



An in-depth analysis of the obesity phenomenon in unveiling the prevalence, risk factors, and consequences of normal-weight obesity among young adults

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Abstract:

Objective: Up until recently, body mass index (BMI) was employed to evaluate obesity. Later research has shown the accuracy of central body fat (BF) measures as an indicator of digestive disorders. As a result, normal-weight obesity (NWO) is described. Metabolic syndromes are discovered to be present at a very young age in people with BMIs that are within the normal range but have higher fat percentages. With food and exercise as possible variables, the research is primarily targeted at young adults in particular since early intervention may stop the onset of many noncommunicable illnesses. This study's objective is to calculate the general incidence of obesity and its contributing factors, paying particular attention to NWO.

Methods: This research was conducted at Mayo Hospital from March 2021 to April 2023. 269 young individuals were the subject of cross-sectional research that looked at nutrition, exercise, and other lifestyle variables. By Jackson and Pollock's and Siri's calculations, the BF % was determined using Harpenden skinfold calipers. Additionally, binary logistic regression was effectively used.

Results: Obesity prevalence was 42.01%, whereas NWO prevalence was 16.1%. Sex, a high-protein diet, eating out often, consuming fewer homemade tiffins, and vigorous exercise use were shown to be substantially linked with obesity. Fish consumption, exercise, a diet high in protein, and daytime sleep were all shown to be strongly linked with NWO.

Conclusions: The research accentuates the significance of BMI and BF % in routine medical procedures. It could support efforts for promotion and prevention.

Keywords: BMI, obesity, normal-weight obesity

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Introduction:

One of the greatest global public health issues is obesity, which is prevalent everywhere. At the moment, India is struggling with both undernutrition and overnutrition. In Pakistan, there are 43.9% of obese persons.[1] Negative metabolic consequences may result from obesity, a common type of malnutrition. As body mass index (BMI) rises, so does the risk of diabetes and heart disease.[2] Both directly and indirectly, these illnesses place a strain on the nation's already precarious healthcare system. The WHO developed a BMI-based classification system for obesity: BMI less than 18.5 is regarded as underweight; BMI between 18.5 and 24.9 indicates normal weight; BMI between 25 and 29.9 is deemed overweight; and BMI above 30 is deemed obese; this approach is mostly based on Western standards.[3] Because obesity-related issues among Asians begin to show up at lower BMIs, the WHO subsequently suggested a lower threshold for

treatments among Asians.[3] The WHO classification is still being used in a variety of obesity studies throughout the world to compare results. According to the WHO Asian BMI standard, obesity is defined as having a BMI >25 kg/m²[4]. The study uses this criterion to get the composite numbers for obesity and overweight.

BMI is often used to describe obesity, yet it has relatively poor sensitivity and high specificity. Later research highlights the use of central body fat (BF) measurements as a trustworthy indicator of metabolic disorders. Lean muscle mass and BF cannot be distinguished by BMI. Those who have more muscle mass but less body fat may be wrongly classified as obese, and vice versa for those who have less muscle mass but more body fat.[5] In 1981, the idea of a person who is metabolically obese yet has a normal BMI but abnormal metabolic markers, such as dyslipidemia and high blood sugar, was developed.[6] The term "normal-weight obesity" (NWO) was then used to describe people with normal body weights and BMIs (18.5-24.9) but elevated BF%, i.e., men and females with BF% of more than 17.6% and more than 31.6%, respectively. Very little research on NWO is conducted in Pakistan. Compared to the general population, NWO persons had a four times greater prevalence of metabolic syndrome.[7] Thus, the primary goal of this research is to determine the frequency of obesity and its factors, with a particular emphasis on NWO, among the community of young adults at Mayo Hospital Lahore, as well as to provide recommendations based on the results.

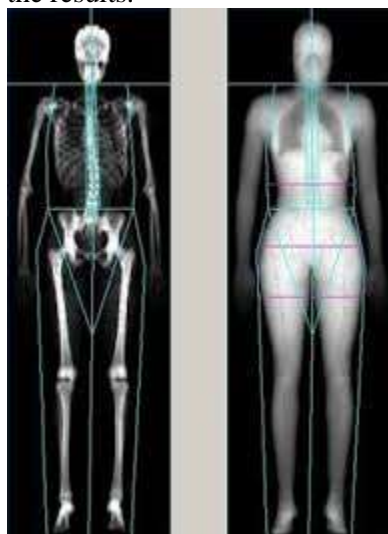


Figure 1: Normal-Weight Obesity

Methods:

Study Design: This descriptive cross-sectional research was undertaken at Mayo Hospital after receiving ethical approval. In this research, 269 participants between the ages of 18 and 24 were included. The study had no exclusion criteria. Systematic random sampling was the technique employed to select the sample. The research was conducted between March 2021 and April 2023.

According to the established methodology, measurements of waist circumference, weight, and height were taken with the help of a non-stretchable measuring tape, a digital scale, and a stadiometer, respectively. The thickness of the skinfold was precisely measured using a Harpenden caliper. When used regularly, this caliper provides 99% accuracy for thicknesses up to 80 mm, which is superior to conventional BF estimating techniques. Considering skin-fold thickness, the Jackson and Pollock technique was used to determine the BF %. The sum of skinfolds is most often employed to measure body composition. The technique used to calculate body density (BD) uses the age and the total of skinfolds. BD was then translated to % BF using the Siri two-component model. NWO is characterized by a BMI that is within the normal range and a BF of more than 17.6% for males and 31.6% for women. People who fell below these thresholds were labeled as normal-weight lean (NWL). Skinfold evaluation has certain drawbacks, yet it is nevertheless a commonly used research technique because of its simplicity, affordability, repeatability, and lack of need for sophisticated equipment.

Statistical Analysis: The SPSS v.27 statistical analysis software was used. Various methods have been used to determine the interaction between the various exposure factors and the result. In the first approach, binary logistic regression was used, which categorizes and binary-files the outcome variables. In the same way, as obese, overweight, and normal weight obese were consolidated into one term, so were underweight and NWL.

Results:

With a focus on the phenomena of normal-weight obesity (NWO), this research investigated the prevalence and causes of obesity in young individuals. There were 269 participants in the research, with 46.5% women and 53.5% men. Males were 21.1 (1.75) years old on average, while females were 20.55 (2.14) years old. Twenty-one percent of participants were in their first year of college, followed by 21.9% of participants in their second year, 20.1% in their third year, 20.1% in their final year, and 23.4% of participants were interns.

Table 1: The relationship between obesity and variables linked to nutrition and lifestyle

Factors	p-value	Chi-sqr	Factors	p-value	Chi-sqr
Fast Foods	< 0.01	22.08	Sleeping at Day-time habit	0.8	0.02
Leaving out morning meal	< 0.01	8	Six hours of sleep, minimum	0.01	7.6
Between-meal snacks	0.6	0.27	Excessive reliance on technology	0.01	6.4
Frequent restaurants visits	< 0.01	22.32	The feeling of being overweight	0.2	1.4
Daily use of tiffins made at home	< 0.01	73.9	Considering life to be stressful	0.02	5.1
Consumption of a diet with high proteins	< 0.01	67.4	Inspiration to maintain good health	< 0.01	22.1
Consumption of cereals with high fiber	< 0.01	78.4	Smoking	0.3	2.17
Fruits	0.6	0.16	Intense physical activity	< 0.01	58.4
Consumption of green leafy vegetables	< 0.01	70.3	Mild physical activity	< 0.01	27.5
Consumption of fish	0.9	0.002	Little physical activity	0.3	2.3

The Modified Kuppaswamy scale was used to assess the socioeconomic position of the participants, and it classified 22.68% of them as upper-lower class, 3% as lower-middle class, 40.89% as upper-middle class, and 33.46% as upper class. 86.2% of the participants were hostel dwellers, while 13.8% were day students. Males had a mean weight and height of 73.33 (12.5) kg and 171.1 (6.4) cm, while females had a mean weight and height of 68.9 (12.8) kg and 165.14 cm (5.9), respectively.

Overweight and obese (BMI >25) were more common than obesity (BMI >30), with a prevalence of 42.01% (51.4% for men and 31.2% for women). 16.4% of people had NWO (females 22.4%, men 11.1%). 28.6% of participants were normal weight (NWL), while 13.01% were underweight. Males had a larger incidence of obesity (P = 0.001), but females had a higher prevalence of NWO. Obesity in first-degree relatives was not substantially correlated with age, religion, academic year, socioeconomic level, or obesity. Vegetarian or mixed diets were likewise not substantially linked to obesity. The relationship between numerous dietary and lifestyle variables and obesity is shown in Table 1.

To ascertain the impact of different variables on the chance of individuals becoming obese, binomial logistic regression analysis was used. The logistic regression model successfully identified 82.9% of cases and had a statistically significant (P 0.0005) Nagelkerke R² of 63.0% for the variation in obesity. As indicated in Table 2, five of these predictor factors were statistically significant.

Table 2: Analysis of obesity risk variables using binary logistic regression

Variables	p-value	B	Exp (B)	Confidence Interval Range
Gender (Male)	0.02	0.86	0.423	0.2-0.8
Intense exercise				
2 to 4 per week	0.918	-0.073	0.93	-1.971-1.75
Less than 2 per week	0.073	1.405	4.074	-0.726-3.68
Not taking homemade tiffins	0.002	1.5	4.48	0.597-2.886

Not getting six hours of sleep every day	0.037	2.083	8.03	0.247-2.624
Consumption of cereals with high fiber less than 3 days per week	0.002	1.693	5.436	0.646-2.936
Consumption of a diet with high proteins	0.007	0.741	8.845	0.849-5.65
Consumption of a diet with low proteins	0.243	0.623	3.231	-0.631-4.68

Table 3 compares NWO among people of normal weight depending on sociodemographic, dietary, and lifestyle-related variables. Gender, snacking patterns, missing breakfast, eating fish, consuming foods rich in protein and fiber, eating out, engaging in physical exercise, and sleeping patterns were all strongly linked to NWO.

Table 3: Comparing obesity rates among people of similar weights

	NOW				p-value	Chi-sqr
	No	%	Yes	%		
Sex						
Female	34	54.8	28	45.2		
Male	43	72.9	16	27.1	0.04	4.23
Staying at Hostels	68	66	35	34	0.19	1.6
Consumers of tiffin made a home	42	72.4	16	27.6	0.54	3.7
Between-meal snacks	21	45.7	25	54.3	0.001	10.3
Leaving out morning meal	10	33.3	20	66.7	0.001	15.8
Vegetarians	27	57.4	20	42.6	0.2	1.27
Consumption of fish	50	72.5	19	27.5	0.02	5.4
Consumption of green leafy vegetables more than 3 per week	72	66.7	36	33.3	0.05	3.9
Consumption of a diet with high proteins of more than 60 g per week	43	91.5	4	8.5	0.001	29.6
Consumption of cereals with high fiber more than 3 per week	54	72	21	28	0.015	5.9
Fruit consumption of more than 3 per week	17	56.7	13	43.3	0.36	0.84
Frequent restaurant visits more than 3 per week	6	35.3	11	64.7	0.004	10.8
Fast food more than 3 per week	11	44	14	56	0.06	5.3
Lacking six hours of sleep	2	12.5	14	87.5	0.001	20.8
Sleeping at Day-time	18	48.6	19	51.4	0.023	5.2
Intense exercise	27	90	3	10	0.005	55.2

Discussions:

According to the research, the occurrence of obesity is 10.03%, while that of being overweight or obese is 42.01. According to the Asian BMI categorization, 42.01% of people are obese. This is consistent with the study's assumed prevalence. The incidence of obesity among men was nearly twice that of women, adding to the body of research.[8]

NWO was present in 16.4% of the population overall, with females having a higher incidence than men. This nearly exactly matches the results of a prior study among young people that was done in this area [9]. We were unable to locate published Indian statistics for a comparison of NWO prevalence. Despite having a greater criterion for BF, guys were more likely to be obese than females to be NWO. Contrary to common assumptions, women are not often considered to be heavier. As BMI may be deceptive for females, this emphasizes the need for BF measurement for early management.

Eating a varied diet was not linked to either obesity or NWO, according to the report.[10] The quantity of oil and other ingredients used in tiffin services may be the reason why people who consume homemade tiffin are less likely to be obese. Contrary to earlier study, it was shown that mid-meal snacking was strongly associated with rising adiposity rather than obesity. [11] Although there was no correlation between fish intake and BMI, there was a strong correlation between adiposity and it since two-thirds of fish eaters were NWL. The omega-3 fatty acid content of a fish-based diet has grown, although there is presently no proof that it has an anti-obesity impact.[12] The fewer omega-3 fatty acids consumed, the more obesity is shown to grow.[13] The WHO technical study on obesity indicated that regular breakfast consumers had BMIs that were within the normal range.[14] A third of NWO routinely skipped breakfast. This might delay metabolism and cause subsequent overeating, which would result in weight gain.[15] It was discovered that frequent diners were on the heavier side, which is in line with the results of the earlier study.[16] This highlights how important it is for working people and students to have access to healthy food alternatives. Obesity has been linked to consuming fast food more than twice a week, which is in line with the literature [17,18]. A higher frequency of dining out and the intake of junk food have both been linked to NWO.

The study's most important conclusion was that two-thirds of the people who frequently ate green leafy vegetables were nonobese. Consumption of green vegetables, however, had little bearing on NWO. The majority of those who ate high-fiber cereal were not fat. A high-fiber diet was shown to affect BMI, which is confirmed by the literature. [19,20] In a larger multicenter experiment, it was shown that there was an inverse relationship between dietary protein consumption and BMI.[21] Participants with NWO were more likely to consume low-protein and less high-fiber cereal.

According to research findings,[22] the majority of people who engaged in moderate to vigorous physical exercise for >4 days a week were not obese. The majority of those with normal weight and more than three days per week of vigorous physical exercise were NWL, which has been demonstrated to be a protective factor against obesity. This confirms the significance of offering young folks leisure space and gyms in their job or study location.

The research is supported by the fact that regular sleep of at least 6 hours affects BMI. [23] An irregular sleep schedule or insufficient sleep raises the risk of becoming overweight or obese because it alters the body's metabolic reactions and may lead to the deposition of more fat. In this research, daytime sleep had no impact on obesity. More than half of the normal-weight individuals who used to sleep during the daytime and the majority of those who reported not getting enough sleep were NWO. This will enable us to comprehend the significance of sleep patterns and quality in obesity.

This study's breadth was constrained by the small sample size and localization to a single institution. Despite the relatively small sample size, this research provides important insights into the factors that contribute to obesity and NWO in young people, both of which are understudied in this region of the globe. Physical activity, dietary practices, and other lifestyle-related aspects fall under this category. Contrary to other imaging approaches, the body caliper method of BF evaluation is a straightforward and affordable instrument that may be used repeatedly on the same person for improved results over time.

Conclusions:

The study found that although women were more likely to have NWO, men were more likely to be obese. Dietary elements that have been linked to obesity prevention include eating more protein, eating a diet rich in fiber, eating fish, eating green leafy vegetables, and eating breakfast often. Insufficient sleep and lack of physical exercise may all cause obesity and NWO. The true burden of NWO in the nation may be estimated by doing comparable research with bigger sample numbers throughout the nation.

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