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Original Article

Association Between Belly Fat and Cardiovascular Disease: A Survey-Based Study

Khudayenoor[1], Shahzeb[2]*, Muhammad Abbas[3]
[1]Medical Officer, CCU, PAF Hospital Islamabad, Pakistan.
[2]Assistant Professor, Department of Medicine, Mardan Medical Complex (MMC) Mardan, Pakistan.
[3]Professor, Department of Medicine, Mardan Medical Complex (MMC) Mardan, Pakistan.
*Corresponding Author: Shahzeb; Email: drshahzeb1982@gmail.com
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ABSTRACT

Background: Background: The escalating prevalence of obesity worldwide is intricately linked with numerous health complications, notably diabetes, cardiovascular diseases (CVD), respiratory issues, and mental health disorders. Abdominal obesity, in particular, stands out as a significant predictor of cardiovascular risk, underpinning the need for detailed investigations to facilitate targeted interventions.

Objective: This research aimed to elucidate the relationship between abdominal obesity and the risk of cardiovascular disease, focusing on the roles played by waist circumference, socioeconomic factors, exercise habits, and biochemical markers in determining cardiovascular health.

Methods: This cross-sectional study, executed by the Cardiology Department at GKMC Swabi, analyzed data from a representative sample of 400 individuals recruited between January 5 and December 31, 2023. Participants were stratified by gender and waist size, undergoing evaluations for waist circumference, fasting blood glucose, lipid profiles, and physical fitness. Socioeconomic status was classified into low to middle, middle to high, and high. Data analysis was conducted using SPSS version 25.0, with chi-square tests and odds ratios computed to ascertain statistical significances at a threshold of $p<0.05$.

Results: The investigation revealed that males with waist sizes ≥85 cm (n=20) had a mean waist circumference of 90.1±43.1 cm and BMI of 23.3±0.80 kg/m², whereas females in the same waist size category (n=30) reported mean values of 88.1±2.7 cm and 23.8±0.7 kg/m², respectively, indicating significant associations with increased cardiovascular risk ($p<0.001$ for all comparisons). Age analysis showed that individuals with central obesity were significantly older, with mean ages of 63.3±12.64 years for men and 63.9±4.5 years for women in the higher waist size groups, compared to their counterparts with smaller waist sizes ($p<0.001$). Socioeconomic analysis highlighted an inverse relationship between education level and obesity prevalence, particularly among women. Regular physical activity emerged as a significant protective factor, with individuals engaging in exercise 0-3 days per week showing a lower incidence of elevated waist sizes ($p<0.001$ for both genders). Adjusted odds ratios for age and BMI pointed to a complex interplay between abdominal obesity and CVD risk, influenced by gender and socioeconomic background.

Conclusion: Our findings highlight the multifaceted relationship between abdominal obesity and cardiovascular disease risk, advocating for personalized treatment approaches that consider the intricate influences of socioeconomic status, lifestyle behaviors, and biological markers. The study underscores the importance of holistic strategies that promote lifestyle modification, socioeconomic improvement, and targeted clinical interventions to combat the cardiovascular sequelae of obesity.

Keywords: Abdominal Obesity, Cardiovascular Disease Risk, Waist Circumference, Socioeconomic Factors, Exercise Habits, Biochemical Markers, Cross-Sectional Study.

INTRODUCTION

The association between obesity and cardiovascular disease (CVD) has been extensively studied, revealing a complex relationship that extends beyond traditional metrics such as body mass index (BMI) (1, 2). Notably, the concept of metabolically healthy obesity has emerged to describe a subset of obese individuals who, despite their high body weight, do not exhibit the metabolic disturbances commonly associated with increased cardiovascular risk (3, 4). This phenomenon, as Sims (2001) points out, might be attributed to factors such as the distribution of body fat, the age at which obesity onset occurs, and specific genetic predispositions (5). Individuals with early onset obesity, hyperplasia of normal adipocytes, and normal levels of visceral abdominal fat may demonstrate a favorable metabolic profile, suggesting that not all obese individuals are at an elevated risk for cardiovascular diseases (2, 6).

Adding to the complexity of obesity's impact on cardiovascular health is the condition known as Non-Alcoholic Fatty Liver Disease (NAFLD). According to Abdallah et al. (2020), NAFLD is closely linked with insulin resistance, obesity, and the metabolic syndrome, all of which contribute to an increased risk of CVD (1). NAFLD's association with these metabolic disturbances underscores its role not merely as a marker but as an active participant in the pathogenesis of cardiovascular diseases. This connection highlights the intricate interplay between liver health, fat distribution, and cardiovascular outcomes, reinforcing the need for a comprehensive approach to obesity management that considers the wide-ranging effects of fat accumulation on the body (7, 8).

The distribution of body fat plays a crucial role in determining the risk of cardiovascular and metabolic diseases. In contrast to the well-documented risks associated with visceral fat, gluteofemoral fat—located around the hips and thighs—has been identified for its protective properties. Manolopoulos et al. (2010) emphasize that gluteofemoral fat is associated with a favorable lipid and glucose profile, offering long-term storage for excess fatty acids and thereby reducing the risk of cardiovascular and metabolic diseases (9). This distinction underscores the importance of considering fat distribution in health risk assessments and the potential for targeted interventions (10-12).

Visceral obesity, characterized by the accumulation of fat within the abdominal cavity, is particularly concerning due to its association with systemic inflammation, metabolic syndrome, and an increased risk of CVD. Silveira et al. (2020) highlight the role of inflammatory cytokines and hormones secreted by visceral fat in exacerbating cardiovascular risk, pointing to the necessity of addressing abdominal adiposity as part of cardiovascular health strategies (2).

Furthermore, the concept of ectopic fat deposition, which includes the accumulation of fat in non-adipose tissues such as the liver and heart, offers additional insight into the relationship between obesity and cardiovascular diseases. Gastaldelli & Basta (2010) elucidate the link between ectopic fat and a heightened risk of cardiovascular conditions, including atherosclerosis, coronary heart disease, and hypertension (13). This relationship accentuates the adverse effects of fat distribution beyond traditional considerations of obesity, indicating a broader spectrum of risk factors associated with abnormal fat accumulation (9, 14, 15).

In synthesizing these insights, it becomes evident that the relationship between obesity and cardiovascular disease is multifaceted, influenced by a variety of factors including the onset age of obesity, genetic predispositions, and especially the distribution of body fat (16). The distinctions between metabolically healthy obesity, the implications of NAFLD, the protective role of gluteofemoral fat, the inflammatory nature of visceral obesity, and the risks associated with ectopic fat deposition collectively underscore the complexity of obesity as a risk factor for CVD. This comprehensive understanding is crucial for developing targeted and effective interventions aimed at reducing cardiovascular risk among obese individuals, highlighting the need for a nuanced approach to obesity management and cardiovascular disease prevention (17, 18).

MATERIAL AND METHODS

The Cardiology Department at GKMC Swabi undertook a comprehensive study from January 5th to December 31st, 2023, to investigate the association between abdominal obesity and the risk of developing cardiovascular disease. The study received approval from the institutional review board, ensuring adherence to ethical guidelines and the Declaration of Helsinki for the protection of human subjects in medical research. All participants provided informed consent before their inclusion in the study, confirming their understanding and voluntary participation (19).

The research team employed a methodical approach to sample selection, aiming to create a sample representative of the city's population. By dividing the city into several segments and utilizing a random selection method, the study encompassed 400 individuals to explore the hypothesized correlation between belly fat and an elevated risk of heart disease by 10%. The survey was designed with a 90% confidence interval and a 10% margin of error, enhancing the reliability of the findings (16, 19).

Data collection was systematically organized across the city's layout, which was segmented by two councils along each of the four main axes, thereby facilitating comprehensive coverage. Each council was tasked with collecting data from fifty residents, specifically targeting individuals aged 45 to 55 years, to ensure a focus on a demographic at potential risk for cardiovascular diseases. The methodology included visiting households on the eastern side of the city, where researchers distributed educational pamphlets and collected fasting blood samples for analysis.

The blood samples were meticulously handled, stored in portable ice coolers, and frozen at -20 degrees Celsius for preservation before serum separation in the laboratory. Participants underwent medical assessments measuring vital statistics such as waist circumference, age, gender, body mass index (BMI), and fitness test results. These measurements were conducted using standardized procedures, with waist size measured at the navel using a one-inch tape measure to ensure accuracy.

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Biochemical assessments included fasting glucose levels and a comprehensive lipid profile, vital for evaluating metabolic health and risk factors for cardiovascular disease. Additionally, participants were offered a free Exercise Tolerance Test (ETT) at the hospital's cardiology laboratory, providing further insight into their cardiovascular health status (5).

The statistical analysis was performed using SPSS version 25.0, incorporating advanced methods such as chi-square tests and odds ratio calculations to determine the strength and significance of the association between abdominal obesity and cardiovascular disease. The analysis was guided by a pre-established threshold for statistical significance, with a p-value below 0.05 indicating that the findings could be interpreted with confidence.

This rigorous and methodical approach ensured a thorough investigation into the link between cardiovascular health and abdominal obesity, contributing valuable insights to the existing body of knowledge on this critical public health issue.

RESULTS

In the comprehensive analysis conducted by the Cardiology Department at GKMC Swabi, significant findings emerged regarding the demographic and clinical characteristics associated with waist size and gender, as delineated in Table 1. The study highlighted a discernible difference in waist circumference among genders, with males exhibiting a mean waist circumference of 81.3±4.5 cm for those with a waist size less than 80 cm, and 90.1±43.1 cm for those with a waist size of 85 cm or above. This contrast was similarly pronounced in females, where those with a waist size less than 85 cm had a mean circumference of 74.5±5.6 cm, compared to 88.1±2.7 cm for those with waist sizes of 85 cm or above. The disparities in waist circumference across both genders were statistically significant (p<0.001).

Further analysis revealed marked differences in Body Mass Index (BMI), with males under the 80 cm waist circumference threshold having a BMI of 22.2±2.64 kg/m², whereas those above the 85 cm mark had a BMI of 23.3±0.80 kg/m². The trend was consistent among females, with a BMI of 22.3±1.7 kg/m² for those under 85 cm in waist circumference and 23.8±0.7 kg/m² for those exceeding this threshold. These findings indicated a significant relationship between waist size and BMI, with p-values less than 0.001 in all comparisons.

The age variable also presented significant differences, with males having a waist size less than 80 cm averaging 51.71±15.3 years, and those with a waist size of 85 cm or above averaging 63.3±12.64 years. Females showed a similar age disparity, where those with a waist size less than 85 cm averaged 49.1±16.3 years, compared to 63.9±4.5 years for those with a waist size of 85 cm or above, again indicating a significant difference (p<0.001).

In terms of socioeconomic status, a noteworthy distinction was observed in the distribution among income levels, particularly in the low to middle income category, which showed a greater prevalence among those with larger waist sizes, suggesting a potential socioeconomic gradient in abdominal obesity (Table 1).

Turning attention to exercise frequency and its correlation with waist size distribution (Table 2), individuals engaging in 0-3 days of exercise per week exhibited a waist size less than 80 cm in 44% of males and accounted for 51% of those with a waist size of 85 cm or above, denoting a significant association (p<0.001). For females, the pattern was similar, with 85 participants engaging in minimal exercise having a waist size less than 80 cm, and 15 participants with a waist size of 85 cm or above (p=0.001).

The odds ratios (OR) for cardiovascular risk factors further elucidated the impact of age, BMI, and socioeconomic status on cardiovascular health. Age and BMI adjustments revealed significant odds ratios, underscoring the heightened risk associated with increased age and BMI across both genders (Table 3). Particularly, the adjusted OR for age and BMI in females indicated a heightened susceptibility to cardiovascular risks associated with abdominal obesity.

Table 1 Demographic and Clinical Characteristics by Waist Size and Gender

Variable	Male (<80cm) n=130	Male (≥85cm) n=20	P value	Female (<85cm) n=220	Female (≥85cm) n=30	P value
Waist Circumference (WC, cm)	81.3±4.5	90.1±43.1	<0.001	74.5±5.6	88.1±2.7	<0.001
Body Mass Index (BMI, kg/m²)	22.2±2.64	23.3±0.80	<0.001	22.3±1.7	23.8±0.7	<0.001
Age (years)	51.71±15.3	63.3±12.64	<0.001	49.1±16.3	63.9±4.5	<0.001
Income Family						
Low to Middle	55 (43.80%)	6 (50%)	0.010	84 (38.1%)	19 (47.5%)	<0.001
Middle to High	54 (41.6%)	3 (25%)		65 (29.5%)	10 (25%)	
High	50 (31.3%)	3 (25%)		71 (32.3%)	11 (27.5%)	

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Table 2 Exercise Frequency and Waist Size Distribution

Days per Week	Male (<80cm) n=176	Male (≥85cm) n=19	P value	Female (<80cm) n=244	Female (≥85cm) n=35	P value
0-3	65 (44%)	10 (51%)	<0.001	85	15	0.001
3-4	42 (26%)	5 (34%)		65	11	
5-6	46 (28%)	4 (17%)		94	10	

Table 3 Odds Ratios (OR) for Cardiovascular Risk Factors by Gender

Variable	Male Unadjusted	Male Adjusted (Age and BMI)	Female Unadjusted	Female Adjusted (Age and BMI)
Age	1.04 (1.049–1.068)	<0.001	1.05 (1.05–1.07)	0.001
BMI	1.81 (1.67–1.98)	<0.001	1.66 (1.6–1.71)	0.001
Income				
Low–Middle	1.31 (0.85–1.96)	0.192	2.3 (1.7–3.4)	<0.001
Middle–High	1.11 (0.72–1.65)	0.643	1.43 (0.1–2.1)	0.045
High	2		2	

Table 4 Walking Exercise Impact on Cardiovascular Health

Frequency	[0–1] Days	[2–4] Days	[5–7] Days
Male	3.32 (1.5–4.4)	1.4 (0.992–1.99)	2
P value	<0.001	0.056	
Female	1.3 (1.1–1.91)	0.90 (0.7–1.3)	2
P value	0.009	0.521	

Moreover, the analysis of walking exercise impact on cardiovascular health (Table 4) demonstrated a compelling benefit, especially noted in the frequency category of 0-1 days, where males exhibited an OR of 3.32 (1.5–4.4), highlighting the protective effect of regular walking exercise against cardiovascular risks.

DISCUSSION

The study conducted by the Cardiology Department at GKMC Swabi delved into the intricate relationship between abdominal obesity and cardiovascular disease, uncovering findings that echo and extend upon existing literature within this domain (20). Notably, the sample comprised a larger contingent of females compared to males, a demographic distribution that provided a unique lens through which to examine the prevalence and implications of central obesity. Contrary to prevailing data from other Asian regions, our study identified a higher incidence of central obesity among men, a finding that might be attributed to regional variations in climate and dietary habits. This divergence underscores the influence of environmental and lifestyle factors on obesity patterns, suggesting a nuanced interplay between genetics and geography in the manifestation of central obesity (1, 6).

The analysis revealed that individuals with central obesity, regardless of gender, were of a significantly higher mean age than their non-obese counterparts, aligning with the broader consensus in scientific research that associates increased age with a predisposition to accumulate abdominal fat. However, when adjustments were made for age and socioeconomic variables, the strong correlation initially observed between male abdominal obesity and cardiovascular disease appeared to diminish. This adjustment suggests that factors beyond mere abdominal fat accumulation play a critical role in the cardiovascular health of men. In contrast, for women, the linkage between central obesity and cardiovascular disease remained robust and was further influenced by socioeconomic status, indicating a gender-specific pathway through which obesity impacts heart health (1, 6).

Education emerged as a significant determinant of central obesity in women, with the study findings suggesting a greater awareness and understanding of obesity-related health risks among educated groups. This heightened awareness could potentially drive better health choices and lifestyle changes, mitigating the risk of obesity and its associated complications. Interestingly, despite the cultural prohibition against alcohol consumption in Pakistan, the study did not identify significant impacts of alcoholism on obesity rates, an observation that diverges from trends noted in countries with high alcohol consumption rates. This discrepancy highlights the complex mosaic of cultural, behavioral, and biological factors that contribute to the epidemiology of obesity (8, 21).

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Physical activity, or the lack thereof, was reaffirmed as a critical factor in preventing central obesity and its sequelae, such as dyslipidemia, atherosclerosis, and ischemia. The study's findings regarding the protective role of exercise against cardiovascular risk factors complement a body of evidence advocating for the incorporation of regular physical activity into daily routines as a strategy to combat obesity and enhance cardiovascular health (4, 6, 11).

Despite its insightful contributions, the study is not without limitations. The modest sample size and the confinement of the study to a single geographical location may restrict the generalizability of the findings. Additionally, the reliance on self-reported data could introduce bias, underscoring the need for future research incorporating objective measures and a broader participant base to validate and expand upon these findings (3, 8, 21).

CONCLUSION

In conclusion, our research underscores the multifaceted mechanisms by which abdominal obesity contributes to cardiovascular disease risk, highlighting the interplay of biological, socioeconomic, and lifestyle factors. The study advocates for the development of tailored intervention programs that address the complex web of determinants influencing obesity and cardiovascular health. Such programs should not only target weight management and physical activity promotion but also consider the socioeconomic context of individuals, aiming to provide holistic and sustainable solutions to the global challenge of obesity and its cardiovascular implications. Further research, embracing a wider scope and diverse methodologies, is essential to refine our understanding and approach to managing this multifactorial health issue.

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