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Original Article

Association between lifestyles, anthropometric measurements and peripheral arterial disease in public sector health workers

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Abstract: *Introduction*: Peripheral arterial disease (PAD) occurs when there is a narrowing of the blood vessels outside the heart; this disease is concentrated in low and middle income countries such as Peru. *Objectives*: To determine the association between lifestyles, anthropometric measurements and PAD in health workers at the Hospital de Huaycan, 2020. *Methods*: Cross-sectional analytical study that recruited health workers of both sexes, who had no history of cardiovascular disease, type 2 diabetes mellitus nor were pregnant. Lifestyle was measured through a questionnaire and PAD through the ankle-brachial index <0.90 in any leg. *Results*: In total 184 health workers, 53 men and 131 women with an average age of 46.0 ± 10.0 years were analyzed. The prevalence of PAD was 31% in the total sample. Both the bivariate and multivariate analyses showed that an inadequate lifestyle (PRa = 1.62; 95% CI: 1.08-2.44), high waist-hip ratio (PRa = 1.90; 95% CI: 1.19-3.03) and increased body fat (PRa = 1.03; 95% CI: 1.00-1.07) present an independent and statistically significant association with PAD. *Conclusion*: There is an association between lifestyles, waist-hip ratio, and body fat percentage with PAD in health workers.

Keywords: Lifestyle, body weights and measures, peripheral arterial disease, health workers

Introduction

Peripheral arterial disease (PAD) or peripheral vascular disease (PVD) is defined as narrowing and partial or complete obstruction of the antegrade flow of ≥1 main systemic arteries other than the cerebral and coronary arteries [1, 2]. It often coexists with cardio-respiratory diseases, stroke, and diabetes and is a strong predictor of myocardial infarction (MI), stroke, and death from vascular causes [3]. Smoking, diabetes, dyslipidemias and hypertension are considered its main risk factors as well as various metabolic and inflammatory variables [4]. Nevertheless, ethnic origin, infections and poverty could influence the global disparities of this disease [5]. The World Health Organization (WHO) analysis at the regional level suggests that the highest number of cases (70%) of PAD is concentrated in low- and middle-income countries, mainly in the regions of Southeast Asia and the Western Pacific [5]. In Peru, of all premature deaths that occur, around 15% are caused by cardiovascular diseases with a mortality rate of 143/100,000 inhabitants, which makes PAD a public health problem [6].

The incidence of PAD is estimated between 7% and 14% in the general population and increases with age to approximately 20% in those over 70 years of age, a value that would be higher if asymptomatic patients were analyzed [7]. In addition, it is likely that it will follow an increasing trend in the next two or three decades due to the aging of the population [8], therefore, understanding the current trends in the prevalence of PAD and its risk factors is essential to guide preventive strategies.

In order to detect PAD, the ankle-brachial index (ABI), the relationship between the systolic blood pressure (SBP) of the ankle and the arm, was standardized in 2012. This measure provides good sensitivity (> 80%) and excellent specificity (> 95%). An ABI of 0.9 or less is generally considered abnormal and suggests PAD [9]. The presence of PAD in patients with coronary heart disease raises the risk of death by 25%, which is why it is important to search for PAD even in asymptomatic patients, to control risk factors early and reduce mortality [10].

In patients with PAD, early diagnosis and prompt application of therapeutic measures are the cornerstone of treatment [11]. However, it has been shown that the practice of healthy lifestyles, a combination of little or no alcohol consumption, not smoking and a Mediterranean diet, could dramatically reduce the risk of PAD in populations with high cardiovascular risk [12, 13]. Sedentary older adults presented a higher incidence of PAD, which highlights the benefits of physical activity; moreover, walking more than 7 hours per week has been described as a protective factor [14]. Anthropometric data such as body mass index (BMI) $\leq$25 kg/m^2 is considered protective, while an increased waist-to-hip ratio greater than 0.9 doubles the prevalence of PAD [15].

Most studies on PAD have focused on older adults; however, it has been observed that it is increasingly common at younger ages [16, 17]. In addition, there is little information on this disease in health care workers, who due to their work characteristics could be at greater risk of developing PAD, since several studies have shown that a large proportion of these workers stated that they do not want to get involved in the practice of healthy lifestyle behaviors [18]. Since lifestyles are closely related to PAD, it is important to evaluate their association in this study population and to be able to implement measures for the timely detection and follow-up of the disease.

In this study, we investigated the association between lifestyles, anthropometric measures, and PAD in public sector health workers with no history of cardiovascular diseases (CVD) in the eastern region of Lima, Peru.

Material and methods

Design and participants

This cross-sectional analytical study was carried out in workers from the Hospital de Huaycan II-1, Lima, Peru. The study considered workers who participate annually in the program for the prevention and surveillance of communicable and non-communicable diseases led by the epidemiology department at the beginning of 2020, which includes 367 workers, 212 of whom are appointed and 155 under administrative service contracts. The study was approved by the Huaycan Hospital's Ethics Committee (Ethical Committee Nº 024-2019). Written informed consent was obtained from all recruited workers after they were fully informed about the study.

To estimate the sample sizes required for this study, we used the equation $n = NZ^2P(1-P)/d^2(N-1) + Z^2P(1-P)$, where N = 367, P = 0.20 and d = 0.05. The minimum sample size for our study was 148 participants. To estimate the possibility of participant drop out, we used the calculation of n + (n × 10%) = 163. Therefore, the minimum total number of participants needed for our study was 163. For the selection of study subjects, the workers who suffered from any cardiovascular disease, type 2 diabetes mellitus, were pregnant, did not fill out the questionnaire correctly, did not attend the agreed dates for the measurements and/or did not sign the informed consent were excluded. Only workers who attended the agreed dates for the measurements, those who had correctly filled out the questionnaire and those who signed the informed consent were included. The final sample was made up of 184 workers (**Figure 1**).

Questionnaire about lifestyle

For data collection, the Healthy Lifestyles questionnaire prepared by Salazar and Arrivillaga in Colombia in 2004 and adapted by Palomares in Peru in 2014 was used [19, 20]. The questionnaire is made up of 48 items distributed in 6 subscales: condition, physical activity and sport (4 items), recreation and free time management (6 items), consumption of alcohol, tobacco and other drugs (6 items), sleep (6 items), eating habits (18 items); self-care and medical care (8 items). The ratings for each item were on a Likert scale: Never = 0, Sometimes = 1, Often = 2 and Always = 3. The rating categories established for the lifestyles were calculated from the 75th percentile into adequate and inadequate.

Measurement of peripheral arterial disease

For peripheral arterial disease, the ABI was used, a non-invasive procedure that has shown

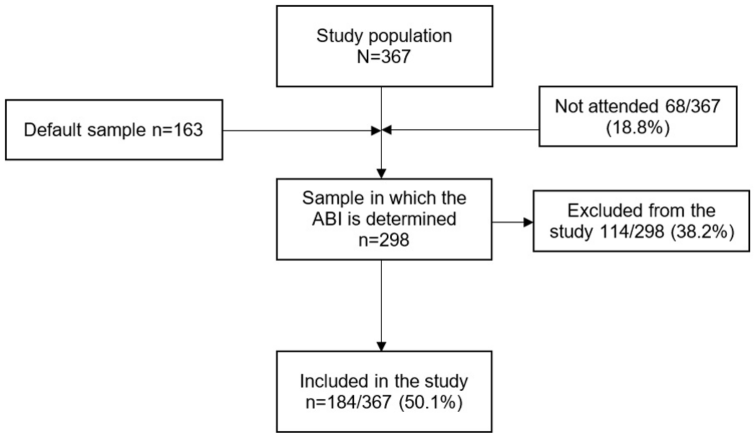

Figure 1. Selection of study participants. ABI: Ankle-brachial index.

high sensitivity and specificity. Following the recommendations of the European Society of Cardiology (ESC) Guide for the diagnosis and treatment of peripheral arterial disease, the participant was placed in a supine position, with the cuff placed just above the ankle [9]. After 5-10 min of rest, SBP was measured with a Doppler probe (8 MHz) on the posterior and anterior tibial arteries of each foot and on the brachial artery of each arm. Left and right ABI measurements were obtained by dividing the systolic occlusion pressure at the ankle by the highest pressure in the arm. Peripheral arterial disease was defined as an ABI <0.90 in either leg.

Anthropometric measures and other variables

The anthropometric measures considered in the study were: weight (kg) and height (cm) for the calculation of body mass index (BMI) and categorized as ≥30 Kg/m^2 or <30 Kg/m^2; waist circumference (cm) and hip circumference (cm) for waist-hip ratio then categorized as high (> 0.94 and > 0.85 for men and women respectively) or normal (≤0.94 and ≤0.85 for men and women respectively) and body fat percentage. Another variable considered was blood pressure (BP) categorized as high (≥130/≥90 mmHg of systolic/diastolic pressure) or normal (<130/<90 mmHg) and pulse pressure categorized as high (≥50 mmHg) or normal (<50 mmHg).

Statistical analysis

For data analysis the programming language R v3.6.2 was used. The categorical variables were described in absolute and relative frequencies. The numerical variables were described via mean and standard deviation. For the comparative analysis, the Mann Whitney U test or Chi-square was performed depending on variable type. To determine the association between lifestyles, anthropometric measures and PAD, the crude prevalence ratios (PRc) and adjusted prevalence ratios (PRa) with their respective 95% confidence intervals (95% CI) were determined through Poisson regression analysis with robust variance. The multivariable analysis considered the adjustment for age, sex, lifestyle, BMI, body fat percentage, waist-hip ratio, BP and PP. A P<0.05 was considered statistically significant.

Results

General characteristics of the population

We analyzed data from 184 health workers, 54 men (28.8%) and 131 women (71.2%) with an average age of 46 ± 10 years old. The highest proportion of health workers held care positions (71.2%) and had an adequate lifestyle (73.4%). The proportion of PAD in the total sample was 31% (n = 57) without statistical differences by sex. The majority of variables presented no significant differences by sex. However, BMI (28.2 ± 4.2) and body fat percentage (33.0 ± 6.5) were high in the total sample. The waist-hip ratio (0.89 ± 0.32) was elevated only in women (**Table 1**).

Socio-demographic and clinical characteristics by PAD status

The comparative analysis showed that 30.2% of the men and 31.3% of the women had PAD (**Table 1**). Furthermore, the variables waist circumference (91.9 vs 87.9 cm, P<0.05), waist-hip ratio (0.91 vs 0.88, P<0.05) and body fat percentage (34.7 vs 32.6%, P<0.05) showed significant differences in the groups with and without PAD. The group with PAD presented a high frequency of inadequate lifestyle compared to the group without PAD (P<0.05) (**Table 2**).

Table 1. General characteristics of the population of health workers by gender

Variables	Total (n = 184)	Men (n = 53)	Women (n = 131)	*p* value
Workers (%)				
Administrative	39 (21.2)	12 (22.6)	27 (20.6)	0.001
Healthcare	131 (71.2)	31 (58.5)	100 (76.3)	
General services	14 (7.6)	10 (18.9)	4 (3.1)	
Age (years)	46.0 ± 10.0	46.0 ± 9.2	46.0 ± 10.4	0.991
Weight (Kg)	67.7 ± 12.8	67.3 ± 11.9	67.9 ± 12.1	0.787
BMI (Kg/m^2)	28.2 ± 4.2	28.9 ± 4.3	27.8 ± 4.1	0.109
Waist circumference (cm)	89.2 ± 10.0	88.8 ± 8.9	89.3 ± 10.4	0.757
Hip circumference (cm)	99.9 ± 7.5	100.9 ± 7.8	99.4 ± 7.4	0.228
Waist-Hip ratio	0.89 ± 0.32	0.88 ± 0.07	0.90 ± 0.07	0.134
Body fat (%)	33.3 ± 6.5	34.2 ± 7.0	32.9 ± 6.2	0.221
SBP (mmHg)	105.6 ± 13.5	105.5 ± 12.2	105.7 ± 13.0	0.909
DBP (mmHg)	65.8 ± 11.0	67.2 ± 12.0	65.2 ± 11.6	0.276
PP (mmHg)	39.9 ± 8.8	38.3 ± 8.0	40.5 ± 8.0	0.123
PAD (%)				
Yes	57 (31.0)	16 (30.2)	41 (31.3)	1
No	127 (69.0)	37 (69.8)	90 (68.7)	
Lifestyle (%)				
Adequate	135 (73.4)	36 (67.9)	99 (75.6)	0.38
Inadequate	49 (26.6)	17 (32.1)	32 (24.4)	
Physical Activity (Score)	5.3 ± 2.1	5.8 ± 2.4	5.1 ± 3.0	0.045*
Recreation (Score)	10.5 ± 2.0	10.7 ± 2.1	10.4 ± 3.0	0.365
Harmful Habits (Score)[a]	14.7 ± 2.6	14.7 ± 2.9	14.7 ± 2.5	0.95
Sleep Quality (Score)	11.7 ± 1.6	11.6 ± 1.8	11.8 ± 1.6	0.54
Dietary Habits (Score)	33.0 ± 4.9	33.3 ± 5.5	32.9 ± 4.6	0.683
Self-care (Score)	13.7 ± 4.2	13.4 ± 4.3	13.8 ± 4.2	0.503

Data expressed as mean ± standard deviation or absolute frequency (relative frequency). BMI, Body mass index; SBP, Systolic blood pressure; DBP, Diastolic blood pressure; PP, Pulse pressure; PAD, peripheral artery disease. [a]Alcohol, tobacco and drugs, *Statistical significance (P<0.05).

Regression analysis of lifestyle, anthropometric characteristics and PAD

To determine the association between anthropometric parameters (body fat percentage, BMI, and waist-hip ratio), lifestyles, and PAD, the variables were dichotomized or analyzed as a continuous variable. The crude poisson regression model showed association between PAD and inadequate lifestyle (PRc = 1.73; 95% CI: 1.14-2.64), demonstrating that an inadequate lifestyle increases the probability of peripheral arterial disease by a factor of 1.73. Likewise, high waist-hip ratio (PRc = 1.95; 95% CI: 1.26-3.00) increases 1.95-fold the probability of PAD, while for each unit of body fat percentage (PRc = 1.04; 95% CI: 1.00-1.07) the probability of PAD increases by 4% (**Table 3**).

In the multivariable Poisson regression models, the association of inadequate lifestyle with PAD was maintained (PRa = 1.62; 95% CI: 1.08-2.44). Similarly, the anthropometric parameters of body fat percentage (PRa = 1.03; 95% CI: 1.00-1.07) and high waist-hip ratio (PRa = 1.90; 95% CI: 1.19-3.03) were associated with PAD (**Table 3**). These results show a strong independent association between these variables despite being adjusted for other confounding variables.

Discussion

In recent decades, mortality from cardiovascular diseases (CVD) have decreased in high-income countries, but have increased in low- and middle-income countries [21]. Peru is a developing country with a growing prevalence of non-communicable chronic diseases, among which cardiovascular disease and obesity stand out [22]. One of the reasons for this increase is the intense internal migration of the Peruvian population that occurred between the 1970s and 1990s (approximately 120,000 families) from rural highlands to urban coastal settlements due to political violence in the country [23]. Most of these people residing in these areas simultaneously experience political, economic, housing and ecological vulnerability, and within this environment there is unequal access to opportunities for healthy eating and lifestyles, which translates into exposure to an environment that directly impacts their risk for cardiovascular disease [21].

Table 2. Socio-demographic and clinical characteristics by PAD status

Variable	Total (n = 184)	PAD (n = 57)	No PAD (n = 127)	*p* value
Gender (%)				
Men	53 (28.8)	16 (28.1)	37 (29.1)	1
Women	131 (71.2)	41 (71.9)	90 (70.9)	
Age (years)	46.0 ± 10.0	46.9 ± 9.6	45.5 ± 10.2	0.384
Weight (Kg)	67.7 ± 12.8	69.2 ± 11.7	67.0 ± 12.2	0.281
BMI (Kg/m^2)	28.2 ± 4.2	28.8 ± 3.9	27.9 ± 4.2	0.184
Waist circunference (cm)	89.2 ± 10.0	91.9 ± 9.0	87.9 ± 10.2	0.012*
Hip circunference (cm)	99.9 ± 7.5	100.90 ± 7.25	99.42 ± 7.65	0.219
Waist-Hip ratio	0.89 ± 0.32	0.91 ± 0.07	0.88 ± 0.07	0.017*
Body fat (%)	33.3 ± 6.5	34.7 ± 6.0	32.6 ± 6.6	0.044*
SBP (mmHg)	105.6 ± 13.5	107.7 ± 14.1	104.7 ± 13.1	0.165
DBP (mmHg)	65.8 ± 11.0	67.5 ± 11.4	65.0 ± 11.8	0.145
PP (mmHg)	39.9 ± 8.8	40.2 ± 9.0	39.7 ± 8.8	0.757
Lifestyle (%)				
Adecuate	135 (73.4)	35 (61.4)	100 (78.7)	0.023*
Inadequate	49 (26.6)	22 (38.6)	27 (21.3)	
Physical activity (Score)	5.3 ± 2.1	5.4 ± 1.9	5.2 ± 2.2	0.45
Recreation (Score)	10.5 ± 2.0	10.5 ± 1.9	10.5 ± 2.1	0.988
Harmful habits (Score)[a]	14.7 ± 2.6	15.2 ± 2.6	14.5 ± 2.6	0.088
Sleep quality (Score)	11.7 ± 1.6	11.6 ± 1.5	11.8 ± 1.7	0.618
Dietary habits (Score)	33.0 ± 4.9	33.6 ± 4.1	32.8 ± 4.8	0.294
Self-care (Score)	13.7 ± 4.2	14.0 ± 4.6	13.6 ± 4.0	0.628

Data expressed as mean ± standard deviation or absolute frequency (relative frequency). BMI, Body mass index; SBP, Systolic blood pressure; DBP, Diastolic blood pressure; PP, Pulse pressure; PAD, peripheral artery disease. [a]Alcohol, tobacco and drugs, *Statistical significance (P<0.05).

Nowadays, considerable attention is being paid to the impact of CVD in the country; however, little attention has been paid to PAD as few epidemiological studies have been conducted. In our study, it was found that the prevalence of PAD was 31% in the sample of health workers, with no differences between genders (**Table 1**). Similarly, various epidemiological studies reveal that the prevalence of PAD varies between 29% and 13% in middle- and high-income countries respectively [5]. On the other hand, studies in the South American population show that the prevalence of PAD varies between 7 to 10%, which is due in part to the selection criteria (rural vs urban) and sample size of the studies carried out [24, 25]. For comparison, a study in the rural population of South Africa reported a 29% prevalence of PAD [26]. However, other studies in the Hispanic population residing in the US found that the prevalence of PAD was 5% [27]. All these changes in the prevalence of PAD suggest that it is subject to biological, socioeconomic and lifestyle determinants of the population [5, 28].

Lifestyles are a set of attitudes and practices adapted to the cultural environment of the communities, which can positively or negatively influence the health of the population [29]. The practice of healthy lifestyles has been shown to prevent and improve the condition of patients with PAD [30]. In our study, 26.6% of the health workers presented an inadequate lifestyle, with no differences between genders (**Table 1**). Several studies have explored the impact of inadequate lifestyles on PAD, such as how more than 13 h/d of sedentary time was associated with higher odds of PAD in a large cohort of Hispanic/Latinos in the United States [27] and a trend towards a protective effect of higher fish and shellfish consumption against incidents of symptomatic PAD was found among individuals with DM [31]. However, most of these studies focused mainly on the type of diet, physical activity and sleep [31-36], leaving aside the personal, environmental and social dimensions that make up a lifestyle, such as recreation, free time management and medical self-care [37, 38]. Our study addresses lifestyles, including all these dimensions, and it was found that an inappropriate lifestyle is associated with the development of PAD in health workers (**Tables 2** and **3**).

Additionally, obesity is an important component in the study of cardiovascular diseases and it plays a fundamental role in the development and control of PAD. This is evidenced in this study, in which the waist circumference,

Table 3. Poisson regression analysis of lifestyle, anthropometric characteristics and PAD

variables	Bivariate analysis			Multivariable analysis		
	PRc[a]	95% CI	*p* value	PRa[b]	95% CI	*p* value
Gender						
Female	1	(Reference)		1	(Reference)	
Male	0.96	(0.60-1.56)	0.884	0.98	(0.62-1.58)	0.954
Age						
<60 years old	1	(Reference)		1	(Reference)	
≥60 years old	1.54	(0.89-2.64)	0.119	1.10	(0.59-2.06)	0.754
Lifestyle						
Adequate	1	(Reference)		1	(Reference)	
Inadequate	1.73	(1.14-2.64)	0.011*	1.62	(1.08-2.44)	0.021*
Body fat %	1.04	(1.00-1.07)	0.035*	1.03	(1.00-1.07)	0.033*
Waist-Hip ratio						
Normal	1	(Reference)		1	(Reference)	
High	1.95	(1.26-3.00)	0.003*	1.90	(1.19-3.03)	0.007*
BMI						
<30 kg/m^2	1	(Reference)		1	(Reference)	
≥30 kg/m^2	1.49	(0.77-2.87)	0.232	0.92	(0.47-1.83)	0.819
PP						
<50 mmHg	1	(Reference)		1	(Reference)	
≥50 mmHg	1.24	(0.77-2.01)	0.368	1.14	(0.66-1.94)	0.640
BP						
<130/90 mmHg	1	(Reference)		1	(Reference)	
≥130/90 mmHg	1.00	(0.47-2.16)	0.980	0.71	(0.34-1.44)	0.342

PR, Prevalence ratio; 95% CI, 95% confidence interval; BMI, Body mass index; PP, Pulse pressure; BP, Blood pressure; [a]Crude PR by Poisson regression analysis with robust variance; [b]Adjusted PR by Poisson regression analysis with robust variance for all the variables included; *Statistical significance (P<0.05).

body fat percentage and the waist-hip ratio were significantly associated with PAD (**Table 2**). Additionally, in the bivariate and multivariate analysis, these central and visceral obesity indexes (the body fat percentage and the waist-hip ratio) are strongly associated with the increase in the prevalence of PAD (**Table 3**). Similar results were evidenced by Pischon et al, who found that both general adiposity and abdominal adiposity are associated with the risk of death [39]. Interestingly, in the clinical field for the evaluation of obesity, the use of the BMI value is preferred, due to its simple application and low cost, while few studies consider body fat percentage, waist circumference and the waist-hip ratio in addition to BMI [40].

There are several studies that indicate that due to the potentially problems with errors in the measurement of BMI that body fat percentage may have a greater value when studying obesity with the classification of cardiovascular diseases [41]. This is observed in a study in Nigeria, in which measures of central and visceral obesity were more related to the development of PAD than BMI, which is a measure of general obesity [42]. In the same sense, a study in patients from a hospital in South Korea showed that men with a lower percentage of fat had a lower cardiovascular risk and a study in Kosovo found a significant positive correlation between the waist-hip ratio and the presence of PAD [41, 43].

This study presented some limitations: first, the study was conducted with health workers from one hospital, therefore, the observations might not fully represent the population of health workers in general; second, although ankle-brachial index measurement has been shown to have high sensitivity and specificity and is widely used for screening for PAD, further evaluation by Doppler ultrasound would have been recommended for a more accurate diagnosis.

Despite these limitations, the results obtained highlight the importance of determining body fat percentage and the waist-hip ratio as factors associated with PAD. These observations are of relevance to clinicians since, based on our results, patients can be identified early at higher risk for PAD to receive more immediate intervention. Furthermore, as far as has been verified, this is the first study in Peru that investigates lifestyle and PAD in healthcare workers.

Conclusion

Finally, our results present scientific evidence on the need to refocus on healthy behaviors in healthcare workers. It may be useful to try to increase patient and physician awareness of the benefits of lifestyle recommendations and secondary prevention, as well as pay greater attention to healthy lifestyles to reduce the prevalence of PAD.

Disclosure of conflict of interest

None.

Abbreviations

PAD, Peripheral arterial disease; PVD, Peripheral vascular disease; MI, Myocardial infarction; CVD, Cardiovascular disease; WHO, World Health Organization; ABI, Ankle-brachial index; SBP, Systolic blood pressures; DBP, Diastolic blood pressure; BMI, Body mass index; PRc, Crude prevalence ratios; PRa, Adjusted prevalence ratios; PP, Pulse pressure.

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