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Research Article

COMPARATIVE ANALYSIS OF THE USE OF EDINBURGH CLAUDICATION QUESTIONNAIRE AND ANKLE BRACHIAL INDEX IN DIAGNOSING PERIPHERAL ARTERY DISEASE AMONG THE ELDERLY IN SOUTH-SOUTH, NIGERIA

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Abstract

Symptomatic and asymptomatic Peripheral Artery Disease (PAD) is a common occurrence in the elderly. Most patients experience functional decline due to claudication pains and are predisposed to higher risk of cardiovascular disease. PAD is a strong prognostic marker of systemic atherosclerosis in those aged 60 years and above, thus impacting negatively on their functionality and quality of life. **Objective:** To compare the accuracy of Edinburgh Claudication Questionnaire (ECQ) and Ankle Brachial Index (ABI) in the elderly with PAD. **Methods:** A cross sectional descriptive hospital-based study was carried out among 370 elderly patients attending a Tertiary Hospital from September to November 2017. A systematic random sampling technique was utilized in recruiting participants into this study and a structured questionnaire was used in collecting participants' information. Information collected using questionnaire included socio-demographic characteristics, lifestyle variables, and medical history. The ABI and ECQ were used to assess for PAD among the Elderly. Data collected were Analysed using SPSS for window version 21 (SPSS Inc., Chicago, IL, USA) statistical package software. **Results:** The prevalence of PAD was 38.1% and 37.8% using ECQ and ABI technique respectively. The sensitivity and specificity were 47.1% and 67.4%, while the Positive Predictive Value (PPV) and Negative Predictive Value (NPV) were 46.8% and 67.7% respectively. **Conclusion:** The ECQ was found to be a valid screening tool for PAD in low resource settings, even though ECQ missed out most of the respondents who actually had PAD, which were diagnosed with ABI. It is imperative that screening for PAD with clinical foot examination, ECQ and ABI where it is available, be done for early detection and prompt intervention.

Keywords: Ankle-brachial-index, elderly, Edinburgh-Claudication-Questionnaire, PAD, Nigerian.

INTRODUCTION

Peripheral Artery Disease (PAD) denotes a pathological process resulting from partial or complete obstruction of more than one peripheral arteries, excluding the coronary and cerebral vessels (Muller *et al.,* 2016). It can also be referred to as an atherosclerotic occlusive disease of the lower limb vessels and the commonly affected vessels are large and medium sized arteries (Criqui and Aboyans, 2015). Arteries are made up of three (3) layers: the tunica intima, tunica media and tunica adventitia. The tunica intima is often implicated in the pathogenesis of PAD. The luminal narrowing seen in PAD is linked to endothelial dysfunction, vascular inflammation and accumulation of cholesterol, calcium and cellular debris within the wall of these vessels (Mascarenhas *et al.,* 2014; Rac-Albu *et al.,* 2014). These vascular changes are further compounded by prolonged exposure of the vessels to other risk factors such as smoking, diabetes, hypertension and dyslipidemia (Muller *et al.,* 2016). Lower limb vessels are largely involved than that of the upper limb. The hallmark of PAD is intermittent claudication, characterized by exercise - induced reduction in blood flow to the distal arterial occlusion resulting in calf pain that resolves within 10 minutes (Lot *et al.,* 2012). The symptoms range from fatigue, numbness, gluteal pain to calf pain. PAD is largely asymptomatic at its earliest stage prior to the development of intermittent claudication and severe vascular compromise that could lead to leg ulcer, which may eventually result in amputation if not promptly diagnosed and managed (Bozkurt *et al.,* 2011).

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According to a recent systematic review, symptomatic PAD subjects had higher 5 year cumulative cardiovascular mortality compared to those without PAD and 4-27% of PAD cases had undergone amputations (Ashis *et al.,* 2007). An individual with PAD is fatally prone to a cardiovascular event as a patient with ischemic heart disease (Ashis *et al.,* 2007). Peripheral artery disease (PAD) is one of the major sequelae of atherothrombosis and a global reflection of the systemic atherosclerotic burden of an individual (Fowkes *et al.,* 2013). Over 3 million elderly people are affected with PAD in the United States of America, with symptomatic presentation being very low, (asymptomatic: symptomatic ratio of 3:1). The presence of Peripheral artery disease is associated with high risk of cardiovascular morbidity and mortality regardless of its clinical form of presentation (symptomatic or asymptomatic). PAD is regarded as an independent predictor of cardiovascular risk than clinical history of coronary artery disease (Bergiers *et al.,* 2011). There is paucity of data on assessment of PAD among the elderly as well as the reliability of screening tools for PAD among the elderly in the study setting. This study is therefore aimed at bridging this gap by comparing the usefulness of ECQ and ABI in the diagnosis of PAD in the elderly with provision of information on the prevalence of PAD, pattern and severity of PAD in the elderly. These facts will add to the wealth of knowledge in this subject area improvement in the quality of care and quality of life of the elderly. This study will therefore provide data on the prevalence of PAD using the ABI and ECQ and also it will reemphasize the need for incorporation of simple and non-invasive screening modalities as part of routine clinical assessment of high risk patients by first contact doctors.

METHODOLOGY

Study Site: The study was carried out in the General Practice Clinic (GPC) of the University of Benin Teaching Hospital (UBTH) in Benin City, Edo State, South-South geopolitical region of Nigeria between September to November 2017. The University of Benin Teaching Hospital was established in 1973 and it is an 800 bedded Federal Government Tertiary Hospital which offers both inpatient and outpatient services. It receives referrals from Edo State and neighbouring states like Delta, Ondo, Anambra, Ekiti, Kogi, Bayelsa etc. Aside from providing primary, secondary and tertiary care to patients, it is also a training centre for high and middle level manpower such as Medical Doctors, Nurses, Paramedics, Laboratory technicians, Health Technologists etc.The General Practice Clinic is run by the Department of Family Medicine and provide outpatient services. There are 12 consulting rooms for the following subunits: Emergency/Observation unit, NHIS clinic, Geriatric clinic and General outpatient clinic.

Study Design: The study was a hospital based descriptive cross-sectional study.

Study Population: The study was carried out among elderly patients that attended the General Practice Clinic of the University of Benin Teaching Hospital, Edo State, Nigeria.

Study Duration: The study was carried out over a period of three months.

Inclusion Criteria: All consenting patients aged 60 years and above that attended the geriatric clinic at the General Practice Clinic of UBTH.

Exclusion Criteria: Elderly who were too ill to participate in the study and those with bilateral lower limb amputation.

Sampling technique: A systematic random sampling technique was used to select respondents for this study. A preliminary survey from the outpatient clinic revealed that an average of 36 elderly patients were seen daily which translates to 180 (36 x 5) and 720 (180x4) elderly patients seen on a weekly and monthly basis, respectively, and 2160 respondents over three months. The calculated sample size was 370. Therefore, the sampling interval was calculated using N/n, where N is the total of patients and n is the sample size. Based on the above formula, the sampling interval was approximately 6. Using a sampling interval of 6, every 6^{th} patient that presented to the clinic was selected and studied until the desired sample size was achieved. However, the first respondent was selected using simple random sampling technique.

Data collection: An interviewer administered, pretested semi-structured questionnaire with 5 sections. Section 1 consisted of the socio-demographic characteristics of the respondents; Section 2 was made up of relevant clinical information such as presence of comorbidities i.e., history of hypertension, diabetes, social history e.g., smoking, and alcohol etc. Section 3 consisted of history of intermittent claudication using Edinburgh Claudication Questionnaire (ECQ) while Section 4 included anthropometric and clinical parameters such as weight, height, BMI, blood pressure measurement, loss of skin appendages, foot ulcers, absence or presence of pedal pulse, hand-held Doppler scan was used to assess the ankle brachial index. Subjects with symptomatic PAD were those with intermittent claudication and ABI of <0.90 while those with asymptomatic PAD did not have above symptom but had an ABI of <0.9 (Lot *et al.,* 2012). Section 5 consisted of Laboratory data of patients, viz: Fasting blood glucose (FBG), fasting serum lipid profile. Pre-Testing Questionnaires:

The Questionnaires were pre-tested in the General Outpatient Department (GOPD), of Irrua Specialist Teaching Hospital, Irrua, Edo State for clarity and consistency. These respondents were not used for the study. Recruitment was done from September to November 2017. Respondents were interviewed to obtain information on their socio-demographic data such as (age, gender, smoking, alcohol intake and clinical characteristics). An Accosson ® mercury sphygmomanometer was used in measuring the brachial and ankle blood pressure of each respondent. Measurement of the Ankle Brachial Index ABI) was done using a hand-held Doppler (Hadeco Smartdop 45, made in Japan). Measurement of the Toe-Brachial Index was also done for those with elevated ABI value to confirm PAD in the presence of arterial calcification using the above-mentioned Doppler device with its photo plethysmograph probe.

Measurement of Blood Pressure: An Accosson ® mercury sphygmomanometer was used in measuring the brachial and ankle blood pressure of each respondent. An appropriate size cuff with bladder length of 80% of patient's arm circumference and an ideal width of at least 40% as recommended by the American Heart Association was used. The blood pressures of the participants from both arms were measured in a sitting position; two readings were taken 5 minutes apart and the average of the two readings taken as the participants' blood pressure. The cuff was placed on the upper arm and inflated while the radial pulse was being palpated. The cuff was inflated to 10mmHg above the pressure at which the radial pulse was obliterated, with the aid of a stethoscope placed over the skin overlying the brachial artery in the cubital fossa, the first sound (first Korotkoff sound) heard on gradual deflation of blood pressure cuff at 2mmHg per decline was taken as the systolic pressure while the diastolic pressure was taken as the point at which the sound became muffled (Korotkoff sound). Measurement of the Ankle Brachial Index (ABI): A hand-held Doppler (Hadeco Smartdop 45, made in Japan, See figure 1) was used to measure the ankle and brachial blood pressures. The procedure was explained to the patient who thereafter lay supine and calmly on a couch for about 5 minutes, thereafter, the brachial systolic blood pressure was measured.

The Doppler probe was then applied at 45 degrees to the artery and the probe was moved until a good signal was obtained. The previously applied cuff was then inflated to obliterate the Doppler signal and then slowly deflated to get the pressure at which the signal returns. A similar procedure was repeated on the other arm and the higher of the two values obtained on the assessment of the two arms was taken as the brachial blood pressure. A digital weighing scale; Hanson's Bathroom weighing scale manufactured by Jindal Medical and Scientific Instrument Company Limited, New Delhi, India (with an accuracy of ±100g) was used to measure the body weight. The weight of each study subject was measured using the above weighing scale with the subjects standing still in the centre of the weighing scale's platform. Weights were recorded to the nearest 0.5kg. The height was measured with a stadiometer to the nearest 0.1cm with the subject barefooted. The body mass

index was calculated from these values (weight and height) as a ratio of the measured weight to the square of the measured height in meters (kg/m^2). Waist circumference was measured using a metric non-stretch measuring tape placed midway between the inferior margin of the lowest rib and the iliac crest in the horizontal plane, at the end of normal expiration.

Ethical consideration: Ethical clearance with a protocol number ADM/E22/A/VOL.VII/1460 was obtained from the Ethics committee of University of Benin Teaching Hospital. All participants were educated on the purpose and benefits of the study before recruitment. Their participation in the study was totally voluntary and unwillingness to participate was without prejudice (Akpan *et al.,* 2020). Their confidentiality was ensured as no name was included in the questionnaire. The hardware for the storage of data was pass-worded to prevent unauthorized access (Akpan *et al.,* 2020). Written informed consent was obtained from each subject.

Data Management: Analysis was done using the statistical package for social science (SPSS) version 21.0 (Chicago, IL, USA). Categorical variables such as gender and marital status were summarised using frequencies and percentages. Numerical data such as age, duration of hypertension, diabetes and smoking were represented using mean and standard deviation if normally distributed, while the median and range was used for data that were not normally distributed. The Chi-square test was used to determine the statistical association between categorical variables while logistic regression was used to determine significant predictors. Statistical significance was set at P<0.05.

RESULTS

Table 1. Socio-Demographic Characteristics of Respondents

Variables	Frequency n=370(%)	Percentage
Age (years)		
60-64	106	28.6
65-69	108	29.2
70-74	73	19.7
75-79	43	11.6
80 and above	40	10.8
Sex		
Male	87	23.5
Female	283	76.5
Marital Status		
Married	185	50.0
Single	1	.3
Divorced	2	.5
Separated	8	2.2
Widower/widow	174	47.0
Educational Status		
None	126	34.1
Primary	156	42.2
Secondary	33	8.9
Tertiary	55	14.9
Religion		
Christianity	360	97.3
Islam	2	.5
Traditionalist	8	2.2
Ethnicity		
Bini	255	68.9
Ishan	44	11.9
Etsako/owan	14	3.8
Igbo	22	5.9
Yoruba	2	.5
Hausa	1	.3
Urhobo/isoko/ijaw	23	6.2
Ika/kwale	9	2.4

The mean age of the respondents was 69.3±7.4years SD and 29.2% of the where of age ranging 65 to 69 years constituting the highest frequency in table 1. Most of the respondents (76.5%) were females and 50% of the total respondents were married.

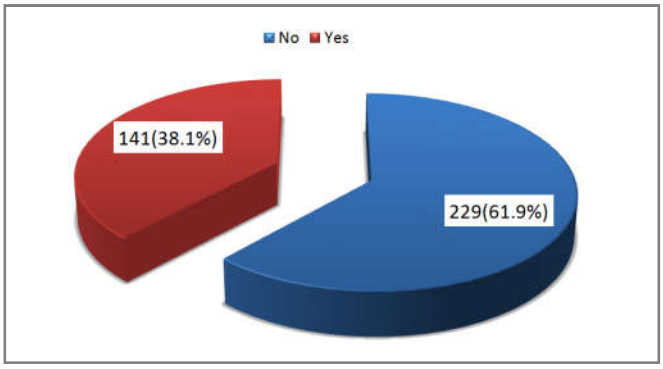


Figure 1. Pie chart showing the prevalence of symptomatic and asymptomatic PAD as classified by Edinburgh Claudication Questionnaire

The results indicated that 141 (38.1%) had symptomatic PAD according to the ECQ while 229(61.9%) where asymptomatic. Table 2: Shows the association between PAD using the Edinburgh Claudication Questionnaire and socio-demographic and lifestyle variables. The proportion with PAD was significantly higher among females (42.4%) compared to males (24.1%) (p = 0.002). The proportion with PAD was higher among widowed women compared to those married (p = 0.016). There was no significant association between PAD and age, educational level, cigarette and alcohol use, and BMI (Table 2). The proportion with PAD based on Edinburgh Claudication Questionnaire was 38.1%, and it was significantly commoner among females (42.4%) compared to males (24.1%) (p = 0.002). There was no significant association between PAD using Edinburgh Claudication Questionnaire and biochemical parameters and sociodemographic variables.

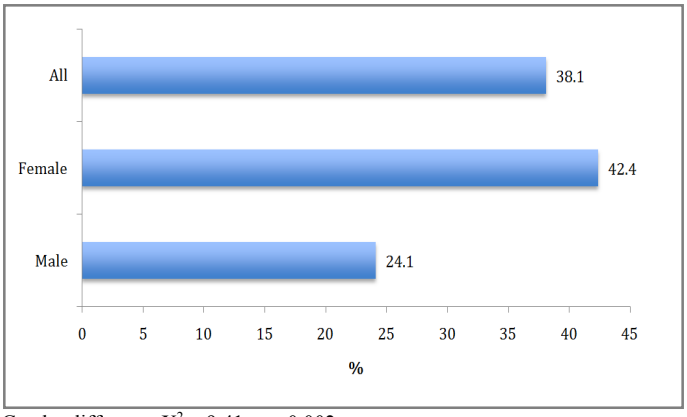
Table 2. Association between PAD using Edinburgh Claudication Questionnaire and socio-demographic and lifestyle variables

	PAD				
Variable	**Yes**	**No**	**Total**	**Chi square**	**P value**
Age (years)					
60-64	39(36.8)	67(63.2)	106	1.59	0.451
65-69	37(34.3)	71(65.7)	108		
70+	65(41.7)	91(58.3)	156		
Marital status					
Married	59(31.9)	126(68.1)	185	5.82	0.016
Widowed	77(44.3)	97(55.7)	174		
Educational level					
None	51(40.5)	75(59.5)	126	6.05	0.109
Primary	66(42.3)	90(57.7)	156		
Secondary	10(30.3)	23(69.7)	33		
Tertiary	14(25.5)	41(74.5)	55		
Gender					
Male	21(24.1)	66(75.9)	87	9.41	0.002
Female	120(42.4)	163(57.6)	283		
Ever smoked cigarette					0.653
Yes	1(20.0)	4(80.0)	5		(Fisher's
No	140(38.4)	225(61.6)	365		Exact test)
Ever taken alcohol					
Yes	19(47.5)	21(52.5)	40	1.68	0.195
No	122(37.0)	208(63.0)	330		
BMI					
Underweight	10(52.6)	9(47.4)	19	3.24	0.355
Normal	54(38.0)	88(62.0)	142		
Overweight	45(33.8)	88(66.2)	133		
Obese	32(42.1)	44(57.9)	76		

*Significant p values are in bold

Table 3: Association between PAD using Edinburgh Claudication Questionnaire and biochemical parameters, medical history and hypertension and hyperglycaemia

	PAD				
Variable	**Yes**	**No**	**Total**	**Chi square**	**P value**
Total cholesterol					
<200	101(36.7)	174(63.3)	275	0.87	0.352
>200	40(42.1)	55(57.9)	95		
LDL					
<150	123(37.0)	209(63.0)	332	1.54	0.215
>150	18(47.4)	20(52.6)	38		
HDL					
<40	19(38.8)	30(61.2)	49	0.01	0.918
>40	122(38.0)	199(62.0)	321		
Triglycerides					
<150	107(36.9)	183(63.1)	290	0.84	0.361
>150	34(42.5)	46(57.5)	80		
Hypertension					
Yes	54(40.0)	81(60.0)	135	0.32	0.570
No	87(37.0)	148(63.0)	235		
Hyperglycemia					
Yes	19(32.2)	40(67.8)	59	1.04	0.308
No	122(39.2)	189(60.8)	311		
Known hypertensive					
Yes	98(38.4)	157(61.6)	255	0.04	0.849
No	43(37.4)	72(62.6)	115		
Known diabetic					
Yes	34(37.4)	57(62.6)	91	0.04	0.848
No	107(38.5)	171(61.5)	278		



Gender difference $X^2 = 9.41$, p = 0.002

Fig. 2. Gender difference in PAD based on Edinburgh Claudication Questionnaire

However, 42.1% and 47.4% of the respondents who had cholesterol and LDL of greater than 200mg/dl and 150mg/dl had more occurrence of PAD. Surprisingly, respondents (38.5%) with diabetic mellitus had less PAD while those with hypertension reported (38.5%) having more PAD. There was also no significant association between PAD and lipid parameters, hypertension or diabetes (Table 3).

Table 4. Multiple logistic regression of PAD using Edinburgh Claudication Questionnaire on variables

Variable	**Odds ratio (OR)**	**95% CI OR**	**P value***
Gender			
Male	1		
Female	1.98	1.07 – 3.68	0.030
Marital status			
Married	1		
Widowed	1.29	0.79 – 2.11	0.303

*Statistically significant at 5%

Table 4: Shows the predictors of PAD using the Edinburgh Claudication Questionnaire on multiple logistic regressions. Females were almost twice more likely to have PAD compared to males after adjusting for marital status (OR = 1.98, 95% CI = 1.07 – 3.68, p = 0.03).

Table 5. Predictors of pad using ABI

Variable	**Odds ratio (OR)**	**95% CI OR**	**P value**
Gender			
Male	1		
Female	1.66	0.91 – 3.02	0.096
Educational level			
None	2.04	0.99 – 4.21	0.053
Primary	1.15	0.57 – 2.33	0.692
Secondary	0.81	0.29 – 2.29	0.690
Tertiary	1		
Hypertension			
Yes	1.44	0.92 – 2.27	0.112
No	1		

There was no significant predictor of PAD using ABI, however, being female and having no education increases the chances of PAD by approximately 2.

Table 6. Comparing the diagnostic accuracy of Edinburgh Claudication Questionnaire with ABI in the elderly with PAD

		PAD using ABI		Total
		Yes	**No**	
PAD using Edinburgh	Yes	66	75	141
Claudication Questionnaire	No	74	155	229
	Total	140	230	370

Sensitivity = 66/140 = 47.1%
Specificity = 155/230 = 67.4%
Positive Predictive Value (PPV) = 66/141 = 46.8%
Negative Predictive Value (NPV) = 155/229 = 67.7%
McNemar's Chi Square = 7.79, p = 0.005

DISCUSSION

Peripheral Artery Disease (PAD) is one of the major sequelea of artherothrombosis and a global reflection of the systemic atherosclerotic burden of an individual. The elderly with PAD may be symptomatic or asymptomatic. Therefore, the use of simple screening tools remains one of the most important measures for early detection. The PAD in this study was higher than the 25.3% reported by Adeko et al., in adult respondents 50 years and above in Sagamu, Ogun State, South West Nigeria (Adeko *et al.,* 2016). However, a much higher prevalence was reported in another study conducted in South East Nigeria (Ogbera *et al.,* 2015). The findings in this study were quite similar to the reported prevalence in Belgium where 40% of the respondents had PAD, (Bergiers *et al.,* 2011) but other studies in other parts of the world reported a prevalence of less than 10% (Ashis *et al.,* 2007; Cho *et al.,* 2015; El-Menyar *et al.,* 2013; Weragoda *et al.,* 2015). The differences in the prevalence of PAD in the various studies compared to ours may be due to the age of the respondents studied and the research setting. The report from our study revealed that gender of the participants was significantly associated with occurrence of PAD using the ECQ. This finding was consistent with the report documented by Subramaniam *et al.* (2011) and Desormaise *et al.* (2015) However, the Framingham Offspring study and a South African study reported a lower prevalence in women compared to other studies in Sri Lanka and China where there wasno relationship between occurrence of PAD and gender of the participants (Weragoda *et al.,* 2015; He *et al.,* 2012). The findings in our study regarding the high prevalence in women is quite surprising considering the protective effect of oestrogen stated in Framingham Study (Murabito *et al.,* 2002). Still on sociodemographic factors, majority of the participants with PAD were 70 years and above, this contrast the findings by Adeko et al where the prevalence was reported more among individuals within the

age range of 60-69 years (Adeko *et al.,* 2016). Surprisingly, smoking was not significantly related with increased occurrence of PAD as majority of those who had PAD in our study reported not to have ever smoked in their life. This observation is a clear contrast to findings from other studies where smoking was significantly associated with increase in PAD (Muller *et al.,* 2016). The difference in findings may be due to recall bias among the elderly. However the use of alcohol was implicated as a risk factor for increase in PAD in our study. This is similar to reports documented in other studies (Wakabayashi *et al.,* 2014; Yang *et al.,* 2017; Jepson *et al.,* 1995). Furthermore, Obesity and dyslipidaemia were found to be associated with higher proportion of PAD among the participants. Expectedly, this result corresponds with findings from other studies where these physical and biochemical parameters had strong association with increased risk of PAD (Desormais *et al.,* 2015; Eraso *et al.,* 2014).

The screening result from our study using the sensitivity, specificity, positive predictive value mirrors the result obtained from another study conducted among community patients in United Kingdom. However, the negative predictive value found in their study was found to be higher than the value reported in our study. This is not surprising considering the fact that the aforementioned study was a multi-ethnic / community research involving large participants (Bennett *et al.,* 2011). Sensitivity refers to the ability of a test to correctly identify those patients with the disease. In our study, ECQ showed that almost half of the participants had PAD while the ability to currently generate a negative result (specificity) was 67.4%. The sensitive pattern in our study was found to be greater than 31% in another study conducted in Turkey (Basgoz *et al.,* 2016). Moreover, the specificity pattern in the Turkey study was found to be greater than the recorded specificity in our study. Furthermore, the PPV of the test, that is, the probability of actually having the disease given a positive test result was found to be 22.2%; this result was less compared to our reported PPV (Basgoz *et al.,* 2016). The variation in the findings may be due to the age of the study participants, sample size and difference in socio-demographic factors. In addition, our sensitivity was less than 50%, however a higher specificity (>60%) and negative predictive value was recorded in our study. These findings are similar to the results obtained from other studies done in other parts of the world (Rabia and Khoo, 2007; Krishnan *et al.,* 2018; Benermacher *et al.,* 2006). The aforesaid similarity in result signifies that ECQ is a very good test to diagnose PAD due to its specificity and negative predictive values.

Conclusion and Recommendation

The Edinburgh Claudication Questionnaire may be useful in a resource poor setting like ours but the findings that it has a high false negative value requires that ABI be done to confirm clinical finding for PAD. Although, ECQ in our study missed out most of the respondents who actually had PAD, in which the diagnosis was confirmed with an ABI. It is therefore imperative that screening for PAD via clinical foot examination, use of ECQ and ABI where it is available, be done to achieve early detection and facilitate prompt treatment. The prevalence of PAD among the elderly respondents was found to be very high. Family Physicians and other specialists are therefore encouraged to actively screen for PAD using clinical foot examination, ECQ and ABI.

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