Research article

DOI: 10.59715/pntjmp.4.3.17

Prevalence and risk factors for asymptomatic peripheral arterial disease from persons of general health screening in Medic Binh Duong General Hospital

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Abstract

Background/Objectives: Peripheral arterial disease (PAD) is a common vascular problem. Peripheral artery disease (PAD) increases the risk of cardiovascular morbidity and mortality. The purpose of this study was to evaluate the prevalence and association of risk factors for asymptomatic PAD from persons of general health screening in Medic Binh Duong General Hospital.

Materials and Methods: This observational transverse field study was carried out from May 2024 to October 2024 on medicine out-patient department of Medic Binh Duong General Hospital, 270 known under general health screening were recruited. Subjects having previous vascular heart disease, having diabetes mellitus were excluded from the study. They underwent thorough assessment for general, symptomatic, medical history and risk factor screening that included gender, age, smoking, family history, obesy, hypertension, hyperlipidemia, new onset diabetes mellitus. Blood Pressure and ABI was measured by Boso ABI System 100 PWV instrument of Germany. PAD was defined when an ABI of 0.9 or less and Borderline PAD was defined as an ABI 0.90 to 0.99, was found in one or both legs, All statistical analyses were conducted with SPSS ver. 20.0.

Results: A total of 270 participants were included with 111 men (41.1%) and 159 women (58.9%). PAD was detected in 15 (5.6%). Borderline ABI showed in 63 (23.3%). Significant risk factors for PAD with univariate analysis were old age (odd ratio, 3.77; P= 0.001), hypertension (odd ratio, 1.54; P = 0.01), hyperlipidemia (odd ratio, 1.43; P = 0.02), smoking (odd ratio, 2.65; P = 0.02), and diabetes mellitus (odd ratio, 2.04; P = 0.05). Significant risk factors for PAD with multivariate analysis were old age (odd ratio, 0.26; P = 0.04), hypertension (odd ratio, 0.14; P = 0.02), and hyperlipidemia (odd ratio, 0.2; P = 0.04).

Conclusion: The prevalence for asymptomatic PAD from persons of general health screening was 5.6%, the prevalence of borderline PAD was 23.3%. Old age, hypertension and hyperlipidemia were significant risk factors for PAD (ABI $\leq$ 0.90). ABI measurement should be routinely performed as a screening test in patients with cardiovascular risk factor for CVD prevention.

Key Words: Ankle brachial index, Peripheral arterial disease, Prevalence, Risk factors

Received: 24/02/2025
Revised: 05/3/2025
Accepted: 20/7/2025
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1. INTRODUCTION

Peripheral artery disease (PAD) represents a significant global health burden, affecting >200 million people and accounting for approximately 10-15% of the population >50 years of age. In

Western populations, PAD affects approximately 3-10% of adults; in Asia and other developing regions, prevalence rates can exceed 20%. PAD is one of the clinical types of atherosclerotic diseases. PAD results in atherosclerotic obstructions in the major conduit arteries supplying the lower extremities. The pathophysiologic mechanism by which arterial insufficiency develops is based on the presence of arterial stenosis that progresses naturally to cause complete occlusion of the artery. PAD particularly affects elderly individuals (>65 years old). [1]. Peripheral artery disease increases the risk of cardiovascular morbidity and mortality. Previous studies have shown that PAD significantly increases the risk of morbidity and mortality from cardiovascular disease [2], [3], [4]. Therefore, early diagnosis and appropriate treatment of PAD are important. However, PAD is underdiagnosed and undertreated, partly because most patients are asymptomatic or present with atypical symptoms. Screening and detection methods such as measuring the ankle-brachial index (ABI) are essential. This is a non-invasive, inexpensive, and highly accurate imaging diagnostic method that is being applied at medical facilities specializing in Cardiology and Endocrinology in many countries around the world as well as in Vietnam.

In the world, there are many studies on PAD in the general population, Korhonen P the incidence of PAD was 5% and borderline PAD was 20% [5]; Urbano L/2017 the incidence of PAD was 4.4% [3]; Cho S/2019 the incidence of PAD was 4.6% [6]. In Vietnam, most studies focus on the frequency of PAD in the population with symptoms or based on clinical conditions such as diabetes or ischemic heart disease [7]. There are no studies evaluating the frequency of asymptomatic PAD in people with general health check-ups.

The purpose of this study was to evaluate the prevalence and association of risk factors for asymptomatic PAD from persons of general health screening in Medic Binh Duong General Hospital.

2. MATERIALS AND METHODS

2.1. Study design: A cross-sectional study

2.2. Study participants

This observational transverse field study was carried out from May 2024 to October 2024 on medicine out-patient department of Medic Binh Duong General Hospital, 270 known under general health screening were recruited, aged ≥40 years. Subjects having previous vascular heart disease, having diabetes mellitus, people who had previously been diagnosed with PAD or did not agree to participate were excluded from the study.

2.3. Methods

The sample size

$$n = Z^2_{(1-\alpha/2)} \cdot \frac{P(1-P)}{d^2}$$

In there Z^2 = 3.84; d = 5%, Deviation range 95%

According to research by Le Tu Phuong Thuy [8], the rate of PAD in hypertensive patients is 9.7%. Substitute into the formula to calculate the sample size, n = 135; According to research by Korhonen 2014 [9], the rate of PAD in patient with at least one cardiovascular risk factor is 5%, sample size n =73. So for this study, we will choose a sample size grater than or equal to 135 people.

They underwent thorough assessment for general, symptomatic, medical history and risk factor screening that included gender, age, smoking, family history, obesy, hypertension, hyperlipidemia, new onset diabetes mellitus, hs-crp. Blood Pressure and ABI was measured by Boso ABI System 100 PWV instrument of Germany.

Blood biochemical test with the AU 680 automatic biochemical machine (Beckmen Coulter 2018) include hungry blood glucose, LDL-C, HDL-C, total cholesterol, triglycerid, creatinin was performed at the laboratory of Medic Binh Duong General Hospital.

Diagnostic criteria

For diagnosis of PAD, the participant was required to rest for at least 5 minutes. Afterwards, a standard blood pressure cuff was placed around the ankles and arms. The subject was laid in the supine position. The systolic blood pressure (SBP) in the bilateral arms (Brachial) was measured. The systolic pressures of the posterior tibial artery or, if absent, the dorsalis pedis artery of bilateral ankles was also measured. The ankle brachial index (ABI) was calculated by dividing the ankle SBP by the higher brachial one. PAD was defined as an ABI of 0.9 or less in either lower extremity. Borderline PAD was defined as an ABI 0.90 to 0.99.

Definition of variables

Body mass index (BMI) was defined as body weight in kilograms divided by height in meters squared. Overweight and Obesity was defined as BMI ≥ 23 kg/m^2. Hypertension was defined as an SBP over 140 mmHg and/or diastolic blood pressure over 90 mmHg in an individual currently taking antihypertensive medication. Other past medical history, familial history, and social history were obtained based on a self-reported questionnaire completed either before or after the measurement of blood pressure. A smoker was defined in cases who have smoked at least a hundred cigarettes during their life and defined on the basis of self-report. Patients diagnosed with new onset diabetes mellitus based on the diagnostic criteria in issued by the Ministry of Health in 2020 (fasting plasma glucose ≥ 126 mg/dL (or 7 mmol/L) or plasma glucose ≥ 200 mg/dL (or 11.1 mmol/L) 2 hours after a 75g oral glucose tolerance test or HbA1c ≥ 6.5%). Diagnose dyslipidemia when one or more of the following disorders are present: HDL cholesterol < 0.9 mmol/l and/or triglyceride ≥ 2.26 mmol/l and/or total cholesterol ≥ 5.2 mmol/L and/or LDL-C ≥ 3.4 mmol/L.

2.4. Statistical Analysis:

Baseline characteristics such as demographics, medical history were summarized. Measurable parameters were expressed as mean ± standard deviation and analyzed by a chi-square test or paired t-test. Descriptive statistics were performed using IBM SPSS Statistics ver. 20.0. Multivariable logistic regression tested associations of potential risk factors with PAD. P-value < 0.05 was considered statistically significant.

2.5. Medical ethics: This is an observational study, does not interfere with the treatment process.

3. RESULTS

3.1. Characteristics of study populations

Table 1. Characteristics of the study populations (n = 270)

Variable	Value
Age (yr), mean ± SD (range)	56.94 ± 10.09 (40-96)
Sex, female, n (%)	159 (58.9)
BMI (kg/m²), mean ± SD	23.9 ± 2.89
Smoking, n (%)	37 (13.7)
Family history: Cardiovascular disease (CVD), n (%)	128 (47.4)
Hyperlipidemia, n (%)	180 (66.7)
Hypertension, n (%)	168 (62.2)
Diabetes, n (%)	56 (20.7)
No.Risk factor, mean ± SD	5.25 ± 1.66

The characteristics of the study population are summarized in Table 1. A total of 270 subjects were enrolled in this study. Among them, the female population was 159 (58.9%). The mean age of the enrolled population was 56.94 ± 10.09 years (range, 40–96 years). The mean BMI was 23.9 ± 2.89 kg/m^2. 62.2% of the subjects were hypertension; 66.7% were hyperlipidemia; 20.7% were diabetes; 13.7% of the subjects were smokers.

3.2. Prevalence of PAD

Table 2. The distribution of population according to ABI by age

Age (yr)	ABI			Total
	ABI ≤ 0.90	**ABI 0.91-0.99**	ABI 1.00-1.40	
40 – 49	1 (1.4%)	14 (20.3%)	54 (78.3%)	69
50 – 59	5 (5.0%)	23 (22.8%)	73 (72.3%)	101
60 – 69	4 (6.0%)	17 (25.4%)	46 (68.7%)	67
≥ 70	5 (15.2%)	9 (27.3%)	19 (57.6%)	33
Total	**15 (5.6%)**	**63 (23.3%)**	192 (71.1%)	270

The prevalence of PAD and borderline PAD by age groups were shown in Table 2. Among 270 participants, PAD was detected in 15 (5.6%). PAD was detected most commonly in age group ≥ 70 years (5; 15.2%), followed by 60–69 years (4; 6.0%), 50–59 years (5; 5.0%) and 40–49 years (1; 1.4%). Borderline PAD in the population was detected in 63 (23.3%). The mean ABI was 1.02 ± 0.07.

3.3. Risk factors for PAD

Table 3. Univariate analysis of the risk factors for PAD

Variable	PAD (+) (ABI≤0.90)	PAD (-) (ABI >0.90)	P value
No. of patients	15	255	
Age (yr), mean ± SD	66.07±13.73	56.4 ± 9.61	0.000
Age ≥ 70, n (%)	6 (40.0)	27 (10.6)	0.001
Sex, female, n (%)	9 (60.0)	150 (58.8)	0.92
BMI ≥ 23 kg/m^2, n (%)	9 (60.0)	166 (65.1)	0.58

Smoking, n (%)	5 (33.3)	32 (12.5)	0.02
Family history: Cardiovascular disease, n (%)	6 (40.0)	122 (47.8)	0.55
Hyperlipidemia, n (%)	14 (93.3)	166 (65.1)	0.02
Hypertension, n (%)	14 (93.3)	154 (60.4)	0.01
Diabetes, n (%)	6 (40.0)	50 (19.6)	0.05
No.Risk factor, mean ± SD	5.93 ± 1.03	5.21 ±1.68	0.10

Statistical analysis was performed with Student t-test, chi-square test, or Fisher exact test.

The average age of the PAD group was higher than the group without PAD (66.07 ± 13.73 vs 56.4 ± 9.61, p = 0.000); Compared with the group without PAD, the PAD group had a higher rate of smoking (33.3% vs 12.5%, p=0.02), rate of hypertension (93.3% vs 60.4%, p=0.01), rate of hyperlipidemia (93.3% vs 65.1%, p=0.02), rate of newly acquired diabetes is higher (40.0% vs 19.6%, p=0.05), The average number of risk factors is higher (5.93±1.03 vs 5.21 ±1.68, p=0.10).

Table 4. Univariate analysis for peripheral arterial disease (ABI ≤ 0.90)

Risk factors	OR (95%CI)	P-value
Age ≥ 70	3.77 (1.84– 7.72)	0.001
Smoking	2.65 (1.21 – 5.82)	0.02
Hyperlipidemia	1.43 (1.21 – 1.68)	0.02
Hypertension	1.54 (1.30 – 1.82)	0.01
Diabetes	2.04 (1.04 – 3.97)	0.05

OR, Odds Ratio; CI, confidence interval;

Significant risk factors for PAD with univariate analysis were old age (odd ratio, 3.77; P= 0.001), hypertension (odd ratio, 1.54; P = 0.01), hyperlipidemia (odd ratio, 1.43; P = 0.02), smoking (odd ratio, 2.65; P = 0.02), and diabetes mellitus (odd ratio, 2.04; P = 0.05).

Table 5. Multivariate analysis for risk factors

Risk factors	OR (95%CI)	P-value
Age ≥ 70	0.26 (0.08 –0.82)	0.04
Smoking	0.55 (0.15 – 2.04)	0.17
Hyperlipidemia	0.20 (0.02 – 1.68)	0.04
Hypertension	0.14 (0.01 – 1.19	0.02
Diabetes	0.60 (0.18- 1.91)	0.40

OR, Odds Ratio; CI, confidence interval

Significant risk factors for PAD with multivariate analysis were old age (odd ratio, 0.26; P = 0.04), hypertension (odd ratio, 0.14; P = 0.02), and hyperlipidemia (odd ratio, 0.2; P = 0.04).

4. DISCUSSION

4.1. Characteristics of study populations

A total of 270 subjects were enrolled in this study. Among them, the female population was 159 (58.9%). The mean

age of the enrolled population was 56.94 ± 10.09 years (range, 40–96 years). The mean BMI was 23.9 ± 2.89 kg/m^2. 62.2% of the subjects were hypertension; 66.7% were hyperlipidemia; 20.7% were diabetes; 13.7% of the subjects were smokers.

Cho S studied 2,044 peoples, female 60.4%. Mean age 67.3 ± 9.1. BMI 24.4 ± 3.1 kg/m2. [6]. Jagt VL studied 6,901 people, Mean age 60.1±10.3; smoking 30.5%, diabetes16.4% [10].

The age and gender in this study are similar to the results of Korhonen PE (Mean age 58.0 ± 7.0, female 53%) [9]; Maggi DL (Mean age 60.6 ± 12.5, female 57.4%) [5]; Le Tu Phuong Thuy (Mean age 58.2 ± 9.6, female (66.7%) [8]

4.2. Prevalence of PAD

Our research showed Prevalence of PAD (ABI ≤ 0.9) was 5.6%, ratio of borderline PAD (ABI 0.91-0.99) was 23.3%. As the population ages, PAD is likely to become an increasing issue. In earlier epidemiological studies carried out in Western countries on adult populations, which used same diagnostic criteria, the prevalence of PAD was about 4.5%. Quach Huu Trung studied 3,133 people through screening, age 55.7 ± 7.6 (21-90), ABI ≤ 0,9 was 2.6% [12]. Research by Cho S, Prevalence of PAD was là 4.6% [6], by Jagt VL was 8.65% [10], by Urbano L was 4.4% [3], by Le Tu Phuong Thuy was 9.7% [8], similar to our research result.

Table 6. The rate of PAD in our study and other studies

Authors	Place / study Year	n	ABI ≤ 0.90 (%)
Gupta DK [2]	United States, 2014	13,150	3.9
Padron AMA [11]	Urban, 2022	243	6.58
Beidelman ET [13]	South Africa, 2023	1,883	6.6
Adams OP [14]	Eastern Caribbean, 2024	2,772	4.4
Our study	Binh Duong, 2024	270	5.6

Our research shows that smoking rates are higher in people with PAD than in people without PAD (33.3% vs 12.5%, p=0.02). Similar to the study of Cho S, smoking rates are higher in people with PAD (47.4% vs 32.9%, p=0.003). Tobacco accumulation is associated with a higher risk of PAD and has been demonstrated in previous studies [6].

In the elderly population, PAD has a higher rate, similar to previous studies [6]. The rate of PAD by age group in this study is shown in Table 3, the rate of PAD increases with age: 40-49 (1.4%); 50-59 (5.0%); 60-69 (6.0%); age ≥70 (15.2%). Borderline PAD also increases with age: 40-49 (20.3%); 50-59 (22.8%); 60-69 (25.4%); age ≥70 (27.3%), statistically significant difference between age groups (p=0.026). Urbano L also noted that the rate of PAD increases with age: 40-49 (0.5%); 50-59 (1.0%); 60-69 (2.9%); age ≥70 (13.8%), p=0.001 [3]. Beidelman ET also noted that the rate of PAD increases with age: 40-49 (3.72%); 50-59 (7.17%); 60-69 (9.26%) [13]. According to Cho S, PAD is most common in people ≥ 80 years old (9.0%) [6].

In this study, we also recorded the rate of PAD (ABI ≤ 0.90) in patients who smoked at 13.5%; in patients with newly acquired diabetes are 10.7%; in patients with BMI ≥ 23 kg/m^2 are 5.1%; in patients with Hyperlipidemia are 7.8%; in patients

with hypertension are 8.3%, statistically significant higher than patients without these risk factors (p<0.05). Research results of Urbano L, the rate of PAD (ABI ≤ 0.90) in patients who smoked at 6.3%; in patients with diabetes are 23.0%; in patients with obesity are 7.4%; in patients with hyperlipidemia are 10.4%; in patients with hypertension are 10.4%, statistically significant higher than patients without these risk factors (p=0.001) [4]. Beidelman ET studied 1,883 people, aged 40-69, 58.8% female, and also recorded a rate of PAD of 6.6%, This rate in people with diabetes is 9.38%, people with hyperlipidemia are 7.08%, people with hypertension are 7.69% [13].

4.3. Risk factors for PAD

In this study, we also recorded the average age of the PAD group was higher than the group without PAD (66.07±13.73 vs 56.4 ± 9.61, p = 0.000); Compared with the group without PAD, the PAD group had a higher rate of smoking (33.3% vs 12.5%, p=0.02), rate of hypertension (93.3% vs 60.4%, p=0.01), rate of hyperlipidemia (93.3% vs 65.1%, p=0.02), rate of newly acquired diabetes is higher (40.0% vs 19.6%, p=0.05), The average number of risk factors is higher (5.93±1.03 vs 5.21 ±1.68, p=0.10); Cho S also noted that the group with PAD had a statistically significant higher rate of risk factors than the group without PAD, such as age (69.4 vs. 67.2, P = 0.025), diabetes (p < 0.005), hypertension (p < 0.001), hyperlipidemia (p < 0.01), smoking (p < 0.001) [6].

Maggi DL cross-sectional study of 115 patients with at least one cardiovascular risk factor, average age 60.6 ± 12.5, ABI rate ≤ 0.90 was 32.2%; the author noted the frequency of risk factors associated with an ABI index ≤ 0.90 including hypertension, family history, smoking, and diabetes [5].

Gupta DK investigated the relationship between ABI index and risk of heart failure, studied 13,150 patients without heart failure, followed for an average of 17.7 years, 1,809 patients with heart failure. The author noted that compared to the normal ABI group (1.00 <ABI ≤1.4), the group of patients with ABI ≤0.90 had a higher rate of risk factors such as hypertension (44.4% vs. 31.1%, p<0.0001); Diabetes (14.4% vs 10.2%, p=0.025); obesity (27.7% vs 25.2%, p=0.0001); smoking (65.5% vs. 57.7%, p=0.02) [2]. Author Urbano L noted that the risk factors for PAD are diabetes (p<0.001), hypertension (p<0.001), and hyperlipidemia (p<0.001) [4].

Logistic regression analysis, we noted that the risk factors for predicting PAD were statistically significant with univariate analysis, age ≥ 70 (OR, 3.77; 95% CI, 1.84–7.72; P = 0.001), hypertension (OR, 1.54; 95% CI, 1.30–1.82; P = 0.01), hyperlipidemia (OR, 1.43; 95% CI, 1.21–1.68; P = 0.02), smoking (OR, 2.65; 95% CI, 1.21 – 5.82; p=0.02), diabetes (OR, 2.04; 95% CI, 1.04 – 3.97; p=0.05). Multivariable regression analysis, age ≥ 70 (OR, 0.26; 95% CI, 0.08–0.82; P = 0.04), hypertension (OR, 0.14; 95% CI, 0.01–1.19; P = 0.02), hyperlipidemia (OR, 0.20; 95% CI, 0.02–1.86; p=0.04) are risk factors that predict PAD.

Urbano L studied 10,000 people in the population in Columbia to screen for PAD, the rate of PAD was 4.4%, the author noted that factors that increase the risk of PAD are smoking (OR 2.0; 95% CI 1.3-2.5); hypertension (OR 12.7, 95% CI

9.68-16.87); obesity (OR 2.0; 95% CI 1.63-2.55); hyperlipidemia (OR 5.2, 95% CI 4.28-6.36) with univariate analysis; and smoking (OR 1.6; 95% CI 1.26-1.94); hypertension (OR 4.6, 95% CI 3.42-6.2); obesity (OR 1.8; 95% CI 1.37-2.3); hyperlipidemia (OR 3.1, 95% CI 2.5-3.88) with multivariate analysis [4].

On univariate analysis, author Cho S showed age (OR 1.02; 95% CI, 1.00–1.05; P =0.025), hypertension (OR 2.14; 95% CI, 1.41–3.24; P <0.001), diabetes (OR 2.11; 95% CI, 1.25–3.57; P = 0.005), hyperlipidemia (OR 1.76; 95% CI, 1.13–2.76, P = 0.01), and smoking (OR 1.83; 95% CI, 1.21–2.78; P = 0.004) were significant risk factors for PAD. Multivariate analysis, age (OR, 1.95; 95% CI, 0.52–7.33; P = 0.045), hypertension (OR, 1.64; 95% CI, 0.99–2.71; P = 0.05) were significant risk factors for PAD [6].

Indeed, PAD increases the risk of cardiovascular events which has been proven in many studies. Research by Natsuaki C, compared to the normal ABI group, PAD (ABI ≤0.90) had a higher mortality rate (34.4% vs 13.5%, P < 0.0001). Multivariate analysis, the risk factor for mortality of PAD (HR: 2.16; 95% CI, 1.46 –3.14; P = 0.0002) was significantly higher than that of normal ABI [3]. Padron AMA/2022 followed 243 people with hypertension, patients with PAD had higher rates of hospitalization (62.5% vs 24.7%, p=0.002) and death (25% vs 2.2%, p<0.001) than patients without PAD [11]

5. CONCLUSION

The prevalence for asymptomatic PAD from 270 persons of general health screening was 5.6%, the prevalence of borderline PAD was 23.3%. Old age, hypertension and hyperlipidemia were significant risk factors for PAD (ABI ≤ 0.90).

ABI measurement should be routinely performed as a screening test in patients with cardiovascular risk factor for CVD prevention. This could lead to an early intervention and follow-up on populations at risk (Old age, hypertension, hyperlipidemia, smoking, diabetes), thus, contributing to improve strategies for reducing CVD burden.

REFERENCES

1. Abuhalimeh BJ, Christopher Jennings Regan (2024), “Peripheral Artery Disease: Implications For Health and Quality of Life”, https://www.acc.org/Latest-in-Cardiology/Articles/2024/10/22/17/25
2. Gupta DK, Hicham Skali, Brian Claggett (2014), “Heart Failure Risk Across the Spectrum of Ankle-Brachial Index. The ARIC Study (Atherosclerosis Risk In Communities), JACC: HEART FAILURE VOL. 2, NO. 5, pp.447 – 454.
3. Natsuaki C, Inoguchi T et al (2014), “Association of borderline ankle-brachial index with mortality and the incidence of peripheral artery disease in diabetic patients”, Atherosclerosis 234 (2), pp. 360-365.
4. Urbano L, Eliana Portillaa, Wilson Munoz (2018), “Prevalence and risk factors associated with peripheral arterial disease in an adult population from Colombia”, Arch Cardiol Mex 88 (2), pp. 107-115.
5. Maggi DL (2014), “Ankle-brachial index: nurses strategy to cardiovascular disease risk factors identification”, Rev Esc Enferm USP; 48(2), pp. 221-225
6. Cho S, Seung Hwan Lee, Jin Hyun Joh (2019), “Risk factors for

asymptomatic peripheral arterial diseasein Korean population: lessons from a community-based screening"Annals of Surgical Treatment and Research 97(4), pp.210-216.

7. Ho Thi Kim Ngan, Nguyen Đinh Linh, Tran Duc Hung (2022), "Nghiên cứu mối liên quan giữa độ cứng động mạch bằng phương pháp đo vận tốc lan truyền sóng mạch với các yếu tố nguy cơ ở bệnh nhân bệnh tim thiếu máu cục bộ mạn tính", tạp chí Y học Việt nam, tập 511, số 1, tr. 123- 126.
8. Le Tu Phuong Thuy, Le Thuong Vu, Pham Nguyen Vinh (2018), "Khảo sát các mối tương quan giữa nồng độ acid uric và tổn thương cơ quan đích trên bệnh nhân tăng huyết áp nguyên phát", Y Học TP. Hồ Chí Minh, Phụ Bản Tập 22 (1).
9. Korhonen P, Kautiainen H and Aarnios P (2014), "Pulse pressure and subclinical peripheral artery disease", Journal of Human Hypertension 28, p.242–245.
10. Jagt VL, Hazenberg CEVB, Kapelle J, et al (2022), "Screen-detected abnormal ankle brachial index: A risk indicator for future cardiovascular morbidity and mortality in patients with manifest cardiovascular disease. PLoS ONE 17(3):e0265050. ttps://doi.org/10.1371/journal.pone.0265050
11. Padron AMA, Sosvilla MS, Bello SR et al (2022), "Abnormal ankle-brachial index, cardiovascular risk factors and healthy lifestyle factors in hypertensive patients: prospective cohort study from a primary care urban population", *BMC Primary Care*, pp. 223-232.
12. Quach Huu Trung, Pham Tuan Duong (2016), "Nghiên cứu độ cứng động mạch qua sàng lọc 3133 trường hợp", https://www.demacvn.com.
13. Beidelman ET, Molly Rosenberg et al (2023), "Prevalence of and risk factors for peripheral artery disease in rural South Africa: A cross sectional analysis of the HAALSI cohort", JAHA 13 (1); doi: https://doi.org/10.1101/2023.07.18.23292814; this version posted July 24, 2023.
14. Adams OP , Deron Galusha , Josefa L Martinez-Brockman , Euclid H Morris at al (2024), "Peripheral Arterial Disease prevalence and risk factors in the Eastern Caribbean Health Outcomes Research Network (ECHORN) cohort", PLoS One. 2024 Aug 26;19 (8):e0306918. doi: 10.1371/journal.pone.0306918.