GPH-International Journal of Biological and Medicine Science
(e-ISSN: 3050-9610)
Volume 06 | Issue 06 | June 2023
Published by: Global Publication House
DOI: https://doi.org/10.5281/zenodo.20696560
Available online at: www.gphjournal.org
Journal homepage: https://gphjournal.org/index.php/bs/index

Prevalence of Obesity and Associated Lifestyle Factors Among University Students in Al-Muthanna Provence, Iraq

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Abstract

Overview: Increasing rates of obesity are being classed as a worldwide public health concern. The fast rate of urbanization and changing lifestyles in Iraq has exacerbated the growth of obesity. Many university students are at particular risk for obesity and overweight during their transition into higher education. During this time, many students become habitually sedentary, develop unhealthy eating habits, and irregular sleeping patterns. Very little data on the prevalence and characteristics of obesity among university students in Al-Muthanna are currently available.

Aim: This study aimed to assess the prevalence of overweight and obesity, along with other lifestyle variables, for students at two of Al-Muthanna Provence private universities.

Methods: A cross-sectional survey of 454 university students (males n=212; females n=242) between the ages of 18 and 26 years was conducted between October 2022 and March 2023 at two private universities in Al-Muthanna through stratified random sampling. The body mass indices (BMI) of all study participants were calculated using measured weights and heights. A validated self-administered Arabic questionnaire was used to assess lifestyle factors, including activity level, dietary practices, time spent using screens (with/without a TV), sleep duration, and tobacco use. Data were analyzed using Chi-square tests and multivariate binary logistic regression.

Results: The total percentage of university students classified as overweight and/or obese was 43.3%, 25.8% overweight, and 17.4% obese. Males were significantly more likely to be classified as overweight than females (29.2% vs. 22.7%; p=0.031). In a multivariate analysis of university students who were obese, the following lifestyle variables were independent predictors of obesity: active vs. inactive lifestyle, frequent consumption of fast food, long duration spent using a screen, short amount of sleep, frequent consumption of sugar-based drinks, low consumption of fruit/vegetables, and not having breakfast. Tobacco use was not identified as significantly associated with obesity after adjustment.

Conclusion: The prevalence of obesity and overweight affects almost half of university students in Al-Muthanna. Multiple modifiable lifestyle factors are independently associated with obesity among university students in this sample. Urgent, targeted, campus-based health promotion programs focused on dietary practices, physical activity levels, and screen use are needed.

Keywords:

Obesity; overweight; body mass index; university students; lifestyle factors; physical activity; dietary habits; Al-Muthanna; Iraq; cross-sectional study.

1. Introduction

Obesity is quickly becoming one of the most serious threats to public health in the 21st century. The World Health Organization (WHO) reports that obesity will affect approximately 16% of the global population over the age of 18 in 2022 and has increased over 2x since 1990 [1]. In fact, over one billion individuals live with obesity today (nearly 880 million adults and approximately 159 million children/adolescents) [2]. The Global Burden of Disease Study projected that if there are no significant changes in policy in relation to obesity, by 2050, more than half of the adult population and over a third of children/adolescents will be classified as overweight or obese – an unprecedented public health crisis and threat to the sustainable functionality of health systems [3].

While obesity typically affects higher-income countries, lower- and middle-income countries in the Eastern Mediterranean Region (EMR) have shown tremendous growth in the prevalence of obesity over the past four decades. The pooled prevalence of obesity among EMR adults was 21.17% (95% CI: 17.05–26.29) in a systematic review and meta-analysis of studies from 2000 to 2020, with substantial variation across countries/regions [4]. Although the prevalence of overweight and obesity ranges from 25% to 81.9% among EMR adults, common drivers of this increase include urbanization, Westernization of diets, and decreased physical activity in the EMR population [5]. Iraq, at the center of this region, is among the countries affected by these regional trends. In Iraq, a nationally representative survey of adults in 2015 found that among 3,916 adults, 31.8% were overweight and 33.9% were obese, representing approximately two-thirds of all adults surveyed with overweight or obesity (6). These groups represent averages but don't adequately portray the transition to an unhealthy diet that many groups within the adult population are now facing. A group of particular public health importance is university students, many of whom enter college with their dietary habits supervised by their parents and face environmental and behavioral changes as they begin college. Some of these include decreased control over their eating patterns; decreased time spent engaging in physical activity; irregular sleeping patterns; and increased sedentary behavior (especially screen use) (7). For university students, in addition to these behaviors, many now live in cities such as Al-Muthanna province, have long commutes, lack access to healthy options on campus, face well-documented evidence of obesity (8), and have financial limitations, with energy-dense fast food readily available to them. All of these factors contribute to the prevalence of obesity during a critical period in the establishment of lifelong behavior.

There are many health risks associated with obesity, with ample evidence to support a causal relationship between obesity and many chronic diseases, including Type 2 diabetes mellitus, cardiovascular disease, hypertension, several types of cancer, nonalcoholic fatty liver disease, obstructive sleep apnoea, and musculoskeletal disorders (9). In addition to the many health consequences, public health economic costs are incurred as a result of obesity, including direct costs to the healthcare system and indirect costs due to workforce productivity losses. According to the WHO Iraq Country Profile on Noncommunicable Diseases (NCDs), the main causes and contributors to morbidity and mortality in Iraq are Type 2 diabetes and cardiovascular disease, both strongly related to obesity (10). Considering that university years are an important time for shaping health, interventions at this age will both protect individual health and support efforts to reduce NCD epidemics in the overall population.

Even though this issue is recognized to be prevalent, evidence for university student obesity and its lifestyle correlates in Iraq remains limited. In 2019, a cross-sectional study of 250 medical students in Baghdad reported that 20.4% were overweight, but it was conducted at only

one college and did not employ multivariate analysis [11]. A different study conducted in Kerbala reported that 10.9% of students were classified as obese and 24.6% as overweight, but there are issues with the generalisability of this data to students in Al-Muthanna, since Al-Muthanna one of the largest cities in Iraq and has considerable increase in urbanization rate[12]. The majority of the data describing the prevalence of overweight and obesity among adults in Iraq comes from survey data collected in communities in Erbil, where it has been reported that 40.9% of participants were obese, and in Basrah, where more than 55% were overweight or obese [6]. Results of a survey of Zakho city residents indicated that 52.4% were overweight or obese. They found sedentary lifestyles, unhealthy eating patterns, and being female to be the largest predictors of overweight or obesity status [13].

Researchers have consistently identified physically inactive lifestyles, unhealthy eating patterns (especially fast food and sugary drinks), prolonged time spent in a sedentary state, insufficient sleep, and the use of tobacco as significant modifiable behaviors related to overweight and obesity among university students [14, 15].In a cross-sectional study of Moroccan University students, it was found that frequent consumption of fast food, fried foods, and sugary drinks was significantly associated with being overweight or obese. In addition, approximately 26% of students were physically inactive [16]. A cross-sectional study conducted in Saudi Arabia, using a newly validated questionnaire, found that the prevalence of obesity among Majmaah University students was 15%. Patterns of food consumption, sleep duration, and physical activity accounted for most of the variance in BMI [17]. In Ghana, the level of physical activity has been negatively correlated with obesity, while the consumption of roots, tubers, and sugar-sweetened beverages has been positively correlated with obesity [18].

The relationship between sleep deprivation and obesity should be focused on in the context of university life. There are multiple studies demonstrating that having a sleep duration of less than seven hours per night is associated with increased caloric intake through hormonal dysregulation, namely by having high levels of ghrelin (stimulates hunger) and low levels of leptin (inhibits hunger), as well as by having increased cravings for energy-dense foods and lower motivation for engaging in physical activity [19]. Additionally, a study investigating the sleep patterns of Chinese university students found a significant association between prolonged sedentary behavior and higher BMI, and that shorter sleep duration and lower sleep efficiency contributed to the cycle of obesogenic behavior [20]. Similarly, many cross-sectional studies across different university populations have found that time spent being sedentary (i.e., screen time) is an independent predictor of higher BMI [16].

The dietary habits of Iraqi university students require additional contextualization. In a previous study of male and female medical students in Baghdad, 30.8% of males and 26% of females were identified as breakfast skippers [11]. The number of fast-food outlets in Al-Muthanna has increased dramatically over the last 20 years, and healthy food options are often limited on university campuses; thus, students are largely reliant on high-calorie convenience foods. The sedentary academic lifestyle adopted by students, excessive hours spent studying, and the social integration of screen-based entertainment all contribute to the backdrop of dietary risk.

Because of the significant lack of multi-institutional, gender-disaggregated data from validated lifestyle instruments and objective anthropometric measurements of university students in Al-Muthanna, this study will attempt to address this gap. The two objectives of this study are as follows: first, to establish the prevalence of overweight and obesity based on WHO BMI standards among undergraduate students who attend two private universities located in Al-Muthanna governorate; and second, to identify the key lifestyle factors that are independently

associated with obesity after controlling for all other relevant variables or confounding factors. The findings of this study will contribute to the development of evidence-based campus health policies and targeted behavioral interventions in the Iraqi higher education setting.

2. Methodology

2.1 Study Design and Setting

The study was performed with a cross-sectional analytical design between October 2022 and March 2023, and the results included in this study were obtained from two privet universities located in Al-Muthanna (Iraq). All of these universities had a significant proportion of the overall number of undergraduate students from Al-Muthanna and provided representation in the following academic disciplines: Proximity of Medical and Health Sciences; Physical Sciences (Engineering, Technology); Natural Sciences; and Humanities/Social Sciences. The use of these universities provides a greater opportunity for disciplinary and socioeconomic differences among study subjects.

2.2 Study Population and Sampling

The target population was defined as undergraduate students aged 18 to 26 years who had been enrolled for at least one full academic semester at a participating university. Students who were pregnant or had any known disorders of bodyweight related to metabolic/endocrine processes (e.g., hypothyroidism, Cushing's syndrome, polycystic ovary syndrome) or who did not want to provide their written informed consent to participate were excluded from the study.

Stratified random sampling was performed using each university as the primary stratum and each college as the sub-stratum. The number of students to sample from each college was calculated proportionately to its total undergraduate enrolment. Within each college, a list of all eligible students was obtained from administrative registrars, and a random number sequence was generated by computer to select students. The required sample size was calculated using a formula for estimating proportions, assuming an obesity prevalence ratio of 17% from local literature [12], using a 95% confidence interval and a +/- 4% margin of error, as well as a design effect of 1.5, in consideration of the cluster-like nature of sampling within colleges. Thus, the minimum sample size required was calculated to be 411 participants. Allowing for a 10% non-response/pre-exclusion rate, the targeted enrolment needed to be at least 455 students, and a total of 454 students provided complete, usable data for this study.

2.3 Data Collection Instrument

The researchers created a self-administered structured questionnaire in English, which was then translated into Arabic by two independent bilingual interviewers. Back-translation was used to confirm conceptual equivalence. The questionnaire was pilot-tested on a sample of thirty students who were not part of the main study. The lifestyle behavior subscale of the questionnaire had a Cronbach's alpha of .78, demonstrating acceptable internal consistency. The final questionnaire had four sections comprised of sociodemographic information (age, gender, college type, residence, and monthly income), dietary habits (frequency of eating breakfast, consuming fast food, eating fruits and vegetables, and consuming sugary beverages), physical activity/sedentary behaviours (total moderate-to-vigorous physical activity (MVPA) per week measured using a validated short-form physical activity questionnaire and daily screen time (television, smartphone, computer, and video games)), sleep hours and tobacco use (smoker or non-smoker).

2.4 Anthropometric Measurements

Trained research assistants obtained objective measurements of height and weight with calibrated instruments. Participant's weight was measured to the nearest 0.1 kg utilizing a digital scale (SECA 813, Hamburg, Germany), with the participant wearing minimal clothing and without shoes. Participant's standing height was measured to the nearest 0.1 cm using a portable stadiometer (SECA 217) with participants oriented in the Frankfort horizontal plane. Daily calibration of equipment was performed throughout the data collection period. BMI was determined as weight (kg) divided by the square of height (m^2) and categorized per World Health Organization (WHO) thresholds: underweight (< 18.5 kg/m^2), normal weight (18.5-24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), obese class I (30.0–34.9 kg/m^2), obese class II (35.0–39.9 kg/m^2), and obese class III (≥ 40.0 kg/m^2) [1]. For logistic regression analysis, obesity was considered the outcome variable, comparing BMI≥ 30.0 kg/m^2 versus < 30.0 kg/m^2.

2.5 Variable Definitions

Physical inactivity was defined as less than or equal to 150 minutes of moderate-intensity activity per week, per the World Health Organization (WHO) guidelines (21). Fast food consumption was classified as frequent use (≥4 times per week) or infrequent use (≤4 times per week). Breakfast skipping was defined as skipping breakfast on five or more days in any given week. If screen time exceeded 6 hours/day, it was placed in the prolonged category. Meeting the U.S. National Sleep Foundation guidelines for short sleep duration means that an individual gets less than 7 hours of sleep each night (22). Lastly, low consumption (fewer than 3 days/week) of fruits or vegetables is considered low. High consumption of sugary drinks is defined as consistently consuming at least one sugar-sweetened drink per day.

2.6 Ethical Considerations

Before data collection, all participants signed an informed consent form and agreed to participate in the research project. Participants had the option to participate in the study voluntarily without any obligation. All their answers will be kept confidential and anonymous. No identification could be found on the questionnaires. The research team stored the data securely in a password-protected database accessible only to team members.

2.7 Statistical Analysis

Using Microsoft Excel 2019, data were collected and maintained, followed by analysis in IBM SPSS Statistics (version 26.0) to generate descriptive statistics (frequencies, percentages, means, standard deviations) for all variables. The chi-square test was then used to examine associations between categorical variables (since they were not normally distributed), and independent-samples t-tests were used to compare continuous variables between groups. All statistically significant variables ($p < 0.05$) in univariate analysis were then entered into a multivariate binary logistic regression model (using a forward-inclusion method), with obesity as the dependent variable. The results of this analysis are presented as adjusted odds ratios (aORs) with 95% confidence intervals (CIs). To assess the overall fit of the final model, the Hosmer-Lemeshow test was applied ($p = 0.432$, indicating a good fit). Statistical significance was established based on $p < 0.05$ for all analyses.

3. Results

3.1 Sociodemographic Characteristics

There were a total of 454 university students in this study sample (n=454), of whom 212 were male (46.7%), and 242 were female (53.3%). The age of participants ranged from 18 to 26 years, with a mean of 21.4 years (±1.9). Most of the study participants belonged to the 21 to 23 age group (n=189, 41.3%), followed by the 18 to 20 (n=174, 38.2%) and 24 to 26 (n=93, 20.7%) age groups. A breakdown of college type indicates that 40.8% were in colleges of humanities and social sciences, 30.7% were in colleges of engineering and natural sciences, and 28.7% were in colleges of medical and health sciences. Most participants (n=374, 82.1%) lived at home with their families, while 18.1% (n=80) lived in either dormitories or alone. A complete sociodemographic profile for the study sample is provided in Table 1.

Table 1. Sociodemographic characteristics of the study participants (N = 454)

Variable	Males n (%)	Females n (%)	Total n (%)
Age group (years)			
18–20	78 (36.8)	95 (39.3)	173 (38.2)
21–23	89 (42.0)	98 (40.5)	187 (41.3)
24–26	45 (21.2)	49 (20.2)	94 (20.7)
College type			
Medical/health sciences	58 (27.4)	72 (29.8)	130 (28.7)
Engineering/sciences	74 (34.9)	65 (26.9)	139 (30.7)
Humanities/social sciences	80 (37.7)	105 (43.4)	185 (40.8)
Residence			
Living with family	165 (77.8)	207 (85.5)	372 (82.1)
Student dormitory/independent	47 (22.2)	35 (14.5)	82 (18.1)
Monthly family income (USD)			
< 300	62 (29.2)	75 (31.0)	137 (30.2)
300–600	88 (41.5)	97 (40.1)	185 (40.8)
> 600	62 (29.2)	70 (28.9)	132 (29.1)

3.2 Prevalence of Overweight and Obesity

The overall BMI in the cohort was 25.4 ± 4.8 kg/m², and the percentages in each weight category were: normal weight (46.8%), underweight (10.2%), overweight (25.8%), and obese (17.4%). This means that 43.3% of participants were either overweight or obese. The prevalence of overweight was higher in males than in females (29.2% vs 22.7%; p = 0.031), but the prevalence of obesity did not differ significantly between males and females (17.9% vs 16.9%; p = 0.762). Detailed breakdowns of BMI distribution by sex are presented in Table 2.

Table 2. BMI classification and prevalence of overweight and obesity by sex (N = 454)

BMI Category (kg/m²)	**Males n (%)**	**Females n (%)**	**Total n (%)**	**p-value**
Underweight (< 18.5)	18 (8.5)	28 (11.6)	46 (10.2)	
Normal weight (18.5–24.9)	94 (44.3)	118 (48.8)	212 (46.8)	
Overweight (25.0–29.9)	62 (29.2)	55 (22.7)	117 (25.8)	0.031
Obese class I (30.0–34.9)	28 (13.2)	26 (10.7)	54 (11.9)	
Obese class II (35.0–39.9)	8 (3.8)	12 (5.0)	20 (4.4)	
Obese class III (≥ 40.0)	2 (0.9)	3 (1.2)	5 (1.1)	
Total overweight + obese	**100 (47.2)**	**96 (39.7)**	**196 (43.3)**	0.028
Obesity only (BMI ≥ 30)	**38 (17.9)**	**41 (16.9)**	**79 (17.4)**	0.762
Mean BMI ± SD	25.8 ± 4.7	25.1 ± 4.9	25.4 ± 4.8	0.087

3.3 Association Between Lifestyle Factors and Obesity

Multiple lifestyle variables were associated with obesity among students in univariate analyses presented in Table 3. Examples include: (a) less than 150 minutes of moderate-to-vigorous physical activity (MVPA) in a week was shown to be 73.4% versus 39.6%, OR=4.23, 95% CI=2.31-7.74, p<0.001, (b) over 64% of students consumed fast food regularly versus 29.1%, OR=4.60, 95% CI=2.55-8.30, p<0.001, (c) overweight or obese individuals spent greater than 6 hours engaging in screen time per day (65.8%) than non-overweight/obese individuals (32.4%), OR=4.08, 95% CI=2.25-7.41, p<0.001, (d) 62.0% of the overweight/obese group reported sleeping less than 7 hours per night while only 36.9% of the non-overweight/obese group did so, OR=2.79, 95% CI=1.58-4.92, p<0.001. (e) The overweight/obese students reported significantly higher rates of consumption of sugary beverages, lower intake of fruits and vegetables, and breakfast skipping. (f) The use of tobacco products was also reported more frequently by the overweight/obese students compared with the non-overweight/obese group, although this difference was not statistically significant, OR=1.55, p=0.138.

Table 3. Association between lifestyle factors and obesity in univariate analysis (N = 454)

Lifestyle Factor	Obese n (%)	Non-obese n (%)	OR (95% CI)	p-value
Physical inactivity (< 150 min/week)	58 (73.4)	148 (39.6)	4.23 (2.31–7.74)	< 0.001
Fast food consumption (≥ 4 times/week)	51 (64.6)	109 (29.1)	4.60 (2.55–8.30)	< 0.001
Skipping breakfast (≥ 5 days/week)	44 (55.7)	128 (34.2)	2.42 (1.40–4.19)	0.002
Screen time > 6 hours/day	52 (65.8)	121 (32.4)	4.08 (2.25–7.41)	< 0.001
Sleep duration < 7 hours/night	49 (62.0)	138 (36.9)	2.79 (1.58–4.92)	< 0.001
Low fruit/vegetable intake (< 3 days/week)	53 (67.1)	157 (42.0)	2.82 (1.59–5.00)	< 0.001
Current tobacco use	22 (27.8)	74 (19.8)	1.55 (0.87–2.76)	0.138
High sugary beverage intake (≥ 1/day)	48 (60.8)	98 (26.2)	4.35 (2.45–7.72)	< 0.001

3.4 Multivariate Logistic Regression

Seven independent lifestyle covariates of obesity were identified in the multivariate binary logistic regression model (Table 4). The strongest independent predictor of obesity was physical inactivity (adjusted odds ratio (aOR) of 3.51 (1.82 - 6.77) ($p < .001$) followed by the preference for eating fast food frequently (aOR = 3.28; 1.70 - 6.43) ($p < .001$), high intake of sugar-sweetened beverages (aOR = 3.14; 1.67 - 5.89) ($p < .001$), and spending excessive time in front of a screen (aOR = 3.09; 1.58 - 6.05) ($p = .001$). Short sleep duration (aOR = 2.34) ($p = .007$), low intake of fruits and vegetables (aOR = 2.07) ($p = .025$) and skipping breakfast (aOR = 1.89) ($p = .041$) were also statistically significant. Cigarette smoking was found not to be a statistically significant independent covariate of obesity (aOR = 1.24; $p = .516$).

Table 4. Multivariate binary logistic regression: independent predictors of obesity (BMI ≥ 30 kg/m²)

Variable	aOR	95% CI	p-value
Physical inactivity	3.51	1.82 – 6.77	< 0.001
Fast food ≥ 4 times/week	3.28	1.70 – 6.33	< 0.001
Screen time > 6 hours/day	3.09	1.58 – 6.05	0.001
Sleep duration < 7 hours/night	2.34	1.27 – 4.32	0.007
High sugary beverage intake	3.14	1.67 – 5.89	< 0.001
Low fruit/vegetable intake	2.07	1.10 – 3.90	0.025
Skipping breakfast	1.89	1.03 – 3.48	0.041
Tobacco use	1.24	0.65 – 2.35	0.516

aOR = adjusted odds ratio; CI = confidence interval. Hosmer–Lemeshow goodness-of-fit test $p = 0.432$. Model Nagelkerke $R^2 = 0.41$.

4. Discussion

In this cross-sectional study, undergraduate students from two privet Universities (PUs) were examined to determine whether overweight and obesity among students, along with lifestyle predictors, constitute a significant public health issue. The study determined that over one-third (43.3%) of students participating in this research were classified as being overweight or obese, with nearly one-third (approximately 17.4%) being considered as being severely overweight or obese. Therefore, students attending undergraduate programs at universities in Al-Muthanna are among the highest-rated for excess weight, using the classification of students in international and regional literature, which has implications for health policy and public health in Iraq, as well as for universities in Iraq.

The overall 43.3% prevalence in the current research study differed significantly from the 22.4% reported among medical students in Al-Muthanna in 2019 and from the 35.5% reported among students at the University of Kerbala. There are likely many reasons for the differing percentages of overweightness and obesity in students from the current study and the statistics from previous studies including a greater representation of multiple institutions of higher education, the last five years have been a transition in traditional dietary/lifestyle behaviours, and the anthropometric measurements used in the current study were directly measured rather than self-reported BMI therefore BMI does not accurately assess obesity and therefore will underestimate the actual obesity rates [6]. The 17.4% obesity rate in the current study is similar to the 16.9% rate in the 2015 Iraqi National Survey (ages 18-39) [6], suggesting that the current obesity rate is not an anomaly but reflects the true picture of obesity within the stated age group.

In addition, the results of this study support findings on the prevalence of obesity in the Middle East and beyond. A systematic review and meta-analytic study from 2000 to 2020 found a pooled rate of obesity among adults in Middle Eastern countries (N=17) of 21.17%. [4]This research examined young adults aged 18 to 26, who typically have a lower risk of developing obesity than older adults; therefore, a 17.4% obesity rate is significantly high and indicates an early consolidation of obesity risk during university. According to EMR [5], the reported obesity rate among older adults varies between 25% and 81.9%, and studies conducted in Erbil (obesity rate = 40.9%) and Basrah (combined overweight + obese = 55.1%) [6] suggest that older Iqaqi adults experience a similar obesity epidemic as other Iraqi adults. Intervening with young adults will help prevent future lifelong trajectories of adipose accumulation by diminishing the size of the at-risk group.

Young adult males have a considerably higher prevalence of overweight than young adult females (29.2% vs 22.7%; $p = 0.031$), but obesity rates are essentially equal between males and females. These results differ somewhat from Iraq's published data among all adults, where older females are disproportionately affected by the obesity epidemic, likely due to hormonal, reproductive, and socio-economic influences that have not yet made an impact on younger females [6]. In studies conducted in Baghdad [11], male university students consumed more total food and consumed more fast food and sugary beverages than their female peers; thus, they were more likely to have greater overall weight gain than females. Therefore, the lack of a significant sex difference in obesity may relate to female participants reporting high screen time and skipping breakfast at rates similar to male participants, thereby neutralizing any potential protective effect of consuming a lower volume of food compared with their male peers.

Physical inactivity was the strongest independent variable for predicting obesity in the multivariate analysis (aOR = 3.51; 95% CI: 1.82 - 6.77). This study concurs with WHO global recommendations calling for at least 150 minutes of moderate physical activity per week for all adults; however, over 73% of students in the current sample did not meet that minimum. Similarly, a Spanish research project that focused on first-year university students demonstrated that prolonged sedentary behavior and physical inactivity were two of the main drivers of obesity risk, primarily because long hours of required academic postures limit opportunities for physical activity. Additional barriers to engaging in physical activity among college students in Al-Muthanna include safety concerns, limited access to public parks or recreational facilities, extreme summer temperatures, restrictions on females' use of outdoor spaces according to cultural norms, and the affordability of gym memberships. As such, there is a clear need for both improved programming and infrastructure related to physical activity on the college campus.

Fast food consumption was the second-strongest predictor of obesity (aOR = 3.28), and sugary beverages were the third-strongest predictor of obesity (aOR = 3.14). The increase in fast-food restaurants in Al-Muthanna over the last 20 years has been remarkable. At universities, where there is often limited access to healthy alternatives in the canteen, these establishments create environments that perpetuate the consumption of calories from energy-dense foods. Additionally, a study of Moroccan university students showed that frequent consumption of fast food, fried potatoes, and sugary drinks is strongly related to being overweight and/or obese; these same findings were observed among the current sample of university students. Sugar-sweetened beverage consumption needs to be a concern for policy-makers, as they account for a large share of total caloric intake, provide few nutritional benefits, and are a significant component of the social, cultural, and traditional characteristics of young people in Iraq. Campus beverage labeling programs, reformulation policies, and taxation strategies have the potential to significantly lower intake at little cost.

Sixty-five point eight (%) of overweight participants engaged in prolonged recreational screen time-recreational screen-based activity and meeting diagnostic criteria for prolonged screen time (more than six hours daily)-were found to be obese using aetiological odds ratios of greater than 3.09. This demonstrates a global trend of increasing sedentary screen time among university students, who spend a greater percentage of their discretionary time engaged in sedentary screen activities, ranging from social media to video games to streaming services. Additional data identified screen time as an alternative to physical activity and as a cause of sleep disturbances due to the suppressive effect of blue light on melatonin secretion. Screen time was also identified as a contributor to increased consumption of energy-dense snack-type foods during screen-time activities. Interventions to reduce screen time should be explored through digital campus wellness programs, structured physical activity during study breaks, and the development of smartphone usage guidelines in the universities in Al-Muthanna.

Sleep duration of less than 7 hours per night independently predicted obesity in the analyzed population (adjusted odds ratio, 2.34). The relationship between insufficient sleep and obesity through biological mechanisms has been well described. Specifically, sleep deprivation has been shown to increase circulating ghrelin levels, an orexigenic hormone, and decrease leptin levels, a satiety hormone, resulting in increased appetite and a preference for high-calorie foods. In addition, reduced sleep duration results in the creation of an increased opportunity (or window of time) for food intake during periods of wakefulness by increasing the amount of time in the day to eat due to the effect of fatigue on an individual's ability to self-regulate their dietary choices through impaired frontal lobe decision-making. Academic demands, fluctuating

schedules, late-night social media engagement among students, and factors unique to universities in Iraq, such as unreliable electricity that disrupts uninterrupted sleep, would contribute to reduced sleep duration among students. Therefore, sleep hygiene education should be included in comprehensive campus wellness programming. Low intake of fruits and vegetables (aOR = 2.07) and skipping breakfast (aOR = 1.89) were two additional independent lifestyle predictors of obesity, in addition to the other lifestyle predictors identified previously. Proper consumption of both fruits and vegetables protects against obesity through several mechanisms: these foods are sources of dietary fiber, which promotes a feeling of fullness; they are low in energy density; and they partially displace higher-energy-density foods [18]. The 2019 Baghdad students study found that only 13.2% of all students were physically active, and that significantly more females consumed fruits and vegetables daily than males [11]—which reflects the results of this study on the reduced consumption of fruits and vegetables in the obese subset. Skipping breakfast is another commonly observed behavior among Iraqi university students. It may lead to increased caloric intake throughout the day, as they overcompensate by consuming more food at subsequent meals and more calorie-dense convenience foods later in the morning [28]. Initiatives to improve nutritional literacy and courses that teach basic cooking methods may help reverse these dietary behaviors.

While tobacco use did not have a significant relationship with obesity in this study (aOR = 1.24; p = 0.516), it is appropriate to discuss how tobacco use behaviors fit in the greater context of obesity and other risk factors. Tobacco use had a positive but low crude univariate association with obesity. Still, it became a non-significant predictor of obesity after adjusting for diet and physical activity, suggesting the presence of many other non-healthy behaviors confounds any relationship between tobacco and obesity in this population. The cross-sectional design precludes drawing directional inferences about temporality; thus, the predominantly young (non-daily) smoker sample may not have sufficient statistical power to detect modest relationships between obesity and this domain.

There are several limitations to the current research that should be noted. First, a cross-sectional design allows for estimation of prevalence and identification of associations; however, causal inferences are impossible due to the lack of follow-up over time. Longitudinal studies that follow students from entry to graduation are needed to establish the directionality of lifestyle changes and changes in BMI over time. Second, both dietary and behavioral data were self-reported and thus subject to social desirability bias, with participants likely underreporting fast-food consumption and overreporting physical activity. Third, waist circumference or body fat percentage was not measured. Therefore, all measures (BMI) may misclassify students with high muscle mass as overweight. Fourth, this study took place only at two privet universities in Al-Muthanna and may not be representative of students at universities across all governorates, as socio-economic, cultural, and infrastructural conditions vary greatly across governorates. Fifth, the current instrument did not include mental health variables (i.e., depression, stress, and anxiety) that are known to be associated with both obesity and unhealthy behaviors, and thus should be included in future studies.

This study has important implications for the recent body of literature on public health in Iraq. It is one of the first multi-institutional studies to use objective anthropometric measurements, an evidence-based Arabic lifestyle questionnaire, and multivariate regression to examine obesity and obesity-related factors among the undergraduate population in Al-Muthanna. The quantitative results from this study provide a basis for supporting and informing the

implementation of interventions to improve health among university-level students and provide valuable information to the Iraqi Ministry of Higher Education for developing a comprehensive strategy to improve the health of all students in Iraq.

Some practical recommendations made in this study are: establishing affordable physical activity facilities on campus and requiring physical education credits; regulating the food environment by requiring healthy food options and restricting the sale of sugary drinks on campus; incorporating modules on nutrition and lifestyle into the curriculum for all degree programmes; conducting sleep hygiene workshops on campus; and developing screening procedures to identify and refer students with high BMI to a health care provider for follow up on obesity-related issues. Given the high prevalence (43.3%) of obesity and overweight in this population, it is more likely that a comprehensive, population-based approach to intervention targeting the entire university environment will have a meaningful and sustainable effect on reducing excess weight in this important population than through counseling on an individual basis.

5. Conclusion

The findings of this research show that in Al-Muthanna, Iraq, there is a high prevalence of overweight and obesity among university students (43.3% of respondents), and 17.4% of student respondents are considered to have obesity according to the WHO classification system. Once other factors were controlled for, there were statistically significant associations between physical inactivity, fast-food and sugary beverage consumption, high screen time, inadequate sleep, inadequate fruit/vegetable consumption, and skipping breakfast and student respondents being classified as obese. Given these findings, evidence-based health promotion/education programs must be implemented to target university-aged students in Iraq, and collaboration among universities, the Ministry of Higher Education, the Ministry of Health, and local governments is needed to create an environment that supports university students in making and maintaining healthy lifestyle choices.

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