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ARTYKUŁ ORYGINALNY / *ORIGINAL ARTICLE*

Cross-sectional study of the ankle–brachial index and cardiovascular risk factors in postmenopausal women

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Abstract

Background: The incidence of peripheral artery disease (PAD) and cardiovascular (CV) events in the female population has been on the increase.

Aim: To analyse the risk factors of a CV event and PAD in women and to assess the usefulness of the ankle–brachial index (ABI).

Methods: Evaluation of selected parameters in a cohort of 365 women living in the same district. The following data were prospectively recorded: weight, height, waist size, hip circumference, smoking, the intima–media complex, ABI value, and laboratory results. PAD symptoms, CV events and neurological events were noted. ABI was analysed assuming pathology for values: ≤ 0.9 or ≤ 1.0.

Results: Age, plasma glucose level, atrial fibrillation, and nicotine addiction were correlated independently with CV disease and stroke ($p < 0.001$). The high-density lipoprotein cholesterol level, height, and systolic blood pressure were correlated independently with ABI values ($p < 0.05$). There was no correlation between the occurrence of a CV event in the past and the ABI, irrespective of the cut-off point for the reference value (p = NS).

Conclusions: There is no evidence that stricter criteria for the assessment of ABI better represent the vascular status in the female population.

Key words: ankle–brachial index, peripheral artery disease in women, risk factors of cardiovascular events

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INTRODUCTION

Peripheral artery disease (PAD), developing mostly in the field of atherosclerosis, is one of the diseases of modern civilisation. It is generally believed that PAD concerns mainly men. In recent times, attention has been paid to the growing number of women in the population of people with PAD. However, the problem of PAD among women remains underestimated in everyday clinical practice. Current research data confirm that women are given worse medical care and are diagnosed at a more advanced stage of the disease. The referral to a vascular surgery specialist is also delayed in this group. The extent of this phenomenon may be partially explained by the fact that the symptoms in females are generally unspecific. The absence of typical intermittent claudication, and sometimes-asymptomatic course, additionally delay reaching the correct diagnosis [1, 2].

Peripheral artery disease symptoms have so far been regarded as a factor diminishing the quality of life of the patients. In the last decade, however, several studies were conducted showing that atherosclerosis of the lower extremities may be a diagnostic marker of the development of atherosclerosis in other locations. The presence of PAD involves a higher risk of the incidence of cardiovascular disease (CVD). The coexistence of PAD and coronary heart disease is currently estimated at 22–42% [3–6]. Patients with ischaemic heart disease and concomitant PAD are also characterised by higher mortality and worse outcome of treatment [7, 8]. The delay in correct diagnosis reduces the quality of medical

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care and increases the proportion of treatment failures in this group of patients.

The ankle-brachial index (ABI) has for many years been considered a valuable parameter allowing for the diagnosis of PAD. Moreover, it can be a marker of the severity of the risk of atherosclerosis and cardiovascular death. The Inter-Society Consensus for the Management of Peripheral Arterial Disease (TASC II) recommends a threshold value of ABI ≤ 0.9. The recommendations of the American College of Cardiology Foundation from 2011 classify patients in terms of ABI into the following groups: pathology (≤ 0.9), borderline (0.91–0.99), standard (1.0–1.4), and pathology — arteries not susceptible to pressure (> 1.4). These differences significantly hamper the interpretation of the results. None of these recommendations differentiate ABI depending on the sex of the patient [9, 10].

The present study attempts to respond to the current recommendations of the interpretation of the ABI. In addition, the incidence of CVD, the symptoms of PAD, and associated risk factors in a selected population of women were evaluated.

The aim of the study was: (1) Analysis of risk factors for cardiovascular incident, cardio-cerebral incident, and PAD incident in a selected population of women; (2) Evaluation of the usefulness of ABI depending on the threshold for the reference value in a selected population of women.

METHODS

The study was conducted among women aged 65–75 years residing in the municipality of Gniewkowo County (Kuyavian-Pomeranian Voivodeship, Poland) in April and May 2012. According to the City Hall and a database from three family medical practitioners in the municipality, there is a population of 612 women in this age group. Written invitations were sent to all those patients, and 365 (59.6%) women agreed to participate in the study. The study protocol consisted of a questionnaire completed during a face-to-face interview, physical examination, and blood sampling. The clinical assessment of study participants consisted of anthropometric measurements: body weight, height, waist and hip circumference, body mass index (BMI), and blood pressure measurements (average of the second and the third measurements according to ESH) [11]. Past medical history was taken, focused on the presence of nicotine addiction, CVD, diabetes, intermittent claudication, cerebrovascular events, and medications. It was noted whether the patient had had a myocardial infarction, stroke, transient ischaemic attack (TIA), percutaneous coronary intervention, coronary artery bypass graft (CABG), vascular surgery, peripheral vascular angioplasty, or amputation. The ABI for both lower limbs was measured according to TASC II [10]. The smallest value was chosen for the analysis. One radiologist using the same device performed ultrasonography fast scans of the posterior-anterior diameter of the abdominal aorta. The intima–media complex of the right and left common carotid artery was measured according to the Mannheim Carotid Intima-Media Thickness and Plaque Consensus [12]. For the analysis, the greatest value was chosen. Laboratory tests performed included the lipid profile, fasting plasma glucose test, and serum creatinine. The oral glucose tolerance test was performed in cases without a history of diabetes if elevated plasma glucose level had been noted. All participants gave their written consent for data collection and analyses.

The material was evaluated comprehensively analysing the impact of variables on three clinical situations: (1) cardio-cerebral incident; (2) PAD incident; (3) cardio-vascular incident. This was necessary for the statistical process. We defined the cardio-cerebral incident (cardiac or neurological event) as a history of ischaemic heart disease, myocardial infarction, coronary angioplasty, CABG, stroke, or TIA. The cardio-vascular incident (cardiac or vascular event) was defined as a history of PAD or CVD event. The PAD incident was recorded if intermittent claudication, revascularisation procedure, or amputation were present in the medical history.

The statistical analysis was performed in groups of patients depending on ABI thresholds: (1) ABI ≤ 0.9 and ABI > 0.9; (2) ABI ≤ 1.0 and ABI > 1.0.

Ethical approval and informed consent

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The Bioethics Committee of the Nicolaus Copernicus University in Torun approved the study.

Informed consent was obtained from all individual participants included in the study.

Statistical analysis

All data were tabulated in MS Excel and computed in Statistica 10, StatSoft Inc. (licensed to Collegium Medicum UMK in Bydgoszcz). The data were assessed for normal distribution and the appropriate tests were applied. The relationship between variables was determined using the Kolmogorov-Smirnov test (KS test), χ^2 Pearson's, t-Student, or Welch tests. Comparisons of categorical variable values were made with the use of the Kruskal-Wallis test. All tests were performed at a significance level of 5.0%. Average and standard deviations were rounded to two decimal places. To assess the independent variables, logistic regression models were built.

RESULTS

Data obtained after examining 365 women were analysed. Quantitative variables were subjected to descriptive statistics and tested for distribution normality with a Kolmogorov-Smirnov test. Table 1 characterises the study population.

Nonparametric variables, which were considered to significantly affect the vascular status of the study popula-

Table 1. Quantitative parameters evaluated in the study population

Variable	Average	SD	Minimum	Maximum	N	p
Age [years]	69.2	3.3	65	75	363	0.01
Height [cm]	157.6	6.25	133	176	365	0.17
Weight [kg]	76	13.6	43.2	124	365	0.38
Body mass index	30.6	5.25	19.4	49.2	365	0.15
Hip circumference [cm]	112.2	10.9	87	147	365	< 0.001
Waist circumference [cm]	98	12.4	59	137	365	0.51
Smoking [pack years of smoking]	17.3	12.4	1	60	365	< 0.001
Ankle–brachial index	0.98	0.16	0.22	1.43	364	0.02
Intima–media complex [mm]	1.06	0.21	0.71	2.04	362	< 0.001
Abdominal aorta diameter [mm]	18.32	2.9	11	37	363	< 0.001
Total cholesterol [mg/dL]	214.7	49.1	91.3	441.4	364	0.01
LDL [mg/dL]	124.36	45.01	34.8	350.9	358	0.18
HDL [mg/dL]	65.9	17.6	19	142.4	361	0.19
Triglyceride [mg/dL]	127.7	65.1	1.1	739.9	364	< 0.001
Serum creatinine [mg/dL]	0.73	0.19	0.2	1.74	363	0.002
Glucose [mg/dL]	109.9	28.2	71	295.1	364	< 0.001
eGFR (MDRD)	83.6	23.4	28.6	261.7	362	0.09
eGFR (CG)	90	24.9	32.2	222.1	362	0.21
eGFR (EPI)	81.9	15.9	28.5	177.1	362	< 0.001
Systolic BP [mm Hg]	150.2	22.1	88	233	365	0.15
Diastolic BP [mm Hg]	83.7	10.4	58	123	365	0.04

BP — blood pressure; eGFR — estimated glomerular filtration rate; HDL — high-density lipoprotein; LDL — low-density lipoprotein; SD — standard deviation

tion, were also evaluated. There were 116 (31.8%) patients with nicotine addiction and 249 (68.2%) non-smokers. Atrial fibrillation was found in 4.4%, hypertension in 81.3%, 34.2% were found to be overweight (BMI 25–29), and 51.8% were obese (BMI ≥ 30). The incidence of abnormal plasma glucose levels was also assessed. A significant proportion of patients with de novo diabetes (7.9%) stood out in the group. It was also noted that 80 patients had impaired fasting glucose (IFG), 38 patients had impaired glucose tolerance (IGT), and 101 had confirmed diabetes.

ABI

Ankle-brachial index ≤ 0.9 was observed in 91 (25%) cases of the study population, and 155 (43%) cases had ABI values above 1.0. In 118 (32%) patients the values were in the range 0.9 < ABI ≤ 1. The average value of the ABI variable was 0.98 (0.22–1.43; SD 0.16; n = 364).

Analysed events and ABI value

Quantitative summary. In the analysed population 123 incidents were recorded. In 93 cases, at least one incident was qualified as one of the analysed events. In 30 cases, two or more incidents were recorded. Table 2 shows the quantitative distribution of the recorded events.

Table 2. Prevalence of analysed events in the studied population

Variable name	Event (%)	Event-free (%)
Cardio-cerebral incident	30 (8.2%)	335 (91.8%)
Peripheral artery disease incident	36 (9.9%)	329 (90.1%)
Cardio-vascular incident	57 (15.6%)	308 (84.4%)

Prevalence of events according to ABI value. An analysis was carried out of the relationship between the onset of the incidents in the past and the present value of the ABI. Working on this assumption, the patients were divided into two groups according to the current ABI value: (1) ABI ≤ 0.9 and ABI > 0.9 — first analysis; (2) ABI ≤ 1.0 and ABI > 1.0 — second analysis.

In the first analysis, a cardio-cerebral incident occurred in 5.5% of patients with ABI ≤ 0.9 vs. 8.8% of patients with ABI > 0.9. Subsequently, a PAD incident occurred, respectively, in 12% vs. 9% of patients, and a cardio-vascular incident was detected in 13.2% vs. 16% of patients.

Table 3. Analysed events in ankle–brachial index (ABI) subgroups

Event	Result χ^2	p
ABI ≤ 0.9 vs. ABI > 0.9		
Cardio-cerebral incident	1.01	NS
PAD incident	0.66	NS
Cardio-vascular incident	0.45	NS
ABI ≤ 1.0 vs. ABI > 1.0		
Cardio-cerebral incident	0.42	NS
PAD incident	1.40	NS
Cardio-vascular incident	0.002	NS

In the second analysis, performed in groups ABI ≤ 1.0 vs. ABI > 1.0, the occurrence of a cardio-cerebral incident was 7.2% vs. 9%, an incident of PAD occurred, respectively, in 11.5% vs. 7.7%, and a cardio-vascular incident occurred in 15.3% vs. 15.5%.

There were no significant differences in the incidence of evaluated parameters in any analysis (Table 3).

Risk factors depending on the ABI value

Prevalence of neurological, cardiac, and vascular risk factors was analysed in groups depending on ABI threshold value. Recorded parametric and nonparametric risk factors were analysed using ABI value less than or equal to 0.9 or 1.0.

There were no significant differences in the incidence of nonparametric risk factors ($p > 0.05$) (Tables 4, 5).

The parametric variables of analysed risk factors were also compared in ABI subgroups. Variables were analysed, as previously, at two levels — below and above the established ABI threshold (0.9 or 1.0). It was found that high-density lipoprotein (HDL) cholesterol level was significantly lower when ABI ≤ 0.9 (62 vs. 67.2; $p = 0.015$). The results are shown in Tables 6 and 7.

Stepwise regression analysis for dependent variable: ABI

Stepwise regression analysis was performed to determine independent predictors of ABI variable. The analysis was carried out on 352 cases. The model proved to be statistically significant.

The strongest predictor was HDL variable, followed by systolic blood pressure and the height variable (Table 8).

The following predictors were rejected: age, weight, BMI, hip size, waist size, smoking, atrial fibrillation, hypertension, total cholesterol, low-density lipoprotein, triglyceride, serum creatinine, plasma glucose level, history of diabetes, IFG, IGT, de novo diabetes, estimated glomerular filtration rate (MDRD, CG, EPI), diastolic blood pressure, and taking beta-blockers.

Table 4. Comparison of risk factors for the 0.9 ankle–brachial index (ABI) threshold value

Risk factors	ABI ≤ 0.9	ABI > 0.9	χ^2	p
Nicotine addiction	34.1%	31%	0.34	NS
Atrial fibrillation	1.1%	5.5%	3.14	NS
Hypertension	83.3%	80.6%	0.34	NS
History of diabetes	20.9%	21.6%	0.02	NS
Impaired fasting glucose	22%	22%	0.0	NS
Impaired glucose tolerance	8.8%	11%	0.35	NS
Diabetes (de novo)	8.8%	7.7%	0.11	NS

Table 5. Comparison of risk factors for the 1.0 ankle–brachial index (ABI) threshold value

Risk factors	ABI ≤ 1.0	ABI > 1.0	χ^2	p
Nicotine addiction	30.6%	33%	0.21	NS
Atrial fibrillation	3.8%	5.2%	0.38	NS
Hypertension	84.6%	76.8%	3.59	NS
History of diabetes	21.5%	21.3%	0.003	NS
Impaired fasting glucose	21.1%	23.2%	0.25	NS
Impaired glucose tolerance	9.1%	12.3%	0.96	NS
Diabetes (de novo)	7.7%	8.4%	0.07	NS

Table 6. Parametric variables in groups for ankle–brachial index (ABI) threshold 0.9

Variable	ABI ≤ 0.9		ABI > 0.9		p
	Average	SD	Average	SD	
Age [years]	68.8	3.3	69.3	3.3	NS
Height [cm]	158.2	6.2	157.4	6.3	NS
Weight [kg]	76.7	13.9	75.8	13.5	NS
Body mass index	30.7	5.35	30.6	5.2	NS
Hip circumference [cm]	112.8	11.3	112.1	10.9	NS
Waist circumference [cm]	98.7	12.9	97.8	12.3	NS
Smoking [pack years of smoking]	16.9	13.9	17.3	12.1	NS
Intima–media complex [mm]	1.1	0.26	1.05	0.2	NS
Abdominal aorta diameter [mm]	18.6	3.8	18.2	2.7	NS
Total cholesterol [mg/dL]	210.8	48.6	216.4	49.1	NS
LDL (mg/dl)	123.5	41.9	124.9	45.9	NS
HDL [mg/dL]	**62.0**	**15.4**	**67.2**	**18.1**	**0.015**
Triglyceride [mg/dL]	130.2	64.8	127.1	65.3	NS
Serum creatinine [mg/dL]	0.7	0.2	0.74	0.18	NS
Glucose [mg/dL]	109.4	28.7	110.2	28.1	NS
eGFR (MDRD)	85.2	26.1	83.02	22.5	NS
eGFR (CG)	90.3	28.4	89.8	23.7	NS
eGFR (EPI)	82.8	19.2	81.6	14.7	NS
Systolic BP [mm Hg]	153.6	25.5	149.2	20.7	NS
Diastolic BP [mm Hg]	83.9	11.1	83.7	10.2	NS

No significant (NS) when p > 0.05; BP — blood pressure; eGFR — estimated glomerular filtration rate; HDL — high-density lipoprotein; LDL — low-density lipoprotein; SD — standard deviation

Table 7. Parametric variables in groups for ankle–brachial index (ABI) threshold 1.0

Variable	ABI ≤ 1		ABI > 1		p
	Average	SD	Average	SD	
Age [years]	69.1	3.3	69.2	3.3	NS
Height [cm]	157.9	6.4	157.2	6.0	NS
Weight [kg]	76.1	14.1	75.9	12.9	NS
Body mass index	30.6	5.4	30.7	5.04	NS
Hip circumference [cm]	112.2	11.5	112.3	10.2	NS
Waist circumference [cm]	98	12.3	98	12.6	NS
Smoking [pack years of smoking]	16.2	12.4	18.5	12.6	NS
Intima–media complex [mm]	1.08	0.2	1.05	0.2	NS
Abdominal aorta diameter [mm]	18.2	3.1	18.5	2.8	NS
Total cholesterol [mg/dL]	216.7	51.4	212.6	45.6	NS
LDL [mg/dL]	127	46.5	121.2	42.6	NS
HDL [mg/dL]	65.01	16.7	67.1	18.8	NS
Triglyceride [mg/dL]	128.3	61.6	127.2	69.7	NS
Serum creatinine [mg/dL]	0.73	0.2	0.74	0.18	NS
Glucose [mg/dL]	110.5	30.7	109.4	24.6	NS
eGFR (MDRD)	84.3	22.8	82.5	24.4	NS
eGFR (CG)	89.3	25.04	90.9	24.8	NS
eGFR (EPI)	82.3	16.7	81.3	14.8	NS
Systolic [mm Hg]	150.7	22.8	149.7	21.1	NS
Diastolic BP [mm Hg]	83.5	10.6	84	10.3	NS

No significant (NS) when p > 0.05; BP — blood pressure; eGFR — estimated glomerular filtration rate; HDL — high-density lipoprotein; LDL — low-density lipoprotein; SD — standard deviation

Table 8. Stepwise regression analysis for dependent variable: ankle–brachial index

Introduced variable	B	β	ΔR^2	F
Step 1 — HDL	0.00114	0.13	0.02	$F(1; 350) = 5.713; p < 0.05$
Step 2 — Systolic BP	–0.0009	–0.13	0.02	$F(1; 349) = 5.714; p < 0.05$
Step 3 — Height	–0.0029	–0.12	0.01	$F(1; 348) = 4.840; p < 0.05$
Total			0.05	$F(3; 348) = 5.490; p < 0.01;$ $R^2 = 0.21$ (corrected $R^2 = 0.05$)

BP — blood pressure; HDL — high-density lipoprotein

Table 9. Logistic regression for dependent variable: cardio--cerebral incident

Predictor	OR	df	p
Age	1.259	1	0.00025
Glucose	1.020	1	0.0008
Atrial fibrillation	5.333	1	0.0186

χ^2 (3) = 24.91; $p < 0.0001$; OR — odds ratio

Table 10. Logistic regression for dependent variable: cardio--vascular incident

Predictor	OR	df	p
Age	1.191	1	0.00013
Nicotine addiction	2.269	1	0.01

χ^2 (2) = 17.42; $p < 0.00$; OR — odds ratio

Logistic regression analysis for dependent variables

In a subsequent analysis of collected material an attempt was made to build three regression models for the following dependent variables: (1) cardio-cerebral incident; (2) PAD incident; and (3) cardio-vascular incident.

The cardio-cerebral incident. To find the optimal set of predictors that explain in the best way whether the cardio-cerebral incident occurred, logistic regression analysis was performed. Regression analysis was performed in the stepwise schema. The test model consists of three factors. The adopted logistic model in a moderate yet statistically significant way explains the impact of age, plasma glucose level, and atrial fibrillation on the occurrence of cardio-cerebral incident (Table 9).

PAD incident. The logistic regression model for dependent variable: PAD incident failed.

The cardio-vascular incident. Regression analysis was performed in the stepwise schema like the previous one. The test model was composed of two factors: age and nicotine addiction. The adopted logistic model in a moderate yet statistically significant way explains the impact on the fact of cardio-vascular events (Table 10).

The performance of a regression model for the PAD variable failed. For the two remaining variables, regression models were significant. The logistic regression analysis found age, plasma glucose level, atrial fibrillation, and nicotine addiction to be independent risk factors of analysed events. The ABI variable did not enter any regression model.

DISCUSSION

The goal of the study was to evaluate the risk factors of CV in the post-menopausal female population. The special range of interest in this study was ABI value.

Several publications in the last decade have shown that ABI is a valuable predictor of cardiovascular events. It has long been known that patients with lower limb ischaemia in a large percentage of cases have coexisting disease of cerebral arteries and coronary arteries. It is estimated that coronary heart disease is the leading cause of death in 40–60% of patients with PAD, and deaths from stroke occur in 10–20%. It is estimated that 5–7% of patients with asymptomatic PAD will have a cardiovascular episode within one year [13]. In Table 2 we have shown that cardiac or cerebral incidents were reported in approximately 8% of our patients. Chronic lower limb ischaemia occurred in approximately 10% of the patients, and more than 15% of our patients had been treated for coronary heart disease or PAD in the past. Carrying out a regression analysis for cardio-cerebral and CVD, a relationship with age, serum glucose level, atrial fibrillation, and smoking was obtained. Interestingly, in none of the models was the impact of ABI on the investigated incident noted. Moreover, in assessing the incidence of vascular events, it was stated that their frequency did not increase when different threshold values were adopted for ABI. The analysis did not confirm the results of other studies focusing on different threshold values of the ABI, in which the compound rate of mortality and cardiovascular events was proven [14–16]. These studies mostly concern the unselected general population, while the authors of this study present only the results of the analysis of post-menopausal women.

In 2006 the results of the REACH study were published. It analysed the risk factors for CVD in 67,888 patients from all over the world. Hypertension was found in 81.8% of the researched, hypercholesterolaemia in 72.4%, diabetes in

44.3%, undiagnosed hyperglycaemia in 4.9%, overweight in 39.8%, obesity in 26.6%, and nicotinism in 14.4% [17]. The results of our research were similar for some parameters. Hypertension occurred with almost the same frequency (81.3% of patients), and the average rate of systolic blood pressure was 150 mm Hg. Excessive body weight was diagnosed in a similar percentage — 34.2% (BMI 25–29). In contrast, obesity with BMI ≥ 30 occurred more frequently, in up to 51.8% of patients. Average BMI value exceeded 30, which correlated with a greater circumference of the hips and waist. Smoking was reported twice as often (31.8%), which is interesting because the authors have studied only the post-menopausal female population. Also, de novo diabetes (7.9%) was more often diagnosed. Hyperglycaemia was found in 61.6%, regardless of whether the patient had had a history of diabetes.

An analysis of anthropometric parameters of the investigated population indicates that we still have to deal with the problem of obesity in modern society. Smoking, hypertension, and hyperglycaemia are other risk factors, the control of which is insufficient. In particular, a high percentage of patients with de novo diabetes indicate that intensive studies are needed to detect previously undiagnosed cases. Nicotine addiction among our patients appeared twice as often as the averaged data from the REACH study. More than one third of studied women admitted to smoking. The TASC II guidelines clearly lay down recommendations for modifying the risk factors of atherosclerosis. The number of cigarettes smoked is associated with the severity of the disease and a higher risk of amputation. Moreover, in the case of vascular grafts there is a three-fold higher risk of therapy failure with continuation of smoking [10, 18, 19]. Several randomised studies clearly demonstrate the advantage of anti-smoking therapy with the use of substitutes for nicotine [9, 10, 20]. The significant issue of nicotine in the selected population of women leads to the conclusion that an appropriate therapeutic intervention should be designed and implemented in our country.

The occurrence of cardiovascular risk factors was evaluated by adopting different values of ankle brachial index as correct. Adopting threshold values of ABI ≤ 0.9 and ABI ≤ 1.0, two analyses were performed. The comparison of the incidence of risk factors for two different reference values was an attempt to respond to the 2011 ACCF/AHA guidelines [9], which distinguish a borderline for the index values in the range between 0.9 and 1.0. In our analysis, the average value of the ABI was 0.98. Patients with index values below 0.9 constituted 25%, approximately 32% were observed to have values between 0.9 and 1.0, while in 43% of the total study population ratios > 1.0 were recorded. Most of the compared parameters were similar and not significant in the analysed subgroups except fort the HDL cholesterol level, which was significantly lower in patients with ABI ≤ 0.9. When a threshold value of 1.0 was adopted, no difference was observed. In none of the studies was there a significant correlation found between belonging to a group of ABI and weight, BMI, waist and hip circumference, smoking, diabetes, hypertension, cholesterol levels, intima–media complex, or renal parameters. In the stepwise regression model, it was demonstrated that independent predictors of ABI are HDL cholesterol, systolic blood pressure, and height. The authors believe that further studies are needed in this regard. Of significance is the fact that the analysis was conducted only in post-menopausal women. It appears that gender could be significant in differences that are formed during the data analysis in patients with PAD.

The study on a selected population of women helped to represent quite accurately the vascular status of patients in a relatively small area of the Kuyavian-Pomeranian Voivodeship, which, in the opinion of the authors, can be easily extrapolated to the scale of the macro-region. According to data from the Statistical Yearbook of the Regions — Poland 2012, published by Central Statistical Office in Warsaw, the studied population may be similar to the entire Polish population [21]. Other Polish studies: NATPOL I, II, III PLUS, NATPOL 2011, WOBASZ, and WOBASZ II also concern CVD [22, 23]. Some of the data can be compared, but our study focused exclusively on the post-menopausal female population.

CONCLUSIONS

Ankle-brachial index remains a fast and simple method of PAD diagnosis, and it can be related to CVD; however, larger studies on the female population are required. The authors plan to perform further prospective studies in five years' time.

Age, hypertension, obesity, nicotine addiction, and diabetes are the main risk factors of CVD in the studied females.

Conflict of interest: *none declared*

References

1. Hirsch AT, Allison MA, Gomes AS, et al. American Heart Association Council on Peripheral Vascular Disease, Council on Cardiovascular Nursing, Council on Cardiovascular Radiology and Intervention, Council on Cardiovascular Surgery and Anesthesia, Council on Clinical Cardiology, Council on Epidemiology and Prevention. A call to action: women and peripheral artery disease: a scientific statement from the American Heart Association. Circulation. 2012; 125(11): 1449–1472, doi: 10.1161/CIR.0b013e31824c39ba, indexed in Pubmed: 22343782.
2. Tendera M, Aboyans V, Bartelink ML, et al. ESC Guidelines on the diagnosis and treatment of peripheral artery diseases: Document covering atherosclerotic disease of extracranial carotid and vertebral, mesenteric, renal, upper and lower extremity arteries: the Task Force on the Diagnosis and Treatment of Peripheral Artery Diseases of the European Society of Cardiology (ESC). Eur Heart J. 2011; 32(22): 2851–2906, doi:10.1093/eurheartj/ehr211, indexed in Pubmed: 21873417.
3. Steg PhG, Bhatt DL, Wilson PWF, et al. REACH Registry Investigators. One-year cardiovascular event rates in outpatients with atherothrombosis. JAMA. 2007; 297(11): 1197–1206, doi: 10.1001/jama.297.11.1197, indexed in Pubmed: 17374814.
4. Poredos P, Jug B. The prevalence of peripheral arterial disease in high risk subjects and coronary or cerebrovascular patients.

Angiology. 2007; 58(3): 309–315, doi: 10.1177/0003319707302494, indexed in Pubmed: 17626985.
5. Dieter RS, Tomasson J, Gudjonsson T, et al. Lower extremity peripheral arterial disease in hospitalized patients with coronary artery disease. Vasc Med. 2003; 8(4): 233––236, doi: 10.1191/1358863x03vm506ra, indexed in Pubmed: 15125482.
6. Atmer B, Jogestrand T, Laska J, et al. Peripheral artery disease in patients with coronary artery disease. Int Angiol. 1995; 14(1): 89–93, indexed in Pubmed: 7658111.
7. Cotter G, Cannon CP, McCabe CH, et al. OPUS-TIMI 16 Investigators. Prior peripheral arterial disease and cerebrovascular disease are independent predictors of adverse outcome in patients with acute coronary syndromes: are we doing enough? Results from the Orbofiban in Patients with Unstable Coronary Syndromes-Thrombolysis In Myocardial Infarction (OPUS-TIMI) 16 study. Am Heart J. 2003; 145(4): 622–627, doi:10.1067/mhj.2003.6, indexed in Pubmed: 12679757.
8. Golomb BA, Dang TT, Criqui MH. Peripheral arterial disease: morbidity and mortality implications. Circulation. 2006; 114(7): 688–699, doi:10.1161/CIRCULATIONAHA.105.593442, indexed in Pubmed: 16908785.
9. Rooke TW, Hirsch AT, Misra S, et al. 2011 ACCF/AHA Focused Update of the Guideline for the Management of Patients With Peripheral Artery Disease (Updating the 2005 Guideline). J Am Coll Cardiol. 2011; 58: 220–2045.
10. Norgren L, Hiatt WR, Dormandy JA, et al. TASC II Working Group. Inter-Society Consensus for the Management of Peripheral Arterial Disease (TASC II). J Vasc Surg. 2007; 45 Suppl S: S5–67, doi: 10.1016/j.jvs.2006.12.037, indexed in Pubmed: 17223489.
11. Giuseppe M, Fagard R, Narkiewicz K, et al. Wytyczne ESH/ /ESC dotyczące postępowania w nadciśnieniu tętniczym w 2013 roku. Kardiol Pol. 2013; 71(III): 27–118, doi: 10.5603/ /KP.2013.0177.
12. Touboul PJ, Hennerici MG, Meairs S, et al. Mannheim carotid intima-media thickness and plaque consensus (2004-2006-2011). An update on behalf of the advisory board of the 3rd, 4th and 5th watching the risk symposia, at the 13th, 15th and 20th European Stroke Conferences, Mannheim, Germany, 2004, Brussels, Belgium, 2006, and Hamburg, Germany, 2011. Cerebrovasc Dis. 2012; 34(4): 290–296, doi: 10.1159/000343145, indexed in Pubmed: 23128470.
13. Hirsch A, Haskal Z, Hertzer N, et al. ACC/AHA 2005 Guidelines for the Management of Patients With Peripheral Arterial Disease. J Am Coll Cardiol. 2006; 47(6): 1239–1312, doi: 10.1016/j.jacc.2005.10.009.
14. Dormandy JA, Murray GD, Dormandy JA, et al. The fate of the claudicant--a prospective study of 1969 claudicants. Eur J Vasc Surg. 1991; 5(2): 131–133, doi: 10.1016/s0950-821x(05)80676-0, indexed in Pubmed: 2037083.
15. Mehler PS, Coll JR, Estacio R, et al. Intensive blood pressure control reduces the risk of cardiovascular events in patients with peripheral arterial disease and type 2 diabetes. Circulation. 2003; 107(5): 753–756, indexed in Pubmed: 12578880.
16. Fowkes FG, Housley E, Cawood E, et al. Edinburgh Artery Study: Prevalence of Asymptomatic and Symptomatic Peripheral Arterial Disease in the General Population. Int J Epidemiol. 1991; 20(2): 384–392, doi: 10.1093/ije/20.2.384.
17. Bhatt DL, Steg PG, Ohman EM, et al. International prevalence, recognition, and treatment of cardiovascular risk factors in outpatients with atherothrombosis. JAMA. 2006; 295(2): 180–189, doi: 10.1001/jama.295.2.180, indexed in Pubmed: 16403930.
18. Willigendael EM, Teijink JAW, Bartelink ML, et al. Smoking and the patency of lower extremity bypass grafts: a meta-analysis. J Vasc Surg. 2005; 42(1): 67–74, doi: 10.1016/j.jvs.2005.03.024, indexed in Pubmed: 16012454.
19. Lassila R, Lepäntalo M, Lindfors O, et al. Cigarette smoking and the outcome after lower limb arterial surgery. Acta Chir Scand. 1988; 154(11-12): 635–640, indexed in Pubmed: 3232481.
20. Jorenby D, Leischow S, Nides M, et al. A controlled trial of sustained-release bupropion, a nicotine patch, or both for smoking cessation. New Engl J Med. 1999; 340(9): 685–691, doi: 10.1056/nejm199903043400903.
21. The Statistical Yearbook of the Regions — Poland 2012, Central Statistical Office in Warsaw. http://stat.gov.pl/obszary-tematyczne/roczniki-statystyczne/roczniki-statystyczne/rocznik-statystyczny-wojewodztw-2012,4,7.html.
22. Zdrojewski T, Bandosz P, Szpakowski P, et al. Rozpowszechnienie głównych czynników ryzyka chorób układu sercowo-naczyniowego w sce. Wyniki badania NATPOL PLUS. Kardiol Pol. 2004; 61: 5–17.
23. Drygas W, Niklas AA, Piwońska A, et al. Multi-centre National Population Health Examination Survey (WOBASZ II study): assumptions, methods, and implementation. Kardiol Pol. 2016; 74(7): 681–690, doi: 10.5603/KP.a2015.0235, indexed in Pubmed: 26620680.

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Ocena wskaźnika kostka–ramię i ryzyka chorób sercowo-naczyniowych w populacji kobiet po menopauzie

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Streszczenie

Wstęp: Choroba tętnic obwodowych (PAD) coraz częściej dotyczy populacji kobiet. Odmienności w symptomatologii i przebiegu klinicznym sugerują, że konieczna jest weryfikacja zaleceń diagnostycznych.

Cel: Analiza czynników ryzyka chorób sercowo-naczyniowych i PAD u kobiet oraz ocena przydatności wskaźnika kostka–ramię (ABI).

Metody: Analizowano wybrane parametry w populacji 365 kobiet zamieszkujących obszar jednego powiatu. Prospektywnie rejestrowano następujące parametry: masa ciała, wzrost, obwód w talii, obwód bioder, palenie tytoniu, kompleks intima–media, wartość ABI oraz wybrane parametry laboratoryjne. Odnotowywano, czy u pacjentów występowały objawy choroby tętnic obwodowych, chorób sercowo-naczyniowych oraz incydenty neurologiczne. Wskaźnik kostka–ramię analizowano przy założeniu patologii dla wartości ≤ 0,9 oraz ≤ 1,0. Zebrane parametry poddano analizie statystycznej.

Wyniki: Wiek, stężenie glukozy, migotanie przedsionków oraz nikotynizm były niezależnymi predykatorami chorób sercowo-naczyniowych i mózgowych ($p < 0{,}001$). Stężenie cholesterolu frakcji lipoprotein o wysokiej gęstości, wartość skurczowego ciśnienia tętniczego i wzrost były niezależnymi czynnikami wpływającymi na ABI ($p < 0{,}05$). Nie wykazano zależności między ABI oraz incydentami sercowo-naczyniowymi w przeszłości, niezależnie od przyjętej wartości progowej (p = NS).

Wnioski: Nie wykazano, że przyjęcie wartości ABI ≤ 1,0 za patologiczną lepiej korelowało z występowaniem chorób sercowo-naczyniowych w badanej populacji kobiet.

Słowa kluczowe: wskaźnik kostka–ramię, choroba tętnic obwodowych u kobiet, czynniki ryzyka chorób sercowo-naczyniowych

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