International Journal of Clinical Science and Medical Research
ISSN(print): 2770-5803, ISSN(online): 2770-582X
Volume 06 Issue 03 March 2026
DOI: https://doi.org/10.55677/IJCSMR/V6I3-05/2026, Impact Factor: 8.005
Page No : 53-65

Impact of lifestyle on Obesity Categories Among Arbaeen Pilgrims, Iraq

Sana Abdul-Jabbar Ali
Al Safwa University College, Karbala, Iraq

ABSTRACT

Background: Diet, physical activity, sleep patterns, bowel habits, and consumption of sugary drinks are some of the lifestyle factors that contribute to obesity, a growing global health concern. Fast food consumption and sedentary lifestyles have led to an increase in obesity rates in Iraq. A special environment for evaluating lifestyle modifications and their effect on the severity of obesity is provided by the Al-Arbaeen pilgrimage.

The study's objective is: to determine the predictors of severe obesity and evaluate the relationship between lifestyle factors and obesity classes among Al-Arbaeen participants.

Method: During the Al-Arbaeen period, a cross-sectional study was carried out. A structured questionnaire was used to gather information on sociodemographics, dietary habits, physical activity levels, sleep duration, bowel habits, and soft drink consumption. Waist circumference and body mass index (BMI) were examples of anthropometric measurements. Class I, Class II, and Class III obesity were distinguished. Descriptive comparisons and multivariate regression were used in the statistical analysis to find important predictors of the severity of obesity.

Findings: Class Obesity was the most prevalent. Fast food, soft drinks, inactivity, poor sleep, sedentary work, and delayed bowel habits were all associated with higher obesity classes. As the degree of obesity increased, so did the waist circumference. A poor diet, inactivity, and gender were important predictors. Conclusion: Among Al-Arbaeen participants, lifestyle choices significantly influence the degree of obesity. To lower the risk of obesity and improve overall metabolic health, the findings highlight the necessity of focused health interventions that improve sleep patterns, increase physical activity, improve diet quality, and reduce consumption of sugary drinks.

Published Online: March 27, 2026

KEYWORDS:
Obesity, lifestyle, arbaeen piligrims, Karbala

INTRODUCTION

In 2016, the World Health Organization (WHO) said that more than 1.9 billion adults were overweight, and more than 650 million of those adults were obese. Obesity is the most common long-term illness in the world right now, and estimates say that by 2030, it will affect more than a billion people (Mahmoud, 2022).

Obesity is a complicated metabolic disorder that greatly raises the risk of insulin resistance, type 2 diabetes mellitus, heart problems, and metabolic dysfunction-associated fatty liver disease (MAFLD). Obesity entails significant disruptions in hormonal regulation, inflammatory signaling, and lipid and glucose metabolism, in addition to excessive fat accumulation (Franzago *et al.*, 2022).

These changes cause problems at the tissue level in the liver, pancreas, skeletal muscle, and cardiovascular system, which makes metabolic homeostasis worse. Even with a lot of research, we still don't fully understand the exact molecular pathways that link obesity to its related health problems. A more thorough understanding of these mechanisms may help create better treatment plans that stop the progression from obesity to metabolic disease (Ghosh *et al.*, 2023). The resulting decline in workforce productivity, coupled with heightened utilization of health care services, is anticipated to impose a profound economic impact (Czernichow *et al.*, 2021).

Corresponding Author: Sana Abdul-Jabbar Ali
Cite this Article: Sana Abdul-Jabbar Ali (2026). Impact of lifestyle on Obesity Categories Among Arbaeen Pilgrims, Iraq. International Journal of Clinical Science and Medical Research, 6(3), 53-65. https://doi.org/10.55677/IJCSMR/V6I3-05/2026

These results highlight the importance of treating obesity as a long-term, chronic, and relapsing disease that needs long-term care. Nonetheless, attaining or maintaining weight loss, or averting weight gain with advancing age, continues to pose a significant challenge for the majority of individuals. In this context, investigating behavioral modifications that can mitigate the detrimental effects of obesity on morbidity and mortality presents significant potential for public health advancement (Aldubikhi, 2023).

Dietary choices are a big reason why people become overweight. Eating too many calories is caused by eating more highly processed foods, sugary drinks, and high-calorie snacks. Research shows that people who eat a lot of fruits, vegetables, whole grains, and lean meats are less likely to become obese after 2021. Irregular meal times and eating late at night also cause weight gain by messing up the body's metabolic cycles (Zaninotto, Head and Steptoe, 2020).

Another major lifestyle factor that is linked to obesity is not being active. Being inactive, like sitting for long periods of time, working at a desk, or spending time on screens for fun, lowers the amount of energy you use. After the COVID-19 pandemic, reports showed that many people gained weight because they couldn't move around as much during lockdowns. Exercise on a regular basis burns calories and also makes your metabolism, body composition, and hormone levels better (Rassy *et al.*, 2023).

The length and quality of sleep have also become significant lifestyle factors influencing obesity. Short sleep and sleep disturbances change hormones that control appetite, like leptin and ghrelin. People who sleep less than seven hours a night are more likely to eat too much of foods high in calories and be less active. Studies conducted after 2021 associate sleep deprivation with weight gain in both adults and adolescents (Hulsegge *et al.*, 2021).

Technology has changed how people live by making them more sedentary and giving them tools to help them lose weight. Using smartphones, computers, and gaming systems for a long time makes people move less. But fitness apps and wearable devices can help you keep track of what you eat and how much you move. Research indicates that individuals utilizing digital health tools are more inclined to sustain healthy habits when accompanied by motivation and education (Lopez-Barreiro *et al.*, 2024).

In conclusion, daily habits have a big effect on obesity. Diet, exercise, sleep, stress, and social factors all work together to help people gain or lose weight. Recent evidence underscores the significance of healthy living in the prevention and management of obesity. Public health strategies, individual accountability, and nurturing environments continue to be essential elements in tackling this global health challenge (Wilson *et al.*, 2022).

The study included a number of Al-Arbaeen pilgrims who went to the yearly religious gathering in Karbala, Iraq, that honors the fortieth day after Imam Hussain's death. More than twenty million people from many different countries, mostly Iraq, Iran, Lebanon, Pakistan, and other Middle Eastern and Asian countries, come to this event. The people who were recruited were from a wide range of ages and genders. During the pilgrimage, volunteer groups set up mawakib (service stations) along the main routes to Karbala to offer free public services like food, water, shelter, and medical care. This setting offered a distinctive opportunity to investigate obesity-related factors within a substantial and diverse population during a densely attended religious event.

AIM OF STUDY

The present study aims to examine the associations between selected lifestyle factors with obesity.

Subjects, materials, and methods:

This cross-sectional study was conducted during the Al-Arbaeen pilgrimage in Karbala, Iraq, between August 1st and August 30th, 2025. The total number of participants was 2666, selected from among pilgrims attending the event. Only (1317) pilgrims' data were included in this study because of incomplete data collected from the others.

Participants were initially identified as obese based on visual observation, after which weight and height were measured using standard procedures to calculate the Body Mass Index (BMI). Those with a BMI below 25 kg/m² were excluded. In addition, waist circumference was measured using a flexible, non-stretchable measuring tape positioned midway between the lower margin of the last palpable rib and the top of the iliac crest, while the participant was standing and breathing normally.

Data collection took place at medical tents, Mawakeb, and hotels, which served both Iraqi and non-Iraqi pilgrims. These service stations offer free food, rest, and medical care, providing convenient and ethical access for volunteer-based data collection.

Before being included in the study, verbal consent was sought from each participant after they were told of its aim. For further statistical analysis, the gathered data comprised anthropometric measurements, health-related indicators, and demographic information.

A structured questionnaire was designed by the research team to collect information related to age, gender, nationality, lifestyle factors (dietary habits, physical activity, smoking, and sleep patterns), and history of chronic diseases. The questionnaire was reviewed by academic experts for content validity and clarity before data collection. Measurements were performed using calibrated portable scales, stadiometers, and flexible measuring tapes, following World Health Organization (WHO) standards for anthropometric assessment. Data accuracy was ensured through double-checking and supervision by trained pharmacy students participating in the study.

Statistical Analysis:

The data were inputted and analyzed utilizing Microsoft Excel (version 2021) and SPSS software (version 26). We used descriptive statistics to summarize the participants' demographic and anthropometric information. Continuous variables were represented as means ± standard deviations (SD), whereas categorical variables were conveyed as frequencies and percentages. We used the chi-square test to look for links between categorical variables and the independent t-test or ANOVA to look for differences in mean values between groups. A p-value of less than 0.05 was thought to be statistically significant.

RESULTS AND DISCUSSION

Figure 1 shows the distribution of obesity classes. Class I obesity had the most participants, followed by Class II, overweight, and Class III. This trend shows that mild to moderate obesity is becoming more common in the general population. This is in line with global findings that early-stage obesity is still the most common type of obesity because of lifestyle factors rather than advanced metabolic problems. This result agreed with (Nam *et al.*, 2021) who stated that class I, class II, and class III obesity prevalences were, respectively, 29.1%, 3.2%, and 0.3%. Also with (Jeong *et al.*, 2024) who stated that the prevalence of class I, II, and III obesity was 32.4%, 5.9%, and 1.09%, respectively.

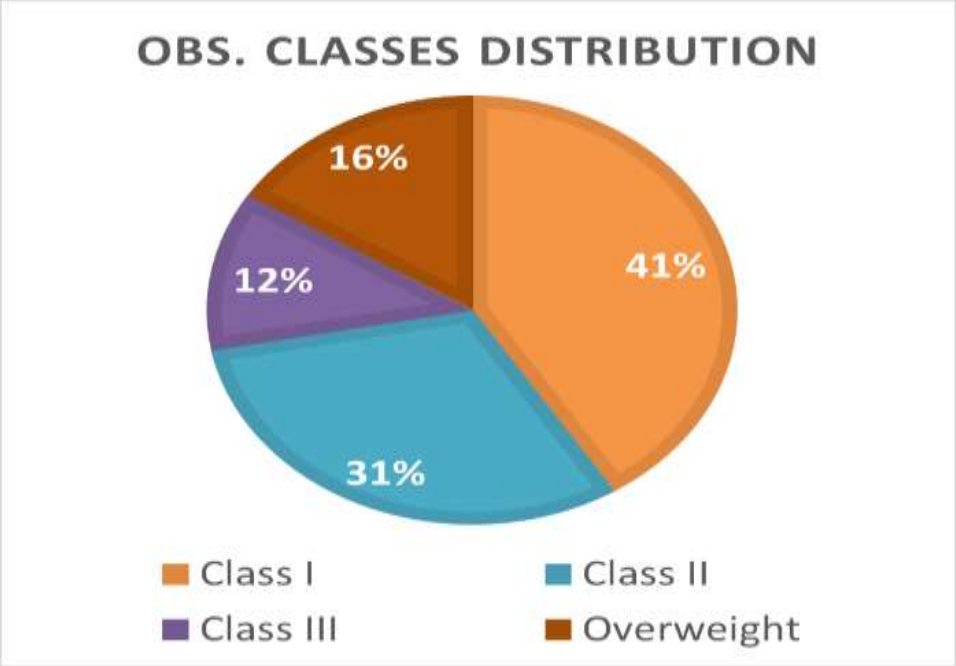

Fig.1: Obesity Classes Distribution

Figure 2 shows that women made up a larger percentage of all obesity classes than men. This finding may be ascribed to hormonal influences, sociocultural factors impacting physical activity, and dietary behaviors. Previous research has documented analogous gender disparities in Middle Eastern cultures, underscoring the imperative for gender-specific obesity control strategies.

This result agreed with (Cooper *et al.*, 2021) as he stated that obesity is more prevalent in women than men in most countries. Also agreed with (Koceva *et al.*, 2024) as he reported that even though obesity is more prevalent in females, females may be protected from obesity-associated metabolic implications. But it disagreed with (Wahabi *et al.*, 2023) who concluded that the pooled prevalence of obesity and overweight was higher in young males 40% compared to young females 25%.

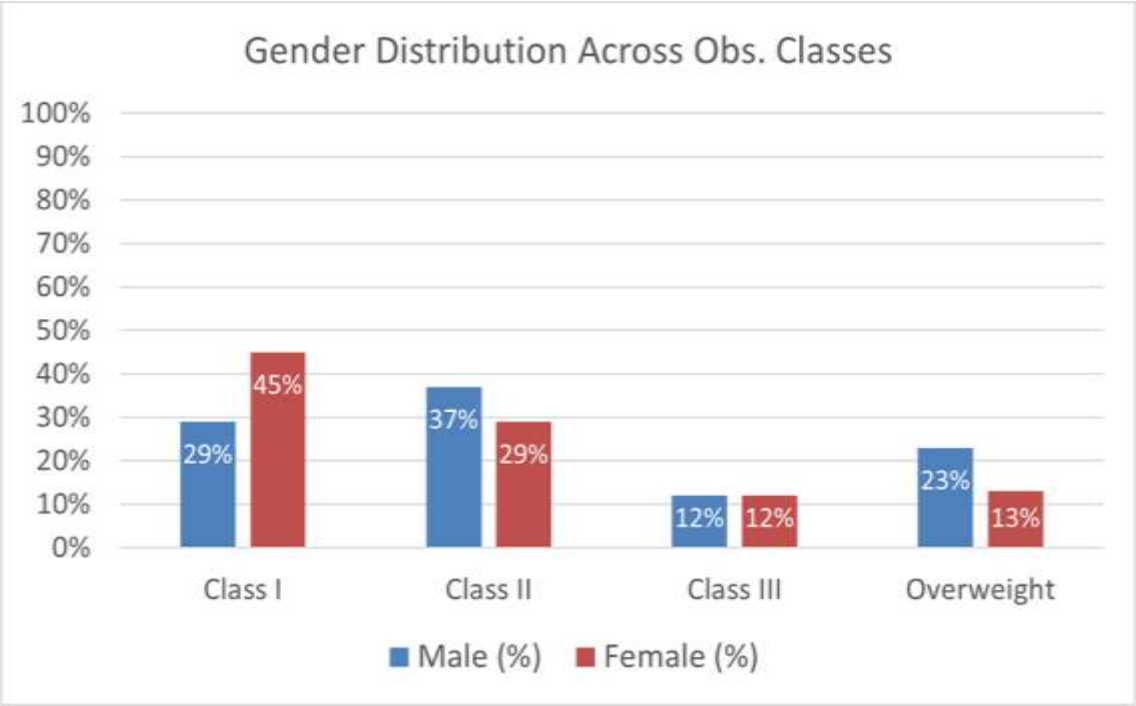

Fig.2: Gender distribution Across Obesity Classes

The highest rates of obesity were found in middle-aged people (30–49 years old). Younger and older people had lower rates. This could be because of the combined effects of metabolic, behavioral, and socio-economic factors during this stage of life. People in this age group often see a gradual drop in their basal metabolic rate along with a rise in insulin resistance, which makes them more likely to gain weight. Also, people in their middle years tend to be less active because of work obligations, long periods of sitting still, and family responsibilities, which leads to a positive energy balance. During this time, eating habits may also change to include more calories, eating at odd times, and relying on processed or convenience foods. Younger people may have higher metabolic rates and be more active, which is good for them. Older people, on the other hand, may lose or stabilize their weight because of sarcopenia, chronic illnesses, dietary restrictions, or increased health awareness after getting a diagnosis. This result agreed with (Pan *et al.*, 2025) who stated that all anthropometric indicators of middle-aged people in China maintained growth, with waist circumference increasing at the highest rate, weight at the second highest rate. Also it agreed with (Wahabi *et al.*, 2023) who found out that obesity was higher in the mid-life group (76%) in Saudi Arabia.

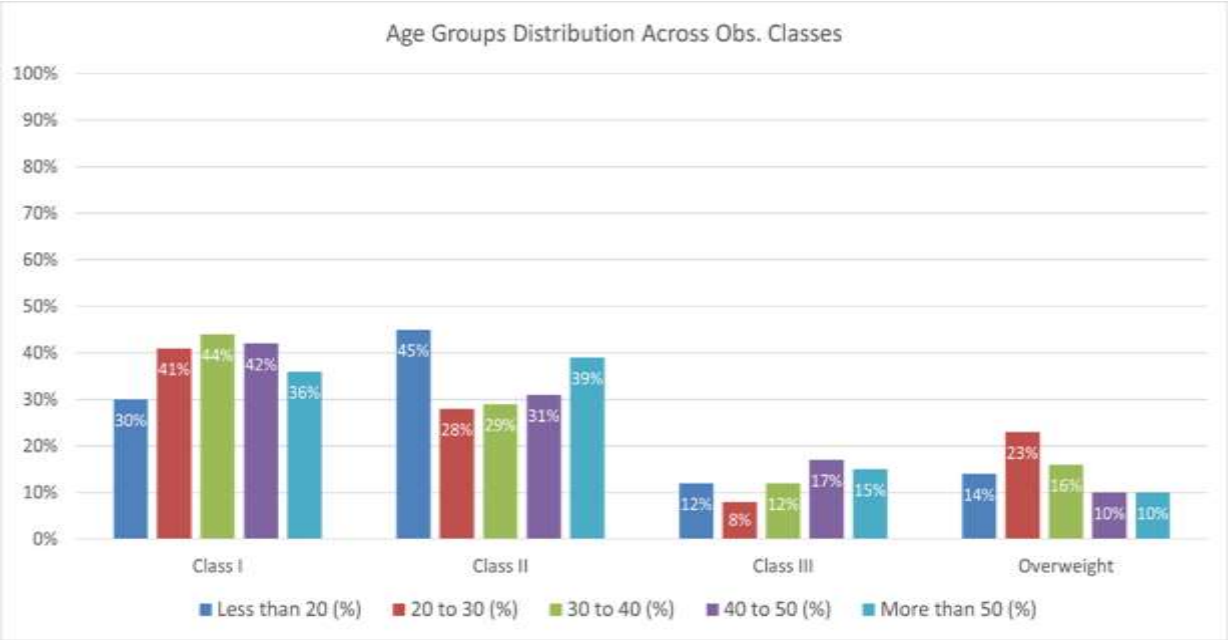

Fig.3 Age Groups Across Obesity Classes

Figure 4 shows that eating fast food a lot was directly linked to higher obesity classes. Individuals in Class III indicated a higher frequency of fast food consumption per week relative to those in Class I. This backs up the idea that foods that are high in calories and low in nutrients are a big part of why people eat too many calories and gain weight. This result agreed with (Elias *et al.*, 2025) who claimed that people who regularly eat fast food are more likely to be obese or overweight; and with (Taha *et al.*, 2025) who reported that frequent consumption of high-caloric foods is a leading cause of obesity in this population-based study. The higher prevalence of obesity among middle-aged adults (30–49 years) may be partly explained by their greater reliance on fast food consumption. Individuals in this age group often face time constraints related to work demands and family responsibilities, which increases dependence on readily available, energy-dense foods. Fast food meals are typically high in saturated fats, refined carbohydrates, and added sugars, while being low in dietary fiber and micronutrients, collectively promoting positive energy balance and weight gain.

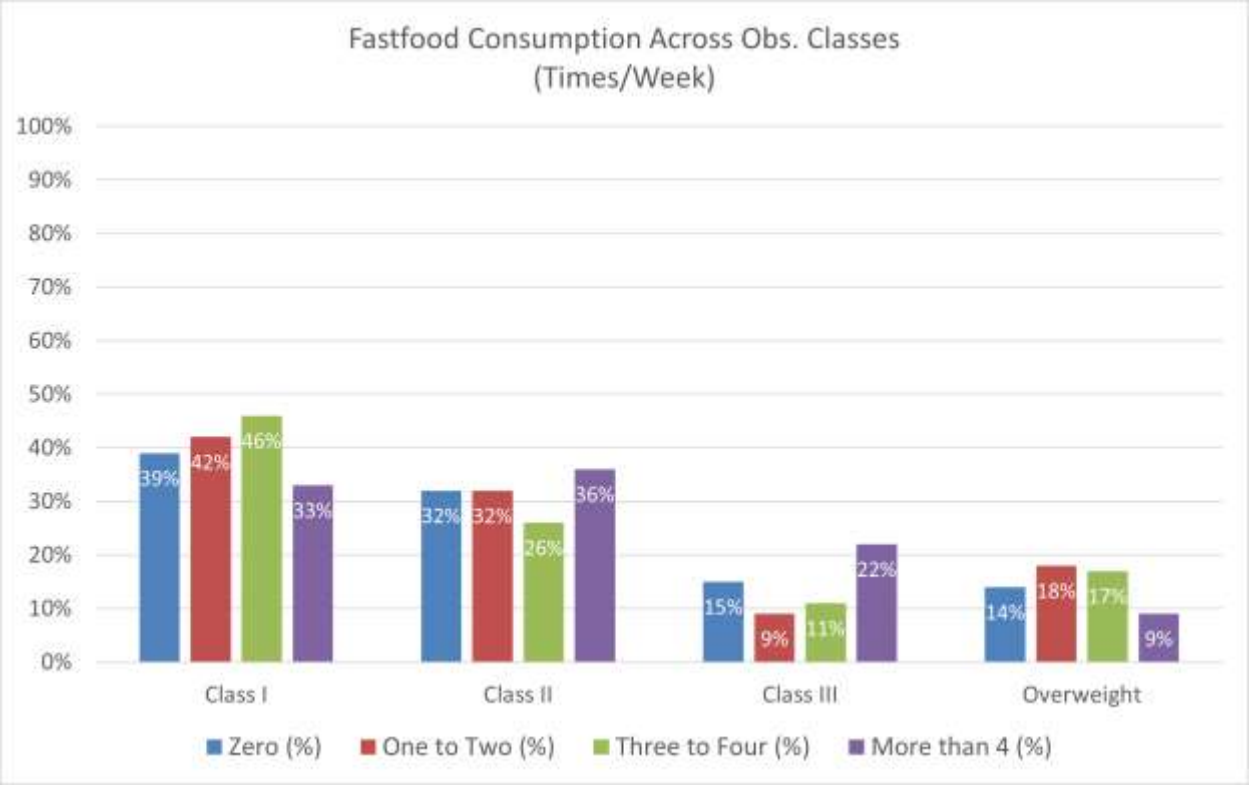

Fig.4: Fast Food Consumption Across Obesity Classes (Times/Week)

The higher obesity classes shown in figure 5 had more participants who said they had delayed or absent bowel movements after breakfast. Obese people often have less gastrointestinal motility because they don't eat enough fiber and don't move around much, which can make metabolic dysregulation worse. This result agreed with (Silveira *et al.*, 2021) who reported that a high prevalence of constipation was found in adults with obesity class II and III) but it was disagreed with (Steenackers *et al.*, 2021) when he showed that food-induced gastric contractility was higher in participants with obesity compared to non-obese).

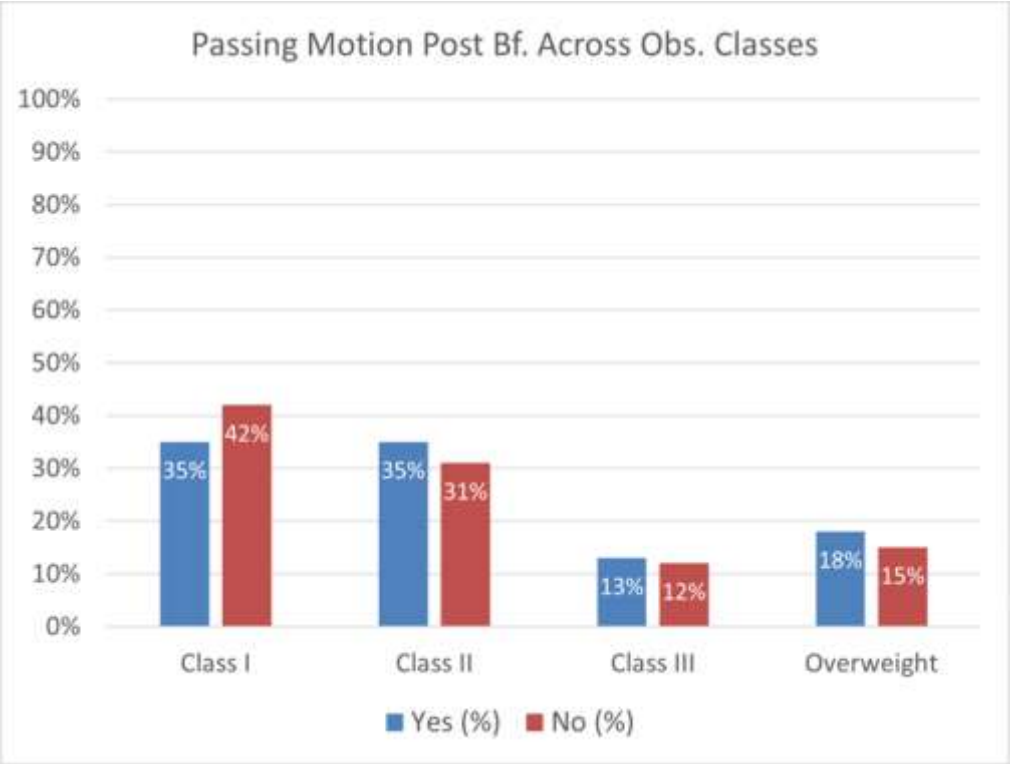

Fig.5 Passing Motion Post Bf. Across Obesity Classes

Figure 6 shows that there is a clear positive link between obesity class and the number of people who have trouble sleeping. Obesity, especially in Class II and III, is associated with sleep apnea and diminished sleep quality, which subsequently aggravate hormonal dysregulations pertaining to appetite control (leptin and ghrelin). This result agreed with (Pardak, Filip and Woliński, 2022) who reported that the majority (82%) of studied patients with obesity had obesity sleep apnea diagnosed, also came in contest with (Akhlaghi and Kohanmoo, 2023) who showed that epidemiological and interventional investigations have suggested a link between sleep deprivation and overweight/obesity. But it disagreed with (Gresser *et al.*, 2025) who stated that no significant evidence that sleep loss directly alters the levels of either leptin or ghrelin and their related effect on obesity.

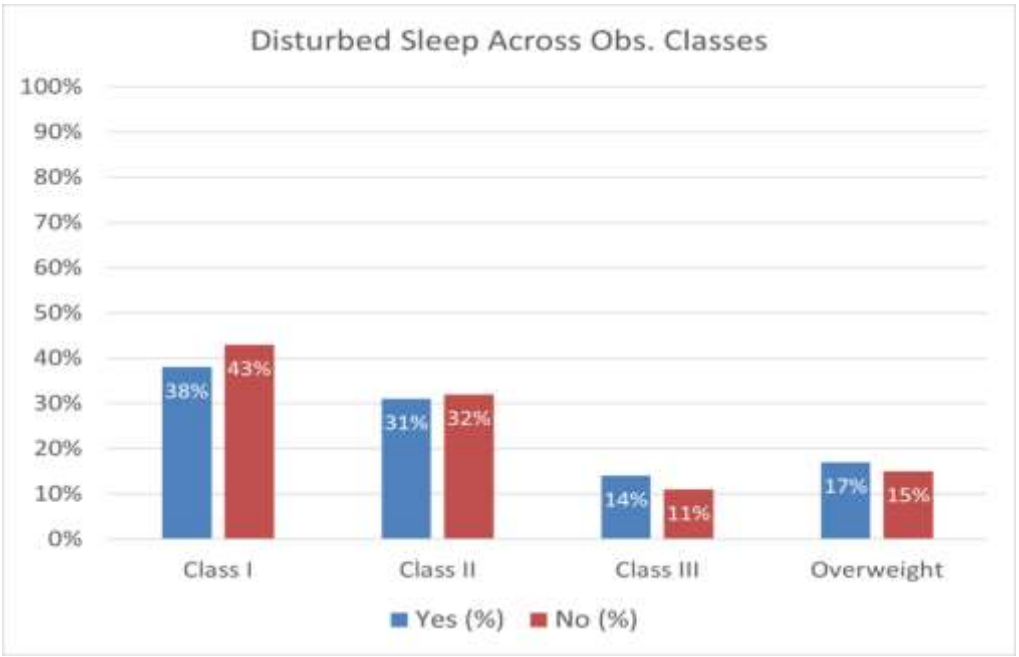

Fig.6 Disturbed Sleep Across Obesity Classes

Figure 7 shows that people with higher obesity classes were more likely to not be active physically. Individuals with Class III obesity reported the lowest levels of weekly exercise, demonstrating a significant inverse

correlation between physical activity and obesity severity. This underscores the pivotal role of a sedentary lifestyle in the etiology of obesity. This result agreed with (Silveira *et al.*, 2022) as she said that those who are obese had higher rates of sedentary behavior and physical inactivity, as well as a positive risk link. Also this results was agreed with (Bhattarai, Vaidya and Tylleskär, 2025) who disclosed that the amount of physical activity in the 40–49 age range could lower the risk of overweight and obesity, according to an unadjusted model.

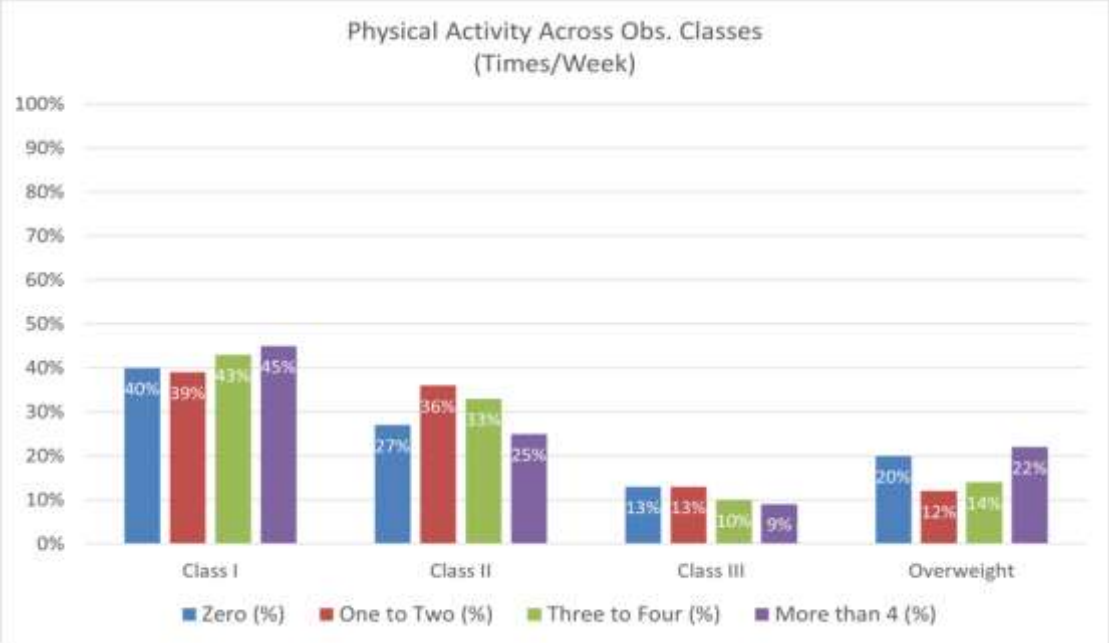

Fig.7 Physical Activity Across Obesity Classes (Times/Week)

Figure 8 shows that people with lower obesity classes were more likely to eat breakfast regularly. Not eating breakfast has been linked to a slower metabolism and more hunger later in the day, which can lead to overeating. The findings indicate that adhering to a consistent breakfast regimen may facilitate improved weight management. This result was agreed with (Yang *et al.*, 2025) who showed that skipping breakfast significantly increased the risk of metabolic syndrome, and its components, including abdominal obesity. Also, it came in consistent with (Wang *et al.*, 2023) who reported that skipping breakfast was positively associated with overweight in children and adolescents. But it disagreed with (Wicherski, Schlesinger and Fischer, 2021) where in his analysis found only a modest increased risk (≈ 11%) of overweight/obesity when skipping breakfast ≥3 days/week, and found no significant association with BMI change over time.

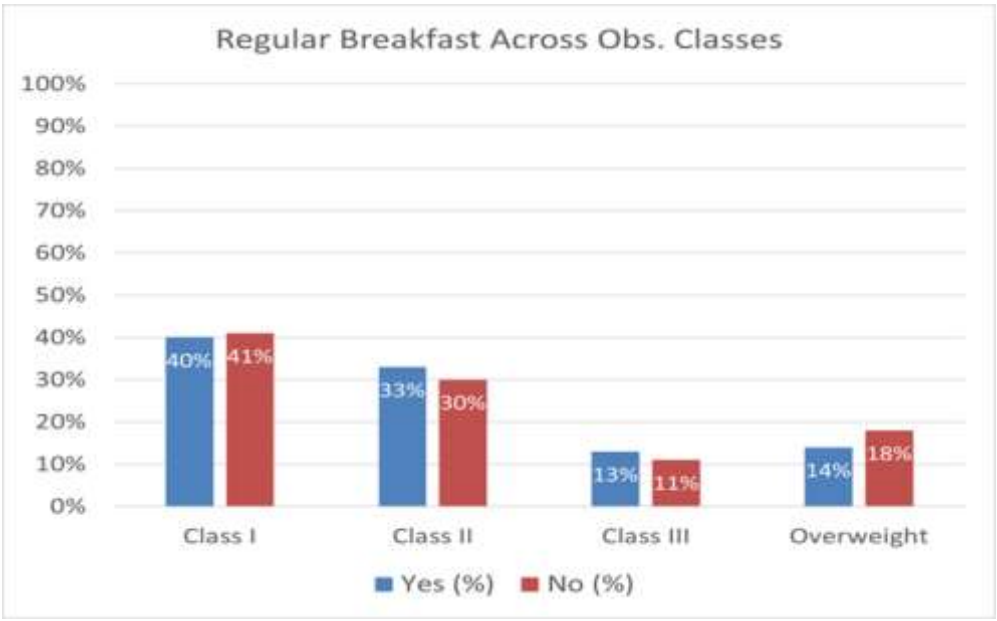

Fig.8 Regular Breakfast Across Obesity Classes

Figure 9 shows that a much higher percentage of people with sedentary jobs were in Class II and III obesity. Long periods of sitting decrease daily energy expenditure and lead to the buildup of visceral fat, highlighting the occupational risk factor in obesity epidemiology. This result agreed with (Yuan *et al.*, 2021) who approved that work sitting time had been found to be associated with overweight/obesity in men. Also, it came in align with (Li *et al.*, 2025) who demonstrated a strong correlation between abdominal obesity and sedentary work.

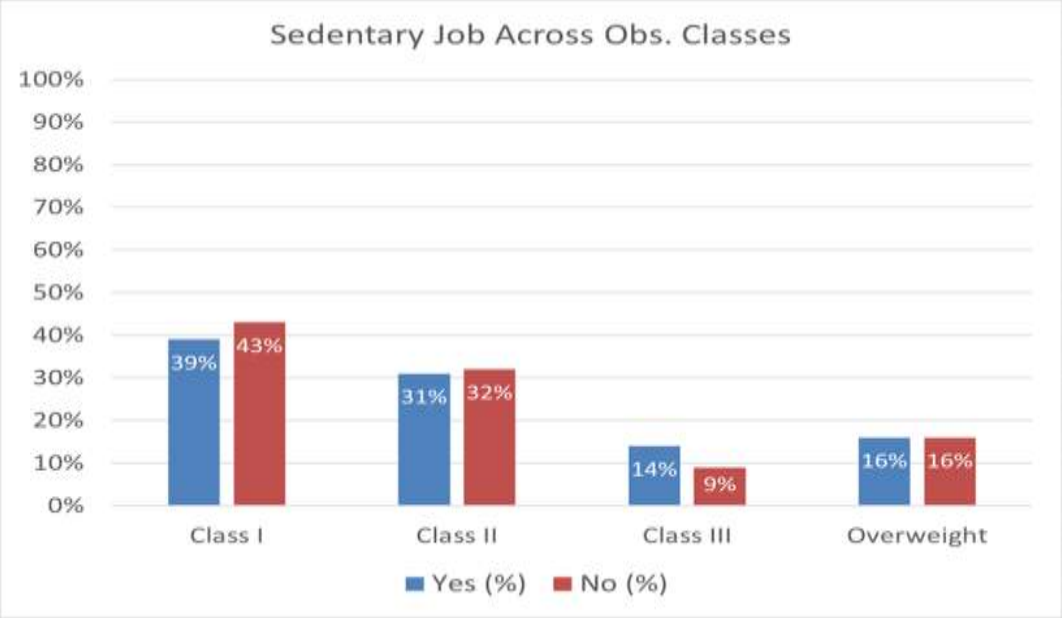

Fig.9 Sedentary Job Across Obesity Classes

Figure 10 shows that people with higher obesity classes were more likely to sleep less than 6 hours a day. Not getting enough sleep raises cortisol levels and makes you hungrier, which makes it easier for your body to store fat. This is in line with current research that shows a link between sleep hygiene and weight control and metabolic health. This result agreed with (Rafique, 2023) It revealed that those who slept for a short period of time had a BMI that was noticeably greater than those who slept for a long period of time. Also, it was agreed with (Kohanmoo *et al.*, 2024) who found in his meta-analysis that an 8% higher incidence of abdominal obesity was linked to short sleep duration (often less than 6 hours) as opposed to normal duration.

Fig.10 Sleeping Hours Across Obesity Classes (Hours/Day)

Figure 11 shows that drinking more soft drinks each day was strongly linked to being in a higher obesity class. Drinking a lot of sugary drinks can make you resistant to insulin and store fat, especially in your stomach. This shows how sugary drinks can make you more likely to be obese. This result agreed with (Nguyen *et al.*, 2023) who evidenced to confirm that soft drinks beverages consumption promotes higher BMI and body weight in both children and adults. Also, it agreed with (Nevill, Duncan and Myers, 2022) when he acknowledged that children and teenagers who drink soft drinks tend to gain weight.

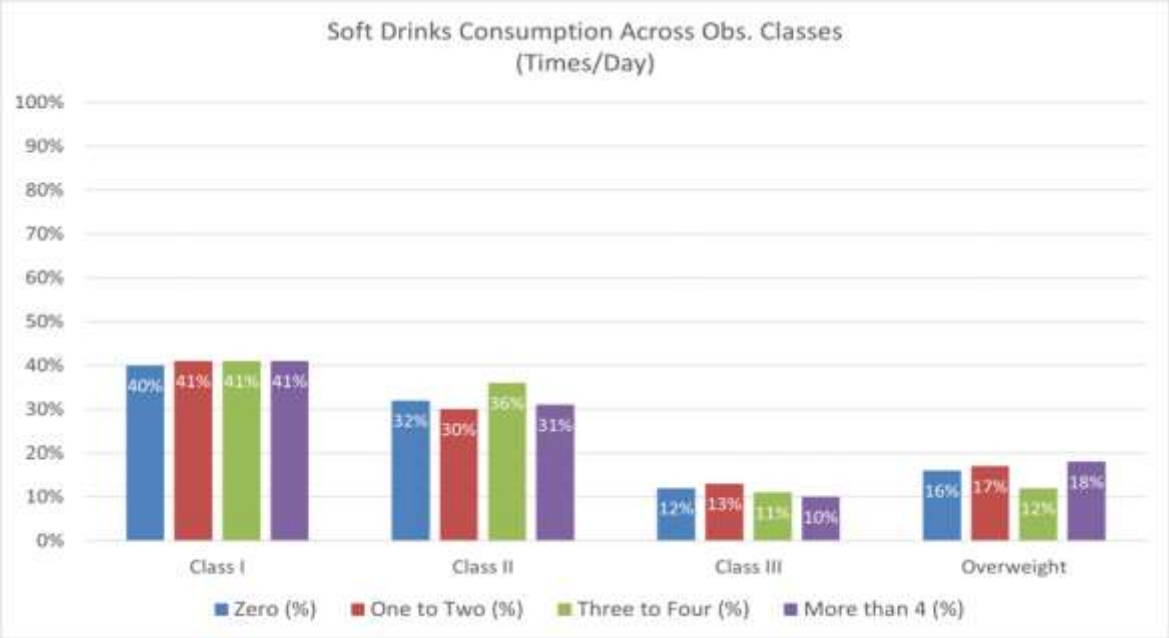

Fig.11 Soft Drinks Consumption Across Obesity Classes

The mean waist circumference steadily rose from Class I to Class III, as shown in Figure 12, confirming central (abdominal) obesity as a significant indicator of metabolic risk. The findings suggest that waist circumference serves as a more sensitive indicator of cardiometabolic complications compared to BMI alone. This result agreed with (Nevill, Duncan and Myers, 2022) and (Li, Zhu and Wang, 2022) as they estimated that anthropometric measures (WC, and WHR) may represent best obesity indicators that describe the metabolic risk of obesity than BMI alone.

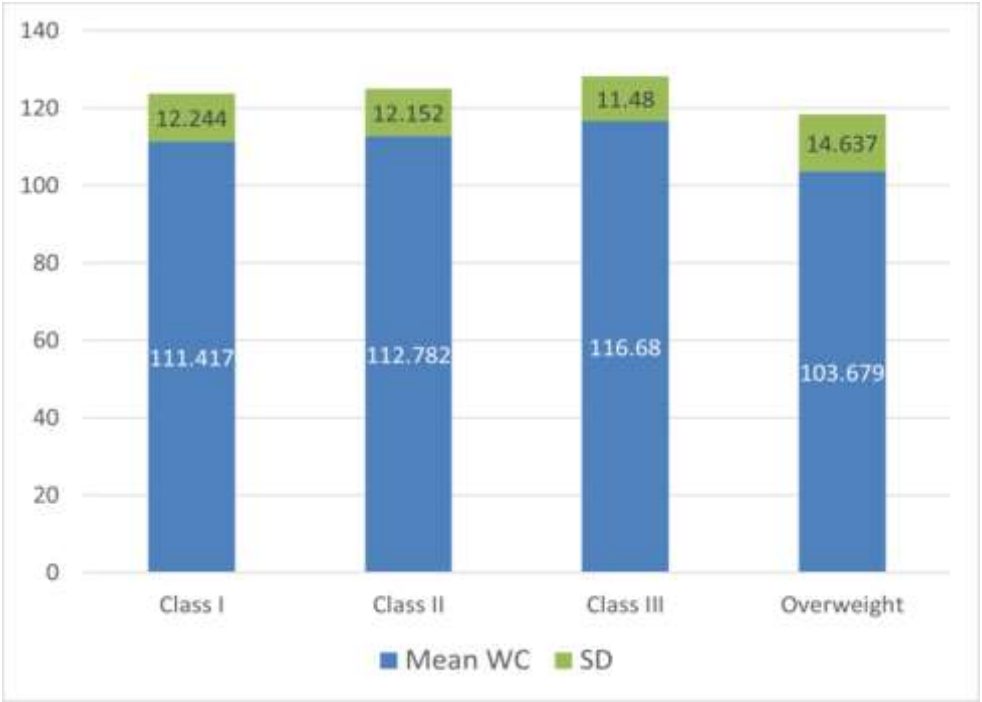

Fig.12 Mean Waist Circumference and Std. Deviation Across Obesity Classe

The ANOVA test was used to compare the average waist circumference (WC) of overweight people and people in different obesity classes (Class I, II, and III), as shown in table 1. The findings reveal a notable progressive rise in waist circumference (WC) correlated with elevated obesity class, signifying a robust positive association between obesity severity and central adiposity. The average difference between Class I and Class II was 1.4 cm, which was not statistically significant ($p = 0.27$). This suggests that there wasn't much difference between the early stages of obesity. The difference between Class I and Class III (5.3 cm) and between Class I and Overweight (7.7 cm) was very significant ($p < 0.001$), which means that people in Class III have a lot more abdominal fat. There was also a significant difference of 3.9 cm ($p = 0.002$) between Class II and Class III. There were also very significant differences ($p < 0.001$) between Class II and Overweight (9.2 cm) and Class III and Overweight (13 cm).

These findings indicate that waist circumference increases proportionally with obesity severity, reflecting a clear pattern of central fat deposition as BMI increases. Because belly fat is a big sign of metabolic syndrome, these results show how important waist circumference is as a reliable way to measure cardiovascular and metabolic risk. It was agree with (Abe *et al.*, 2021) and (Li *et al.*, 2025) as they give great importance to the combined effect of BMI and WC on the prevention and management of metabolic syndrome as a consequent condition of obesity.

Table-1: Comparison of WC by ANOVA Test Across Obesity Classes

Group 1	Group 2	Mean Difference	std. error	p-value
Class I	Class II	1.4	±0.53	0.27
Class I	Class III	5.3	±0.74	<0.001
Class I	Overweight	7.7	±0.67	<0.001
Class II	Class III	3.9	±0.76	0.002
Class II	Overweight	9.2	±0.69	<0.001
Class III	Overweight	13	±0.86	<0.001

The multinomial regression analysis was conducted to assess the correlation between various sociodemographic and behavioral factors and the severity of obesity, categorized as Class I, II, and III. The results in table 2 showed that gender, not being active, and eating a lot of fast food and soft drinks were all statistically significant predictors of higher obesity classes ($p < 0.05$). Women were more likely than men to be in Class II and III, which suggests that lifestyle and hormonal changes make women more likely to be in these classes, which agreed with (Alsulami *et al.*, 2023) and (Koceva *et al.*, 2024) where they showed that more women were obese compared to men.

Moreover, a significant correlation existed between elevated obesity classifications and reduced physical activity levels, suggesting that sedentary behavior constitutes an independent risk factor this agree with (Silveira *et al.*, 2022) who found an elevated rates of sedentary behavior and physical inactivity in individuals with obesity. Also, with (Stamatakis, Hirani and Rennie, 2008) who revealed a positive risk association with moderate–vigorous physical activity and sedentary behavior are both strongly and independently related to the risk of obesity).

Regular consumption of fast food (≥3 times/week) and soft drinks (≥2 times/day) markedly elevated the likelihood of severe obesity, highlighting the influence of detrimental dietary practices on energy equilibrium which agree with (Santos *et al.*, 2022) who demonstrated in his meta-analysis that consumption of SSB appears to increase the risk obesity and cardiometabolic diseases. while it disagree with (Nestle and Jacobson, 2000) who stated that consumption incidence of indulgent foods was not positively correlated with measures of BMI.

While age and disrupted sleep patterns exhibited moderate correlations, they did not achieve robust statistical significance, indicating that their effects are probably mediated by other behavioral factors. The regression model illustrates that obesity is a multifactorial condition influenced by interrelated demographic, behavioral, and lifestyle factors.

These findings are consistent with previous studies reporting similar trends among Middle Eastern populations, where cultural habits, dietary transitions, and reduced physical activity contribute to the growing prevalence of obesity agree with (Alsulami *et al.*, 2023).

Table-2: Multinominal Regression Test for Sociodemographic Factors Across Obesity Classes

Variable	Obs Class	Odds Ratio	P-Value
Gender (Female)	Class I (Ref)	-	-
	Class II	0.51	<0.001
	Class III	0.668	0.033
	Overweight	0.368	<0.001
Age Groups (Per Group)	Class I (Ref)	-	-
	Class II	1.056	0.304
	Class III	1.217	0.007
	Overweight	0.792	<0.001
Fastfood Times/Week (Per Time)	Class I (Ref)	-	-
	Class II	1.04	0.55
	Class III	1.265	0.007
	Overweight	0.917	0.299
Regular Breakfast (Yes)	Class I (Ref)	-	-
	Class II	1.137	0.292
	Class III	1.302	0.12
	Overweight	0.788	0.114
Passing Motion Post Breakfast (Yes)	Class I (Ref)	-	-
	Class II	1.38	0.024
	Class III	1.296	0.184
	Overweight	1.465	0.028
Physical Activity Times/Week (Per Time)	Class I (Ref)	-	-
	Class II	1.014	0.838
	Class III	0.851	0.103
	Overweight	0.884	0.164
Soft Drinks Times/Day (Per Time)	Class I (Ref)	-	-
	Class II	1.016	0.819
	Class III	0.946	0.575
	Overweight	0.936	0.46
Sedentary Job (Yes)	Class I (Ref)	-	-
	Class II	1.071	0.574
	Class III	1.677	0.003
	Overweight	1.075	0.637
Sleep Hrs/Day (Per Level)	Class I (Ref)	-	-
	Class II	1.126	0.01
	Class III	1.113	0.093
	Overweight	1.173	0.006
Disturbed Sleep (Yes)	Class I (Ref)	-	-
	Class II	1.124	0.335
	Class III	1.473	0.02
	Overweight	1.297	0.085

CONCLUSION

Unhealthy lifestyle choices, such as eating fast food often, drinking a lot of soft drinks, not exercising much, skipping breakfast, sleeping too little, and working sedentary jobs, were always linked to higher obesity classes. Multinomial regression established that female gender, fast-food consumption, physical inactivity, and soft-drink intake are significant predictors of severe obesity.

REFERENCES

1. Abe, M. *et al.* (2021) "Comparison of body mass index and waist circumference in the prediction of diabetes: a retrospective longitudinal study," *Diabetes Therapy*, 12(10), pp. 2663–2676.
2. Akhlaghi, M. and Kohanmoo, A. (2023) "Sleep deprivation in development of obesity, effects on appetite regulation, energy metabolism, and dietary choices," *Nutrition Research Reviews*, pp. 1–21.
3. Aldubikhi, A. (2023) "Obesity management in the

Saudi population," *Saudi Medical Journal*, 44(8), p. 725.

4. Alsulami, S. *et al.* (2023) "Obesity prevalence, physical activity, and dietary practices among adults in Saudi Arabia," *Frontiers in Public Health*, 11, p. 1124051.
5. Bhattarai, P., Vaidya, A. and Tylleskär, T. (2025) "Overweight, obesity and physical inactivity among women of reproductive age in Eastern Nepal: a cross-sectional community-based study," *PLOS Global Public Health*, 5(3), p. e0004360.
6. Cooper, A.J. *et al.* (2021) "Sex/gender differences in obesity prevalence, comorbidities, and treatment," *Current obesity reports*, 10(4), pp. 458–466.
7. Czernichow, S. *et al.* (2021) "Costs of the COVID-19 pandemic associated with obesity in Europe: A health-care cost model," *Clinical Obesity*, 11(2), p. e12442.
8. Elias, C. *et al.* (2025) "Prevalence of overweight/obesity and its association with fast food consumption among adolescents in Southern Ethiopia, 2022: a community-based cross-sectional study," *Frontiers in Nutrition*, 11, p. 1475116.
9. Franzago, M. *et al.* (2022) "The epigenetic aging, obesity, and lifestyle," *Frontiers in Cell and Developmental Biology*, 10, p. 985274.
10. Ghosh, S. *et al.* (2023) "Sedentary lifestyle with increased risk of obesity in urban adult academic professionals: an epidemiological study in West Bengal, India," *Scientific reports*, 13(1), p. 4895.
11. Gresser, D. *et al.* (2025) "The Impact of Sleep Deprivation on Hunger-Related Hormones: A Meta-Analysis and Systematic Review," *Obesities*, 5(2), p. 48.
12. Hulsegge, G. *et al.* (2021) "The mediating role of lifestyle in the relationship between shift work, obesity and diabetes," *International Archives of Occupational and Environmental Health*, 94(6), pp. 1287–1295.
13. Jeong, S.-M. *et al.* (2024) "2023 obesity fact sheet: prevalence of obesity and abdominal obesity in adults, adolescents, and children in Korea from 2012 to 2021," *Journal of Obesity & Metabolic Syndrome*, 33(1), p. 27.
14. Koceva, A. *et al.* (2024) "Sex-and gender-related differences in obesity: from pathophysiological mechanisms to clinical implications," *International Journal of Molecular Sciences*, 25(13), p. 7342.
15. Kohanmoo, A. *et al.* (2024) "Short sleep duration is associated with higher risk of central obesity in adults: A systematic review and meta-analysis of prospective cohort studies," *Obesity Science & Practice*, 10(3), p. e772.
16. Li, M., Zhu, P. and Wang, S. (2022) "Risk for cardiovascular death associated with waist circumference and diabetes: a 9-year prospective study in the Wan Shou Lu cohort," *Frontiers in Cardiovascular Medicine*, 9, p. 856517.
17. Li, Z. *et al.* (2025) "Differential impact of general and abdominal obesity on the labor–bone health association: a cross-sectional study in rural China," *BMC Public Health* [Preprint].
18. Lopez-Barreiro, J. *et al.* (2024) "Artificial intelligence-powered recommender systems for promoting healthy habits and active aging: A systematic review," *Applied Sciences*, 14(22), p. 10220.
19. Mahmoud, A.M. (2022) "An overview of epigenetics in obesity: the role of lifestyle and therapeutic interventions," *International journal of molecular sciences*, 23(3), p. 1341.
20. Nam, G.E. *et al.* (2021) "Obesity fact sheet in Korea, 2020: prevalence of obesity by obesity class from 2009 to 2018," *Journal of obesity & metabolic syndrome*, 30(2), p. 141.
21. Nestle, M. and Jacobson, M.F. (2000) "Halting the obesity epidemic: a public health policy approach," *Public health reports*, 115(1), p. 12.
22. Nevill, A.M., Duncan, M.J. and Myers, T. (2022) "BMI is dead; long live waist-circumference indices: But which index should we choose to predict cardio-metabolic risk?," *Nutrition, Metabolism and Cardiovascular Diseases*, 32(7), pp. 1642–1650.
23. Nguyen, M. *et al.* (2023) "Sugar-sweetened beverage consumption and weight gain in children and adults: a systematic review and meta-analysis of prospective cohort studies and randomized controlled trials," *The American Journal of Clinical Nutrition*, 117(1), pp. 160–174.
24. Pan, Q. *et al.* (2025) "A study of trends in body morphology, overweight, and obesity in Chinese adults aged 40–59 years," *BMC Public Health*, 25(1), p. 833.
25. Pardak, P., Filip, R. and Woliński, J. (2022) "The impact of sleep-disordered breathing on ghrelin, obestatin, and leptin profiles in patients with obesity or overweight," *Journal of Clinical Medicine*, 11(7), p. 2032.
26. Rafique, N. (2023) "Short sleep duration is a novel independent risk factor for overweight and obesity," *Saudi Medical Journal*, 44(11), p. 1160.
27. Rassy, N. *et al.* (2023) "Association of healthy lifestyle factors and obesity-related diseases in adults in the UK," *JAMA network open*, 6(5), pp. e2314741–e2314741.
28. Santos, L.P. *et al.* (2022) "Sugar sweetened beverages intake and risk of obesity and cardiometabolic diseases in longitudinal studies: a systematic review and meta-analysis with 1.5

million individuals," *Clinical nutrition ESPEN*, 51, pp. 128–142.
29. Silveira, E.A. *et al.* (2021) "Prevalence of constipation in adults with obesity class II and III and associated factors," *BMC gastroenterology*, 21(1), p. 217.
30. Silveira, E.A. *et al.* (2022) "Sedentary behavior, physical inactivity, abdominal obesity and obesity in adults and older adults: A systematic review and meta-analysis," *Clinical nutrition ESPEN*, 50, pp. 63–73.
31. Stamatakis, E., Hirani, V. and Rennie, K. (2008) "Moderate-to-vigorous physical activity and sedentary behaviours in relation to body mass index-defined and waist circumference-defined obesity," *British Journal of Nutrition*, 101(5), pp. 765–773.
32. Steenackers, N. *et al.* (2021) "Effect of obesity on gastrointestinal transit, pressure and pH using a wireless motility capsule," *European Journal of Pharmaceutics and Biopharmaceutics*, 167, pp. 1–8.
33. Taha, S. *et al.* (2025) "The consumption of fast food and obesity associated with hypertension among restaurant workers in Jordan," *Clinical Nutrition Open Science*, 60, pp. 141–154.
34. Wahabi, H. *et al.* (2023) "The impact of age, gender, temporality, and geographical region on the prevalence of obesity and overweight in Saudi Arabia: scope of evidence," in *Healthcare*. MDPI, p. 1143.
35. Wang, K. *et al.* (2023) "The effect of breakfast on childhood obesity: A systematic review and meta-analysis," *Frontiers in nutrition*, 10, p. 1222536.
36. Wicherski, J., Schlesinger, S. and Fischer, F. (2021) "Association between breakfast skipping and body weight—A systematic review and meta-analysis of observational longitudinal studies," *Nutrients*, 13(1), p. 272.
37. Wilson, J.E. *et al.* (2022) "Associations between childhood to adulthood socio-economic mobility and adult diet quality," *British Journal of Nutrition*, 128(1), pp. 103–113.
38. Yang, B. *et al.* (2025) "Association of Skipping Breakfast with Metabolic Syndrome and Its Components: A Systematic Review and Meta-Analysis of Observational Studies," *Nutrients*, 17(19), p. 3155.
39. Yuan, F. *et al.* (2021) "Association of physical activity and sitting time with overweight/obesity in Chinese occupational populations," *Obesity Facts*, 14(1), pp. 141–147.
40. Zaninotto, P., Head, J. and Steptoe, A. (2020) "Behavioural risk factors and healthy life expectancy: evidence from two longitudinal studies of ageing in England and the US," *Scientific Reports*, 10(1), p. 6955.