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Prevalence and Determinants of Overweight and Obesity Among Tobruk University Students: Associations with Diet Knowledge, Dietary Behaviours, Sedentary Lifestyle, and Physical Activity

Hamdi Lemamsha [1*], Rida Benfayed [2], Heba Jawaidah[3], Ahmed Othman[4], Hind Ismail[5], Salem Rages[6], Murad Buijlayyil [7], Mohmmed Algebani[8], Abdulghani Lamamsha[9], Walid Al-Khuram[10], Mohsen Alkmeshi[11], Malak Ali[12]

[1, 3, 4, 5]Faculty of Health Sciences, University of Tobruk, Tobruk, Libya
[2] Tebyan Medical Training and Education Ltd, London, United Kingdom
[6, 7, 8,] Faculty of Medical Technology, Public health, Derna, Libya
[9] Services, Health Ministry Derna, Libya
[10] National Health Service (NHS), Merseyside, United Kingdom
[11]Leicester University Hospitals NHS Trust, United Kingdom
[12] Chesterfield Royal Hospital, Calow, Chesterfield, Derbyshire, S44 5BL, United Kingdom

*Corresponding author email: hamdi_lemamsha@tu.edu.ly

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ABSTRACT

Overweight and obesity are growing public health concerns among university students because lifestyle changes during early adulthood often promote unhealthy dietary behaviours, physical inactivity, and prolonged sedentary lifestyles. Despite the increasing burden of obesity in Libya, evidence among university students remains limited, particularly in eastern Libya. This study determined the prevalence of overweight and obesity among Tobruk University students and examined their associations with diet knowledge, dietary behaviours, sedentary behaviour, and physical activity. A quantitative cross-sectional study was conducted among 500 undergraduate students (275 females and 225 males) recruited using a probability-informed sampling approach. Data were collected using a structured paper-based questionnaire assessing demographic characteristics, body weight perception, diet knowledge, dietary behaviours, sedentary behaviour, physical activity, and lifestyle attitudes. Anthropometric measurements, including height, weight, waist circumference, body fat percentage, visceral fat rating, and body mass index, were obtained using the TANITA RD-545HR Smart Segmental Body Composition Analyser. Data were analysed using Statistical Package for the Social Sciences version 28 through descriptive statistics, reliability and validity assessment, normality testing, Pearson correlation, and multiple linear regression. The combined prevalence of overweight and obesity was 50.0%, comprising 31.0% overweight and 19.0% obesity, with females showing a higher prevalence than males (56.4% versus 42.2%). Body mass index was significantly associated with diet knowledge ($r = -0.42$, $\beta = -0.38$), dietary behaviours ($r = 0.47$, $\beta = 0.41$), sedentary behaviour ($r = 0.51$, $\beta = 0.45$), and physical activity ($r = -0.49$, $\beta = -0.43$) (all $p < 0.001$), with associations remaining significant after adjustment. These findings support university-based nutrition education, healthier campus environments, increased physical activity, and interventions to reduce sedentary behaviour among Libyan university students.

1. INTRODUCTION

Escalating global trends in overweight and obesity since 1990 indicate that excess body weight has become a major non-communicable disease risk, with projections suggesting continued growth towards 2050 and increasing relevance for young adults transitioning into long-term lifestyle patterns (Ng et al., 2025). University students are an important population because habits formed during late adolescence and early adulthood may persist into later life and influence future cardiometabolic risk (Ng et al., 2025; Seyam, 2025). Body mass index remains the most widely used epidemiological indicator for classifying weight status, with overweight commonly defined as BMI ≥25 kg/m² and obesity as BMI ≥30 kg/m², allowing comparison across populations and supporting campus-level health surveillance (Ng et al., 2025). **However**, BMI alone does not explain why weight gain occurs, especially in student populations where diet knowledge, eating practices, sedentary time, and physical activity may interact. Evidence from university settings shows that frequent snacking, fast-food consumption, sugary drinks, meal skipping, and screen-time eating are associated with higher BMI and obesity risk (Syed et al., 2020; Aljefree et al., 2022; Saintila et al., 2024). Similar findings have been reported in broader student lifestyle research, where sedentary behaviour, low activity, and poor lifestyle scores have been linked with poorer health-promoting behaviours (Alothman et al., 2024; Dutta et al., 2025). The Libyan context strengthens the need for this study because national evidence has already shown a substantial burden of overweight and obesity among adults, suggesting that younger university populations may be entering adulthood within an obesogenic environment (Lemamsha et al., 2019). Unhealthy dietary habits have also been associated with obesity among Libyan adults, including meal skipping, large portion sizes, sugar-sweetened beverages, and fast-food consumption (Lemamsha et al., 2022). Earlier evidence from Benghazi among adolescents and early adults identified overweight and obesity alongside low physical activity and problematic dietary patterns, indicating that risk behaviours may begin before university or continue during higher education (Sachithananthan et al., 2013; Omar et al., 2017). More recent university-based evidence from Benghazi has linked junk-food consumption with obesity risk among students, further suggesting that Libyan university settings may expose students to energy-dense diets and unhealthy routines (Saad et al., 2024). **Nevertheless**, most available Libyan evidence comes from Benghazi, Tripoli, or general adult samples, while Tobruk University remains under-represented. This creates a clear local evidence gap because the lifestyle environment, food access, transport patterns, recreational opportunities, and student routines in Tobruk may differ from those in other Libyan cities. The rationale for the present study is therefore grounded in the need for institution-specific evidence that can support realistic prevention planning at Tobruk University. Without local prevalence data and behavioural analysis, health-promotion activities may rely on general assumptions rather than measured student needs. Diet knowledge is included because awareness of sugar, fast food, portion size, fruit and vegetable intake, and physical inactivity may influence food choices, yet previous studies suggest that knowledge does not always translate into healthy behaviour (Syed et al., 2020; Saad et al., 2024; Alothman et al., 2024). Dietary behaviours are also central because obesity risk is often shaped by repeated daily practices, such as skipping meals, snacking, eating out, and consuming sugary or energy drinks during screen use (Syed et al., 2020; Aljefree et al., 2022; Saintila et al., 2024). Sedentary behaviour and physical activity require parallel assessment because prolonged sitting may reduce energy expenditure, while regular activity may protect against weight gain (Elmahgoub et al., 2025; Dutta et al., 2025). The novelty of this study lies in examining these factors together within one quantitative model among Tobruk University students, rather than studying BMI, diet, or physical activity separately. It also combines questionnaire-based behavioural data with anthropometric measurements, providing a more complete picture of obesity-related risk. The problem addressed in this study is that Tobruk University lacks locally derived evidence estimating overweight and obesity prevalence and explaining how diet knowledge, dietary behaviours, sedentary lifestyle, and physical activity relate to BMI among its students. This absence limits the ability of university leaders, health educators, and policymakers to develop targeted, evidence-informed interventions. Accordingly, the aim of the study is to quantitatively determine the prevalence of overweight and obesity among Tobruk University undergraduate students and examine their associations with diet knowledge, dietary behaviours, sedentary lifestyle, and physical activity. The study specifically seeks to estimate BMI categories, assess diet-related knowledge, examine dietary practices, quantify sedentary behaviour and physical activity, and test associations between BMI and lifestyle factors after adjustment for sex, age, faculty, and smoking status (Ng et al., 2025; Syed et al., 2020; Elmahgoub et al., 2025; Seyam, 2025).

The significance of the study is that its findings could provide a practical baseline for university health education, healthier campus food policies, physical activity promotion, and gender-sensitive obesity prevention. More broadly, the study may contribute to Libyan public health evidence by extending obesity research into an under-studied eastern university setting and offering data that could inform future longitudinal and intervention-based studies.

Theoretical Framework and Hypothesis Development

The present study is informed by a behavioural health framework, which proposes that overweight and obesity among university students result from the interaction of cognitive, behavioural, and lifestyle-related factors rather than a single determinant. Within this framework, Body Mass Index (BMI) represents the dependent variable, while diet knowledge, dietary behaviours, sedentary behaviour, physical activity, and lifestyle attitudes are conceptualised as modifiable determinants influencing weight status (Figure 1). Previous evidence indicates that adequate diet knowledge may encourage healthier food choices, whereas unhealthy dietary practices, prolonged sedentary behaviour, and insufficient physical activity contribute to positive energy balance and increased obesity risk (Syed et al., 2020; Lemamsha et al., 2022; Elmahgoub et al., 2025; Dutta et al., 2025). However, these factors have often been investigated independently, particularly within university populations in developing countries. Therefore, the proposed framework integrates these behavioural constructs into a single explanatory model to examine their combined associations with BMI among Tobruk University students. Based on the reviewed literature and the conceptual model presented in Figure 1, the study proposes five hypotheses: H1, lower diet knowledge is associated with higher BMI; H2, unhealthy dietary behaviours are positively associated with BMI; H3, sedentary behaviour is positively associated with BMI; H4, physical activity is negatively associated with BMI; and H5, these associations remain significant after adjustment for sociodemographic characteristics.

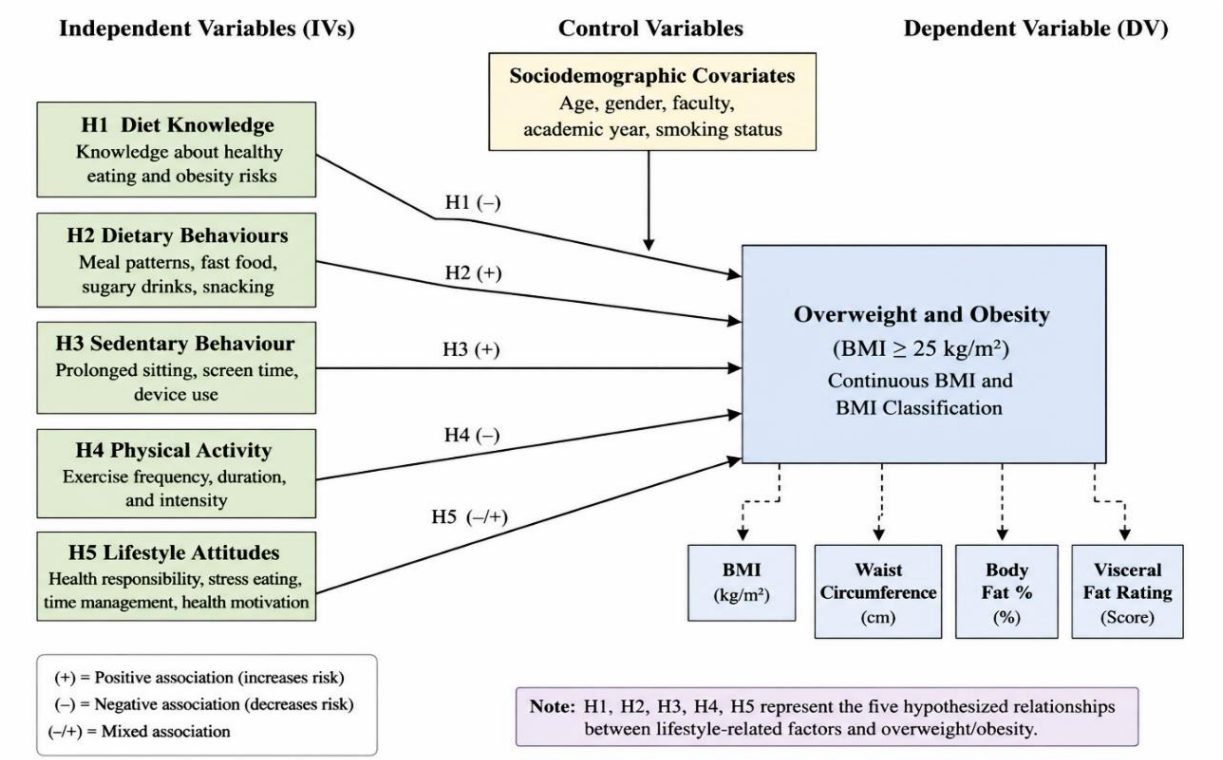

Figure 1: Conceptual framework and hypothesised associations between lifestyle-related factors and overweight/obesity among Tobruk University students.

2. MATERIALS AND METHODS

2.1 Study Design and Setting

A quantitative cross-sectional study design was adopted to estimate the prevalence of overweight and obesity and examine their associations with lifestyle-related factors among undergraduate students at Tobruk University, Libya. Cross-sectional designs were considered appropriate because exposure variables and outcome measures were assessed simultaneously, allowing prevalence estimation and identification of statistical associations within a defined student population (Setia, 2016; Wang and Cheng, 2020). Although causal inference cannot be established from this design, it provides an efficient approach for examining multiple behavioural, demographic, and anthropometric variables at one time point (Kesmodel, 2018; Cvetkovic-Vega et al., 2021). The study was conducted across different faculties at Tobruk University, including Health Sciences, Medicine, Science, Arts, Engineering, and other academic departments, to ensure representation from diverse educational backgrounds.

2.2 Study Population and Eligibility Criteria

The target population comprised undergraduate students enrolled at Tobruk University during the data-collection period. Eligible participants were male and female students aged 18 years or above who were registered at the university and willing to complete the questionnaire and anthropometric assessment. Students were excluded if they declined participation, submitted incomplete questionnaires, or refused physical measurements. Selection was based on eligibility rather than exposure or weight status, consistent with standard procedures for cross-sectional research (Setia, 2016).

2.3 Sampling Technique and Sample Size

A probability-informed sampling approach was used across faculties to improve representation of the student population. Sampling was organised by faculty to avoid over-reliance on one academic group and to include students from different years of study. Probability-based sampling principles are recommended in quantitative research because they support more transparent participant selection and improve the credibility of prevalence estimates (Rahman et al., 2022). The final sample consisted of 500 students, including 275 females and 225 males. This sample size was selected to provide sufficient precision for prevalence estimation, support subgroup comparison, and allow reliable correlation and regression analyses. Larger samples are recommended where studies aim to estimate prevalence and test associations across multiple predictors (Lakens, 2022).

2.4 Questionnaire Design and Measures

Data were collected using a structured paper-and-pencil questionnaire administered in person. The questionnaire was developed from constructs commonly used in student lifestyle, diet, and obesity research (Syed et al., 2020; Aljefree et al., 2022; Seyam, 2025). The first section collected demographic information, including gender, age group, faculty, year of study, smoking status, residence, marital status, height, and weight. The remaining sections used a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree. The dependent variable scale assessed perceived body weight and health impact. Independent variable scales measured diet knowledge, dietary behaviours and practices, sedentary behaviour, physical activity, and lifestyle and health attitudes. These domains were selected because previous studies have linked dietary practices, screen-time behaviours, physical inactivity, and lifestyle attitudes with BMI and obesity risk among university students (Alothman et al., 2024; Dutta et al., 2025; Elmahgoub et al., 2025). Completed questionnaires were checked immediately after completion to minimise missing data.

2.5 Questionnaire Design, Validity and Reliability

The questionnaire was designed as a structured measurement tool consisting of six main scales: BMI perception as the dependent variable, and five independent variables covering diet knowledge, dietary behaviour, sedentary behaviour, physical activity, and lifestyle attitudes. Each scale included eight items measured using a five-point Likert scale. Internal consistency was assessed using Cronbach's alpha, while convergent validity was examined using Average Variance Extracted (AVE). Table 1 shows that all scales exceeded acceptable thresholds, with Cronbach's alpha values ranging from 0.84 to 0.89 and AVE values ranging from 0.56 to 0.62, indicating that the questionnaire was reliable and suitable for statistical analysis.

Table 1: Reliability and Validity Summary

Scale Name	No. of Items	Cronbach's Alpha (α)	AVE
BMI Perception (DV)	8	0.89	0.62
Diet Knowledge (IV1)	8	0.87	0.59
Dietary Behaviour (IV2)	8	0.85	0.57
Sedentary Behaviour (IV3)	8	0.88	0.60
Physical Activity (IV4)	8	0.86	0.58
Lifestyle Attitudes (IV5)	8	0.84	0.56

2.6 Anthropometric Measurements and Instrumentation

Anthropometric measurements were obtained using standardised procedures. Height was measured barefoot to the nearest 0.1 cm using a portable stadiometer. Body weight, body fat percentage, visceral fat rating, and segmental body composition were assessed using the TANITA RD-545HR Smart Segmental Body Composition Analyser, TANITA Corporation, Tokyo, Japan. The device applies bioelectrical impedance analysis and recorded body weight to the nearest 0.1 kg. Waist circumference was measured to the nearest 0.1 cm using a non-elastic measuring tape at the midpoint between the lowest rib and the iliac crest. Body mass index was calculated as weight in kilograms divided by height in metres squared and classified into underweight, normal weight, overweight, and obesity according to international BMI thresholds (Ng et al., 2025). Body fat percentage, waist circumference, and visceral fat rating were used as complementary indicators of adiposity.

2.7 Validity and Reliability

The questionnaire was reviewed for clarity, relevance, and content coverage before use. Internal consistency reliability was assessed using Cronbach's alpha, with values of 0.70 or above considered acceptable. Construct validity was examined using Average Variance Extracted (AVE), with values above 0.50 indicating acceptable convergent validity. Normality of continuous composite variables was assessed using skewness, kurtosis, and histogram inspection before applying parametric tests. These procedures were used to ensure that the questionnaire scales were suitable for subsequent statistical analysis.

2.8 Data Analysis

Data were analysed using IBM SPSS Statistics version 28.0. Descriptive statistics were used to summarise participant characteristics, anthropometric measures, BMI categories, and questionnaire responses. Frequencies and percentages were reported for categorical variables, while means and standard deviations were reported for continuous variables. Pearson's correlation was used to examine bivariate associations between BMI and diet knowledge, dietary behaviours, sedentary behaviour, physical activity, and lifestyle attitudes. Linear regression was used to test the predictive relationship between each independent variable and BMI. Multiple linear regression was then applied to examine whether lifestyle-related predictors remained significant after adjustment for gender, age, faculty, year of study, and smoking status. Statistical significance was set at $p < 0.05$.

3. Ethical Considerations

This study was approved by the Ethical Committee of the Faculty of Health Sciences, Tobruk University before the start of data collection (Ref: 12/25. Health. Sce, TU, dated 15 November 2025). Written informed consent was obtained from all participants prior to enrolment. Participation was voluntary, and each student received an information sheet explaining the study aim, procedures, possible minimal discomfort during anthropometric measurement, confidentiality, anonymity, and the right to withdraw at any time without penalty. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki for research involving human participants. No personal identifying information was collected, and all questionnaire responses and anthropometric data were coded and stored securely for academic research purposes only. Physical measurements were conducted privately and respectfully to minimise embarrassment or discomfort. Since the study involved university students and did not involve animals, no animal ethics approval was required.

4. RESULT

3.1 Participant Characteristics

A total of 500 Tobruk University students were included in the analysis. Table 2 presents the demographic profile of the sample. Females represented 55.0% of participants, while males represented 45.0%. Most students were aged 19–21 years (42.0%), followed by 22–24 years (36.0%). Participation was distributed across several faculties, with Health Sciences (22.0%) and Medicine (19.0%) contributing the largest proportions. Most participants were single (92.0%), non-smokers (72.0%), and living in the family home (60.0%). The sample therefore reflected a predominantly young undergraduate population suitable for examining lifestyle-related obesity risk.

Table 2: Demographic Characteristics of Participants (n = 500)

Variable	Category	n (%)
Gender	Male	225 (45.0%)
	Female	275 (55.0%)
Age group	≤18	40 (8.0%)
	19–21	210 (42.0%)
	22–24	180 (36.0%)
	≥25	70 (14.0%)
Faculty	Health Sciences	110 (22.0%)
	Medicine	95 (19.0%)
	Science	85 (17.0%)
	Arts	90 (18.0%)
	Engineering	70 (14.0%)
	Other	50 (10.0%)
Year of study	1st	120 (24.0%)
	2nd	130 (26.0%)
	3rd	110 (22.0%)
	4th	100 (20.0%)
	≥5th	40 (8.0%)
Smoking status	Smoker	140 (28.0%)
	Non-smoker	360 (72.0%)
Residence	Family home	300 (60.0%)
	Rented	200 (40.0%)
Marital status	Single	460 (92.0%)
	Married	40 (8.0%)

3.2 Anthropometric Profile and Prevalence of Overweight and Obesity

Table 3 presents continuous anthropometric measurements by gender. The overall mean BMI was 26.50 ± 5.00 kg/m², placing the average student within the overweight range. Female students recorded higher mean BMI (27.80 ± 5.20 kg/m²) than male students (25.00 ± 4.40 kg/m²). Female students also showed higher waist circumference, body fat percentage, and visceral fat rating, indicating a higher adiposity burden.

Table 3: Anthropometric Measurements by Gender

Anthropometric variable	Male students (n = 225), Mean ± SD	Female students (n = 275), Mean ± SD	Total (n = 500), Mean ± SD
Height (cm)	172.40 ± 7.20	162.80 ± 6.60	167.10 ± 8.30
Weight (kg)	74.30 ± 12.80	73.60 ± 14.10	73.90 ± 13.50
BMI (kg/m²)	25.00 ± 4.40	27.80 ± 5.20	26.50 ± 5.00
Waist circumference (cm)	86.20 ± 10.40	90.10 ± 11.30	88.35 ± 11.00
Body fat (%)	24.80 ± 6.90	34.60 ± 7.40	30.20 ± 8.60
Visceral fat rating	8.90 ± 3.10	9.80 ± 3.40	9.40 ± 3.30

3.3 Anthropometric Profile and Prevalence of Overweight and Obesity

Table 4 presents the body mass index (BMI) classification of Tobruk University students according to gender. Overall, 31.0% of students were classified as overweight and 19.0% as obese, resulting in a combined overweight/obesity prevalence of 50.0%. Female students demonstrated a higher combined prevalence of overweight and obesity (56.4%) than male students (42.2%). Likewise, obesity alone was more common among females (21.8%) than males (15.5%), whereas males showed a higher proportion of normal body weight (48.9% versus 36.4%). Overall, these findings indicate that excess body weight represents a considerable health concern within the study population, particularly among female students (Table 4 and Figure 2).

Table 4: Distribution of Body Mass Index Classification and Prevalence of Overweight and Obesity among Tobruk University Students by Gender (n = 500)

BMI category	Male students (n = 225)	Female students (n = 275)	Total (n = 500)
Underweight (<18.5 kg/m²)	20 (8.9%)	20 (7.3%)	40 (8.0%)
Normal weight (18.5–24.9 kg/m²)	110 (48.9%)	100 (36.4%)	210 (42.0%)
Overweight (25.0–29.9 kg/m²)	60 (26.7%)	95 (34.5%)	155 (31.0%)
Obesity (≥30.0 kg/m²)	35 (15.5%)	60 (21.8%)	95 (19.0%)
Combined overweight/obesity	95 (42.2%)	155 (56.4%)	250 (50.0%)

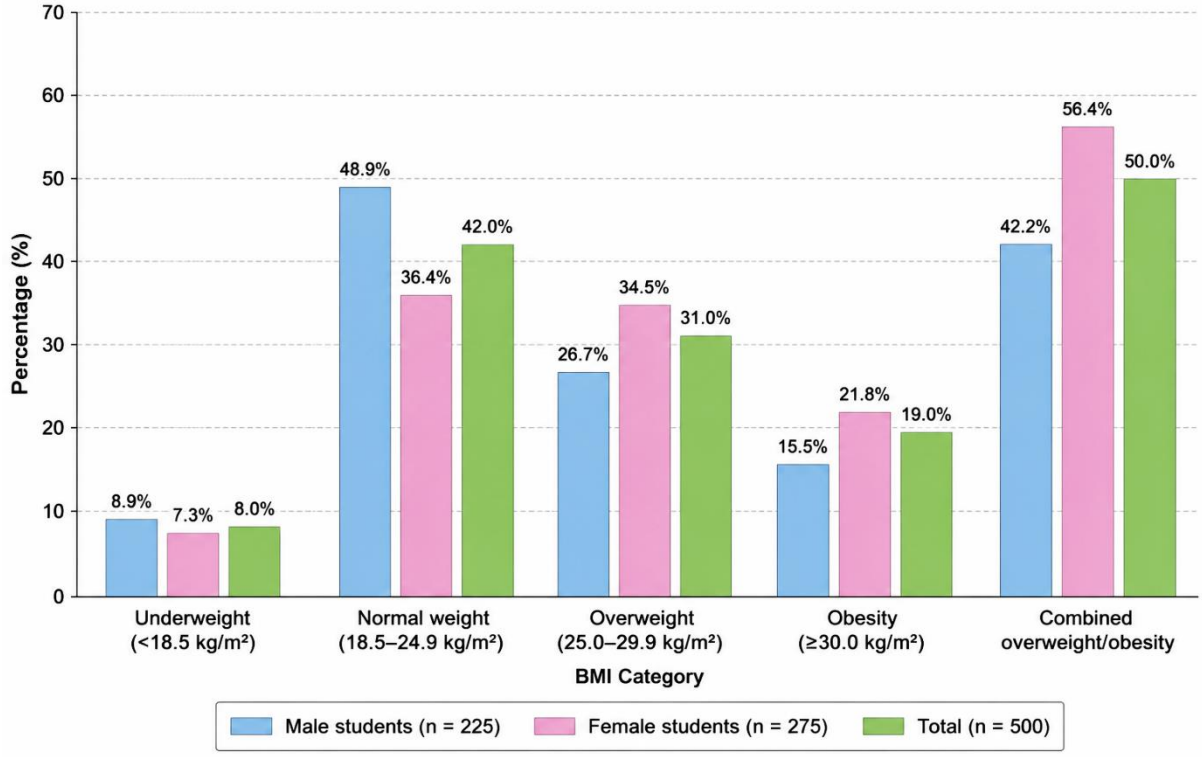

Figure 2: Prevalence of Body Mass Index Categories among Male and Female Tobruk University Students (n = 500)

3.4 Body Weight Perception, Diet Knowledge, Sedentary Behaviour, Physical Activity, and Lifestyle Attitudes

Table 5 summarises participants' responses across the five study constructs. Students generally demonstrated moderate to high awareness of the health implications of overweight and obesity. The strongest agreement was observed for the belief that excess body weight may negatively affect future health (3.88 ± 0.95), followed by concern about gaining weight during university life (3.72 ± 1.01). In contrast, satisfaction with current body weight showed the lowest mean score (3.14 ± 1.10), suggesting that many students were concerned about their current weight status.

Diet knowledge was generally high. Participants demonstrated strong awareness that physical inactivity contributes to obesity (3.95 ± 0.82), that fast foods are high in unhealthy fats (3.92 ± 0.85), and that sugary drinks increase the risk of weight gain (3.90 ± 0.88). However, knowledge regarding meal skipping and frequent snacking was comparatively lower, indicating some uncertainty about specific dietary practices.

Sedentary behaviour was common among participants. The highest mean scores were observed for prolonged daily sitting (3.98 ± 0.86), using electronic devices before sleeping (3.95 ± 0.88), extended screen time (3.92 ± 0.89), and prolonged study without movement breaks (3.85 ± 0.91). These findings suggest that screen-based and sitting-related activities formed a substantial part of students' daily routines.

Physical activity levels were comparatively low. Students reported difficulty finding sufficient time for exercise because of academic commitments (2.75 ± 1.10), while participation in organised sports or fitness activities was also limited (2.88 ± 1.09). Despite this, participants strongly acknowledged the importance of physical activity for maintaining good health (4.12 ± 0.76). Lifestyle attitudes were generally positive, with high agreement regarding personal responsibility for maintaining health (4.02 ± 0.80), willingness to improve lifestyle habits (4.10 ± 0.78), and the belief that universities should provide greater support for healthy living (4.05 ± 0.82). Overall, the findings demonstrate a clear gap between students' health awareness and their actual lifestyle behaviours.

Table 5. Body Weight Perception, Diet Knowledge, Sedentary Behaviour, Physical Activity, and Lifestyle Attitudes among Tobruk University Students (n = 500)

Construct	Statement (Short Phrase)	Mean ± SD
Body Weight Perception	Healthy body weight	3.35 ± 1.05
	Weight gain concern	3.72 ± 1.01
	Weight affects self-image	3.55 ± 1.02
	Future health risk	3.88 ± 0.95
	Pressure to control weight	3.50 ± 1.06
	Previous weight management	3.54 ± 1.03
	University weight impact	3.60 ± 0.98
	Weight satisfaction	3.14 ± 1.10
Diet Knowledge	Sugary drinks risk	3.90 ± 0.88
	Fast food fats	3.92 ± 0.85
	Fruit and vegetables	3.85 ± 0.90
	Large portion sizes	3.72 ± 0.95
	Frequent snacking	3.64 ± 1.00
	Meal skipping effects	3.60 ± 1.02
	High-salt foods	3.70 ± 0.97
	Inactivity causes obesity	3.95 ± 0.82
Sedentary Behaviour	Prolonged sitting	3.98 ± 0.86
	Screen time	3.92 ± 0.89
	Long study sitting	3.85 ± 0.91
	Screen preference	3.70 ± 0.95
	Sitting during leisure	3.78 ± 0.92
	Daily inactivity	3.60 ± 1.00
	Device use before sleep	3.95 ± 0.88
	Sitting-related fatigue	3.72 ± 0.96
Physical Activity	Regular exercise	2.98 ± 1.08
	Walking or cycling	3.10 ± 1.05
	30-minute exercise	2.95 ± 1.07
	Sports participation	2.88 ± 1.09
	Exercise motivation	3.20 ± 1.00
	Time for exercise	2.75 ± 1.10
	Physical fitness	3.05 ± 1.02
	Importance of exercise	4.12 ± 0.76
Lifestyle Attitudes	Healthy living difficulty	3.60 ± 0.98
	Academic stress eating	3.75 ± 0.92
	Stress-related eating	3.68 ± 0.95
	Study–health balance	3.55 ± 0.97
	Health responsibility	4.02 ± 0.80
	Time constraints	3.80 ± 0.90
	Lifestyle improvement	4.10 ± 0.78
	University health support	4.05 ± 0.82

3.4 Normality Testing Prior to Hypothesis Testing

Before conducting hypothesis testing, normality was assessed using skewness, kurtosis, and histogram inspection. All continuous composite variables showed approximately bell-shaped distributions. Table 6 Skewness values ranged from −0.85 to +0.92, while kurtosis values remained within ±1.5, indicating acceptable normality. These findings supported the use of parametric statistical tests, including Pearson's correlation and regression analysis.

Table 6: Normality Test Summary

Variable	Skewness	Kurtosis	Interpretation
BMI (DV)	−0.41	0.72	Normal
Diet Knowledge	−0.58	0.63	Normal
Dietary Behaviour	0.67	0.91	Normal
Sedentary Behaviour	0.72	1.12	Normal
Physical Activity	−0.83	0.88	Normal
Lifestyle Attitudes	−0.49	0.76	Normal

3.5 Hypothesis Testing

Parametric analyses were applied after confirming acceptable distributional assumptions for the continuous variables. Pearson's correlation was first used to examine bivariate associations with BMI, followed by linear regression to assess predictive relationships. Multiple linear regression was then applied to determine whether associations remained significant after adjustment for sociodemographic variables.

Diet knowledge showed a significant negative association with BMI ($r = -0.42$, $p < 0.001$). Linear regression confirmed that diet knowledge was a significant negative predictor of BMI ($\beta = -0.38$, $t = -6.95$, $p < 0.001$), supporting H1. This indicates that lower diet knowledge scores were associated with higher BMI.

Dietary behaviours were positively associated with BMI ($r = 0.47$, $p < 0.001$). Regression analysis showed that unhealthy dietary behaviours significantly predicted BMI ($\beta = 0.41$, $t = 7.22$, $p < 0.001$), supporting H2. Students reporting more frequent fast-food intake, sugary drink consumption, and irregular meal patterns tended to have higher BMI.

Sedentary behaviour demonstrated the strongest positive correlation with BMI ($r = 0.51$, $p < 0.001$). Regression results confirmed that sedentary behaviour significantly predicted BMI ($\beta = 0.45$, $t = 8.10$, $p < 0.001$), supporting H3. This suggests that prolonged sitting, extended screen time, and limited movement were strongly associated with higher BMI.

Physical activity showed a significant negative relationship with BMI ($r = -0.49$, $p < 0.001$). Linear regression confirmed that physical activity was a significant negative predictor of BMI ($\beta = -0.43$, $t = -7.85$, $p < 0.001$), supporting H4. Lower physical activity levels were therefore associated with higher BMI.

In the adjusted multiple regression model, lifestyle-related predictors remained statistically significant after controlling for sex, age, faculty, and smoking status. Diet knowledge ($\beta = -0.31$, $p < 0.001$), dietary behaviours ($\beta = 0.35$, $p < 0.001$), sedentary behaviour ($\beta = 0.39$, $p < 0.001$), and physical activity ($\beta = -0.37$, $p < 0.001$) retained significant associations with BMI. These results supported H5 and indicated that modifiable lifestyle factors remained important predictors beyond demographic characteristics. The final hypothesis model is summarised in Table 7 and Figure 3.

Table 7: Summary of Hypothesis Testing Results (n = 500**)**

Hypothesis	Statistical test used	Result	Significance	Interpretation
H1: Diet knowledge → BMI	Pearson correlation + linear regression	r = −0.42; β = −0.38	p < 0.001	Supported
H2: Dietary behaviours → BMI	Pearson correlation + linear regression	r = 0.47; β = 0.41	p < 0.001	Supported
H3: Sedentary behaviour → BMI	Pearson correlation + linear regression	r = 0.51; β = 0.45	p < 0.001	Supported
H4: Physical activity → BMI	Pearson correlation + linear regression	r = −0.49; β = −0.43	p < 0.001	Supported
H5: Adjusted model	Multiple linear regression	β range = −0.31 to 0.39	p < 0.001	Supported

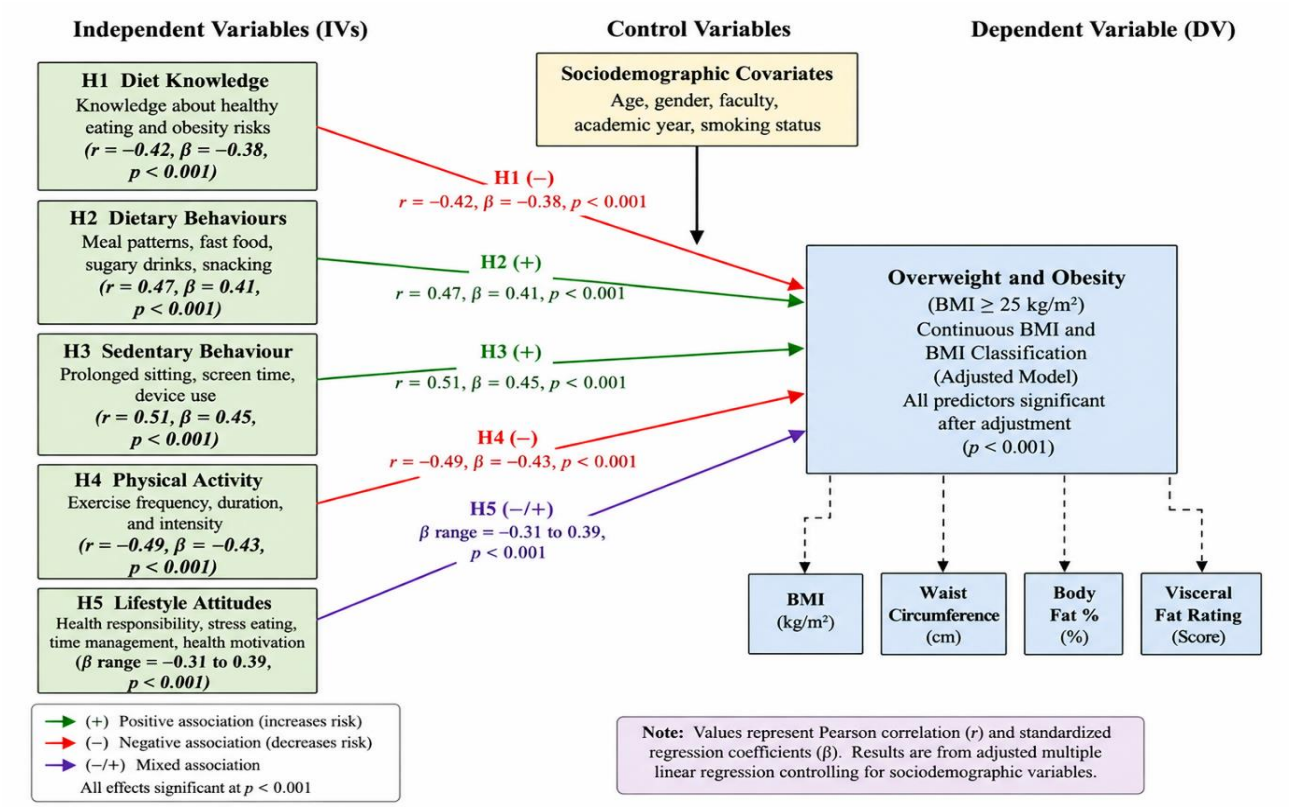

Figure 3**:** Final hypothesis model showing associations between diet knowledge, dietary behaviours, sedentary behaviour, physical activity, adjusted sociodemographic factors, and BMI among Tobruk University students.

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5. DISCUSSION

The present study examined the prevalence of overweight and obesity among undergraduate students at Tobruk University and investigated the associations between body mass index (BMI) and modifiable lifestyle-related factors, including diet knowledge, dietary behaviours, sedentary behaviour, physical activity, and lifestyle attitudes.

The findings demonstrated that overweight and obesity represent a substantial public health concern within this university population, with one in every two students classified as either overweight or obese.

Behavioural factors, particularly unhealthy dietary practices, prolonged sedentary behaviour, and inadequate physical activity, were consistently associated with BMI, while higher diet knowledge was associated with lower BMI. These findings support the multidimensional nature of obesity, whereby cognitive, behavioural, and environmental influences interact to shape weight status rather than acting independently (Ng et al., 2025; Syed et al., 2020; Aljefree et al., 2022). Although the cross-sectional design precludes causal inference, the observed associations provide important epidemiological evidence regarding modifiable risk factors among university students in eastern Libya. The overall findings are consistent with previous Libyan studies reporting increasing obesity prevalence among young adults (Lemamsha et al., 2019; Lemamsha et al., 2022; Saad et al., 2024) and correspond with international evidence identifying university years as a critical period for the development of unhealthy lifestyle behaviours and long-term cardiometabolic risk (Bede et al., 2020; Saintila et al., 2024; Seyam, 2025).

The demographic profile of the participants reflected a typical university population, with slightly more female than male students and most participants aged between 19 and 24 years. Similar demographic distributions have been reported in university-based obesity studies conducted in Saudi Arabia, Peru, and other Middle Eastern countries, where young adulthood represents a transitional life stage characterised by increasing independence, changing dietary habits, and reduced parental supervision (Syed et al., 2020; Saintila et al., 2024). Unlike studies from Europe and North America, where many students live independently, most participants in the present study continued to reside with their families. This cultural characteristic may influence dietary choices, meal preparation, and eating routines, suggesting that family environments continue to play an important role in shaping health behaviours among Libyan university students. Consequently, obesity prevention strategies in Libya may require greater engagement with families alongside university-based interventions.

Anthropometric assessment revealed that the average BMI of the study population fell within the overweight category, while half of all participants were classified as either overweight or obese. Female students demonstrated higher BMI, waist circumference, body fat percentage, and visceral fat ratings than male students, indicating a greater overall adiposity burden. These findings closely resemble previous national evidence demonstrating a high prevalence of overweight and obesity among Libyan adults, particularly women (Lemamsha et al., 2019; Lemamsha et al., 2022). Similar patterns have also been reported among university students in Saudi Arabia and neighbouring Gulf countries, where female students frequently exhibit higher obesity prevalence than males (Syed et al., 2020). Conversely, studies conducted in several European universities have reported lower obesity prevalence, possibly reflecting differences in physical activity participation, campus infrastructure, dietary environments, and health promotion programmes (Bede et al., 2020). The relatively high prevalence observed in Tobruk therefore suggests that obesity has become an important health challenge among Libyan university students and warrants early preventive action before unhealthy weight patterns persist into adulthood.

Students generally demonstrated moderate concern regarding their body weight and recognised its potential impact on future health. The highest levels of agreement related to concern about future health consequences and weight gain during university years, whereas satisfaction with current body weight was comparatively lower. These findings suggest that many students recognise obesity as an important health issue while remaining dissatisfied with their own weight status. Similar observations have been reported in previous university-based studies, where awareness of obesity-related health risks did not necessarily translate into healthier behaviours (Alothman et al., 2024; Syed et al., 2020). This discrepancy between perception and behavioural change may reflect psychological barriers, social norms, academic pressures, or environmental constraints that reduce students' ability to adopt healthier lifestyles despite recognising the importance of doing so.

Diet knowledge among Tobruk University students was generally satisfactory. Most participants correctly recognised the adverse health effects of sugary drinks, fast food, inadequate fruit and vegetable intake, large portion sizes, and physical inactivity. Comparable findings have been reported among Saudi university students, where nutritional awareness was relatively high despite substantial obesity prevalence (Syed et al., 2020). Nevertheless, lower agreement regarding meal skipping and frequent snacking indicates that important knowledge gaps remain. More importantly, the persistence of high overweight and obesity prevalence despite relatively good nutritional knowledge suggests that knowledge alone is insufficient to modify behaviour. This observation supports previous Libyan research indicating that obesity is more strongly associated with actual dietary practices than with awareness alone (Lemamsha et al., 2022).

Therefore, future health promotion programmes should move beyond traditional health education towards interventions that facilitate behavioural change within everyday university life.

The behavioural findings reinforce this interpretation. Participants reported frequent unhealthy dietary practices, prolonged sedentary behaviour, limited physical activity, and considerable academic pressures affecting healthy living. Long periods of sitting, extensive electronic device use, and prolonged screen exposure were common, consistent with international evidence demonstrating increasing sedentary lifestyles among university students (Elmahgoub et al., 2025; Dutta et al., 2025). At the same time, regular exercise participation remained relatively low despite students expressing strong agreement that physical activity is important for health and showing positive attitudes towards improving their lifestyles. This discrepancy illustrates the well-recognised gap between health knowledge, behavioural intention, and actual practice that has been observed across numerous university populations (Alothman et al., 2024; Seyam, 2025). Academic workload, limited recreational opportunities, insufficient time, and environmental barriers may all contribute to reduced physical activity within the Libyan university setting. Collectively, these descriptive findings indicate that obesity among Tobruk University students is likely influenced by the interaction of dietary practices, sedentary lifestyles, and insufficient physical activity rather than by lack of awareness alone, highlighting the need for comprehensive, behaviour-oriented university health promotion strategies.

Discussion of Hypothesis 1 (H1)

The findings supported H1, indicating that lower diet knowledge was associated with higher body mass index among Tobruk University students. Students with greater awareness of healthy eating generally demonstrated more favourable weight status, suggesting that nutritional knowledge may contribute to healthier lifestyle choices. These findings are consistent with previous university-based research reporting that nutrition knowledge supports healthier food selection and weight management (Syed et al., 2020; Seyam, 2025). However, evidence also suggests that knowledge alone is insufficient to change behaviour without supportive environments and practical skills (Aljefree et al., 2022; Alothman et al., 2024). Therefore, nutrition education should be combined with behaviour-focused interventions that encourage healthy food choices and long-term lifestyle modification.

The findings also supported H2, demonstrating that unhealthy dietary behaviours were associated with overweight and obesity among university students. Frequent consumption of energy-dense foods, sugary beverages, and irregular eating patterns appeared to contribute more strongly to excess body weight than nutritional knowledge alone. Similar findings have been reported among university students in Saudi Arabia and other countries, where unhealthy eating habits consistently predicted obesity (Syed et al., 2020; Aljefree et al., 2022). Comparable evidence has also been reported in Libya, reflecting increasing dietary westernisation and greater consumption of processed foods (Lemamsha et al., 2022; Saad et al., 2024). These findings highlight the importance of improving campus food environments alongside nutrition education to encourage healthier dietary practices.

The results supported H3, showing that sedentary behaviour was positively associated with overweight and obesity. Prolonged sitting, extended screen use, and limited movement throughout the day were linked with less favourable weight outcomes. These findings agree with previous research identifying sedentary lifestyles as an important behavioural determinant of obesity among young adults (Elmahgoub et al., 2025; Dutta et al., 2025). Similar associations have been reported internationally, where excessive screen time contributes to reduced energy expenditure and unhealthy eating behaviours (Saintila et al., 2024). Although sedentary behaviour interacts with diet and physical activity, reducing prolonged sitting and promoting regular movement may represent practical strategies for obesity prevention within university settings.

The findings further supported H4, demonstrating that lower physical activity was associated with higher body mass index. Students reporting lower participation in exercise and recreational activities were more likely to experience excess body weight. These findings are consistent with evidence showing that regular physical activity protects against obesity and improves metabolic health (Elmahgoub et al., 2025; Seyam, 2025). Nevertheless, despite recognising the importance of exercise, many students remained insufficiently active, suggesting that academic demands, limited opportunities, and motivational barriers may restrict participation (Alothman et al., 2024). Universities should therefore promote accessible physical activity programmes and supportive environments that facilitate regular exercise.

The findings supported H5, indicating that lifestyle-related variables remained significant predictors of body mass index after adjustment for sociodemographic characteristics. This suggests that modifiable behaviours exerted stronger influences on weight status than demographic factors alone. Similar conclusions have been reported in previous university-based studies and international obesity research, emphasising the central role of dietary habits, physical activity, and sedentary behaviour in obesity development (Ng et al., 2025; Syed et al., 2020; Saintila et al., 2024). Although causal relationships cannot be established because of the cross-sectional design, the persistence of these associations supports comprehensive university health promotion programmes that address multiple lifestyle behaviours simultaneously rather than focusing exclusively on demographic risk groups.

THEORETICAL AND PRACTICAL IMPLICATIONS

Growing evidence indicates that overweight and obesity among young adults are influenced by the interaction of behavioural, cognitive, and environmental factors rather than by individual choices alone (Ng et al., 2025; Syed et al., 2020). Likewise, ecological and behavioural health models propose that diet knowledge, eating behaviours, physical activity, and sedentary lifestyles collectively contribute to obesity development (Aljefree et al., 2022; Dutta et al., 2025). The present findings support this multidimensional perspective by demonstrating that diet knowledge, dietary behaviours, sedentary behaviour, and physical activity were all significantly associated with BMI among Tobruk University students. Although adequate nutritional knowledge was evident among many participants, unhealthy behavioural patterns remained common, suggesting that knowledge alone may not be sufficient to produce healthier lifestyles. These findings reinforce behavioural theories proposing that environmental opportunities, social influences, and daily habits mediate the translation of knowledge into practice.

Evidence from Libya has highlighted the increasing burden of obesity among young adults and the growing influence of westernised dietary habits, physical inactivity, and sedentary lifestyles on population health (Lemamsha et al., 2019; Lemamsha et al., 2022). Similar concerns have been reported across university populations internationally, where academic pressures, limited time, and digital dependency frequently reduce healthy lifestyle behaviours (Saintila et al., 2024; Elmahgoub et al., 2025). The higher prevalence of overweight and obesity among female students observed in the present study further suggests that cultural, behavioural, and environmental influences may differ across genders and should be considered when designing prevention strategies. Consequently, obesity prevention within Libyan universities should adopt an integrated approach that addresses behavioural change alongside the wider university environment.

The study also has several practical implications for higher education institutions and public health policy. Universities may benefit from strengthening nutrition education through practical rather than purely theoretical programmes, including healthy meal planning, food-label interpretation, and behaviour-change skills. Campus food services could increase the availability and affordability of healthier food options while reducing the promotion of energy-dense products. Furthermore, universities may encourage regular physical activity through accessible sports facilities, structured exercise programmes, and active campus initiatives designed to reduce prolonged sitting and excessive screen time. Health promotion campaigns should also emphasise behavioural self-management and healthy lifestyle habits throughout university life. Collectively, these findings provide evidence that may support the development of culturally appropriate obesity prevention strategies within Libyan universities and contribute to national efforts aimed at reducing non-communicable disease risk among young adults.

STRENGTHS AND LIMITATIONS

Several methodological strengths enhance the credibility of the present study. A relatively large sample of 500 undergraduate students recruited from multiple faculties provided broad representation of the Tobruk University population and increased the precision of prevalence estimates. Direct anthropometric assessment using calibrated equipment strengthened measurement accuracy compared with studies relying exclusively on self-reported height and weight. Furthermore, the integration of objective anthropometric measurements with structured behavioural questionnaires enabled comprehensive evaluation of obesity and its potential behavioural determinants. Assessment of reliability, validity, and normality before hypothesis testing further strengthened the robustness of the analytical procedures, while multivariable regression analysis allowed adjustment for important sociodemographic characteristics.

Nevertheless, several limitations should be considered when interpreting the findings. The cross-sectional design measured exposures and BMI simultaneously, preventing determination of temporal relationships or causal inference (Setia, 2016; Wang & Cheng, 2020).

Consequently, the observed associations should be interpreted as statistical relationships rather than evidence that lifestyle behaviours directly caused overweight or obesity. Behavioural variables were measured using self-reported questionnaires and therefore remain susceptible to recall bias and social desirability bias despite supervised questionnaire administration. In addition, participants were recruited from a single university in eastern Libya, which may limit the generalisability of the findings to other universities or regions of the country. Finally, although important behavioural determinants were included, other factors such as psychological wellbeing, sleep quality, food environment, family influences, and genetic susceptibility were not examined and may also contribute to obesity risk.

RECOMMENDATIONS FOR FUTURE STUDIES

Previous research has demonstrated the value of longitudinal and multi-centre investigations for understanding obesity development among young adults (Ng et al., 2025; Saintila et al., 2024). Future studies should therefore recruit students from universities across western, eastern, and southern Libya to improve national representativeness and permit regional comparisons. Longitudinal cohort designs would provide stronger evidence regarding temporal relationships between lifestyle behaviours and changes in body weight throughout university education.

Future research may also incorporate objective measurements of physical activity and sedentary behaviour using wearable devices, together with more detailed dietary assessment methods, to improve behavioural measurement accuracy. Mixed-methods studies exploring students' beliefs, motivations, and barriers to healthy lifestyles could provide deeper understanding of behavioural determinants that cannot be fully captured through structured questionnaires. Finally, intervention studies evaluating nutrition education, digital health applications, behavioural counselling, and campus-based physical activity programmes would provide valuable evidence regarding effective strategies for preventing overweight and obesity among Libyan university students.

CONCLUSION

Increasing evidence identifies obesity among university students as an emerging public health concern associated with modifiable lifestyle behaviours . The present study demonstrated that overweight and obesity are highly prevalent among Tobruk University students, with female students experiencing a greater burden than males. Diet knowledge, dietary behaviours, sedentary behaviour, and physical activity were all significantly associated with BMI, highlighting the importance of behavioural factors in shaping weight status during early adulthood. Although students generally recognised the importance of healthy lifestyles, unhealthy dietary practices, prolonged sedentary behaviour, and limited physical activity remained common. These findings suggest that knowledge alone is insufficient to reduce obesity without supportive behavioural and environmental interventions. Overall, the study provides the first comprehensive evidence describing overweight and obesity among Tobruk University students and offers a foundation for future research and university-based health promotion initiatives. Strengthening nutrition education, improving campus food environments, encouraging regular physical activity, and reducing sedentary behaviour may contribute to healthier lifestyles and help reduce the future burden of obesity and related non-communicable diseases among young adults in Libya.

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