviours and mental well-being in young adults.

**Keywords:** Obesity, physical activity, mental health, sugar-sweetened beverages, young adults

### INTRODUCTION

Obesity has become one of the most significant public health challenges worldwide, with its prevalence increasing rapidly across all age groups. According to recent global estimates, more than one billion people are currently living with overweight or obesity, and this number continues to rise, particularly among adolescents and young adults.<sup>1,2</sup> This growing epidemic is associated with a substantial burden of non-communicable diseases, including cardiovascular diseases, type 2 diabetes, and certain types of cancer, placing significant pressure on healthcare systems globally.<sup>3</sup>

Beyond its medical consequences, obesity is increasingly recognized as a complex condition influenced by behavioural, environmental, and psychosocial factors. In particular, obesogenic environments that promote excessive energy intake and sedentary lifestyles play a critical role in shaping dietary patterns and weight-related outcomes in young populations.<sup>4,5</sup> Therefore, understanding the interplay between

lifestyle behaviours and health outcomes during early adulthood has become a major priority for public health research.

Young adulthood represents a critical life stage during which long-term lifestyle behaviours are established. University students, in particular, experience significant transitions in their daily routines, including changes in dietary habits, physical activity, sleep patterns, and psychosocial stressors. These transitions may increase the likelihood of adopting unhealthy eating behaviours and contribute to weight gain.<sup>6,7</sup>

Previous studies have described obesogenic eating behaviours as dietary patterns that promote excessive energy intake and weight gain.<sup>5</sup> However, the present study focused on selected obesity-related dietary behaviours, including dietary behaviour score, fruit and vegetable consumption, and sugar-sweetened beverage intake.



Psychological factors also play an important role in the development of obesity. Depression, which is increasingly prevalent among young adults, has been associated with unhealthy dietary behaviours, reduced physical activity, and weight gain.<sup>8</sup> Conversely, obesity may negatively affect psychological well-being and increase the risk of depressive symptoms, suggesting a bidirectional relationship between obesity and mental health.<sup>9</sup>

Previous studies have reported associations between obesity and depressive symptoms, as well as between selected obesity-related dietary behaviours and obesity, although these relationships have generally been investigated separately.<sup>5,8,9</sup> Diet quality has also been shown to be closely associated with mental health among university students.<sup>10</sup> However, studies simultaneously evaluating selected obesity-related dietary behaviours, body-mass index (BMI), and depressive symptoms within the same young adult population remain limited.

Therefore, this study aimed to examine the associations between selected obesity-related dietary behaviours, BMI, and depressive symptoms among university students aged 18-24 years.

## METHODS

### Ethics

This study was conducted with the approval of the Amasya University Ethics Committee for Non-interventional Clinical Researches (Date: 25.07.2022, Decision No: 74). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki. Written informed consent was obtained from all individual participants prior to their inclusion in the study.

### Study Design and Participants

This cross-sectional study was conducted among university students aged 18-24 years studying at Amasya University, Türkiye. According to university records, the total student population consisted of 11,437 individuals.

The minimum required sample size was calculated as 372 participants based on a population of 11,437 students, a 95% confidence level, a 5% margin of error, and an expected proportion of 50%. Considering that multivariable statistical analyses were planned, the study sample was expanded to 632 participants to increase statistical power.

Participants were recruited from different faculties of the university using a voluntary participation approach. Questionnaires were administered face-to-face, and students who agreed to participate were included in the study.

### Data Collection

Data were collected using a structured questionnaire prepared by the researchers based on the relevant literature. The questionnaire consisted of sections related to:

- socio-demographic characteristics
- health status
- nutritional behaviours
- physical activity habits

Participants were asked to report their age, sex, monthly income (categorized as sufficient or insufficient to meet basic needs), presence of chronic disease, and whether they had previously received medical nutrition therapy (MNT), defined as individualized dietary counselling provided by a physician or dietitian for weight management or healthy eating.

### Anthropometric Assessment

BMI was calculated using the participants' self-reported body weight and height values. BMI was calculated according to the standard formula:

$$\text{BMI} = \text{weight (kg)} / \text{height (m}^2\text{)}$$

Participants were classified according to World Health Organization (WHO) BMI classification criteria as normal weight, overweight, or obese.<sup>11</sup>

### Assessment of Selected Obesity-related Dietary Behaviours

Dietary behaviours were assessed using a 14-item Dietary Behaviour Scale previously described by Haney and Erdogan.<sup>12</sup> Each item presents two illustrated food options representing a healthier and a less healthy choice, and participants were asked to indicate which food they consumed more frequently. Less healthy choices were scored as -1, whereas healthier choices were scored as +1. The total raw score ranged from -14 to +14, with higher scores indicating healthier dietary behaviours. The raw score was subsequently converted into a percentage score ranging from 0 to 100, with higher percentage scores representing healthier dietary behaviours.<sup>12</sup>

In addition, participants were asked about the frequency of fruit consumption, frequency of vegetable consumption, and daily caloric intake from sugar-sweetened beverages (kcal/day). These variables were analysed separately to evaluate their associations with BMI. Daily caloric intake from sugar-sweetened beverages was entered into the logistic regression model as a continuous variable.

### Physical Activity Assessment

Physical activity was assessed using the short form of the International Physical Activity Questionnaire (IPAQ-SF), which evaluates vigorous-intensity activity, moderate-intensity activity, walking, and sitting time performed during the previous seven days. Participants reported the frequency (days/week) and duration (minutes/day) of each activity. Metabolic equivalent (MET) scores were calculated according to the IPAQ scoring protocol and used as a continuous measure of physical activity in the statistical analyses. Higher MET scores indicated higher levels of physical activity.<sup>13</sup>

### Depression Assessment

Depressive symptoms were assessed using the Patient Health Questionnaire-9 (PHQ-9), a widely used screening instrument for depression. The PHQ-9 consists of nine items evaluating the frequency of depressive symptoms experienced over the previous two weeks. Each item is scored on a four-point Likert scale ranging from 0 (not at all) to 3 (nearly every day), resulting in a total score ranging from 0 to 27.

Higher PHQ-9 scores indicate greater severity of depressive symptoms.<sup>14</sup>

## Statistical Analysis

The data were performed using IBM SPSS Statistics version 22 (IBM Corp., Armonk, NY, USA). The distribution of continuous variables was assessed using the Kolmogorov-Smirnov test. Variables showing an approximately normal distribution were summarized as mean±standard deviation, whereas categorical variables were presented as frequencies and percentages.

BMI was used as the main outcome variable in the analyses evaluating obesity-related factors. Independent variables included dietary behaviour score, daily caloric intake from sugar-sweetened beverages, fruit and vegetable consumption frequency, screen time, and physical activity level expressed as MET score.

For logistic regression analysis, BMI classification was dichotomized as normal weight versus increased BMI category, which included participants classified as overweight or obese according to the WHO criteria. Normal weight was used as the reference category.

Logistic regression analysis was performed to examine the associations between selected obesity-related dietary behaviours and BMI classification. Independent variables included dietary behaviour score, sugar-sweetened beverage consumption, fruit consumption frequency, vegetable consumption frequency, screen time, and physical activity level. Regression coefficients (B), odds ratios (ORs), Wald statistics, and p values were reported.

Linear regression analysis was used to evaluate the association between BMI and depressive symptoms assessed using PHQ-9 scores. BMI was entered as the independent variable and depression score as the dependent variable. Regression coefficients, standardized beta coefficients ( $\beta$ ), t statistics, and p values were reported.

Statistical significance was accepted as  $p < 0.05$ .

## RESULTS

### Participant Characteristics

A total of 632 university students aged 18-24 years participated in the study. Among the participants, 398 (63%) were female and 234 (37%) were male. The mean age of the participants was 20.2 years.

According to BMI classification, 435 participants (68.8%) were of normal weight, 150 (23.7%) were overweight, and 47 (7.4%) were classified as obese.

Regarding monthly income status, 144 participants (22.8%) reported that their income was insufficient to meet their basic needs, whereas 488 participants (77.2%) reported that their income was sufficient.

Most participants ( $n=516$ ; 81.6%) reported that they had not previously sought MNT for weight loss or healthy eating, while 116 participants (18.4%) had received such therapy.

The majority of participants reported no diagnosed disease ( $n=536$ ; 84.8%), whereas 96 participants (15.2%) reported having at least one disease.

Among participants reporting a disease, the most frequently reported conditions were anaemia (19.8%), respiratory tract diseases (13.5%), digestive system diseases (12.5%), diabetes (10.4%), and bone and joint diseases (10.4%).

Detailed socio-demographic and health characteristics of the participants are presented in **Table 1**.

**Table 1. Sociodemographic characteristics of university students**

|                                                                            | n        | %    |
|----------------------------------------------------------------------------|----------|------|
| <b>Gender</b>                                                              |          |      |
| Female                                                                     | 398      | 63   |
| Male                                                                       | 234      | 37   |
| <b>Body-mass index classification</b>                                      |          |      |
| Normal                                                                     | 435      | 68.8 |
| Overweight                                                                 | 150      | 23.7 |
| Obese                                                                      | 47       | 7.4  |
| <b>Monthly income</b>                                                      |          |      |
| Insufficient to meet my basic needs                                        | 144      | 22.8 |
| Sufficient to meet my basic needs                                          | 488      | 77.2 |
| Mean age (years)±SD                                                        | 20.2±1.5 |      |
| <b>Seeking medical nutrition therapy due to weight loss/healthy eating</b> |          |      |
| No                                                                         | 516      | 81.6 |
| Yes                                                                        | 116      | 18.4 |
| <b>Condition of having the disease</b>                                     |          |      |
| No                                                                         | 536      | 84.8 |
| Yes                                                                        | 96       | 15.2 |
| <b>Diseases possessed by individuals (n=96)</b>                            |          |      |
| Cardiovascular diseases                                                    | 9        | 9.4  |
| Diabetes                                                                   | 10       | 10.4 |
| Kidney diseases                                                            | 5        | 5.2  |
| Anaemia                                                                    | 19       | 19.8 |
| Bone and joint diseases                                                    | 10       | 10.4 |
| Digestive system diseases                                                  | 12       | 12.5 |
| Liver and gallbladder diseases                                             | 2        | 2.1  |
| Respiratory tract diseases                                                 | 13       | 13.5 |
| Other                                                                      | 16       | 16.7 |
| n=632. SD: Standard deviation                                              |          |      |

### Association Between Selected Obesity-related Dietary Behaviours and BMI Classification

The associations between selected obesity-related dietary behaviours and BMI classification were examined using logistic regression analysis. Dietary behaviour scores were significantly associated with BMI classification ( $B=-0.10$ ,  $p=0.001$ ), indicating that higher dietary behaviour scores were associated with lower odds of belonging to the increased BMI category ( $B=-0.10$ ,  $OR=0.91$ ,  $p=0.001$ ). In contrast, higher caloric intake from sugar-sweetened beverages was associated with higher odds of increased BMI ( $B=0.02$ ,  $OR=1.02$ ,  $p=0.001$ ).

No statistically significant association was observed between BMI classification and fruit consumption frequency, vegetable consumption frequency, or screen time ( $p > 0.05$ ). However, physical activity level (MET score) was significantly associated with BMI classification ( $p=0.010$ ).

The detailed results of the logistic regression analysis are presented in **Table 2**.

### Association Between BMI and Depression

The relationship between BMI and depression scores was examined using linear regression analysis.

The results showed that BMI was significantly associated with depression scores ( $B=1.64$ ,  $\beta=0.15$ ,  $t=2.91$ ,  $p=0.004$ ), indicating that individuals with higher BMI values tended to have higher depression scores.

The detailed results of this analysis are presented in **Table 3**.

## DISCUSSION

This study examined the associations between selected obesity-related dietary behaviours, BMI, and depressive symptoms among university students aged 18-24 years. The findings indicate that unhealthy dietary behaviours and higher caloric intake from sugar-sweetened beverages were associated with higher BMI, while physical activity level showed a significant relationship with BMI. In addition, the results demonstrated a significant association between BMI and depressive symptoms among the participants. These findings highlight the complex interaction between behavioural, lifestyle, and psychological factors influencing obesity risk in young adults.

One of the most important findings of the present study is the association between selected obesity-related dietary behaviours and BMI. Higher dietary behaviour scores were associated with lower odds of belonging to the increased BMI category, suggesting that healthier dietary behaviours may play a protective role against obesity risk among university students. This finding is consistent with previous research suggesting that unhealthy dietary behaviours, particularly frequent consumption of energy-dense and ultra-processed foods, contribute to excessive energy intake and subsequent weight gain.<sup>15,16</sup>

**Table 3.** The relationship between depression and body-mass index among university students

|                              | B    | SE  | $\beta$ | t    | p      |
|------------------------------|------|-----|---------|------|--------|
| Body-mass index              | 1.64 | .56 | .15     | 2.91 | .004** |
| p<0.01**. SE: Standard error |      |     |         |      |        |

University students may be particularly vulnerable to unhealthy dietary behaviours due to lifestyle transitions, including irregular meal patterns and increased reliance on convenience foods. Environmental factors such as easy access to fast food and limited time for meal preparation may further promote unhealthy eating behaviours.<sup>16</sup>

In addition, financial limitations commonly experienced by university students may increase reliance on inexpensive, energy-dense foods, which may further contribute to unhealthy dietary behaviours associated with obesity.<sup>16</sup>

Another key finding of the present study is the association between sugar-sweetened beverage consumption and BMI. Sugar-sweetened beverages are considered a major contributor to excess caloric intake and may promote positive energy balance due to their low satiety effect.<sup>17</sup> Previous epidemiological studies have consistently demonstrated that regular consumption of sugar-sweetened beverages is associated with increased risk of overweight, obesity, and weight gain among both adolescents and adults.<sup>18,19</sup> In addition, frequent consumption of sugary beverages has been linked to poorer overall dietary quality and increased intake of ultra-processed foods, which may further contribute to obesity risk.<sup>17,18</sup>

In contrast, the present study did not find a significant association between fruit and vegetable consumption frequency and BMI. Although fruit and vegetable intake is generally considered protective against obesity, previous studies have reported mixed findings in young adult populations.<sup>16</sup> One possible explanation is that frequency of consumption alone may not accurately reflect total intake or dietary quality. For example, individuals may consume fruits

**Table 2.** Association between selected obesity-related dietary behaviours and body-mass index

|                                                                                                                                                                                                                       | B      | SE     | Wald $\chi^2$ | df | p-value  | OR   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------|---------------|----|----------|------|
| Dietary behaviour score (%)                                                                                                                                                                                           | -.10   | .01    | 69.65         | 1  | 0.001*** | 0.91 |
| Calorie intake from daily consumption of sweetened beverages                                                                                                                                                          | 0.02   | .00    | 54.5          | 1  | 0.001*** | 1.02 |
| <b>Fruit consumption frequency</b>                                                                                                                                                                                    |        |        |               |    |          |      |
| Every day                                                                                                                                                                                                             | 1.30   | 0.71   | 3.35          | 1  | .067     | 3.68 |
| Every other day                                                                                                                                                                                                       | .65    | .69    | .88           | 1  | .348     | 1.91 |
| Once or twice a week                                                                                                                                                                                                  | .16    | .65    | .06           | 1  | .810     | 1.17 |
| Once every 15 days                                                                                                                                                                                                    | .40    | .75    | .28           | 1  | .594     | 1.49 |
| <b>Vegetable consumption frequency</b>                                                                                                                                                                                |        |        |               |    |          |      |
| Every day                                                                                                                                                                                                             | 0.05   | .75    | 0.00          | 1  | .950     | 1.05 |
| Every other day                                                                                                                                                                                                       | .42    | .74    | .32           | 1  | .570     | 1.52 |
| Once or twice a week                                                                                                                                                                                                  | .11    | .72    | 0.02          | 1  | .877     | 1.12 |
| Once every 15 days                                                                                                                                                                                                    | .30    | .80    | 0.14          | 1  | .710     | 1.35 |
| Screen time                                                                                                                                                                                                           | 0.04   | 0.08   | 0.27          | 1  | .601     | 1.04 |
| Physical activity level (MET score)                                                                                                                                                                                   | -.0003 | 0.0001 | 6.56          | 1  | 0.010*   | -    |
| Reference category: Never/rarely consumption. OR was not shown for MET score because the effect size per one-unit increase was extremely small. SE: Standard error, OR: Odds ratio, MET: Metabolic equivalent of task |        |        |               |    |          |      |

and vegetables occasionally while still maintaining an overall energy-dense diet.

Physical activity level was significantly associated with BMI in the present study. Although the magnitude of the association was relatively small, this finding is consistent with previous studies reporting that physically inactive university students are at greater risk of overweight and obesity than their more active peers.<sup>20</sup> Regular physical activity contributes to energy balance by increasing energy expenditure and may help prevent excessive weight gain. Although the observed effect sizes were modest, the association may still have important public health implications because physical activity is a modifiable behaviour. Even relatively small increases in physical activity across university populations could contribute to meaningful reductions in obesity risk and improvements in overall well-being.

Another important finding of the present study is the significant association between BMI and depressive symptoms. Participants with higher BMI values were more likely to report higher depression scores. This finding is consistent with previous research indicating a bidirectional relationship between obesity and depression.<sup>21</sup> Several mechanisms have been proposed to explain this relationship. For example, obesity may negatively influence self-esteem, body image, and social interactions, which may contribute to depressive symptoms.

At the same time, depression may influence eating behaviours and physical activity patterns. Individuals experiencing depressive symptoms may be more likely to engage in emotional eating, reduce their level of physical activity, and adopt unhealthy lifestyle behaviours that may contribute to weight gain.<sup>22,23</sup> This reciprocal relationship highlights the importance of considering both physical and mental health factors when addressing obesity among young adults.

In university populations, this relationship may be further influenced by psychosocial stressors such as academic pressure, irregular sleep patterns, social isolation, and concerns related to future career opportunities. These factors may contribute both to unhealthy lifestyle behaviours and to increased psychological distress among young adults.

Previous studies have also suggested that psychosocial stressors commonly experienced during university years may contribute to both depression and unhealthy eating behaviours.<sup>23,24</sup> Academic pressure, social adjustment, financial stress, and lifestyle changes may increase vulnerability to both mental health problems and unhealthy lifestyle habits among students. Therefore, addressing psychological well-being may be an important component of obesity prevention strategies in this population.<sup>24</sup>

The findings of the present study have important public health implications. University years represent a critical period for the establishment of long-term lifestyle behaviours. Interventions targeting university students may therefore play an important role in preventing obesity and promoting healthier lifestyles. Health promotion programs focusing on improving nutritional behaviours, reducing sugar-sweetened beverage consumption, and increasing physical activity

may help reduce obesity risk among young adults. In many developing countries, including Türkiye, rapid lifestyle changes, increasing consumption of processed foods, and reduced physical activity among young adults may further increase obesity risk in university populations.

In addition, integrating mental health support into health promotion strategies may further improve the effectiveness of obesity prevention interventions. Considering the relationship between depression and BMI observed in this study, addressing mental health may be an important component of comprehensive obesity prevention programs targeting university populations.

### Limitations

The present study has several limitations that should be considered. First, the cross-sectional design limits the ability to establish causal relationships between variables. Second, anthropometric measurements, dietary behaviours, physical activity, and depressive symptoms were assessed using self-reported data, which may have introduced recall and reporting bias. Finally, because the study was conducted at a single university, the findings may not be generalizable to other university populations.

### CONCLUSION

The findings of this study highlight the significant role of selected obesity-related dietary behaviours and lifestyle factors in shaping BMI among university students. In particular, unhealthy dietary behaviours, sugar-sweetened beverage consumption, and low levels of physical activity were associated with higher BMI.

In addition, the observed association between BMI and depressive symptoms suggests that physical and mental health factors are closely interconnected in this population. These results support the view that obesity in young adults should be addressed within a multidimensional framework that includes both behavioural and psychological determinants.

Given that young adulthood is a critical period for the establishment of long-term health behaviours, early interventions targeting dietary habits, physical activity, and mental well-being may play an essential role in preventing obesity and its associated health consequences. Therefore, integrated and multidisciplinary strategies are needed to effectively address obesity risk among university students.

### ETHICAL DECLARATIONS

#### Ethics Committee Approval

This study was conducted with the approval of the Amasya University Ethics Committee for Non-interventional Clinical Researches (Date: 25.07.2022, Decision No: 74).

#### Informed Consent

Written informed consent was obtained from all individual participants prior to their inclusion in the study. Participants were fully informed about the study's aims, procedures, potential risks and benefits, and their rights-including the right to withdraw at any time without consequence. All participants voluntarily signed a written informed consent

form.

### Peer Review Process

This manuscript was subject to external peer review.

### Conflict of Interest

The authors declare no conflicts of interest related to this study.

### Financial Disclosure

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### Author Contributions

Concept: AEA, AA, ST; Design: AEA, AA, ST; Control: AA, YK, SGB, HFG, SFB; Data Collection and/or Processing: AEA; Analysis and/or Interpretation: AEA, AA, ST; Literature Review: AEA, AA; Writing the Article: AEA, AA; Critical Review: AA, ST, YK, SGB, HFG, SFB.

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