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ORIGINAL ARTICLE

# Ankle-brachial index: nurses strategy to cardiovascular disease risk factors identification

## ÍNDICE TORNOZELO-BRAQUIAL: ESTRATÉGIA DE ENFERMEIRAS NA IDENTIFICAÇÃO DOS FATORES DE RISCO PARA DOENÇA CARDIOVASCULAR

## INDICE TOBILLO-BRAZO: ESTRATEGIA DE ENFERMERAS EN LA IDENTIFICACIÓN DE LOS FACTORES DE RIESGO DE ENFERMEDAD CARDIOVASCULAR

**Daniela Luisa Maggi[1], Leyla Regina Dal Piva de Quadros[2], Karina de Oliveira Azzolin[3], Silvia Goldmeier[4]**

**ABSTRACT**

Elevated risk of fatal and non-fatal cardiovascular events is associated with high prevalence of peripheral arterial disease, with assessment through the ankle-brachial index (ABI). This study aimed to demonstrate that the ABI and the Edinburgh Claudication Questionnaire are tools to be used by nurses in prevention and/or treatment of CVD (cardiovascular disease). A cross-sectional study was carried out with patients from a cardiovascular clinic. The Edinburgh Claudication Questionnaire was applied and the ABI was measured with the formula (ABI= Blood Pressure Ankle/ Blood Pressure Brachial). A total of 115 patients were included, most were females (57.4%), aged 60.6 ± 12.5 years. The most prevalent risk factors were hypertension (64.3%), physical inactivity (48.7%) and family history (58.3%). The study showed that abnormal ABI was frequently found and 42.6% of the patients with abnormal ABI showed intermittent claudication. The method to evaluate the ABI associated to the Edinburg Claudication Questionnaire, can be easily used by nurses in the clinical evaluation of asymptomatic and symptomatic CVD patients.

**DESCRIPTORS**

Peripheral arterial disease
Ankle brachial index
Intermittent claudication
Risk factors
Nursing care

**RESUMO**

O risco elevado de eventos cardiovasculares fatais e não fatais está associado à alta prevalência da doença arterial obstrutiva periférica, avaliada por meio do índice tornozelo-braquial (ITB). Objetivou-se demonstrar que o ITB e o Questionário de Claudicação de Edimburgo são ferramentas que podem ser utilizadas pelos enfermeiros na prevenção e no tratamento da doença cardiovascular (DCV). Realizou-se estudo transversal em pacientes de uma clínica cardiovascular. Aplicou-se o Questionário de Claudicação de Edimburgo e verificou-se a medida do ITB (PAS tornozelo/PAS braquial). Foram incluídos 115 pacientes, a maioria do sexo feminino (57,4%), com idade média de 60,6 ± 12,5 anos. Os fatores de risco mais prevalentes foram hipertensão arterial sistêmica (64,3%), sedentarismo (48,7%) e história familiar (58,3%). O ITB alterado foi um achado frequente e 42,6% dos pacientes com ITB anormal apresentaram claudicação intermitente. O método de avaliação do ITB, associado ao Questionário de Claudicação de Edimburgo, pode ser facilmente utilizado pelos enfermeiros para avaliação clínica de pacientes e prevenção de eventos cardiovasculares.

**DESCRITORES**

Doença arterial periférica
Índice tornozelo-braço
Claudicação intermitente
Fatores de risco
Cuidados de enfermagem

**RESUMEN**

El riesgo elevado de eventos cardiovasculares fatales y no fatales está asociado con la alta prevalencia de enfermedad arterial periférica, cuya evaluación puede realizarse por medio del índice tobillo-brazo (ITB). El objetivo de este estudio fue demostrar que el ITB y el Cuestionario de Claudicación de Edimburgo son herramientas que pueden ser utilizadas por las enfermeras en la prevención y tratamiento de enfermedades cardiovasculares (ECV). Se realizó un estudio transversal en pacientes de una clínica cardiovascular, aplicándose el Cuestionario de Claudicación de Edimburgo y realizándose la medición de cálculo del ITB (PAS tobillo/ PAS braquial). Fueron incluidos 115 pacientes, la mayoría de sexo femenino (57,4%) con una edad media de 60,6 años ± 12,5 años. Los factores de riesgo más frecuentes fueron: la hipertensión arterial (64,3%), el sedentarismo (48,7%) y los antecedentes familiares (58,3%). El estudio demostró que el ITB alterado fue un hallazgo frecuente y el 42,6% con ITB anormal mostró claudicación intermitente. El método de evaluación del ITB asociado con el Cuestionario de Claudicación de Edimburgo, puede ser utilizado fácilmente por los enfermeros para la evaluación clínica de los pacientes sintomáticos y asintomáticos de ECV y para la prevención de eventos cardiovasculares.

**DESCRIPTORES**

Enfermedad arterial periférica
Índice tobillo braquial
Claudicación intermitente
Factores de riesgo
Atención de enfermería

[1] Nurse, Specialist in Cardiology at the Nursing Postgraduate Program, Institute of Cardiology, Fundação Universitária de Cardiologia, Porto Alegre, RS, Brazil. [2] Nurse, Specialist in Cardiology at the Nursing Postgraduate Program, Institute of Cardiology, Fundação Universitária de Cardiologia, Porto Alegre, RS, Brazil. [3] Adjunct Professor, Department of Medical-Surgical Nursing, School of Nursing, Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil. [4] Professor of the Postgraduate Program, Institute of Cardiology, Fundação Universitária de Cardiologia, Porto Alegre, RS, Brazil. pesquisa.sgold@gmail.com

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## INTRODUCTION

Aging causes changes in the walls of blood vessels, affecting the transport of oxygen and nutrients to the tissues. These changes make vessels stiffen, resulting in increased peripheral resistance [1].

Effective diagnostic measures of early intervention are needed to minimize the increase in cardiovascular morbidity and mortality[2]. A measure of great significance to evaluate the cardiovascular deficit is the Ankle-Brachial Index (ABI), an important marker of Peripheral Artery Disease (PAD) in its asymptomatic phase. Patients with PAD are five to seven times more likely to suffer acute myocardial infarction (AMI) and cerebrovascular accident (CVA), compared to a person who does not suffer from cardiovascular disease (CVD)[3].

Measures of ABI between 0.90 and 1.30 are considered normal, and values above 1.30 or below 0.90 are strong predictors of atherosclerotic vascular disease due to calcification of the middle layer and therefore rigidity of vascular walls[4]. The values of ABI and symptoms worsen with advancing age, as shown by a cohort study carried out in Rio de Janeiro, in which among 248 individuals (of the 407 surveyed with PAD), 89.9% had ABI below 0. 90[5].

The risk factors for PAD are similar to CVD and include smoking, physical inactivity, diabetes mellitus, systemic arterial hypertension (SAH), obesity, advanced age and dyslipidemia[6]. To assist in the early detection of PAD and hence CVD was created an assessment tool called The Edinburgh Claudication Questionnaire[7], which aids in the differential diagnosis of peripheral vascular disease. The instrument investigates episodes of claudication, which are characterized by intense pain in areas with arterial blockage - usually the calf, thigh or buttock - because of ambulation[8].

In order to monitor changes in the ABI and of intermittent claudication (IC) in a general population over time, a study was carried out with 1,592 individuals followed for 12 years in the city of Edinburgh, Scotland. Among them, 695 had worsening of the ABI and IC. In addition to this worsening, another 179 new cases had IC. Subjects with abnormal ABI values in the beginning of the study were twice more likely to have fatal risks than those with normal ABI[9].

The recognition of PAD as a sensitive marker of systemic atherosclerosis and the increased risk of fatal and nonfatal cardiovascular events become decisive factors for the use of the ABI and the Edinburgh Claudication Questionnaire in clinical practice. Its results indicate the need to program changes in habits, adopting secondary prevention measures because of the high cardiovascular risk[10].

This study aimed to demonstrate that the ABI and the Edinburgh Claudication Questionnaire are tools that can be used by nurses in the prevention of CVD.

## METHOD

This is a cross-sectional study that was carried out between January and September/2012, in a clinic specialized in cardiovascular examinations. Adults aged ≥18 years with at least one risk factor for CVD, in use of medication or not, with or without claudication were included. The following patients were excluded: Two with cognitive impairment, three with amputation of lower limb (LL) or upper limb (UL), two obese that required appropriate cuffs and one in which there was contraindication of BP measurement at the ankles by the presence of painful inflammation and phlebitis.

The study variables were related to the sociodemographic profile, the score of the Edinburgh Claudication Questionnaire, the ABI and risk factors for CVD such as hypertension, sedentary lifestyle, smoking and diabetes mellitus.

The Edinburgh Claudication Questionnaire has been culturally adapted into Brazilian Portuguese and validated through analysis of sensitivity and specificity for IC[7]. It contains six questions about discomfort, intensity, onset and location of pain in the lower limbs. The responses offer positive and negative options or another option, characterizing the presence or absence of claudication.

The study was approved by the local Ethics Research Committee under no. CEP/IC-FUC UP 4703/12. All the study participants signed an Informed Consent Form (ICF).

### *Logistics of the study*

After the participants accepted to participate in the study and signed the informed consent form, the clinic nurses applied a sociodemographic questionnaire and the Edinburgh Claudication Questionnaire in a private room. The average time to answer the questions was 15 minutes.

In a second step, for the analysis of ABI, patients remained seated or in orthostatic position, and the circumference of the arm was measured to determine the optimal cuff. Then they were placed in supine position to start pressure measurements. The brachial artery was located and the cuff was adjusted on the brachial pulse. The measures of the left and right brachial arteries were measured according to the VI Brazilian Guidelines on hypertension[11]. The highest measurement of the pressure obtained by the method was used to calculate the ABI. The sound related to blood flow velocity was detected with the aid of a Doppler. The dorsalis pedis and tibial pulses were located in the ankle, and the pressure of blood and of both lower limbs were measured according to the standards recommended by the VI Brazilian Guidelines on hypertension.

The measurements of ABI were made by the nurses in accordance with the recommended protocol[5,12]. The portable Vascular Doppler (*DV 610 Med Mega*) and the premium aneroid sphygmomanometer were used. Patients were kept at rest in the supine position and the systolic blood pressure (SBP) was measured in all four limbs; the right and

left pedis arteries of the lower limbs, and the right and left brachial arteries of the upper limbs. The ABI was calculated based on the highest SBP recorded in the upper and lower limbs, whether right or left. The value was obtained by dividing the highest value of SBP obtained in each artery of the lower limbs by the highest SBP value obtained in the upper limbs, according to the formula: ABI= SBP Ankle/SBP Brachial[5]. The reference values were: abnormal ABI ≤ 0.90 and ≥1.30; normal ABI between 0.91 and 1.29[5].

### *Statistical analysis*

Data were entered in *Excel for Windows* and analyzed with the statistical software SPSS version 18.0. The categorical variables were expressed in percentage and absolute values; the continuous variables as mean ± standard deviation or median and interquartile range, in accordance with normal distribution or not. The Chi-squared test was used to analyze the association between the variables. For the sample size calculation it was considered the significance level of 5% and power of 80%. The association between claudication and ABI was based on a study by Torres et al.[12], in which the percentage difference of claudication between patients with normal and abnormal ABI was 27.3% in a sample of 72 patients.

## RESULTS

A total of 115 patients were evaluated, among which 57.4% were females, with mean age of 60.6 ± 12.5 years. In the assessment of risk factors, hypertension (64.3%), sedentary lifestyle (48.7%) and family history (58.3%) stand out. An abnormal ABI was found (≤ 0.90 and ≥ 1.3) in 42.6% of the sample (Table 1).

Table 2 shows the association of risk factors for CVD and abnormal ABI. A sedentary lifestyle was significantly associated with abnormal ABI values (p=0.05). Other cardiovascular risk factors showed no association with abnormal ABI values.

**Table 1** - Clinical and sociodemographic characteristics of the sample - Porto Alegre, RS, 2012

| Characteristics | n(%) |
|---|---|
| **Gender** | |
| Female | 66 (57.4) |
| **Age *** | 60.6 ±12.5 |
| **Risk factors** | |
| Systemic hypertension | 74 (64.3) |
| Family history | 67 (58.3) |
| Sedentary lifestyle | 56 (48.7) |
| Smoking | 25 (21.7) |
| Diabetes Mellitus | 6 (5.2) |
| **ABI** | |
| < 0.90 | 37 (32.2) |
| ≥0.90 - 1.3 | 66 (57.4) |
| >1.3 | 12 (10.4) |

*Variables described as mean ± standard deviation. ABI=ankle-brachial index .Note: (N=115).

**Table 2** - Prevalence of risk factors for CVD associated with ABI measurement - Porto Alegre, RS, 2012

| Risk Factors | Total n=115(%) | Abnormal ABI n(%) | P value |
|---|---|---|---|
| Systemic hypertension | 74(64.3) | 33(67.3) | 0.56 |
| Diabetes mellitus | 6(5.2) | 4(8.2) | 0.22 |
| Smoking | 25(21.7) | 14(28.6) | 0.12 |
| Sedentary lifestyle | 56(48.7) | 29(59.2) | 0.05 |
| Family history | 67(58.3) | 29(59.2) | 0.94 |
| Cholesterol | 41(35.7) | 21(42.9) | 0.16 |

The data presented in Figure 1 show the percentage of claudication among patients according to ABI measurement. Among those with ABI>1.3 the percentage in the sample was 75% (p=0.001).

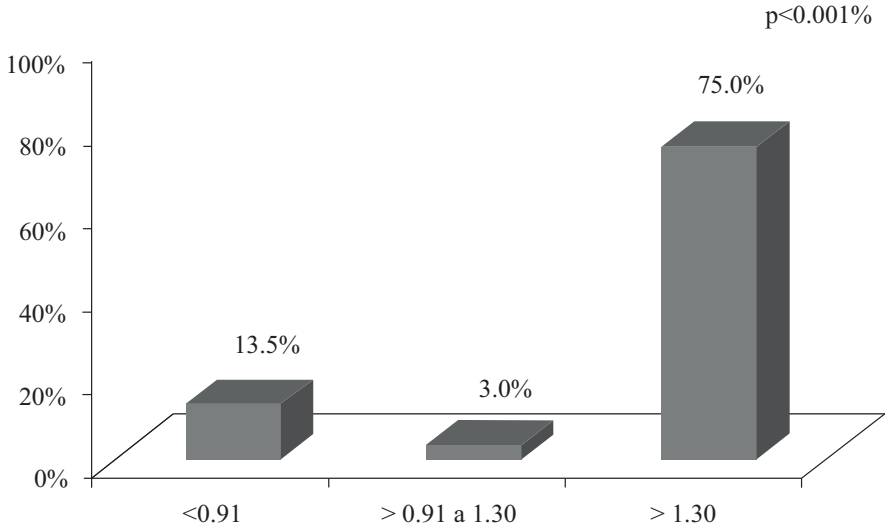


**Figure 1** - Percentage of claudication associated with ABI measurements - Porto Alegre, RS, 2012

## DISCUSSION

This study demonstrated that the ABI and the Edinburgh Claudication Questionnaire are tools that provide important information on the risk for CVD, assisting in the early detection of asymptomatic cases. Moreover, they are instruments easy to use during clinical evaluation.

Currently, there are diagnostic measures of early intervention that are effective in preventing cardiovascular morbidity and mortality. The ABI is one of them, which is used in the early detection of PAD and hence, CVD[11,13]. New technologies have emerged in recent years and a range of new drugs and effective procedures for the treatment of atherosclerotic diseases have been developed. The preventive care is encouraged by acting in the control of risk factors, since the numerous complications of CVD have a major impact on the health of individuals and also generate significant public cost increases[6].

The Edinburgh Claudication Questionnaire assisted in the detection of peripheral artery disease. It guided the definition of the presence or absence of IC in patients, along with clinical assessment. The IC can be a manifestation of PAD, characterized by pain, burning and stinging in the calf region and buttocks after physical activity[14]. Among patients with claudication, in 28.6% (p= 0.001) the ABI was abnormal. Thus, the ABI showed to be valuable for detecting abnormality in both symptomatic as in asymptomatic individuals[15]. Foremost, it proved to be an important strategy to help tracking the patients with CI, which was confirmed through the questionnaire applied by nurses[14].

In this investigation, the results are similar to those of other studies that indicate a relationship of ABI with PAD and greater frequency in females[11-12,14-15]. A study with 407 patients, which aimed at detecting the prevalence of asymptomatic and symptomatic peripheral artery disease through the ABI<0.90 with PAD and between 0.90 – 1.3 without PAD, associated with risk factors, also showed a predominance of females (54%) and older age (70.1±10.2 years)[5].

Another important aspect was the presence of a sedentary lifestyle in 59.2% of patients with abnormal ABI (p= 0.05). In an observational study on the presence of risk factors in the general population, physical inactivity appeared at the top of the most significant risk factors[15]. This reinforces the importance of encouraging physical activity at all ages and organizing activities of greater impact for this population.

Smoking was also present in the sample, however, with no statistical significance in relation to abnormal ITB. A study that also used the ABI and investigated its relation with coronary artery disease in 107 individuals, with the aim of analyzing the presence of PAD in patients undergoing cardiac catheterization, showed a 64% prevalence of smoking in patients with abnormal ABI. Therefore, it confirmed that smoking is an important predictor for PAD[15]. The presence of elevated total cholesterol, even when associated with ABI, did not show statistical significance, in spite of atheromatosis being related to aging[16]. The average age of the sample was 60.6 ± 12.5 years, with the use of hypolipidemic without compromising peripheral circulation.

The ABI is also associated with hypertension since patients with ABI <0.90 are 52% more likely to develop hypertension. This fact shows the importance of the care to hypertensive individuals, avoiding aggravations that may result in the development of arterial disease in a shorter time[6]. However, in this study, no statistically significant difference was found when hypertension was analyzed separately and compared with abnormal ABI.

The alteration of ABI values and the presence of CVD risk factors in the vascular clinic proved the existence of a relation between symptomatic and asymptomatic patients. However, when analyzing the prevalence of abnormal ABI values in Figure 1, it was found that the value>1.3 was significant (p=0.001) when compared to other values.

In a cohort of *The Strong Heart Study* (SHS), the authors followed for 10 years (1989-1999) a population of 4,549 patients to verify whether there were differences among all the causes of mortality from CVD in the group with normal ABI values (≥ 0.9 – 1.3) and abnormal (< 0.9 or > 1.3). Abnormal ABI values were present in older patients, diabetics, hypertensive, with elevated cholesterol and microalbuminuria, plus a percentage 3-5 times higher in those with death from CVD[17].

A limitation of this study was the high age of the sample. Vascular greater impairment in this age group should be considered, since the patients who had claudication also had altered ABI.

## CONCLUSION

This study demonstrated that the ABI associated with the result of the Edinburgh Claudication Questionnaire is correlated with the risk factors investigated, which qualifies it as a very important tool for clinical practice. Information regarding subclinical atherosclerotic disease, predictors of cardiovascular events, should be considered for use. It is a noninvasive method, easy to use by nurses, which should be encouraged given its low cost and potential for prevention of cardiovascular events.

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**Correspondence addressed to:** Silvia Goldmeier
Av. Princesa Isabel, 370, 3º andar - Santana
CEP 90620-000 - Porto Alegre, RS, Brazil