Journal of Clinical & Experimental Cardiology

Hagos et al., J Clin Exp Cardiolog 2017, 8:7
DOI: 10.4172/2155-9880.1000534

Research Article Open Access

The Prevalence of Peripheral Arterial Disease and Associated Factors among Adults in Jimma Town, South-West Ethiopia: A Community Based Survey

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Received date: June 14, 2017; **Accepted date:** July 10, 2017; **Published date:** July 14, 2017

Abstract

Background: Peripheral arterial disease (PAD) is defined as an ankle-brachial index (ABI) ≤ 0.90 in individuals aged 40 years or over. So far, the prevalence of PAD in Ethiopia is not known. We assessed the prevalence of PAD among Ethiopians using ABI and thus evaluated its applicability as a screening tool at the community level.

Methods: A cross-sectional community based survey was conducted on 178 sampled individuals aged 40 years and above in Jimma town, Southwest Ethiopia from June 15 to July 15, 2011. Conventional cardiovascular risk factors and intermittent claudication (with Edinburgh Claudication assessment tool) were assessed using a structured questionnaire. Blood pressure was measured using a mercury sphygmomanometer and a hand held Doppler flow detector at arm and ankle respectively. The ABI was calculated from the ratio of higher ankle systolic blood pressure and the higher of the two brachial systolic pressure measurements. Descriptive statistics and chi-square or Fischer's exact test, were used for data analysis and interpretation. Predictors of PAD were estimated using univariate and multivariate regression models.

Results: The overall prevalence of peripheral arterial disease was 10.8%. But, none of the participants with peripheral arterial disease fulfilled the criteria for claudication. The traditional risk factors identified were; hypertension, diabetes mellitus, and current cigarette smoking accounting for 29.5%, 6.8% and 12.5% of participants respectively. Female sex, current smoking and diabetes mellitus were significantly associated with increased risk of PAD.

Conclusion: Peripheral arterial disease is common among Ethiopians aged 40 years and above. Intermittent claudication was found to be insensitive in the detection of peripheral arterial disease. Female sex, current smoking and diabetes mellitus were predictors of PAD.

Keywords: Ankle brachial index; Ethiopia; Jimma; Peripheral arterial disease; Prevalence

Abbreviations: ABI: Ankle-Brachial Index; CHD: Coronary Heart Disease; CVD: Cardiovascular Disease; WHO: World Health Organization.

Background

Low and middle income countries, where nearly 80% of the cardiovascular deaths occurred in the year 2013, are now facing an unprecedented surge in the incidence of cardiovascular diseases (CVD) and the attendant substantial economic burden of managing this health problem [1]. The threat of CVD seems less direct, and few reliable data as to its prevalence are available. This could result in neglecting serious warning signs of the emergence of CVD in the region even in the presence of proven, cost-effective strategies to prevent and control this growing disease burden [2]. The presence of peripheral artery disease (PAD) is an important indicator of cardiovascular risk [3,4] and is associated with increased cardiovascular and all-cause mortality [5-7]. Ethiopia, like many developing nations, is also witnessing the growing epidemic of CVD. For example; acute coronary syndrome and diabetic ketoacidosis were among the most common causes of intensive care unit admission in Black Lion Teaching Hospital in Addis Ababa [8].

To date, there is no single study conducted in Ethiopia both in the clinical setting and at the population level to assess the prevalence of peripheral arterial disease. In Sub Saharan Africa, there are few studies [9-12], which assessed PAD both at the community level and clinical setting. The prevalence of PAD in these studies varied from 12-52.5%. The major conventional risk factors for PAD are hypertension, diabetes mellitus, cigarette smoking and chronic kidney disease [13-15].

We assessed the prevalence of peripheral arterial disease, as defined by ankle-brachial index (ABI) ≤ 0.9 and demonstrated its application for screening of subclinical systemic atherosclerotic disease at the community level. Since most patients are asymptomatic and carry

potentially significant risk of morbidity and mortality, screening for PAD should become a routine practice at primary care level [2]. Thus, determination of ABI will have a dual function with its application in resource limited settings for this purpose.

Methods and Materials

Study setting

The study was conducted in Jimma town, located about 345 km from Addis Ababa in the southwestern part of Ethiopia. The town is formally divided into thirteen administrative villages. According to the 2007 population and housing Census, the projected population size of Jimma town is 135,613. The adult population in the age group 40 and above in Jimma town constitutes about 14% of the total urban population of Oromia regional national state giving a crude estimate of 18,985. The town has a well-established university teaching hospital and chronic disease programs in which patients with chronic non-communicable diseases attend both the University hospitals and satellite rural health centers.

Study design

A population based cross-sectional design was used to investigate the prevalence of subclinical peripheral arterial disease among Ethiopian adults aged 40 years and older.

Using the single population proportion formula with an expected prevalence (p) of a low ABI as 12%, from a population based study done in South Africa among individuals aged 40 years and above [9], 95% confidence level, 5% margin of error and 10% non-response rate, a total sample size of 178 was computed.

Selection of participants

The sample size was distributed to all thirteen administrative villages by employing proportional to size allocation based on the household proportion of the total households in the town. Each household was selected using a systematic random sampling method based on the sampling unit, calculated from the allocated size for each administrative village. Study subjects were then selected by a lottery method when more than one eligible individual is found in the selected households. When no adult aged 40 years and above was found in a selected household, the next household in order of house number was contacted.

Inclusion criteria

All individual residents of Jimma town who were 40 years of age or older were included in the study.

Exclusion criteria

Individuals with marked limb edema or wounds or ulcerations proximal to the metatarsal heads in the lower limbs, limb amputations proximal to the heads of the metatarsals of one or both lower limbs and amputations proximal to the wrist joint of one or both arms, and prior bypass surgery to the lower limb arteries or prosthetic vascular reconstructions of the abdominal aorta and subclavian or axillary arteries and suspected acute limb ischemia were excluded. Participants who did not give written informed consent were also excluded from the study.

Data collection tools

A structured questionnaire, originally developed in English was translated in to the local languages (Amharic and Afan Oromo) to facilitate easy understanding by participants and data collectors was used for data collection. The presence of intermittent claudication was assessed using the Edinburgh Claudication Assessment Questionnaire [16]. Mercury sphygmomanometer for adult (GIMA Sphygmomanometer) and a hand held Doppler blood flow detector with 5 MHz probe (Meda Sonics ULTRASOUND STETHOSCOPE® Doppler Blood Flow Detector Model BF4B) were used to measure the systolic blood pressure.

Data collection

Participants were interviewed to complete the questionnaire and then underwent a series of measurements for determination of ABI. Participants were asked about their general socio-demographic characteristics, current or past history of smoking, diabetes mellitus, hypertension, dyslipidemia and a previous diagnosis of peripheral arterial disease using the structured questionnaire. Blood pressure measurements were carried out with participants in both sitting and supine positions. But, supine measurements in the examination bed from the right and left brachial arteries and the dorsalis pedis and posterior tibial arteries of the right and left ankle were used to compute their ABI. Blood pressure cuff was applied to bare ankles with the midpoint of the bladder over the posterior tibial artery, approximately three centimeters above the medial malleolus. The maximum inflation level was determined separately for the arm and ankle by rapidly inflating the cuff to 70 mmHg and then inflating by 10 mmHg increments until the pulse is no longer audible. The maximal inflation level was 30 mmHg above the systolic level. Then the cuff was deflated at a rate of around 2 mmHg per second until the systolic blood pressure became audible. The first reappearance sound was recorded as the systolic pressure [17]. ABI was calculated by taking the highest ankle systolic measurement as the numerator and the higher of the two brachial systolic measurements as the denominator. The use of the lower ankle systolic pressure of ABI calculation has been shown to be superior to the higher systolic pressure in identifying more patients at risk and is currently the recommended method of screening for PAD [18,19]. This modified calculation was also applied to compare the results with the above mentioned standard method. According to The Seventh Report of the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7) report, hypertension is considered when the highest sitting brachial blood pressure measurement is 140/90 mmHg or higher [20]. Values were rounded off to two decimal points.

Data quality control, processing and analysis

The questionnaire was pretested on twenty individuals. ABI measurement was also done on twenty asymptomatic attendants who visited the outpatient department of the Jimma University Hospital. The pretested data were only used to structure the final data collection tool and not included in the final analysis. The data collectors were trained by the principal investigator on the aims of the study, data collection techniques, proper filling of the questionnaire, and participant handling for two days. ABI measurement was done by experienced physician staff of the Jimma University Teaching Hospital. Overall supervision of data collection and completeness of the filled questionnaire was regularly checked by the principal investigator at the site during the data collection process.

Data were coded, cleaned, entered and analyzed using SPSS for Windows version 20.0 of the computer software. Multivariate analysis, descriptive statistics, and either chi-square or Fischer's exact test were used as appropriate. Predictors of peripheral artery disease, odds ratio (OR) and 95% confidence interval (CI) were estimated using univariate and multivariate logistic regression model and a p-value <0.05 was considered statistically significant. All tests and variables with a p-value of ≤ 0.2 on univariate analysis were entered into the multiple regression model and Hosmer- Limeshow was used for evaluation of calibration of the regression model.

Results

A total of 176 adults aged 40 years and above with a response rate of more than 98% were included in the study. Two female participants were excluded because of gross bilateral lower limb lymphedema. Most (46.6%) were in the age range of 40-50 years, followed by age 51-60 years in 29.6% subjects. The median age of the study participants was 54 (Interquartile range, IQR: 50-60) years. Among the study participants, 92 (52%) were females. A significant number (43.2%) of participants were illiterate. The mean (± standard deviation) sitting systolic and diastolic blood pressure measurement of the study participants was 139.3 (± 21.6) and 82.6 (± 8.6) mmHg respectively. Fifty-four (31%) study participants had never had their blood pressure measured. From these 33 (18.8%) participants had hypertension during the study. Nineteen (10.8%) subjects were currently taking antihypertensive drugs. Overall, fifty-two (29.5%) participants were either currently hypertensive or taking antihypertensive medication. Two participants (1.1%) had significant (greater than 10 mmHg) blood pressure discrepancies between right and left arm. But, none of them had ABI ≤ 0.9. Forty- eight (27%) participants had their blood sugar checked at least once, while 12 (7%) of the participants were told to have diabetes mellitus and 8 (4.5%) are currently on glucose lowering medications. Previous diagnosis of both hypertension and diabetes mellitus was reported by another 8 (4.5%) participants. Forty- six (26.1%) participants reported to have ever smoked cigarette and 22 (12.5%) are current smokers. Three (1.7%) and 2 (1.1%) participants reported to have chronic kidney disease (CKD) and previous stroke respectively. None of the participants reported to have coronary artery disease. One study participant was found to have three conventional coronary artery disease risk factors; hypertension, diabetes mellitus and cigarette smoking (Table 1).

Peripheral arterial disease (ABI ≤ 0.9) was diagnosed in 19 participants giving the overall prevalence of 10.8% (4.8% in men and 16.3% in women) and nobody had an ABI value >1.3. Assessment for clinical PAD using the Edinburgh intermittent claudication tool did not reveal symptoms of classic intermittent claudication in any of the subjects with low ABI. About 37 (21%) subjects reported leg pain during walking, but none of them fulfilled the criteria for positive symptoms of intermittent claudication. Of the 19 participants with subclinical atherosclerosis, 4 (21.1%) had none of the assessed conventional risk factors, 8 (42.1%) had systemic hypertension, 4 (21.1%) had diabetes mellitus, 2 (10.5%) were smokers and the rest 1 (5.3%) had two risk factors (hypertension and diabetes mellitus). Univariate analysis (Table 2) showed increased prevalence of PAD in women and those with diabetes mellitus. In our study, PAD was three times more common as in women than men (OR: 3.85 (CI: 1.23-12.5) and was statistically significant (p-value=0.002). There was no significant impact of hypertension (both systolic and diastolic), history of smoking, CKD and previous stroke on PAD (Tables 1 and 2). In a multivariate analysis (Table 3), after adjusting for age and blood pressure; female sex, current smoking and self-reported diabetes mellitus were independently associated with PAD.

Characteristics	N (%) 176 (100)
Age (years)	
40-50	82 (46.6)
51-60	52 (29.6)
61-70	27 (15.3)
71-80	13 (7.4)
>80	2 (1.1)
Gender	
Male	84 (47.7)
Female	92 (52.3)
Educational status	
Illiterate	76 (43.2)
Literate	100 (56.8)
Systolic blood pressure, mean (± SD), mmHg	139.3 (± 21.6)
Diastolic blood pressure, mean (± SD), mmHg	82.6 (± 8.6)
Hypertension (on antihypertensive or current elevated BP)	52 (29.5)
Diabetes mellitus (self-reported)	12 (6.8%)
Current smoker	22 (12.5)
Former smoker	24 (13.6)
Peripheral arterial disease (self-reported)	3 (1.7)
Chronic kidney disease (self-reported)	3 (1.7)
Stroke (self-reported)	2 (1.1)
Coronary artery disease (self-reported)	-
Atypical claudication	37 (21.0)
Peripheral artery disease	19 (10.8)

Table 1: Baseline characteristics of the study population. BP: blood pressure, N: number of participants, SD: standard deviation.

Discussion

This is the first population based study that determined the burden of PAD in Ethiopia using ABI as a screening tool to identify subclinical systemic atherosclerosis. The overall prevalence of peripheral arterial disease was 10.8%. Though there is no national data for comparison, this appears to be similar to a report from rural South Africa [9]. But, it was lower than reports from Angola, Uganda and Nigeria [10-12]. This could be explained by the differences in the characteristics of study population. Those studies were conducted in clinical setting but

ours is a community based study. Thus, participants from the other African countries were high risk for PAD. In the study by Feliciano et al. participants from Angola had higher percentage of hypertension (67%) and diabetes mellitus (39%).

Characteristics	OR (95%CI)	p-value
Female sex	3.85 (1.23-12.5)	0.002
Smoking history	0.33 (0.08-1.38)	0.1
Current smoking	0.36 (0.05-2.84)	0.31
Hypertension (on antihypertensive or current elevated BP)	1.78 (0.76-4.17)	0.18
Diabetes mellitus (self-reported)	3.64 (1.43-9.28)	0.01
CKD	0.45 (0.22-0.67)	0.42
Previous stroke	0.56 (0.17-0.78)	0.55

Table 2: Univariate analysis of predictors of Peripheral Artery Disease. BP: Blood pressure, OR: Odds ratio, CI: Confidence interval, CKD: chronic kidney disease.

Characteristics	OR (95%CI)	p-value
Female sex	1.80 (1.20-2.80)	0.03
Current smoking	2.01 (1.67- 2.83)	0.01
Diabetes mellitus (self-reported)	1.32 (1.06- 1.45)	<0.001

Table 3: Multivariate analysis of predictors of Peripheral Artery Disease. OR: Odds ratio, CI: Confidence interval.

The study by Okello et al. and Oyelade et al. from Uganda and Nigeria respectively, was conducted among diabetic subjects, where we expect higher prevalence of PAD as compared to the general population. Similarly, PAD in our study is lower than studies from high income countries [21,22], where the prevalence of PAD ranges from 16-18%. This might also be attributed to the differences in the study population. In Hirsch et al. (PARTNERS trial), the study was hospital based and all subjects were moderate risk. In the study by Sigvant et al. in Sweden, the participants were older than ours and thus are at increased risk than our population. A small sample size in our study could be another factor that might lead to underestimation of the prevalence of peripheral arterial disease. However, a population based study conducted three decades ago in the United States of America reported a comparable prevalence of about 12% [23].

The prevalence of hypertension and current cigarette smoking were similar to a study [24] from Ethiopia. But, lower than reports from other countries [9-12]. On the other hand, this study showed a higher rate of undiagnosed systemic hypertension among participants who had no prior blood pressure checkup. Moreover, a significant proportion of participants with previous diagnosis of hypertension and diabetes mellitus were not on treatment. However, the prevalence of other risks factors including chronic kidney disease, stroke and coronary artery disease in very low in our study population. A significant proportion (62.7%) of hypertensive patients in our study were not on any form of antihypertensive therapy. This figure is twice higher than reports from other Sub Saharan countries [9,12]. This disparity might be related to a low level of awareness about hypertension in the presence of a high proportion of illiteracy in our community.

None of the subjects who were found to have PAD fulfilled the diagnostic criteria for intermittent claudication using the Edinburgh Claudication Questionnaire. This is consistent with the results of other studies [9-12] that have come up with very low prevalence of intermittent claudication in patients with confirmed PAD and concluded that it is insensitive in diagnosing PAD. Certain variables assessed in this study; including female sex, diabetes mellitus and current smoking showed significant association with PAD. However, hypertension, CKD and previous stroke did not show a significant association with PAD. This could largely be because of the small sample size in our study. Hypertension (OR 1.78; p=0.18) tended to have a higher risk of getting PAD though appeared to be statistically non-significant.

The major limitations of this study are the use of small sample size and assessment of some risk factors was based on verbal reports, which is liable to recall bias. We have also calculated ABI using the higher values of ankle and brachial systolic blood pressure measurements. The presence of a different method of calculation of ABI and the current ongoing debate on the use of a modified calculation using the lower ankle pressure than the higher as numerator, has remained a challenge in direct comparison of results from various studies. Using the latter approach for the calculation of ABI, the prevalence of PAD in our study would have been 25.6%.

Conclusion and Recommendation

Subclinical peripheral arterial disease is prevalent among Ethiopian population. The prevalence of undiagnosed and untreated hypertension is also very high. Female gender, diabetes mellitus and current smoking were predictors of peripheral artery disease.

Although further large scale comprehensive studies should complement the findings of this study, interventions that raise public awareness about hypertension, diabetes mellitus and other risk factors for atherosclerosis, the importance of screening for hypertension and linking asymptomatic hypertensive patients to treatment would be important and feasible interventions that can be applied in resource limited settings.

Authors' Contributions

AH conceived and designed the study, data collection, supervision, data analysis and drafted the manuscript.

SF designed the study protocol, coordination, data analysis and manuscript writing up and edited.

TA involved in the design of the protocol, supplied the Doppler flow detector, and edited the manuscript.

MW designed the study protocol, and involved in the data analysis and manuscript editing.

AW designed the study protocol, and involved manuscript writing.

HA critically revised the final manuscript and processed it for publication.

All the authors have read and approved the final manuscript.

Acknowledgements

We would like to thank Jimma University for funding this study.

References

1. WHO (2014) Chronic Diseases and Health Promotion. Global status report on noncommunicable diseases.
2. Van der Sande MA(2003) Cardiovascular disease in sub-Saharan Africa: a disaster waiting to happen. Neth J Med 61: 2.
3. Criqui MH, McClelland RL, McDermott MM, Allison MA, Blumenthal RS, et al. (2010) The ankle-brachial index and incident cardiovascular events in the MESA (Multi-Ethnic Study of Atherosclerosis). J Am Coll Cardiol 56: 1506–1512.
4. Araki Y, Kumakura H, Kanai H, Kasama S, Sumino H, et al. (2012) Prevalence and risk factors for cerebral infarction and carotid artery stenosis in peripheral arterial disease. Atherosclerosis 223: 473-477.
5. Resnick HE, Lindsay RS, McDermott MM, Devereux RB, Jones KL, et al. (2004) Relationship of high and low ankle brachial index to all-cause and cardiovascular disease mortality: the Strong Heart study. Circulation 109: 733–739.
6. Heald CL, Fowkes FGR, Murray GD, Price JF (2006) Risk of mortality and cardiovascular disease associated with the ankle-brachial index: systematic review. Atherosclerosis 189: 61–69.
7. Luo YY, Li J, Xin Y, Zheng LQ, Yu JM, et al. (2007) Risk factors of peripheral arterial disease and relationship between low ankle brachial index and mortality from all-cause and cardiovascular disease in Chinese patients with hypertension. Circ J 21: 461–466.
8. Zenebe M, Mengistu A, Kebede O, Getachew T (2006) Pattern of admissions to the medical intensive care unit of Addis Ababa University Teaching Hospital. Ethiop Med J 44: 33-42.
9. Margaret T, Myles C, Stephen T, Gillian LH, Gerry F, et al. (2007) A cross-sectional study of vascular risk factors in a rural South African population: data from the Southern African Stroke Prevention Initiative (SASPI). BMC Public Health, 7: 326.
10. Feliciano CP, Arminda PB, Almeida BC (2016) Prevalence of peripheral artery disease among adults attending an outpatient clinic at a general hospital in South Angola. Scintifica 2016: 2520973.
11. Okello S, Millard A, Owori R, Asiimwe SB, Siedner MJ, et al. (2014) Prevalence of lower extremity Peripheral artery disease among adult diabetes patients in Southwestern Uganda. BMC Cardiovasc Disord 14: 75.
12. Oyelade BO, Ola Olorun AD, Odeigah LO, Amole IO, Adediran OS (2012) The prevalence of peripheral arterial disease in diabetic subjects in southwest Nigeria. Afr J Prm Health Care Fam Med 4: 354.
13. Ostchega Y, Paulose-Ram R, Dillon CF, Gu Q, Hughes JP (2007) Prevalence of peripheral arterial disease and risk factors in persons aged 60 and older: data from the National Health and Nutrition Examination Survey 1999–2004. J Am Geriatr Soc 55: 583–589.
14. Alzamora MT, For´ Es R, Baena-D´iez JM, Pera G, Toran P, et al. (2010) The Peripheral Arterial Disease study (PERART/ARTPER): prevalence and risk factors in the general population. BMC Public Health 10: 38.
15. Eraso LH, Fukaya E, Mohler ER, Xie D, Sha D, et al. (2014) Peripheral arterial disease, prevalence and cumulative risk factor profile analysis, Eur J Prev Cardiol 21: 704–711.
16. Leng G, Fowkes F (1992) The Edinburgh claudication questionnaire: an improved version of the WHO/Rose questionnaire for use in epidemiological surveys. J Clin Epidemiol 45: 1101-1109.
17. Christine EK, Hans JR, Christoph B, Karl L, Savvas S, et al. (2008) Different Calculations of Ankle-Brachial Index and Their impact on Cardiovascular Risk Prediction. Circulation 118: 961-967.
18. Murabito JM, Evans JC, Nieto K, Larson MG, Levy D, et al. (2002) Prevalence and clinical correlates of peripheral arterial disease in the Framingham Offspring Study. Am Heart J 143: 961-965.
19. Schröder F, Diehm N, Kareem S, Ames M, Pira A, et al. (2006) A modified calculation of ankle-brachial pressure index is far more sensitive in the detection of peripheral arterial disease. J Vasc Surg 44: 531-536.
20. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, et al. (2003) Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. Hypertension 42: 1206-1252.
21. Hirsch AT, Criqui MH, Jacobson DT, Regensteiner JG, Creager MA, et al. (2001) Peripheral Arterial Disease Detection, Awareness, and Treatment in Primary Care. JAMA 286: 1317-1324.
22. Sigvant B, Wiberg-Hedman K, Bergqvist D, Rolandsson O, Andersson B, et al. (2007) A population-based study of peripheral arterial disease prevalence with special focus on critical limb ischemia and sex differences. J Vasc Surg 45: 1185–1191.
23. Criqui MH, Fronek A, Barrett- Connor E, Klauber MR, Gabriel S, et al. (1985) The prevalence of peripheral arterial disease in a defined population. Circulation 74: 510-515.
24. Tesfaye F (2008) Epidemiology of Cardiovascular Disease Risk Factors in Ethiopia: The rural-urban gradient. Umeå University Medical Dissertations.