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RESEARCH ARTICLE

DETERMINANTS OF OBESITY AMONG GARMENT WORKERS IN BANGLADESH: A CASE-CONTROL STUDY OF SOCIODEMOGRAPHIC, LIFESTYLE, AND BIOCHEMICAL FACTORS

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ABSTRACT

With the global escalation of obesity, understanding its determinants in specific populations is crucial. This study investigates the socio-demographic, lifestyle, and biochemical factors contributing to obesity among garment workers in Bangladesh, a group particularly vulnerable due to economic and occupational conditions. Methods A case-control study was conducted involving garment workers from urban areas in Bangladesh. Participants were divided into obese (case group) and non-obese (control group) based on BMI criteria. Data on socio-demographic characteristics, lifestyle habits, and biochemical markers (total cholesterol, triglycerides, HDL cholesterol, and C-reactive protein levels) were collected and analyzed. Results The study included 100 participants, with 50 in each group. Key findings indicate a significant association between obesity and lower income levels, with 64% of the obese group earning below 25,000 BDT monthly. Additionally, 74% of the obese participants reported low physical activity levels. Biochemical analysis revealed higher levels of total cholesterol, triglycerides, and CRP in the obese group. Lifestyle factors such as skipping breakfast and frequent consumption of fast food were markedly more common among obese workers. Conclusions The findings underscore a complex interplay between socio-demographic factors, lifestyle choices, and biochemical markers in the prevalence of obesity among garment workers in Bangladesh. These insights highlight the need for targeted health interventions and policy reforms aimed at improving the occupational and economic conditions of garment workers, addressing both lifestyle habits and access to healthcare services to mitigate obesity and its associated health risks.

KEYWORDS

Obesity Garment Workers, Bangladesh, Lifestyle Factors, Socio-demographic Factors, Biochemical Markers.

1. INTRODUCTION

The global epidemic of obesity represents one of the most pressing public health challenges of the 21st century, affecting populations across both affluent and less developed nations. With more than 650 million adults classified as obese worldwide, the condition is a leading risk factor for numerous non-communicable diseases (NCDs), including cardiovascular diseases, diabetes mellitus type 2, and various cancers, contributing significantly to morbidity, mortality, and healthcare costs (World.,2024; Ng.,2014). The phenomenon of obesity is particularly concerning in low- and middle-income countries (LMICs), where rapid urbanization, changing dietary habits, increasingly sedentary lifestyles and industrialization have precipitated a dramatic rise in prevalence (Popkin.,2012; Uddin.,2020).

Bangladesh, a country marked by its burgeoning economy and rapid industrial growth, exemplifies this trend. The nation has experienced significant nutritional transitions, characterized by increased consumption of high-calorie, nutrient-poor foods, and a decline in physical activity levels, factors that collectively fuel the obesity epidemic (Khan.,2017). Within this context, the garment industry, as the linchpin of Bangladesh's economy, employing over 4 million people and accounting for a substantial portion of the nation's exports, emerges as a critical area of study (Bangladesh.,2019). The workforce, predominantly comprised of young women from rural areas, faces unique occupational hazards and lifestyle factors that predispose them to obesity and its associated health risks (Bangladesh.,2020; Ahmed.,2018).

Socio-demographic factors, including age, income levels, and educational background, significantly influence obesity risk. Previous studies have highlighted a higher prevalence of obesity among individuals with lower socio-economic status in developing countries, contrary to patterns observed in developed nations (Monteiro.,2004; Subramanian.,2011). This paradox underscores the complex interplay between economic disparities and access to healthy dietary options and physical activity opportunities (Drewnowski.,2004;picket.,2005). Lifestyle factors, such as dietary habits, physical activity levels, and occupational stress, further compound the risk of developing obesity. In industrial settings like the garment sector, long working hours, limited breaks, and the physical environment can adversely affect employees' lifestyle choices, leading to increased consumption of calorie-dense fast foods and reduced physical activity (Monda.,2008;Devries.,2017).

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Beyond socio-demographic and lifestyle influences, the biochemical profile of individuals offers profound insights into the obesity conundrum. Specifically, dyslipidemia, characterized by elevated levels of total cholesterol and triglycerides, alongside reduced HDL cholesterol, underscores the metabolic imbalances often seen in obesity (Expert.,2001.,Grundy2005). Specifically, these lipid abnormalities reflect the body's inefficient fat metabolism and storage, core aspects of obesity's physiological impact. Additionally, the role of C-reactive protein (CRP) as a marker of inflammation is particularly significant in obesity, where elevated CRP levels serve as a biomarker for the chronic low-grade inflammation that often accompanies excess adiposity (Ridker.,2002)This inflammation is not merely a consequence but also a driver of further weight gain and fat accumulation, creating a vicious cycle that exacerbates obesity and its related metabolic disturbances (Hotamisligil.,2006).

The significance of focusing on garment workers in the study of obesity cannot be overstated. This demographic is particularly vulnerable due to the nature of their work, which is characterized by long hours of sedentary activity, limited access to healthy dietary options, and exposure to chronic job-related stress (Islam.,2018). These conditions are exacerbated by low socioeconomic status and a lack of health literacy, which hinder access to healthcare services and information on healthy lifestyle practices (Biswas.,2017;Rahman.,2019). The cumulative effect of these factors' places garment workers at a higher risk of developing obesity and related NCDs, underscoring the need for targeted research and interventions in this population.

Moreover, the plight of Bangladeshi garment workers reflects broader global health disparities and the challenges faced by workers in similar settings worldwide. Understanding the determinants of obesity in this context is not only crucial for developing effective public health strategies in Bangladesh but also for informing global efforts to combat the obesity epidemic in vulnerable populations. Given this backdrop, the present study aims to elucidate the determinants of obesity among garment workers in Bangladesh by examining a comprehensive range of socio-demographic, lifestyle, and biochemical factors. This research not only contributes to the existing body of knowledge but also will have implications for policymakers, public health professionals, and stakeholders within the garment industry, offering a foundation for targeted strategies to improve the health and well-being of this crucial workforce.

2. Methods and Materials

2.1 Study time and settings:

This case-control study was conducted from October 2023 to January 2024 within the garment industry sector located in the urban areas of Dhaka, Bangladesh. Dhaka, being the capital and the largest city, is home to a substantial number of garment factories that contribute significantly to the country's economy. The study focused on various factories spread across the city to ensure a diverse participant pool representing the broader garment worker population.

2.2 Study population and sample:

The baseline population for this study comprised garment workers aged 18 to 45 years, employed in selected factories around Dhaka. The sample was divided into two groups: cases (obese individuals with a BMI ≥ 25) and controls (non-obese individuals with a BMI < 25), based on the WHO Asian classification for BMI (World.,2004). Informed consent was obtained from all participants. Pregnant or breastfeeding women were excluded from the study. Purposive sampling was used to select individuals willing to participate and who met the age and BMI criteria. The sample size for this case-control study was predetermined to be 100 participants, with 50 individuals assigned to each group (cases and controls). Given the study's aim to detect a significant difference in obesity determinants between the groups, a power analysis was conducted aiming for 80% power and a 5% level of significance. However, due to logistical constraints, the predetermined sample size was utilized, which consisted of 50 cases and 50 controls.

2.3 Data collection procedure:

Data were gathered through semi-structured interviews using a questionnaire segmented into socio-demographic characteristics, dietary behaviors, and physical activity. The questionnaire items were adapted from widely cited studies within the context of Bangladesh (Banna.,2022; Bhuiyan.,2013).

2.3.1 Blood collection and sample preparation:

Blood samples were collected at a local medical facility to ensure participant comfort and adherence to safety protocols. Venipuncture was performed, with samples collected in vacuum tubes and allowed to clot at room temperature. Serum was separated by centrifugation and stored at -20°C for subsequent biochemical analysis of total cholesterol, triglycerides, HDL cholesterol, and CRP levels.

2.4 Measurement/Analysis:

Dietary Behaviour: In the dietary behavior section of the questionnaire, participants answered five questions on eating habits, recent illnesses, and family history of overweight and obesity. Responses were collected through Likert scales and closed-ended questions, drawing from widely referenced articles in our country (World.,1995; Who.,2024).

Anthropometric Measurements and BMI: Anthropometric measurements were conducted by trained health workers according to World Health Organization protocols (Flegal.,2007). Body weight was measured on platform scales accurate to 0.1 kg, and height was measured to the nearest 0.1 cm using a height chart, both without shoes or heavy clothing. Body Mass Index (BMI) was calculated as weight in kilograms divided by height in meters squared. Mid-Upper Arm Circumference (MUAC) was measured at the midpoint between the shoulder and elbow, waist circumference at the iliac crest, and hip circumference at the level of the greater trochanters, with all circumferences measured to the nearest 0.1 cm. The waist-hip ratio (WHR) was calculated as the waist measurement divided by the hip measurement.

Physical Activity Assessment: Physical activity was assessed using the Global Physical Activity Questionnaire, covering work-related activities, travel, recreational activities, and sedentary behavior (World.,2020). Activities were quantified into MET-minutes per week across these domains, following standard procedures. Physical activity levels were classified based on MET-minutes: High (≥1500 MET-minutes/week for vigorous or ≥3000 for mixed activities), Moderate (60-1499 MET-minutes/week for vigorous or 150-2999 for mixed), and Low (<60 MET-minutes/week for vigorous or

<150 for mixed).

Biochemical Analysis: The study conducted biochemical analyses for total cholesterol, triglycerides, HDL cholesterol, and CRP at the Department of Food Technology and Nutrition Science Laboratory, Noakhali Science and Technology University. The analyses utilized serum samples with cutoff values specified in Table 1 for categorizing biochemical parameters into various levels of concern.

Table 1: Biochemical Parameter Cutoff Levels

Biochemical Test	Level	Cut off values
Total cholesterol	Good	<200 mg/dL
	Borderline	200–239 mg/dL
	High	>240 mg/dL
Total triglyceride	Good	<150 mg/dL
	Borderline	150-199 mg/dL
	High	>200 mg/dL
HDL cholesterol	Good	>59 mg/dL
	At risk	40-59 mg/dL [Male] 50-59 mg/dL [Female]
	High risk	<40 mg/dL [Male] <50 mg/dL [Female]
CRP	Normal	<10 mg/L
	High	>10 mg/L

2.5 Statistical analysis

Data were analyzed using SPSS, with descriptive statistics summarizing participant characteristics. Chi-square tests for categorical variables and independent t-tests for continuous variables assessed differences between groups. Logistic regression was used to identify factors significantly associated with obesity. A p-value of <0.05 was considered statistically significant.

3. Results

The socio-demographic characteristics of the study participants are shown in Table 2. The age analysis indicates a significant trend toward obesity in individuals above 35 years. The income analysis within the study reveals a notable economic disparity, with 64% of the obese group (case group) earning below 25000 BDT monthly, pointing to a potential link between lower income levels and increased obesity rates. Physical activity levels between the groups showed pronounced differences: 74% of the case group participants reported low physical activity, contrasting sharply with 88% of the control group, who reported moderate levels of physical activity. Furthermore, the study recorded an average weight of 68.95 kg (SD = 12.95) and an average height of 158.7 cm (SD = 9.19).

Table 2: Sociodemographic characteristics of study participants.

Variable		CASE	CONTROL
		Percent (%)	Percent (%)
Age	18-24 years	24.0	70.0
	25 – 35 years	42.0	28.0
	36-45 years	34.0	2.0
Gender	Male	50.0	64.0
	Female	50.0	36.0
Religion	Islam	82.0	86.0
	Hinduism	18.0	14.0
Educational Qualification	Illiterate	24.0	16.0
	Primary	20.0	24.0
	Secondary	26.0	24.0
	Higher secondary	30.0	36.0
Income	<25000	44.0	44.0
	25000-35000	38.0	40.0
	>35000	18.0	16.0
PAL	Low	74.0	6.0
	Moderate	26.0	88.0
	High	0.0	6.0
		Mean ±Std. Deviation	Mean ±Std. Deviation
Weight in kg		77.65 ± 8.89	60.266 ± 10.29
Height in cm		155.73 ± 9.99	161.78 ± 7.24

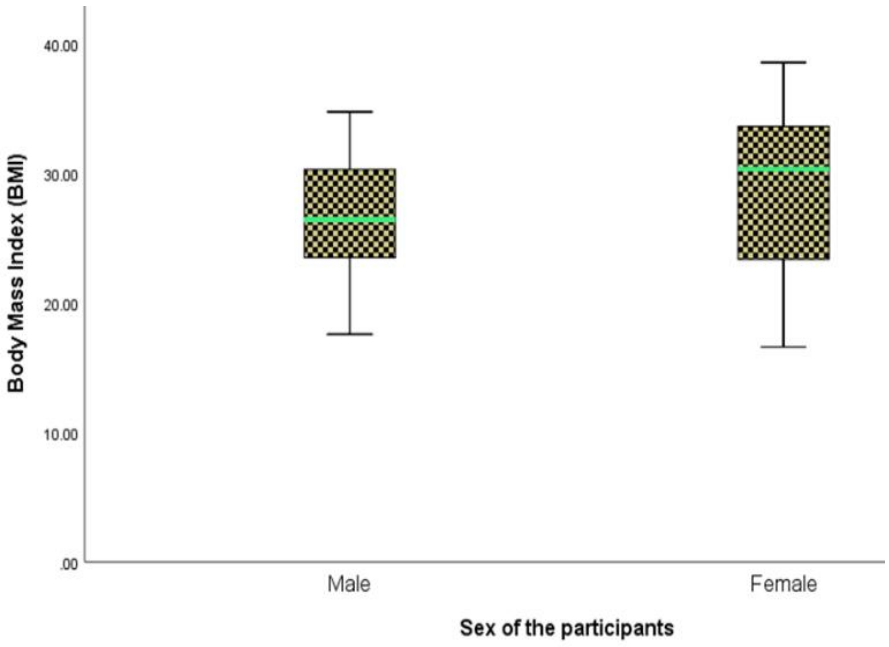

Figure 1: Comparison of BMI among Male and Female respondents.

Figure 1. presents the distribution of Body Mass Index (BMI) among male and female participants using box-and-whisker plots to compare the variability and central tendency of BMI values. The interquartile range for females was observed to be broader than that for males, indicating greater variability in BMI among female participants. Furthermore, the median BMI for females was significantly higher than that for males, suggesting a

higher central tendency of BMI values among females. Notably, the majority of data points for both genders exceeded a BMI of 25, indicating a prevalent trend towards overweight and obesity among the study population.

Table 3: Anthropometric indices and physical activity level of the study population comparing case and control group.

Variable		Case	Control	Chi-Square (p-value)
		Mean ±Std. Deviation	Mean ± Std. Deviation	
Blood Pressure (mm Hg)	Systolic	124.70 ± 13.56	119.00 ±7.42	0.011
	Diastolic	83.90 ± 9.27	79.40 ±6.03	0.005
BMI		32.02 ± .321	22.91 ± 2.98	0.41
Waist Circumference		99.87 ± 5.143	80.09 ± 8.00	0.000
Hip Circumference		106.02 ± 5.82	90.67 ± 6.38	0.26
Waist-Hip ratio		0.94 ± 0.047	0.88 ± 0.04	0.41
Mid Upper arm circumference (MUAC)		34.24 ± 2.98	27.48 ± 2.57	0.73
PAL		652.00 ± 290.10	1353.20 ± 536.07	0.00 (Close)

Independent sample t test. For continuous variables, P-values were obtained by doing independent samples t-test and for categorical variable from chi- squared test

In the table 3 compared anthropometric measurements and physical activity levels (PAL) between obese (case group) and non-obese counterparts (control group). Systolic and diastolic blood pressures were significantly higher in the case group (124.70 ± 13.56 mm Hg and 83.90 ± 9.27 mm Hg, respectively) compared to the control group (119.00 ± 7.42 mm Hg and 79.40 ± 6.03 mm Hg, respectively) with p-values of 0.011 and 0.005. Waist circumference significantly differed, with the case group showing a higher mean (99.87 ± 5.143 cm) than the control group (80.09 ± 8.00 cm, $p < 0.001$). However, BMI, waist-hip ratio, and mid-upper arm circumference (MUAC) differences did not reach statistical significance with p-values of 0.41, 0.41, and 0.73, respectively, suggesting variations in body composition that do not uniformly distribute across different anthropometric measures. Notably, PAL was markedly lower in the case group (652.00 ± 290.10) compared to the control group (1353.20 ± 536.07), indicating significantly reduced physical activity among obese workers. These findings underscore the complex interplay between obesity, physical activity, and health parameters among garment workers.

Table 4: Dietary Behaviors and Health Comparisons between Case and Control Groups.

Variable		Case	Control	Chi-Square (p-value)
		Percent (%)	Percent (%)	
Skip breakfast	Always	66.0%	32.0%	0.004
	Few times (<2 in a week)	12.0%	16.0%	
	Sometimes (2-3 times in a week)	18.0%	32.0%	
	Usually (4-6 times in a week)	4.0%	32.0%	
Eating Speed	Very slowly	8.0%	2.0%	0.084
	Slowly	30.0%	20.0%	
	Average	14.0%	36.0%	
	Fast	42.0%	34.0%	
	Very fast	6.0%	8.0%	
Fast Food Consumption	Always	44.0%	10.0%	0.001
	Sometimes (1-3 days/week)	36.0%	48.0%	
	Usually (4-6 days/ week)	10.0%	30.0%	
	Never	10.0%	12.0%	
Parents overweight or obese	One of them	44.0%	20.0%	0.004
	Both	10.0%	2.0%	
	None	46.0%	78.0%	

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Recent Illness (Last 3 months)	Yes	76.0%	62.0%	0.130

* Chi-squared test was conducted, and P-values <0.05 was considered significant.

In the table-4 presented analysis, a significant association was observed between certain lifestyle factors and obesity among case and control group. The case group (Obese) were significantly more likely to skip breakfast (66% vs. 32%, p=0.004) and consume fast food regularly (44% vs. 10%, p=0.001) compared to their control group counterparts (non-obese). Additionally, a higher proportion of obese workers reported having at least one overweight or obese parent (54% vs. 22%, p=0.004). No significant differences were found in eating speed between the two groups (p=0.084), and the incidence of recent illnesses did not significantly vary (76% vs. 62%, p=0.130).

Table 5: Comparison of Biochemical Parameters Between Case and

Biochemical Test	Level	Case	Control	Chi-Square (p-value)
		Percent (%)	Percent (%)	
Total cholesterol	Good (<200 mg/dL)	33.9	66.7	0.021
	Borderline (200–239 mg/dL)	50.0	50.0	
	High (>240 mg/dL)	76.5	23.5	
Total triglyceride	Good (<150 mg/dL)	11.1	88.9	<0.001
	Borderline (150-199 mg/dL)	52.1	47.9	
	High (>200 mg/dL)	67.6	32.4	
HDL cholesterol	Good (>59 mg/dL)	22.6	77.4	<0.001
	At risk (40-59 mg/dL [M] 50-59 mg/dL [F])	50.0	50.0	
	High risk (<40 mg/dL [M] <50 mg/dL [F])	87.0	13.0	
CRP	Normal (<10 mg/L)	39.4	60.6	0.003
	High (>10 mg/L)	70.6	29.4	

Control Groups.

* Chi-squared test was conducted, and P-values <0.05 was considered significant.

In Table 5, the analysis of biochemical test levels between case group and control group reveals distinct patterns across several key indicators, including total cholesterol, total triglyceride, HDL cholesterol, and C-reactive protein (CRP), with statistical significance evaluated through Chi-Square tests. Notably, a smaller proportion of the case group exhibited desirable total cholesterol levels (<200 mg/dL) at 33.9%, compared to 66.7% in the control group, marked by a significant p-value of 0.021. This suggests that individuals within the obese sample are more likely to have elevated total cholesterol levels. The distribution of borderline total cholesterol levels (200–239 mg/dL) was evenly split between both groups, indicating no significant difference in this category. However, the case group had a higher percentage of individuals with high cholesterol levels (>240 mg/dL) at 76.5%, compared to just 23.5% in the control group.

Similarly, disparities were observed in total triglyceride levels, with only 11.1% of the case group having levels considered good (<150 mg/dL) against 88.9% of the control group, substantiated by a p-value of <0.001. The HDL cholesterol analysis further supported these findings, where a mere 22.6% of the case group had good levels (>59 mg/dL) compared to 77.4% of the control group, also with a p-value of <0.001. Lastly, CRP levels were normal (<10 mg/L) in 39.4% of the case group versus 60.6% of the control group, with a significant difference denoted by a p-value of 0.003, indicating a higher inflammatory status in obese individuals.

4. Discussion

This case-control study among garment workers in Bangladesh aimed to uncover the determinants of obesity by examining socio-demographic characteristics, lifestyle, and biochemical factors. Our findings highlight the multifaceted nature of obesity, underscoring the interplay between economic, lifestyle, and physiological factors in its prevalence among the study population. Notably, the study revealed that lower income levels, reduced physical activity, unhealthy dietary practices, and adverse biochemical profiles are more prevalent among obese workers compared to their non-obese counterparts.

The socio-demographic analysis revealed a significant trend toward obesity in individuals over 35 years, aligning with global research that associates increasing age with higher obesity risk due to metabolic slowdown and decreased physical activity (Anderson.,2020; Popkin.,2012). Moreover, the notable economic disparity observed, with a majority of the obese group earning below 25000 BDT monthly, suggests a potential link between lower income levels and increased obesity rates. This is consistent with findings from other developing countries, were economic constraints limit access to healthy dietary choices, leading to higher consumption of calorie-dense, nutrient-poor foods (Patel.,2021;owen,2010). This finding suggests that interventions aiming to reduce obesity prevalence should also address socio-economic barriers to healthy lifestyles.

Physical activity emerged as a critical determinant of obesity status. The stark contrast in activity levels between the case and control groups, with a vast majority of the obese group reporting low physical activity, this factor emerges as a significant determinant of obesity, corroborating existing literature that highlights sedentary lifestyles as a major risk factor for obesity (Lee.,2020; Rosenheck.,2008). This emphasizes the need for interventions aimed at increasing physical activity among garment workers, potentially through workplace wellness programs.

The significant associations between obesity and lifestyle factors, such as skipping breakfast and regular consumption of fast food, underline the importance of healthy eating habits. Skipping breakfast has been linked to increased obesity risk due to compensatory overeating later in the day (Garcia.,2018;Elks.,2018). Additionally, the consumption of fast food, often high in calories, fats, and sugars, has a well-established link with obesity

(Grundy.,2008). The finding that a higher proportion of obese workers reported having at least one overweight or obese parent suggests a genetic or familial predisposition to obesity, highlighting the role of genetic factors in obesity risk (Hassan.,2020).

Biochemical analyses provided insight into the metabolic consequences of obesity, with the obese group exhibiting less favorable profiles in terms of total cholesterol, triglycerides, HDL cholesterol, and CRP levels. These disparities not only underscore the metabolic dysregulation associated with obesity but also highlight the elevated risk of cardiovascular and inflammatory conditions in the obese group, as evidenced by elevated total cholesterol and triglyceride levels and reduced HDL cholesterol levels (Perarson .,2003). The higher CRP levels in the obese group suggest an elevated inflammatory status, which is a known risk factor for several chronic conditions, including heart disease and diabetes.

Our study's findings emphasize the need for comprehensive interventions targeting lifestyle modifications, including diet and physical activity, to combat the rising tide of obesity among garment workers in Bangladesh. Workplace wellness programs that encourage active lifestyles and provide education on healthy dietary practices could serve as effective strategies in this regard. Moreover, policy interventions aimed at improving the socio-economic conditions of garment workers may indirectly contribute to obesity prevention by enhancing access to nutritious foods and physical activity opportunities.

In conclusion, the determinants of obesity among garment workers in Bangladesh are multidimensional, involving socio-demographic characteristics, lifestyle behaviors, and biochemical factors. Addressing these determinants through targeted interventions could significantly reduce the burden of obesity and its associated health risks in this population. Future research should focus on longitudinal and interventional studies to explore these relationships further and to test strategies aimed at mitigating obesity in this and similar populations.

4.1 Limitations Of The Study

While this study provides valuable insights into the determinants of obesity among garment workers in Bangladesh, several limitations must be acknowledged to contextualize its findings and implications accurately. First, the inherent nature of case-control studies restricts our ability to establish causality between the observed factors and obesity. The temporal relationship between these factors and the onset of obesity cannot be determined definitively, thus warranting cautious interpretation of the results.

Second, the reliance on self-reported data for physical activity levels and dietary habits introduces the potential for recall bias and social desirability bias. Participants may have overestimated their physical activity levels or underreported their consumption of unhealthy foods, leading to inaccuracies in the assessment of these critical variables.

Third, the sample size and specific population of garment workers may limit the generalizability of the findings. The unique socioeconomic and occupational conditions of garment workers in Bangladesh might not fully represent the broader population, thereby restricting the applicability of the results to other groups or settings.

Additionally, the biochemical assessments were limited to a specific set of markers. A more comprehensive examination including additional metabolic and inflammatory markers could provide a more nuanced understanding of the physiological impacts of obesity and its underlying mechanisms in the context of garment workers.

Despite these limitations, the study sheds light on critical factors associated with obesity among garment workers in Bangladesh, offering a foundation for future research and intervention strategies aimed at mitigating this growing health concern.

5. Conclusion

The findings underscore the multifactorial nature of obesity, highlighting the significant roles played by age, income level, physical activity, dietary habits, and familial obesity history. Notably, the study revealed that lower income levels, reduced physical activity, unhealthy dietary practices, and adverse biochemical profiles are more prevalent among obese workers compared to their non-obese counterparts.

The implications of these findings are profound, indicating a pressing need for targeted interventions aimed at mitigating the risk factors for obesity within this population. Workplace wellness programs that promote physical activity, provide nutritional education, and offer healthy eating options could be pivotal in curbing the trend of rising obesity rates among garment workers. Moreover, policy initiatives focused on improving the socioeconomic conditions of these workers may indirectly contribute to reducing obesity prevalence by enabling healthier lifestyle choices.

Ethical Consideration

This study was approved by the Ethical Review Committee of Department of Nutrition and Food Science, University of South Asia (Reference Number. EH10270). Either verbal or written consent was taken from the participant, informing them about the purpose of the study, anonymity, their rights to refuse to answer any question, withdrawal from the study at any point in time, and other issues mentioned in the form before starting the interviews.

Author Contributions

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Conflicts of Interest

The authors declare no conflicts of interest for this work.

Data Availability

Data are available upon reasonable request.

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