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Association of Peripheral Artery Disease with Obesity

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ABSTRACT

Obesity has emerged as a significant contributor to the development and progression of Peripheral Artery Disease (PAD) which has significant impact on local population as the frequency of obesity is high. **Objective:** To determine the association between obesity and the development of Peripheral Artery Disease in patients attending General Medicine clinics. **Methods:** This cross-sectional study using non-probability convenient sampling was done to investigate association of obesity on the development of peripheral artery disease for six months. The study population consisted of adult patients (aged 18 and above) attending cardiovascular and metabolic clinics at Al-Tibri Medical Hospital. Inclusion criteria included patients with PAD confirmed by ankle-brachial index (ABI) of less than 0.90 into mild, moderate and severe. Patients with acute infections, malignancies were excluded. Hypothesis of the study stated that whether there was an association between obesity and development of PAD or not. Statistical analysis done using SPSS version 23.0, involved association between BMI and PAD using chi-square tests keeping $p<0.05$ statistically significant. **Results:** The mean age of participants was 50.87 ± 8.32 years. Mean ABI was 1.02 ± 0.12. Individuals having normal BMI (18-22.99 kg/m^2), 6 had PAD. In the overweight category (23-24.99 kg/m^2), 8 had PAD. In the Obese I category (25-26.99 kg/m^2), 11 had PAD. In the Obese II category (27-29.99 kg/m^2), 20 had PAD. In the Obese III category (>30 kg/m^2), 24 had PAD. A significant association between BMI and PAD was observed between both groups (p-0.01). **Conclusion:** A significant association between obesity and PAD development was observed in this study. Obesity was a significant factor in the development of PAD. The significant association between obesity and PAD observed in this study underscores the need for public health interventions aimed at weight management.

INTRODUCTION

Peripheral artery disease (PAD) is frequently reported circulatory problem characterized by narrowed arteries, reducing blood flow to limbs [1]. This condition primarily results from atherosclerosis, where fatty deposits build up in the artery walls. Among various risk factors, obesity is regarded as significant contributor in developing and progressing of PAD [2]. Obesity, is a growing global health issue [3]. It is established that obesity is a major risk factor for cardiovascular diseases, including PAD. Interplay between obesity and PAD is multifaceted, involving metabolic, inflammatory, and hemodynamic mechanisms [4]. Metabolic dysfunction is one of mechanism by which obesity primarily influences PAD. It is seldom linked to hyperglycemia, insulin resistance and dyslipidemia [5]. The metabolic alterations tend to cause dysfunction of endothelium, which is a precursor of atherosclerosis. Elevated levels of blood glucose and resistance to insulin can both lead to endothelial damage, which consequently causes deposition of fats in arterial walls [6]. In addition, obesity associated dyslipidemia, observed in terms of high triglycerides and low-density lipoprotein (LDL) levels. They further accelerate formation of atherosclerotic plaques [7]. Another vital link between PAD and obesity is inflammation. Adipose tissue, especially visceral fat, secretes multiple pro-inflammatory cytokines [8]. Such mediators cause chronic low-grade inflammatory conditions and promote atherosclerosis and subsequently lead to development of PAD. Oxidative stress can also occur because of chronic inflammation, thereby exacerbating plaque instability and endothelial dysfunction [9]. In the development of PAD, obesity associated hemodynamic changes also play a pivotal role.

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High body weight raises mechanical load on the heart which causes hypertension [10]. It is a well-known risk factor for atherosclerosis since it leads to stressed arterial walls and also promotes injury to endothelium. Furthermore, obesity alters dynamics of blood flow, as in increase in blood viscosity and alterations in shear stress which can further lead to damage to vascular endothelium and formation of plaque [11]. Researchers have continuously reported strong link between PAD and obesity. Research studies have observed obesity to be strongly associated with PAD when compared to individuals with normal weight [12]. Furthermore, PAD severity is often correlated with degree of obesity. For example, high BMI is linked to severe occlusion of arteries and increased risk for adverse cardiovascular event [13]. Obesity impacts PAD beyond development of disease, influencing clinical outcome of obese patients with PAD. This leads to complications, often whose rates tend to be high [14]. PAD patients who are obese tend to experience severe symptoms like resting pain and claudication, having higher risk for amputation of limb. In addition, even treatment of complications can sometimes be of limited help, wherein obesity can cause limited effectiveness of revascularization techniques, for instance bypass surgery or angioplasty. Factors associated with limited effectiveness amongst obese individuals are increase in peri-operative risks and technical challenges [15]. There to prevent and manage PAD, it is crucial to address obesity in terms of reduction of weight via modification in lifestyles, (dietary alterations and increased physical activity). Both have been reported to improve metabolic alterations, reducing inflammation and enhancing vascular function [16]. Peripheral Artery Disease (PAD) is a significant public health concern associated with considerable morbidity and mortality, yet the role of obesity in its development remains underexplored. Obesity, a global epidemic, is linked to systemic inflammation, endothelial dysfunction, insulin resistance, and pro-atherogenic metabolic disturbances, all of which contribute to vascular injury and atherosclerosis. While traditional risk factors like smoking, diabetes, and hypertension are well-established, obesity's independent role as a PAD risk factor is less clearly defined. This study aims to determine association between obesity and development of PAD in patients attending General Medicine clinics.

METHODS

This cross-sectional analytical study using non-probability convenient sampling was carried out on adult patients (18 years and above) attending medical out-patient department at Al-Tibri Medical Hospital, Karachi for a period of six months after approval from the Institutional Review Board (Ref no: ATMC/IERC/13th (01-2023)/15). Patients with clinical diagnosis of PAD confirmed by an ankle-brachial index (ABI) of less than 0.90 or imaging studies were included in the research. Patients having acute infections, malignancies, or conditions that might have confounded relationship between obesity and PAD (e.g., vasculitis) were excluded. A sample size calculation was performed based on the expected prevalence of PAD in obese population. Assuming a prevalence of PAD of 20% in the obese, with a power of 80% and a significance level of 5%, sample size was estimated at around 200 participants [13]. After ethical approval from Institutional Review Board (IRB) of hospital, data were collected through structured interviews, clinical examinations, and review of medical records. Informed consent was sought from each patient prior to inclusion in the study. The following information was gathered; demographic data included age, gender and BMI (kg/m2). Clinical data included ABI measurement and presence or absence of PAD. Initially 200 participants were included in the study but 10 had missing data, therefore a total of 190 participant's data were then processed. The data were collected on a pre-designed proforma, and data consistency were maintained by using the same proforma for all patients. All statistical analysis were carried out by SPSS version 23.0. Descriptive statistics was presented as frequency and percentage for gender while mean and standard deviation for age and BMI. Statistical analysis involved association between BMI and PAD using chi-square tests keeping $p<0.05$ as statistically significant.

RESULTS

The included participants had mean age of 50.87 ± 8.32 years. The Ankle Brachial Index (ABI), a measure used to assess peripheral arterial disease, had a mean value of 1.02 ± 0.12 (Table 1).

Table 1: Age and Ankle Brachial Index (ABI) of Patients Included (n=190)

Variable	Mean ± SD
Age	50.87 ± 8.32
ABI	1.02 ± 0.12

The gender distribution of the sample consisted of 88 male (46.3%) and 102 female (53.7%). The BMI categorization of the participants was as follows: 30 individuals (15.8%) had a normal BMI, 30 individuals (15.8%) were classified as Obese I, 55 individuals (28.9%) were classified as Obese II, 50 individuals (26.3%) were classified as Obese III, and 25 individuals (13.2%) were overweight. Regarding the Ankle Brachial Index (ABI) groups, 112 individuals (58.9%) had normal ABI values, 43 individuals (22.6%) were classified as having acceptable ABI values, 29 individuals (15.3%) had some arterial disease, 5 individuals (2.6%) had moderate arterial disease, and 1 individual (0.5%) had severe arterial disease (Table 2).

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Table 2: Baseline Demographics of Categorical Variables

Variable		Frequency (%)
Gender	Male	88 (46.3)
	Female	102 (53.7)
BMI	Normal	30 (15.8)
	Obese I	30 (15.8)
	Obese II	55 (28.9)
	Obese III	50 (26.3)
	Overweight	25 (13.2)
Ankle Brachial Index Groups	Normal	112 (58.9 %)
	Acceptable	43 (22.6 %)
	Some AD	29 (15.3 %)
	Moderate AD	05 (2.6 %)
	Severe AD	01 (0.5 %)

Figure 1 shows that 69 patients included in this study were reported to have PAD.

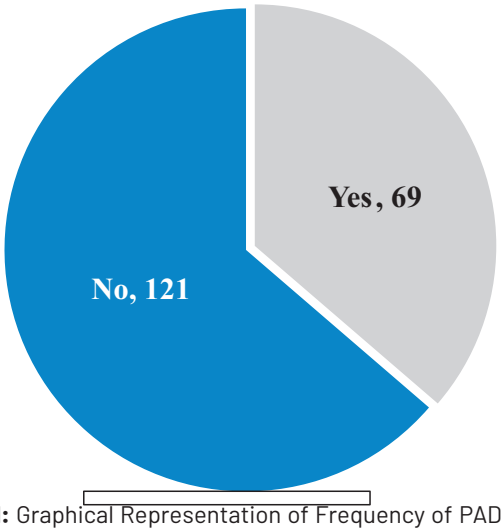

Figure 1: Graphical Representation of Frequency of PAD Among Patients Included in The Study (N=190)

Among individuals with a normal BMI (18-22.99 kg/m^2), 6 had PAD and 24 did not, out of a total of 30 individuals. In the overweight category (23-24.99 kg/m^2), 8 had PAD and 17 did not, out of a total of 25 individuals. In the Obese I category (25-26.99 kg/m^2), 11 had PAD and 19 did not, out of a total of 30 individuals. In the Obese II category (27-29.99 kg/m^2), 20 had PAD and 35 did not, out of a total of 55 individuals. In the Obese III category (>30 kg/m^2), 24 had PAD and 26 did not, out of a total of 50 individuals. A significant association between BMI and PAD was observed between both groups (p-0.01)(Table 3).

Table 3: Association between BMI and PAD (n=190)

Laterality of Eye		PAD		p-value	Proportion	95 % CI Lower	95 % CI Upper
		Yes	No				
BMI (kg/m^2)	Overweight (23-24.99)	06	24	0.01	0.20	0.057	0.343
	Overweight (23-24.99)	08	17		0.32	0.137	0.503
	Obese I (25-26.99)	11	19		0.367	0.194	0.539
	Obese II (27-29.99)	20	35		0.364	0.237	0.491
	Obese III (>30)	24	26		0.48	0.342	0.618

DISCUSSION

This study highlighted the association between Body Mass Index (BMI) and Peripheral Arterial Disease (PAD) which observed in this study aligns with findings from other research, highlighting the significant role that obesity plays in the development of PAD. Numerous research has established obesity as significant risk factor for PAD. For instance, a study published demonstrated that higher BMI was associated with higher risk of developing PAD [17]. The study found that individuals with a BMI ≥30 kg/m^2 had a significantly higher prevalence of PAD in comparison to BMI <30 kg/m^2. Similarly, the findings from the Framingham Heart Study highlighted that obesity, defined by a BMI ≥30 kg/m^2, was strongly associated with the incidence of PAD in either gender [18]. Current study, reporting higher BMI categories (Obese I, II and Obese III) are associated with a higher prevalence of PAD, are consistent with previous research. For example, a large cohort study reported individuals classified as obese had two-fold increased risk of PAD in comparison to those with normal weight [19]. Obesity seldom is linked with chronic low-grade inflammation which mainly contributes to pathogenesis of PAD and atherosclerosis [20]. Pro-inflammatory cytokines are secreted by adipose tissues that increase vascular inflammation, contributing towards PAD development [21]. Risk factors for PAD and atherosclerosis include hyperglycemia and resistance to insulin, both of which are closely linked to obesity [22]. Dyslipidemia is mostly observed in patients with a high BMI. Characteristic feature of dyslipidemia included elevated lipid levels overall. It is a well-known risk factor for PAD and atherosclerosis [23]. The findings of this research underscore the importance of managing weight for prevention and management of PAD. Clinicians should focus on signifying maintenance of healthy BMI via lifestyle modifications, dietary control and physical exercises. This should be practiced in patients which PAD or at-risk of PAD. Public health awareness programs ought to target weight reducing interventions in obese individuals for decreasing PAD burden. In order to achieve optimal health, nutritional counseling, weight loss programs and community-based activities should be promoted [24]. It should be routinely practiced that adult patients presenting to General Medicine clinics with obesity ought to be ruled out for peripheral arterial disease (PAD) by using Ankle Brachial Index (ABI). Patients presenting with any other complaint could possibly be diagnosed with PAD as an incidental finding. This study was

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not free from limitations. A single centered study with limited sample size cannot be used for generalization of the results. Moreover, BMI was recorded as a sole measure for obesity and no differentiation was made based on obesity types (central or peripheral) or through any laboratory investigations. Further multi-centered studies with greater sample size would be enlightening to the findings reported in this study.

CONCLUSIONS

Obesity was a significant factor in the development of PAD. The significant association between obesity and PAD observed in this study is consistent with previous research, highlighting the need for effective weight management strategies to mitigate the risk of PAD. Future research should explore the longitudinal impact of weight loss on the incidence and progression of PAD, as well as the underlying mechanisms linking obesity with peripheral arterial disease. The significant association between obesity and PAD observed in this study underscores the need for public health interventions aimed at weight management.

Authors Contribution

Conceptualization: HZ
Methodology: TA, AK
Formal analysis: HA
Writing review and editing: HA, SI, NAM

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

The authors declare no conflict of interest.

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