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Peripheral Arterial Disease in Diabetes and its Relation to Cardiovascular Risk Factors in Women

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ABSTRACT

Objectives: Peripheral arterial disease (PAD) is characterized by occlusive disease in the abdominal aorta, iliac, and femoral arteries, leading to reduced blood flow and complications. Diabetes mellitus (DM) is known to contribute to the development and progression of PAD due to factors such as hyperglycemia, dyslipidemia, endothelial dysfunction, and inflammation. However, PAD may be underdiagnosed in women with DM, leading to adverse cardiovascular outcomes. The present study aimed to investigate the prevalence of PAD in women with type 2 DM (T2DM) and its relationship with cardiovascular risk factors.

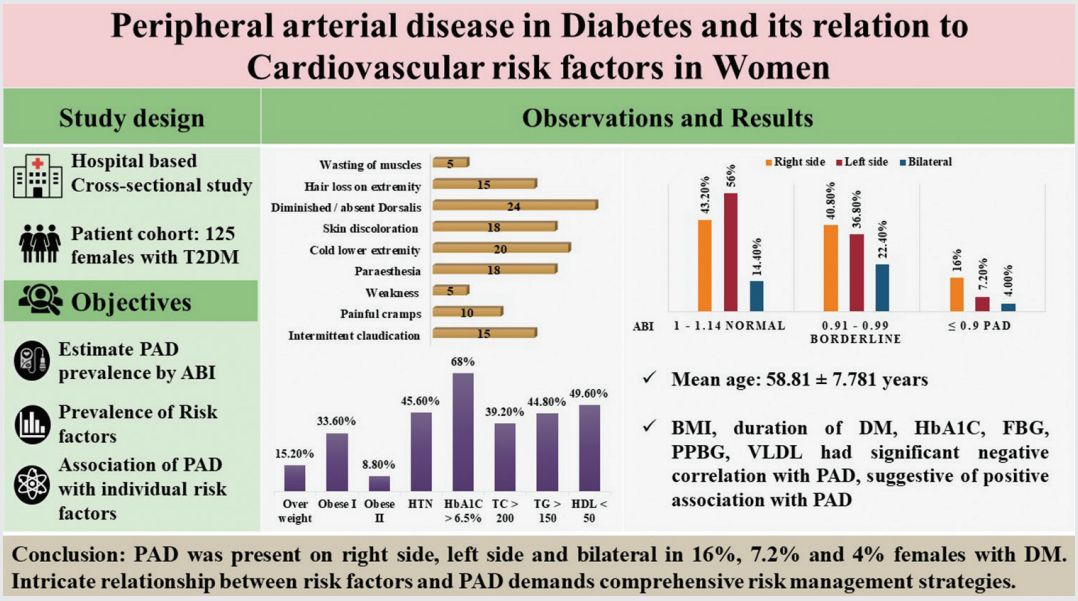
Materials and Methods: This hospital-based, cross-sectional, and observational study was conducted for a period of 3 months from June 10, 2023, to September 10, 2023, in the outpatient department of general medicine. After obtaining the approval from the Institutional Ethical Committee, the study was performed according to the Declarations of Helsinki and Good Clinical Practice requirements for human subject protection. Non-probability purposive sampling technique was used to enroll participants. Participants underwent face-to-face interviews and clinical examinations. Sociodemographic data, medical history, and pharmacotherapy details were collected. Laboratory investigations were conducted, including blood glucose, lipid profile, and glycosylated hemoglobin (HbA1C) tests. The ankle-brachial index (ABI) was measured.

Results: The results showed that the majority of the participants were between 50 and 70 years of age, married, and had a high school education. Participants had an average body mass index (BMI) indicating overweight, and the average duration of diabetes was 6.571 years. Hypertension was the most prevalent comorbidity. Overweight, obesity I, and obesity II were present in 15.25% (n = 19), 33.6% (n = 42), and 8.8% (n = 11), respectively. Average values for HbA1C, fasting blood glucose (FBG), and postprandial blood glucose (PPBG) were within the diabetic range. ABI was normal in the right side, left side, and bilateral in 43.2%, 56%, and 14.4% of participants, respectively. ABI was borderline on the right side, left side, and bilateral in 40.8%, 36.8%, and 22.4% of participants, respectively. PAD was observed on the right side, left side, and bilateral in 16%, 7.2%, and 4% of participants, respectively. BMI, duration of DM, glycosylated hemoglobin, FBG, and PPBG showed significant negative correlations with ABI. Age, triglycerides, high-density lipoprotein, and low-density lipoprotein did not show any statistically significant correlation with ABI.

Conclusion: The study highlighted the importance of screening for PAD in women with T2DM to improve cardiovascular outcomes. The findings shed light on the prevalence of risk factors for PAD and their association with the disease. These insights can contribute to the development of targeted interventions to reduce adverse clinical outcomes in this population.

Keywords: Peripheral arterial disease, Diabetes mellitus, Cardiovascular risk factors, Women

ABSTRACT IMAGE



INTRODUCTION

Peripheral arterial disease (PAD) is defined as atherosclerotic occlusive disease, more common in abdominal aorta, iliac, and femoral arteries.[1] The consequential hemodynamic depends on the degree of arterial narrowing and the rate of its progression. The reduced blood flow can effectuate as organ ischemia, non-healing ulcers, limb amputation, paresthesia, pain, functional disabilities, and compromised quality of life. Thus, PAD is associated with significant morbidity, mortality, and health-care expenditures.[2]

Diabetes mellitus (DM) has the constellation of hyperglycemia, dyslipidemia, endothelial dysfunction, and low-grade inflammation which fuel the pathophysiology of atherosclerosis.[3] Hence, the duration of DM and glycemic control is the key factors in PAD development and progression. Patient with DM and PAD is more susceptible for major/minor amputations.[4] There has been surge in the prevalence of PAD among women who are usually asymptomatic or have atypical presentations as compared to men.[5] The presence of DM-associated peripheral neuropathy may interfere with pain perception. Hence, the stereotypical claudication symptoms or peripheral absent pulses may prove inadequate for diagnosis for PAD in DM patients, thus increasing the risk of under-diagnosis in primary care settings.

DM patients have two-fold risk for PAD and have different presentations as compared to the general population. Furthermore, PAD increases the susceptibility for myocardial infarction (MI), stroke, and mortality.[6] Lower-limb complications challenge autonomy, mental health, productivity, and financial status in an individual. PAD screening is recommended for all DM patients age ≥50 years and every 5 years, or in the presence of risk factors such as hypertension, dyslipidemia, or smoking.[6] Ankle-brachial index (ABI) has high sensitivity and specificity for PAD diagnosis.[3,7] It is non-invasive, objective, and bedside measure of arterial perfusion in limbs. It can serve as a prognosticator for cardiovascular events, even in asymptomatic PAD patients.

With the increasing age expectancy in women, PAD shall be a disease of concern in women in future.[5] Hence, it is imperative to shed light on this ignored condition which has debilitating and deleterious health consequences. Females have poor outcomes in PAD due to ignorance, procrastinations, and medical treatment in the advanced stages.[8] Assessment of peripheral pulses through ABI may mirror the atherosclerosis, which is a generalized disease. Timely diagnosis, appropriate interventions, and focused preventive strategies are essential to improve cardiovascular outcomes in females. The study aimed to gain new insights in multifactorial pathogenesis in PAD with coexistent DM to reduce adverse clinical outcomes.

Aims and objectives

Primary objectives

1. The primary objective of this study was to estimate the prevalence of PAD in females with T2DM.

Secondary objectives

The secondary objectives of this study were as follows:
1. To estimate the prevalence of various risk factors for PAD in females with T2DM
2. To explore the association of PAD with various risk factors in females with T2DM.

MATERIALS AND METHODS

This was a hospital-based, cross-sectional, and observational study which was conducted for a period of 3 months from June 10, 2023, to September 10, 2023, in the outpatient department of general medicine. The study was initiated after obtaining the approval from the Institutional Ethical Committee reference ID: GVPIHCMT/IEC/20230510/02 dated May 10, 2023. The informed written consent was obtained from each participant with the guarantee of anonymity of collected data. The study was performed according to the Declarations of Helsinki and Good Clinical Practice requirements for human subject protection.

Patient selection

Females with DM formed the cohort from which the study participants were selected.

Inclusion criteria

The following criteria were included in the study:
1. Age ≥30 years and ≤75 years
2. Diagnosis of T2DM as per guidelines of American diabetes association, 2022[9]
3. Diagnosis of T2DM for minimum 1 year
4. Compliant with pharmacotherapy for DM.

Exclusion criteria

The following criteria were excluded from the study:
1. Clinically unstable requiring hospitalization
2. ABI >1.4
3. History of (H/o) amputation, fracture/swelling, and wound in extremity
4. H/o deep vein thrombosis in lower limbs
5. H/o infectious disease, autoimmune disease, storage diseases, or malignancy
6. H/o recent MI, stroke
7. Severe cognitive impairment
8. Pregnancy or lactation
9. Refusal for participation.

Sample size calculation

As per Arora *et al*., the prevalence of PAD was 8.52% among patients with DM.[10] The minimum sample size was calculated as 120 using the following formula:

$$n \geq \frac{Z^2_{1-\alpha/2} \times p(1-p)}{d^2}$$

Where,
n: Sample size
Z: Standard normal variate
d: Absolute error or precision
p: Estimated proportion
For our present study, $Z = 1.96$ (at 5% type 1 error [$P<0.05$]), $d = 0.05$, and $p = 0.0852$.

Data collection

The study participants were enrolled using non-probability purposive sampling technique. They were screened first for inclusion into the study. In a non-coercive environment, they were explained about voluntary participation, purpose of the study, its design, duration, benefits, and potential risks involved. Permission for access to medical records, interview, and blood sample collection was obtained. They were explained that no rewards/incentives would be awarded, and their healthcare would not be affected irrespective of study participation. All details were included in the informed consent form. The study identification number was assigned to each subject by the investigator to maintain confidentiality and anonymity. The selected participants were subjected to face-to-face interviews and clinical examinations.

The sociodemographic data

It included age, gender, marital status, educational qualification, family history, and history of substance abuse.

Patient information sheet

It included clinical examination, medical history, presence of any comorbidities or complications, if any, and pharmacotherapy details.

Laboratory investigations

Venous samples were drawn after 12 hours of fasting ensuring all aseptic precautions and tested for Fasting blood glucose (FBG), post-prandial blood glucose (PPBG), glycosylated hemoglobin (HbA1C), creatinine and lipid profile. The samples were processed on the same day in the Institutional Central Laboratory. FBG, PPBG and creatinine were determined by using Merilyzer CliniQuant Micro semi-automated biochemistry analyzer (marketed by Meril Diagnostics Pvt Ltd, Gujarat, India). HbA1C was determined using a fully automated Cobas 6000 chemistry analyser. Lipid profile was assessed by fully automatic AU480 Chemistry Analyzer Beckman Coulter

ABI

It is the ratio of ankle and brachial systolic blood pressure (SBP) as per American College of Cardiology.[3] It uses the Doppler effect and is a non-invasive technique to assess arterial and venous flow patency. The patient was advised to avoid consumption of nicotine/caffeine 2 h before measurement.[7]

Following 10 min of rest in supine position, SBP was recorded using fully automatic hand-held vascular Doppler (Summit Doppler™ LifeDop 150®).

For brachial SBP

Pneumatic cuff was placed on the arm. With prior application of gel, the transducer of Doppler was positioned on antecubital fossa over brachial pulse until maximum intensity of signal is obtained. Cuff was first inflated 20 mmHg above the expected SBP until flow ceased, then deflated slowly at the rate of 1 mm Hg/sec till reappearance of flow signals. That corresponding pressure was considered as SBP. Two readings were obtained.

For ankle SBP

Cuff was placed proximal to the malleolus and the transducer was positioned on the dorsalis pedis pulse. SBP was measured the same as for brachial SBP.

Order of SBP measurements

First arm, same side ankle, then opposite leg, and opposite arm.

ABI calculation

It was determined by dividing higher ankle SBP at ankle by higher brachial SBP of the same side. The values of ABI were interpreted as per Table 1.[2,3]

Table 1: Grades of severity of peripheral arterial disease based on ABI values

ABI value	Interpretation
>1.4	Calcification/vessel hardening
1.00–1.4	Normal
0.91–0.99	Borderline
≤0.90	Peripheral arterial disease

ABI: Ankle-brachial index

Data analysis

The collected data were scrutinized for its quality in terms of its completeness and accuracy. The data were organized into a Microsoft Excel spreadsheet and then subjected to the Statistical Package for the Social Science version-26 for statistical analysis. The normal distribution of the data was assessed so that parametric statistical tests could be considered for statistical analyses. For continuous variables, mean and standard deviations were determined. Categorical data were expressed as frequency and percentages. Linear regression analysis was utilized to determine the correlation of ABI with different variables among patients with T2DM. For all statistical analyses, the level of significance was $P < 0.05$.

RESULTS

The present study involved 139 female patients with T2DM after considering the inclusion and exclusion criteria. However, 14 patients were excluded from the study due to the reasons cited in Figure 1. Hence, the data analysis was limited to 125 participants.

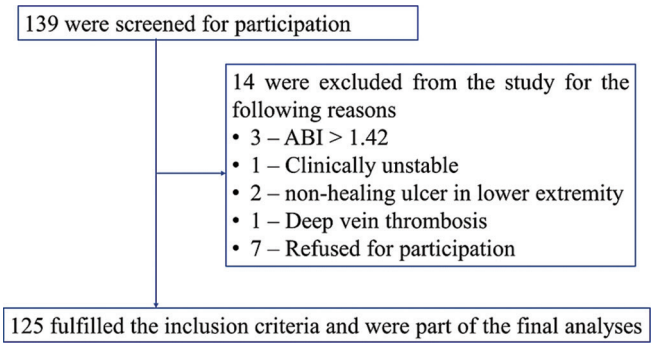


Figure 1: Flowchart representing the recruitment of participants for the present study. (ABI: Ankle brachial index).

The mean age of the participants was 58.81 ± 7.781 years [Table 2]. Majority of the participants fell in the range of 50–70 years with a smaller representation below 50 years. All the participants were married and the majority (n = 108 [86.4%]) lived with their families. A notable proportion had a high school certificate (n = 56 [44.8%]) or primary school certificate (n = 30 [24%]). A small percentage of individuals are either illiterate (n = 14 [11.2%]). Majority are unemployed, followed closely by agricultural and fishery workers (n = 40 [32%]). Tobacco use is the predominant form of substance abuse (n = 8 [6.4%]) among this population. A majority of participants have a mixed diet (63.2%), followed by vegetarians (24.8%) and a smaller percentage of non-vegetarians (12%).

The average body mass index (BMI) was 25.55 ± 2.65 kg/m², indicating that, on average, participants were in the overweight category [Table 3]. The average duration of diabetes among participants was 6.571 ± 2.038 years. Hypertension was the most prevalent comorbidity among participants, affecting 45.6 % (n = 57) of individuals, followed by ischemic heart

disease (n = 26 [20.8%]). The average values of HbA1C, FBG, and PPBG were 7.82 ± 1.2, 144.6 ± 31.98 mg%, and 198 ± 46.43 mg%, respectively [Table 4].

Diminished or absent dorsalis pedis was the most common clinical finding in 19% (n = 24) patients, followed by cold extremity, paresthesia, and skin discoloration in 16% (n = 20), 18% (n = 14.4), and 18% (n = 14.4) patients, respectively [Figure 2]. Intermittent claudication was reported by 15% (n = 12) patients.

ABI was normal in the right side, left side, and bilateral in 43.2%, 56%, and 14.4% of participants, respectively [Table 5]. ABI was borderline on the right side, left side, and bilateral in 40.8%, 36.8%, and 22.4% of participants, respectively. PAD was observed on the right side, left side, and bilateral in 16%, 7.2%, and 4% of participants, respectively. Overweight, obesity I, and obesity II were present in 15.25% (n = 19), 33.6% (n = 42), and 8.8% (n = 11), respectively [Table 6]. HbA1C > 6.5% was prevalent in 68% (n = 85).

Age, triglycerides, high-density lipoprotein (HDL), and low-density lipoprotein (LDL) did not show any statistically

Table 2: Sociodemographic features of study participants with type 2 diabetes mellitus (n=125).

Variable	*n* (%)
Age (in years)	
<45	0
45–50	6 (4.8)
50–55	27 (21.6)
55–60	20 (16)
60–65	27 (21.6)
65–70	22 (17.6)
>70	23 (18.4)
Mean age (in years)*	58.81±7.781
Marital status	
Single	0
Married	125 (100)
Staying with	
Alone	17 (13.6)
Family	108 (86.4)
Educational qualification	
Illiterate	14 (11.2)
Primary school certificate	30 (24)
High school certificate	56 (44.8)
Intermediate and diploma	11 (8.8)
Graduate	14 (11.2)
Occupation	
Unemployed	45 (36)
Agricultural and fishery workers	40 (32)
Shop and market sales workers	23 (18.4)
Clerks and technicians	10 (8)
Professionals	7 (5.6)
Substance abuse	
Tobacco	8 (6.4)
Alcohol	0
Drugs	0
Diet	
Vegetarian	31 (24.8)
Non-vegetarian	15 (12)
Mixed	79 (63.2)

*Expressed as mean±standard deviation

Table 3: Clinical profile among the study participants with type 2 diabetes mellitus (n=125).

Variable	*n* (%)
Height (in meters)	1.697±0.08
Weight (in kilograms)	73.97±12.65
BMI (kg/m^2)	25.55±2.65
Pulse rate (beats/min)	85.81±11.08
SBP (mm of Hg)	123.4±14.1
DBP (mm of Hg)	80.68±7.99
Respiratory rate (per min)	16.7±3.16
Mean duration of DM (in years)	6.571±2.038
Comorbidities*	
Hypertension	57 (45.6)
Ischemic heart disease	26 (20.8)
Retinopathy	9 (7.2)
Nephropathy	6 (4.8)
Neuropathy	12 (9.6)

BMI: Body mass index, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, DM: Diabetes mellitus, *Expressed as frequency (percentages)

Table 4: Laboratory investigations among the study participants with type 2 diabetes mellitus (n=125).

Variable	*n* (%)
HbA1C (%)	7.82±1.2
FBG (mg/dL)	144.6±31.98
PPBG (mg/dL)	198±46.43
Creatinine (mg/dL)	0.89±1.25
Total cholesterol (mg/dL)	170.2±32.87
Triglycerides (mg/dL)	165.1±35.32
HDL (mg/dL)	41.22±5.49
LDL (mg/dL)	99.9±27.54
VLDL (mg/dL)	34.03±10.8

HbA1C: Glycosylated hemoglobin, FBG: Fasting blood glucose, PPBG: Post-prandial blood glucose, HDL: High-density lipoprotein, LDL: Low-density lipoprotein, VLDL: Very low-density lipoprotein.

Table 5: Ankle-brachial index among the study participants with type 2 diabetes mellitus (n=125).

ABI	Interpretation	Right side n (%)	Left side n (%)	Bilateral sides n (%)
1–1.4	Normal	54 (43.2)	70 (56)	18 (14.4)
0.91–0.99	Borderline	51 (40.8)	46 (36.8)	28 (22.4)
≤0.9	PAD	20 (16)	9 (7.2)	5 (4)

ABI: Ankle brachial index, PAD: Peripheral arterial disease

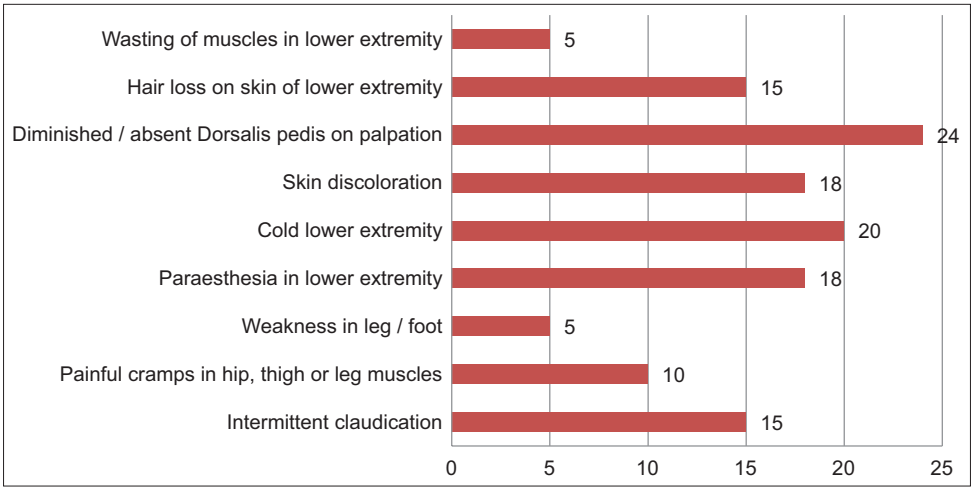


Figure 2: Clinical presentation of the study participants with type 2 diabetes mellitus (n = 125).

Table 6: Prevalence of risk factors for PAD in the study participants with type 2 diabetes mellitus (n=125).

Variable	*n* (%)
Body mass index	
23–24.9 kg/m^2 (Overweight)	19 (15.2)
25–29.9 kg/m^2 (Obese I)	42 (33.6)
>30 kg/m^2 (Obese II)	11 (8.8)
Glycosylated hemoglobin>6.5%	85 (68)
Total cholesterol>200 mg%	49 (39.2)
Triglycerides>150 mg%	56 (44.8)
High-density lipoproteins<50 mg%	62 (49.6)
Hypertension	57 (45.6)

PAD: Peripheral arterial disease

Table 7: Simple linear regression analysis of various parameters with ankle-brachial index (n=125).

Variable	Correlation	*P*-value
Age	−0.04173	0.644
Body mass index	−0.4232	< 0.001*
Duration of diabetes mellitus	−0.3916	<0.001*
Glycosylated hemoglobin	−0.4937	<0.001*
Fasting blood glucose	−0.445	<0.001*
Postprandial blood glucose	−0.2658	0.003*
Total cholesterol	0.1686	0.06*
Triglycerides	−0.109	0.226
High-density lipoproteins	0.1097	0.223
Low-density lipoproteins	0.136	0.131
Very low-density lipoproteins	−0.208	0.02*

*P<0.05: Statistically significant

significant correlation with ABI [Table 7]. BMI exhibited significantly moderate negative correlation (−0.4232) with ABI. Duration of DM, HbA1C, FBG, and PPBG displayed significantly moderate negative correlation with ABI. Very LDL (VLDL) displayed a significantly weak negative correlation (−0.208) with ABI.

DISCUSSION

The present study aimed to analyze the prevalence and risk factors associated with PAD in females with DM.

In the present study, the mean age of the participants was 58.81 ± 7.781 years, suggestive that the study cohort predominantly comprised patients within middle-age to older adult range. It had smaller representation (4.8%) in age <50 years. Premature PAD often has an aggressive clinical course among patients. Sykora *et al.* derived the hazard risk ratio of 2.33 for cardiovascular events in patients with PAD before age of 50 years.[11] Savji *et al.*, during the vascular screening for 3.6 million patients, derived the odds ratio for age group 40–50 years, 51–60 years, 61–70 years, 71–80 years, 81–90 years, 91–100 years as 1, 1.37, 2.27, 4.84, 12.03, and 26.70 (P for trend < 0.001) for PAD.[12] In a prospective study in Kerala, Krishnan *et al.* concluded that age was a strong predictor of PAD.[13] However, in the present study, age did not show any significant correlation with PAD.

In the present study, tobacco consumption was confirmed by 6.4% of participants. Findings from global adult tobacco survey India revealed that 13.3% and 1.8% of females consumed smokeless tobacco products and current smokers, respectively. Tobacco negatively impacts women's health due to its anti-estrogen effect.[14] It induces premature menopause and accelerates systemic inflammation.

The present study also shed light on the clinical manifestations of peripheral vascular abnormalities. Diminished or absent dorsalis pedis was identified as the most prevalent clinical finding, affecting 19% (n = 24) patients. Cold extremity, paresthesia, and skin discoloration was present in 16% (n = 20), 18% (n = 14.4), and 18% (n = 14.4) patients,

respectively. Intermittent claudication was reported by 15% (n = 12) patients, indicating compromised blood flow to the extremities during physical activity. The presence of these symptoms underscores the multifaceted nature of vascular pathologies, necessitating the need of detailed history and comprehensive clinical assessment along with in conjunction with ABI measurement to diagnose PAD among at-risk patients.[15] Recognizing the diverse presentations of PAD shall allow timely management, potentially preventing the progression of the disease and improving patient outcomes.

In the present study, PAD was observed on the right side, left side, and bilaterally in 16%, 7.2%, and 4% of participants, respectively. Similar findings of PAD are observed among females in studies by Pradeepa *et al*.,[16] Eshcol *et al*.,[17] and Agarwal *et al*.[18] Female have lesser caliber of vessel diameter, and hence, lower ABI values as compared to men as per studies by Kapoor *et al*.,[19] and Aboyans *et al*.[20] Messiha *et al*. in his population-based study highlighted gender-based inequality in treatment pattern and pharmacotherapy where female had lesser visits to hospitals.[21] Collins *et al*.[22] and McDermott *et al*.[23] observed that females with PAD had greater risk for limb events and compromised quality of life. PAD holds substantial clinical significance as it is considered an equivalent to cardiovascular disease. It is recognized as the third leading etiology of atherosclerotic morbidity, following closely behind coronary artery disease and stroke.

In the present study, the average BMI is 25.55 ± 2.65 kg/m², indicating that, on average, participants are in the overweight category. Overweight, obesity I, and obesity II were present in 15.25% (n = 19), 33.6% (n = 42), and 8.8% (n = 11), respectively. Obesity is an independent predisposing factor for insulin resistance, low-grade inflammation, and hypertension, all of them negatively impacting on endothelial integrity.[24] In the present study, BMI exhibited significantly moderate negative correlation (−0.4232) with ABI, thus suggestive of positive association with PAD. This finding goes in accordance with the studies by Heffron *et al*.,[25] Cantú-Brito *et al*.,[26] and Yeboah *et al*.[27] However, studies by Li *et al*.[24] and Zhang *et al*.[28] observed U-shaped relationship between BMI and PAD. However, Skilton *et al*. concluded that overweight and obesity did not have any association with PAD.[29]

In the present study, the average duration of diabetes among participants was 6.571 ± 2.038 years and HbA1C >6.5% was prevalent in 68% (n = 85) which was a substantial proportion. Jude *et al*. observed that diabetic patients had higher degree of severity of PAD, higher mortality rate, and younger age of death as compared to non-diabetic patients.[30] Duration of DM, HbA1C, FBG, and PPBG displayed significant negative correlation with ABI., suggestive that poor glycemic control had a positive association with PAD. Dick *et al*., in his prospective study of 1 year follow-up, concluded that non-diabetic patients had significantly better outcomes following revascularization procedures compared to diabetics.[31]

In the present study, triglycerides, HDL, and LDL did not show any statistically significant correlation with ABI, despite indications from other research linking cholesterol levels, especially HDL, with PAD risk. The Cardiovascular Health Study highlighted 10% greater risk of an ABI <0.9 with every 10 mg/dL increase in total cholesterol.[32] Xu *et al*. underscored that HDL was more strongly associated with the lower risk of PAD in women than men.[33] VLDL displayed a significantly weak negative correlation with ABI, suggestive that VLDL has positive association with PAD. This goes in accordance with Women's Health study which demonstrated that triglyceride-rich lipoproteins may be especially important in the development of PAD as they may induce inflammation, activation of monocyte, and endothelial dysfunction.[34]

A clinician must be vigilant about PAD in females with DM, even in the absence of significant correlation with risk factors. Given the potential aggressive nature of PAD in younger individuals, especially among female diabetics, early screening for PAD should be considered, even if age <50 years. Addressing tobacco use becomes critical due to its detrimental impact on women's health. Comprehensive strategies to address vascular care, healthy weight, and optimal glycemic control and lipid profile are pivotal to reduce the risk or progression of PAD in diabetics. Awareness and education of the prevalence and nuances of PAD among females shall enable them to understand the disease burden and seek timely medical treatment. It is the call of the hour for paradigm shift toward proactive measures, emphasizing prevention, equitable care, and targeted interventions for enhancing health outcomes and reducing disability due to PAD associated complications.[35]

Limitations

While this study provides valuable insights into the clinical landscape of peripheral vascular abnormalities, certain limitations need to be acknowledged. Cross-sectional studies capture snap-shot data, making it challenging to establish the temporal sequence of events. The static nature of cross-sectional designs limits the ability to study changes or developments over time. Longitudinal studies are better suited for examining trends and understanding how variables evolve. There is also risk of selection bias due to the non-probability sampling technique. The sample size may influence the generalizability of the findings to the entire population. Larger cohorts and incorporation of additional variables shall further refine our understanding of the clinical presentations as well as disease courses to improve patient care strategies.

CONCLUSION

The present study revealed that PAD was observed on the right side, left side, and bilateral in 16%, 7.2%, and

4% of the study cohort of females with DM. Tobacco consumption in 6.4% of participants aligns with broader trends in India. Overweight, obesity I, and obesity II were present in 15.25% (n = 19), 33.6% (n = 42), and 8.8% (n = 11), respectively. Diminished or absent dorsalis pedis was identified as the most prevalent clinical finding, affecting 19% of the patients. A substantial proportion of 68% participants had HbA1C >6.5%. BMI, duration of diabetes, HbA1C, FBG, PPBG, and VLDL displayed significant negative correlations with ABI, emphasizing the intricate relationship between various risk factors and PAD. The multifaceted nature of this condition demands the need for comprehensive risk management strategies in clinical practice. Further, research is warranted to delve deeper into these associations and their implications for preventive interventions and treatment approaches.

Acknowledgments

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Ethical approval

The research/study was approved by the Institutional Review Board at GVPIHCMT, number GVPIHCMT/IEC/20230510/02, dated May 10,2023.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

REFERENCES

1. Gul F, Janzer SF. Peripheral Vascular Disease. In: StatPearls. Treasure Island, FL: StatPearls Publishing; 2022. Available from: https://www.ncbi.nlm.nih.gov/books/NBK557482 [Last accessed on 2020 Dec 20].
2. Olin JW, Sealove BA. Peripheral Artery Disease: Current Insight into the Disease and its Diagnosis and Management. Mayo Clin Proc 2010;85:678-92.
3. Aboyans V, Criqui MH, Abraham P, Allison MA, Creager MA, Diehm C, *et al*. American Heart Association Council on Peripheral Vascular Disease. Council on Epidemiology and Prevention. Council on Clinical Cardiology. Council on Cardiovascular Nursing. Council on Cardiovascular Radiology and Intervention, and Council on Cardiovascular Surgery and Anesthesia. Measurement and interpretation of the Ankle-Brachial Index: A Scientific Statement from the American Heart Association. Circulation 2012;126:2890-909.
4. Kamitani F, Nishioka Y, Noda T, Myojin T, Kubo S, Higashino T, *et al*. Incidence of Lower Limb Amputation in People with and without Diabetes: A Nationwide 5-Year Cohort Study in Japan. BMJ Open 2021;11:e048436.
5. Srivaratharajah K, Abramson BL. Women and Peripheral Arterial Disease: A Review of Sex Differences in Epidemiology, Clinical Manifestations, and Outcomes. Can J Cardiol 2018;34:356-61.
6. American Diabetes Association. Peripheral Arterial Disease in People with Diabetes. Diabetes Care 2003;26:3333-41.
7. Królczyk J, Piotrowicz K, Chudek J, Puzianowska-Kuźnicka M, Mossakowska M, Szybalska A, *et al*. Clinical Examination of Peripheral Arterial Disease and Ankle-brachial Index in a Nationwide Cohort of Older Subjects: Practical Implications. Aging Clin Exp Res 2019;31:1443-9.
8. Barochiner J, Aparicio LS, Waisman GD. Challenges Associated with Peripheral Arterial Disease in Women. Vasc Health Risk Manag 2014;10:115-28.
9. American Diabetes Association. Standards of Medical Care in Diabetes- 2022 Abridged for Primary Care Providers. Clin Diabetes 2022;40:10-38.
10. Arora E, Maiya AG, Devasia T, Bhat R, Kamath G. Prevalence of Peripheral Arterial Disease among Type 2 Diabetes Mellitus in Coastal Karnataka. Diabetes Metab Syndr 2019;13:1251-3.
11. Sykora D, Firth C, Girardo M, Bhatt S, Matti L, Tseng A, *et al*. Patient Age at Diagnosis of Peripheral Artery Disease and its Impact on Cardiovascular and Limb Outcomes. Am J Cardiol 2022;177:144-50.
12. Savji N, Rockman CB, Skolnick AH, Guo Y, Adelman MA, Riles T, *et al*. Association between Advanced Age and Vascular Disease in Different Arterial Territories: A Population Database of Over 3.6 Million Subjects. J Am Coll Cardiol 2013;61:1736-43.
13. Krishnan MN, Geevar Z, Mohanan PP, Venugopal K, Devika S. Prevalence of Peripheral Artery Disease and Risk Factors in the Elderly: A Community Based Cross-sectional Study from Northern Kerala, India. Indian Heart J 2018;70:808-15.

14. Ruan X, Mueck AO. Impact of Smoking on Estrogenic Efficacy. Climacteric 2015;18:38-46.
15. Bailey MA, Griffin KJ, Scott DJ. Clinical Assessment of Patients with Peripheral Arterial Disease. Semin Intervent Radiol 2014;31:292-9.
16. Pradeepa R, Chella S, Surendar J, Indulekha K, Anjana RM, Mohan V. Prevalence of Peripheral Vascular Disease and its Association with Carotid Intima-media Thickness and Arterial Stiffness in Type 2 Diabetes: The Chennai Urban Rural Epidemiology Study (CURES 111). Diab Vasc Dis Res 2014;11:190-200.
17. Eshcol J, Jebarani S, Anjana RM, Mohan V, Pradeepa R. Prevalence, Incidence and Progression of Peripheral Arterial Disease in Asian Indian Type 2 Diabetic Patients. J Diabetes Complications 2014;28:627-31.
18. Agarwal AK, Singh M, Arya V, Garg U, Singh VP, Jain V. Prevalence of Peripheral Arterial Disease in Type 2 Diabetes Mellitus and its Correlation with Coronary Artery Disease and its Risk Factors. J Assoc Physicians India 2012;60:28-32.
19. Kapoor R, Ayers C, Visotcky A, Mason P, Kulinski J. Association of Sex and Height with a Lower Ankle Brachial Index in the General Population. Vasc Med 2018;23:534-40.
20. Aboyans V, Criqui MH, McClelland RL, Allison MA, McDermott MM, Goff DC Jr., *et al*. Intrinsic Contribution of Gender and Ethnicity to Normal Ankle-brachial Index Values: The Multi-Ethnic Study of Atherosclerosis (MESA). J Vasc Surg 2007;45:319-27.
21. Messiha D, Petrikhovich O, Lortz J, Mahabadi AA, Hering R, Schulz M, *et al*. Gender Differences in Outpatient Peripheral Artery Disease Management in Germany: A Population Based Study 2009-2018. Eur J Vasc Endovasc Surg 2022;63:714-20.
22. Collins TC, Suarez-Almazor M, Bush RL, Petersen NJ. Gender and Peripheral Arterial Disease. J Am Board Fam Med 2006;19:132-40.
23. McDermott MM, Greenland P, Liu K, Criqui MH, Guralnik JM, Celic L, *et al*. Sex Differences in Peripheral Arterial Disease: Leg Symptoms and Physical Functioning. J Am Geriatr Soc 2003;51:222-8.
24. Li J, Yu S, Zhou W, Zhu L, Wang T, Bao H, *et al*. U-Shaped Association of Body Mass Index with the Risk of Peripheral Arterial Disease in Chinese Hypertensive Population. Int J Gen Med 2021;14:3627-34.
25. Heffron SP, Dwivedi A, Rockman CB, Xia Y, Guo Y, Zhong J, *et al*. Body Mass Index and Peripheral Artery Disease. Atherosclerosis 2020;292:31-6.
26. Cantú-Brito C, Chiquete E, Antezana-Castro JF, Toapanta-Yanchapaxi L,Ochoa-Guzmán A, Ruiz-Sandoval JL, *et al*. Peripheral Artery Disease in Outpatients with a Recent History of Acute Coronary Syndrome or at High Atherothrombotic Risk. Vascular 2020;29:1708538120938921.
27. Yeboah K, Puplampu P, Yorke E, Antwi DA, Gyan B, Amoah AG. Body Composition and Ankle-brachial Index in Ghanaians with Asymptomatic Peripheral Arterial Disease in a Tertiary Hospital. BMC Obes 2016;3:27.
28. Zhang Y, Guo Y, Shen X, Zhao F, Yan S. Lower Body Mass Index is not of More Benefit for Diabetic Complications. J Diabetes Invest 2019;10:1307-17.
29. Skilton MR, Chin-Dusting JP, Dart AM, Brazionis L, Lantieri O, O'Dea K, *et al*. Metabolic Health, Obesity and 9-Year Incidence of Peripheral Arterial Disease: The DESIR Study. Atherosclerosis 2011;216:471-6.
30. Jude EB, Oyibo SO, Chalmers N, Boulton AJ. Peripheral Arterial Disease in Diabetic and Nondiabetic Patients: A Comparison of Severity and Outcome. Diabetes Care 2001;24:1433-7.
31. Dick F, Diehm N, Galimanis A, Husmann M, Schmidli J, Baumgartner I. Surgical or Endovascular Revascularization in Patients with Critical Limb Ischemia: Influence of Diabetes Mellitus on Clinical Outcome. J Vasc Surg 2007;45:751-61.
32. Newman AB, Siscovick DS, Manolio TA, Polak J, Fried LP, Borhani NO, *et al*. Ankle-arm Index as a Marker of Atherosclerosis in the Cardiovascular Health Study. Cardiovascular Heart Study (CHS) Collaborative Research Group. Circulation 1993;88:837-45.
33. Xu Y, Harris K, Pouncey AL, Carcel C, Low G, Peters SA, *et al*. Sex Differences in Risk Factors for Incident Peripheral Artery Disease Hospitalisation or Death: Cohort Study of UK Biobank Participants. PLoS One 2023;18:e0292083.
34. Aday AW, Lawler PR, Cook NR, Ridker PM, Mora S, Pradhan AD. Lipoprotein Particle Profiles, Standard Lipids, and Peripheral Artery Disease Incidence. Circulation 2018;138:2330-41.
35. GBD 2019 Peripheral Artery Disease Collaborators. Global Burden of Peripheral Artery Disease and its Risk Factors, 1990-2019: A Systematic Analysis for the Global Burden of Disease Study 2019. Lancet Glob Health 2023;11:e1553-65.

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