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Burden of Malnutrition in Undergraduate Students of a Public Sector University in Lahore

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ABSTRACT

Background: Double burden of malnutrition, defined as the coexistence of underweight (undernutrition) and obesity, is a growing public health concern of both developed and developing countries.
Objective: To estimate the prevalence of the double burden of underweight and obesity among undergraduate students.
Methods: The cross-sectional analytical study conveniently included 456 volunteer students of both genders, aged 17-24 years. Data were collected using a purposely designed interviewer-administered questionnaire. Weight and height were measured to calculate body mass index (BMI). Data analysis was performed using the Statistical Package for Social Sciences (SPSS) version 25.
Results: The mean age of the participants was 19.1±2.7 years for males and 20.9±1.8 years for females. The prevalence rates of underweight, normal weight, and overweight were 25.7%, 52.6%, and 21.8%, respectively. The double burden of underweight and overweight was more prevalent in males than in females. According to the WC criteria, abdominal obesity was slightly higher in females than males (39.2% vs. 37.0%). However, according to the WHR criteria, the prevalence of abdominal obesity in females was more than double that of males (53.4% vs. 24.9%). Abdominal obesity was found to be more common than general obesity and remained significantly high among females (p-value <0.001).
Conclusion: Double burden of malnutrition was prevalent among undergraduate students and females were more obese than males. Urbanization, nutritional transitions, and sedentary lifestyles contribute to this health problem. Regular physical activity and a balanced diet are crucial for preventing obesity-related health issues. Implementation of health education programs at college and university levels is strongly recommended.

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Introduction

The double burden of malnutrition, defined as the coexistence of undernutrition (underweight) and obesity, is increasingly prevalent among populations in both developed and developing countries [1]. This phenomenon has been observed at both national and household levels [2][3]. Despite significant social and

economic growth in low- and middle-income countries, undernutrition remains widespread and continues to be a primary cause of poor health, exacerbated by low physical activity and high consumption of fat-rich foods [4]. Conversely, the prevalence of obesity is steadily increasing due to unhealthy lifestyle practices across affluent and less affluent nations [5]. Obesity is a major risk factor for non-communicable diseases such as diabetes mellitus, hypertension, cardiovascular disease, arthritis, and cancer [6].

Globally, the estimated prevalence of overweight adults in 2008 was 1.46 billion, with 502 million categorized as obese [7]. In Pakistan, the prevalence of overweight and obesity among the general population is approximately 25.0% [8]. Body mass index (BMI) is a widely accepted criterion for assessing overweight and obesity in adults, while waist circumference (WC) is considered the most reliable measure of abdominal obesity. However, the relationship between BMI and body fat percentage varies among different ethnic groups [9]. Therefore, the BMI cutoff values for overweight and obesity have been redefined as ≥23 kg/m² and ≥25 kg/m², respectively, for Asian populations [10].

Economic development has significantly influenced the lifestyles of the general population, including undergraduate students in Pakistan. Accurate and comprehensive data on the prevalence of underweight and overweight is essential for effective public health interventions. The objective of this study was to estimate the double burden of underweight and obesity among undergraduate students.

Methods

The cross-sectional analytical study was conducted at a Public Sector University of Lahore. The criteria for participation were undergraduate students, aged 17-24 years, and of both genders. Total 456 volunteer students were selected using a non-probability convenient sampling technique. Data were collected using a purposely designed interviewer-administered questionnaire. Data included age, gender, background, socioeconomic status, smoking, drug use, TV watching, internet usage, video gaming, exercise, sports participation, personal and family medical history, dietary habits (type and frequency), and anthropometric measurements (height, weight, waist circumference, and hip circumference).

Body weight (kg) was measured using a digital weighing machine with 100g precision, ensuring participants wore light clothing and no shoes. Height (cm) was measured using a non-extensible scale with 1 cm precision on a flat surface. Measurements were taken with participants standing upright, arms at their sides, and without footwear.

BMI was calculated using the formula:

$$\text{Body Mass Index} = \text{Weight (Kg)} / \text{Height (m)}^2$$

General obesity was defined as shown in Table 1.

Table 1: BMI classification criteria for overweight and obesity in adults Asia Pacific [10]

	BMI	Risk
Underweight	<18.5	Low
Normal range	18.5 – 22.9	Average
Overweight: ≥23.0		
At Risk	23.0 – 24.9	Increased
Obese class I	25.0 – 29.9	Moderate
Obese class II	≥30.0	Severe

Waist circumference (in inches) was measured just above the belly button and below the rib cage, while hip circumference (in inches) was measured at its widest point. Abdominal obesity was defined as a waist circumference of ≥35 inches for males and ≥32 inches for females [10].

Statistical Analysis: Data analysis were performed using the Statistical Package for Social Sciences (SPSS) version 25. Age, height, weight, BMI, waist circumference, hip circumference, and waist-hip ratio were presented as Mean ± SD. The prevalence of underweight, overweight, and obesity was expressed as frequency (percentage). Comparisons of anthropometric measurements between genders were conducted using the Mann-Whitney U test, with a p-value ≤0.05 considered statistically significant.

Results

The study included 173 males (37.9%) with a mean age of 19.1±2.7 years and 283 females (62.1%) with a mean age of 20.9±1.8 years. The overall prevalence of underweight, normal weight, and overweight was 25.7%, 52.6%, and 21.8%, respectively. The double burden of underweight and overweight was observed more frequently in males compared to females. When comparing overweight individuals (BMI ≥23.0 kg/m²) between genders, more females were classified in the "At

Risk" group (BMI 23.0–24.9 kg/m²) and "Obese Class I" group (BMI 25.0–29.9 kg/m²). Notably, no females were categorized in the "Obese Class II" group (BMI ≥30.0 kg/m²).

Abdominal obesity prevalence was significantly higher than general obesity. Waist-hip ratio (WHR) was the most sensitive measure of abdominal obesity, identifying 42.5% of participants, followed by waist circumference, which identified 38.4%. According to the WC criteria, abdominal obesity was slightly higher in females than males (39.2% vs. 37.0%). However, according to the WHR criteria, the prevalence of abdominal obesity in females was more than double that of males (53.4% vs. 24.9%). These findings confirm that abdominal obesity was more common in females than in males, as evidenced by both WC and WHR measures (Table 2).

The mean height and weight differed significantly between genders (p-value <0.001); however, this difference was not significant when comparing the mean BMI. Conversely, the mean waist circumference and waist-hip ratio showed significant differences between genders (p-value <0.001) (Table 3).

Among overweight individuals (BMI ≥23.0 kg/m²), the proportion of males was higher than females; however, abdominal obesity was more prevalent in females. Urban residency appeared to be associated with general obesity, while higher socioeconomic status (upper class) was a significant factor among overweight individuals. Abdominal obesity (based on WC) was notably more common among cigarette smokers.

Interestingly, a majority of overweight and abdominally obese students reported engaging in regular exercise, which could be attributed to efforts aimed at weight loss. Sedentary behaviors, such as prolonged TV watching and internet use, were linked to both general and central obesity.

Non-vegetarian students and those who reported eating to full satiety showed higher frequencies for elevated BMI and WC but lower frequencies for increased WHR.

Table 2: Prevalence of general and abdominal obesity according to BMI, WC and WHR

	Findings	All(n=456)	Males(n=173)	Female (n=283)	P-Value
Body Mass Index	**Underweight (<18.5)**	117 (25.7%)	55 (31.8%)	62 (21.9%)	0.018
	Normal (18.5-22.9)	240 (52.6%)	76 (43.9%)	164 (58.0%)	0.003
	Overweight (≥23)	99 (21.8%)	42 (24.3%)	57 (20.1%)	0.291
	At Risk (23.0-24.9)	51 (51.5%)	21 (50.0%)	30 (52.6%)	0.589
	Obese Class I (25.0- 29.9)	43 (43.4%)	16 (38.1%)	26 (46.4%)	0.082
	Obese Class II (≥30.0)	05 (5.1%)	05 (11.9%)	0 (0.0%)	<0.001
Waist circumstances	**Abdominal Obesity**	175 (38.4%)	64 (37.0%)	111 939.2%)	0.639
	Waist-Hip Ratio	194(42.5%)	43(24.9%)	151 (53.4%)	<0.001

n (%), BMI=Body Mass Index, WC=Waist Circumference, WHR=Waist-Hip Ratio

Table 3: Comparison of anthropometric measurements across the gender

	All	Males	Females	p-value
Waist (Inch)	32.08±3.52	30.75±3.13	33.40±3.73	<0.001
Hip (Inch)	35.70±3.65	35.32±3.45	35.93±3.75	0.086
WHR	0.89±0.07	0.87±0.06	0.90±0.07	<0.001
Height (m)	1.64±0.08	1.70±0.06	1.60±0.06	<0.001
Weight (kg)	55.79±10.49	60.27±12.81	53.05±7.59	<0.001
BMI (kg/m²)	20.82±3.37	20.84±4.12	20.81±2.83	0.149

Mean±SD, BMI=Body Mass Index, WHR=Waist-Hip Ratio; * P-Value ≤0.05 considered significant

Table 4: General characteristics and prevalence of underweight, overweight and abdominal obesity

	Total Cases	General Obesity	Abdominal Obesity	
	n=456	BMI	WC	WHR
		99 (21.8%)	175 (38.4%)	194 (42.5%)
Gender	**Male=173 (37.9%)**	42 (24.3%)	64 (37.0%)	43 (24.9%)
	Female=283 (62.1%)	57 (20.1%)	111 (39.2%)	151 (53.4%)
Residence	**Urban=386 (84.6%)**	86 (22.3%)	151 (39.1%)	169 (43.8%)
	Rural=70 (15.4%)	13 (18.6%)	24 (34.3%)	25 (35.7%)
SES	**Lower=22 (4.8%)**	05 (22.7%)	06 (27.3%)	07 (31.8%)
	Middle=406 (89.0%)	86 (21.2%)	159 (39.2%)	175 (43.1%)
	Upper=28 (6.1%)	08 (28.6%)	10 (35.7%)	12 (42.9%)
Smoking	**No=441 (96.7%)**	96 (21.8%)	167 (37.9%)	193 (43.8%)
	Yes=15 (3.3%)	03 (20.0%)	08 (53.3%)	01 (6.7%)
Exercise	**No=190 (41.7%)**	34 (17.9%)	56 (29.5%)	83 (43.7%)
	Yes=266 (58.3%)	65 (24.4%)	119 (44.7%)	111 (41.7%)
TV Watching	**No=87 (19.1%)**	17 (19.5%)	29 (33.3%)	31 (35.6%)
	Yes=369 (80.9%)	82 (22.2%)	146 (39.6%)	163 (44.2%)
Use Internet	**No=141 (30.9%)**	30 (21.3%)	44 (31.2%)	53 (37.6%)
	Yes= 315 (69.1%)	69 (21.9%)	131 (41.6%)	141 (44.8%)
Meal type	**Vegetarian=09 (2.0%)**	01 (11.1%)	03 (33.3%)	06 (66.7%)
	Non-Vege=447 (98.0%)	98 (21.9%)	172 (38.5%)	188 (42.1%)
Eat full appetite	**No=162 (35.5%)**	27 (16.7%)	52 (32.1%)	72 (44.4%)
	Yes=294 (64.5%)	72 (24.5%)	123 (41.8%)	122 (41.5%)
Meals per day	**02 times=145 (31.8%)**	32 (22.1%)	58 (40.0%)	68 (46.9%)
	03 times=286 (62.7%)	64 (22.4%)	107 (37.4%)	113 (39.5%)
	04 times=25 (5.5%)	03 (12.0%)	10 (40.0%)	13 (52.0%)
High fat diet	**No=312 (68.4%)**	59 (18.9%)	116 (37.2%)	143 (45.8%)
	Yes=144 (31.6%)	40 (27.8%)	59 (41.0%)	51 (35.4%)
High protein diet	**No=80 (17.5%)**	16 (20.0%)	28 (35.0%)	30 (37.5%)
	Yes=376 (82.5%)	83 (22.1%)	147 (39.1%)	164 (43.6%)
Fast Food	**No=103 (22.6%)**	19 (18.4%)	36 (35.0%)	43 (41.7%)
	Yes=353 (77.4%)	80 (22.7%)	139 (39.4%)	151 (42.8%)
Carbonated water	**No=65 (14.3%)**	09 (13.8%)	20 (30.8%)	30 (46.2%)
	Yes=391 (85.7%)	90 (23.0%)	155 (39.6%)	164 (41.9%)

SES=Socioeconomic status, BMI=Body Mass Index, WC=Waist Circumference, WHR=Waist-Hip Ratio General obesity BMI (≥23 Kg/m^2); Abdominal obesity: WC ≥35 inches in males and ≥32 inches in females; and/or WHR, ≥0.90 in males and ≥0.85 in females

Overweight individuals who consumed two meals per day outnumbered those who ate four meals per day. A majority of participants denied consuming high-fat diets (e.g. Siri, Paaye, and Nehari), potentially as a lifestyle adjustment after becoming obese.

Overweight and abdominal obesity were more frequently observed among students consuming protein-rich diets, fast food, and carbonated beverages (Table 4).

Discussion

In this cross-sectional study involving 456 students of both genders aged 17–24 years, the overall prevalence of underweight, normal weight, and overweight was 25.7%, 52.6%, and 21.8%, respectively. The double burden of underweight and obesity observed in this study was slightly higher than the frequencies reported in Karachi students, where underweight and overweight prevalence were 17.0% and 18.0%, respectively [11]. In contrast, the prevalence of overweight among Kuwaiti students

reported by Almajed et al. was nearly double (30.6%), likely due to greater urbanization and industrialization in Kuwait [12]. According to the Asia-Pacific BMI (kg/m²) classification criteria for overweight and obesity,[10] the prevalence of obesity in this study (10.5%) aligned closely with the 10.3% prevalence reported by Jafar et al. A gender-based comparison showed that obesity was more common in males than females, which contrasts with Jafar's findings, where females in the 17–24 age group were more obese than males [13].

Suliga et al. reported underweight, overweight, and abdominal obesity prevalence rates of 11.1%, 7.0%, and 11.2% in female students [14], which were 2-4 times lower than the respective frequencies observed among females (n = 283) in this study. Similarly, the prevalence rates of overweight (21.8%) and obesity (15.7%) reported by Al-Rethaiaa et al. among male Saudi students [15] were comparable to those for overweight (24.3%) and obesity (12.1%) among male students (n = 173) in this study.

Consistent with the findings of Okosun et al. [16], the prevalence of abdominal obesity in this study was significantly higher than general obesity. Waist-hip ratio proved to be a more effective criterion for assessing abdominal obesity than waist circumference, with females showing higher rates of abdominal obesity than males. Czernichow et al. found no association between abdominal obesity and socioeconomic status [17], which aligns with the present study's findings. Additionally, suggested that low levels of physical activity contribute more to obesity than unhealthy dietary habits. A study has proposed that nutrition counseling must be an essential part of antenatal care for all pregnant women [18]. Factors such as female gender, urban residence, sedentary behavior, and dietary patterns (including high-protein diets, fast food, and carbonated drinks) were identified as potential contributors to overweight and abdominal obesity.

Conclusion

Double burden of malnutrition was prevalent among undergraduate students and females were more obese than males. Urbanization, nutritional transitions, and sedentary lifestyles contribute to this health problem. Regular physical activity and a balanced diet are crucial for preventing obesity-related health issues. Implementation of health education programs at college and university levels is strongly recommended.

Authors' contributions

ICMJE criteria	Details	Author(s)
1. Substantial contributions	Conception, OR Design of the work, OR Data acquisition, analysis, or interpretation	1 1,2 3,4,5
2. Drafting or reviewing	Draft the work, OR Review critically for important intellectual content	1,5 2,3,4
3. Final approval	Approve the version to be published	1,2,3,4,5
4. Accountable	Agree to be accountable for all aspects of the work	1,2,3,4,5

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Informed consent was obtained from all participants.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests

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