ORIGINAL ARTICLE

Type-D Personality and Ankle Brachial Index as Predictors of Impaired Quality of Life and Depressive Symptoms in Peripheral Arterial Disease

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Background: Patient-based outcomes, such as impaired quality of life (QOL) and depression, may adversely affect the clinical course of patients with peripheral arterial disease (PAD). Disease severity indices, including the ankle brachial index, are only partially associated with these outcomes.

Objective: To examine whether individual differences in personality would predict impaired QOL and depression above and beyond PAD severity.

Design: A prospective follow-up study.

Setting: Vascular outpatient clinic of a teaching hospital.

Patients: Consecutive patients with newly diagnosed PAD (n=150). Diagnosis and severity of PAD were based on history, physical examination, treadmill walking distance, and ankle brachial index. At their first visit, all patients completed the 14-Item Type-D Personality Scale, the World Health Organization Quality of Life Assessment Instrument-100, and the Center for Epidemiological Studies Depression Scale to assess distressed (type-D) personality, QOL, and depressive symptoms, respectively. The QOL and depression scales were repeated after 6 months' follow-up.

Main Outcome Measures: Impaired QOL and depressive symptoms at follow-up.

Results: Indices of PAD severity (ankle brachial index and walking distance) did not predict impaired QOL or depressive symptoms at follow-up. In contrast, type-D personality predicted poor physical health (odds ratio, 3.94; 95% confidence interval, 1.60-9.67; $P=.003$), decreased level of independence (odds ratio, 4.26; 95% confidence interval, 1.69-10.73; $P=.002$), and poor overall QOL (odds ratio, 4.72; 95% confidence interval, 1.73-12.88; $P<.01$) after controlling for age, sex, PAD severity, and cardiovascular risk factors. Type-D personality also independently predicted increased risk of depressive symptoms (odds ratio, 8.55; 95% confidence interval, 3.01-24.25; $P<.001$).

Conclusions: Type-D personality independently predicted individual differences in impaired QOL and depressive symptoms in patients with PAD above and beyond ankle brachial index. It is important to account for personality when evaluating patient-based outcomes in the context of PAD.

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PERIPHERAL ARTERIAL DISEASE (PAD) is a chronic atherosclerotic condition that is associated with an increased risk of cardiovascular morbidity and mortality.[1-3] In addition to medical outcome measures, quality of life (QOL) has become an important outcome to evaluate the effect of disease and treatment from a patient's perspective.[2,4,5] Moreover, impaired QOL has also been associated with an increased risk of poor clinical course and prognosis.[6] Despite the increased interest in assessing patient-based outcomes, determinants of QOL are still not fully understood.[7] Measures of PAD severity, such as the ankle brachial index (ABI), may predict functional impairment,[8] but they are only partially associated with QOL.[9,10] Therefore, other factors that may influence QOL in patients with PAD have to be taken into account.[7]

In cardiovascular research, previous studies have demonstrated the importance of the distressed, or type-D, personality profile as an emerging risk factor for adverse health outcomes.[11] Type-D individuals tend to experience negative emotions and inhibit the expression of these emotions in social interactions.[12] Type-D personality was found to be a strong predictor of poor QOL and depressive symptoms in cardiac populations.[13-15] In patients with PAD, depressive symptoms have been related to impaired functioning,[16] but research is needed to examine determinants of depressive symptoms in patients with PAD.[16] Therefore, in the present prospective study, we examined whether individual differences in personality would predict impaired QOL and depression above and beyond PAD severity.

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METHODS

STUDY POPULATION

Between September 2001 and October 2003, a total of 190 consecutive patients presenting with intermittent claudication, a common form of PAD, visited the vascular outpatient clinic of the department of surgery at St Elisabeth Hospital in Tilburg, the Netherlands. Intermittent claudication was defined as limitations in a patient's walking capacity due to pain caused by obstruction of the arteries in the lower limbs.[17] All patients were diagnosed with intermittent claudication based on history, physical examination, treadmill walking distance, and the ABI. Five patients were excluded from the study because of cognitive impairment (2 patients), visual problems (1 patient), illness (influenza, 1 patient), and participation in another study (1 patient). Of the remaining 185 patients, 150 (81%) agreed to participate. All patients with PAD completed measures of type-D personality, QOL, and depressive symptoms at baseline. Quality of life and depressive symptoms were reassessed at 6 months' follow-up. The local ethical committee approved the study, and all patients gave written informed consent.

DISEASE SEVERITY

In all patients, the pain-free walking distance (PFWD), maximum treadmill walking distance (MWD), and ABI were measured at baseline as indices of PAD severity. The ABI is defined as the ratio of the ankle systolic blood pressure to the brachial artery systolic blood pressure and has a normal resting value of about 1.1.[18] A value of less than 0.9 is 95% sensitive in detecting PAD[1,2] and has been shown to be a strong predictor of cardiovascular disease and mortality.[19]

CARDIOVASCULAR RISK FACTORS

It has been shown that PAD is highly associated with cardiovascular risk factors like smoking, diabetes, hypertension, and hyperlipidemia.[20] Results from previous studies have shown that 95% of patients with prevalent PAD have at least 1 of these risk factors.[21] In the present study, diabetes, smoking, hypertension, hyperlipidemia, and cardiac, carotid, renal, and pulmonary statuses were evaluated at baseline in all patients, according to the standards recommended by the Society for Vascular Surgery/North American Chapter of the International Society for Cardiovascular Surgery.[5]

TYPE-D PERSONALITY

The 14-Item Type-D Personality Scale (DS14) was used to measure type-D personality.[12] All questions consist of a 5-point Likert-type scale, ranging from 0 to 4. The DS14 consists of 2 subscales: negative affectivity (the tendency to experience negative emotions) and social inhibition (the tendency to inhibit the expression of emotions in social interaction). High scores (≥ 10) on both scales indicate type-D personality. Both subscales have good reliability; Cronbach α is 0.88 and 0.86, respectively.[12] The DS14 has previously been recommended for the assessment of psychosocial risk factors in cardiovascular research.[22]

QUALITY OF LIFE

The evaluation of QOL has become increasingly important in cardiovascular research.[23] In the present study, the World Health Organization Quality of Life Assessment Instrument-100 (WHOQOL-100) was used to measure QOL.[24,25] The WHOQOL-100 is a generic QOL measure that consists of 100 questions assessing QOL with 24 facets within 6 domains. In the present study, an abbreviated version of the WHOQOL-100 was used, which had previously been reduced for patients with intermittent claudication.[9] This version included 10 QOL facets: 3 facets of the QOL physical health domain, 4 facets of the QOL level of independence domain, and 3 separate facets—overall QOL and general health, negative feelings, and participation in and opportunities for recreation/leisure. Scores range from 4 to 20, and studies have shown that in healthy elderly persons, the mean score is generally about 16.[4] The WHOQOL-100 has good reliability and validity[25] and is sensitive to treatment-related change.[26]

DEPRESSIVE SYMPTOMS

The Center for Epidemiological Studies Depression Scale (CES-D) was used to measure current depressive symptoms.[27] The CES-D questionnaire is widely used and easy to administer, especially in older adults.[28] In the present study, the Boston form (10 items) was used,[29] which consists of dichotomous response options. Patients were asked to indicate whether or not they had experienced each symptom "much of the time during the past week."[29] The 10-item version of the CES-D has good reliability (Cronbach $\alpha = .88$) and a sensitivity of 97% in detecting major depression according to the *Diagnostic and Statistical Manual of Mental Disorders* (Fourth Edition) criteria.[28] In accordance with Irwin and colleagues,[28] we used a cutoff score of 4 or more to detect depressive symptoms.

STATISTICAL ANALYSIS

Indices of PAD severity (ABI, PFWD, and MWD) were dichotomized into low scores (first quartile, indicating poor ABI or limited walking distance) vs average or high scores. This resulted in a cutoff distance of 40 m or less to indicate limited PFWD and a cutoff distance of 130 m or less for short MWD. A cutoff score of 0.50 or less was found to indicate low ABI, in accordance with previous studies.[18,30] Cardiovascular risk factors were dichotomized into present or absent. To detect differences in QOL and depressive symptoms at baseline, we used *t* tests for independent samples and χ^2 tests for comparing patients on the basis of the dichotomized ABI, PFWD, and MWD scores. Subsequently, we examined differences in QOL and depressive symptoms at baseline between patients with and patients without type-D personality. Multivariate logistic regression analyses (the enter method) were used to examine the relative prognostic power of PAD severity and type-D personality with regard to QOL and depressive symptoms at 6 months' follow-up after controlling for age, sex, and cardiovascular risk factors. Therefore, scores on the WHOQOL-100 questionnaire were dichotomized into low scores (first quartile, indicating poor QOL) vs average or high scores. Finally, using *t* tests for independent samples, we compared patients with an ABI of 0.50 or less with patients with an ABI higher than 0.50 to detect differences in QOL and depressive symptoms at 6 months' follow-up. Differences in QOL and depressive symptoms at 6 months' follow-up were then studied between patients with and patients without type-D personality. Statistical analyses were done using the Statistical Package for the Social Sciences, version 11.5 (SPSS Inc, Chicago, Illinois).

RESULTS

Baseline characteristics and distribution of risk factors of the 150 patients with PAD are presented in **Table 1**. Mean age was 64.1 years (range, 40-85 years), and the majority of patients were men (n=97). During the

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6-month follow-up period, 61 patients (40.7%) were treated invasively for their PAD. Modes of invasive treatment were percutaneous transluminal angioplasty (80%), bypass surgery (16%), and endarterectomy (4%). Patients who were treated conservatively received 3 months of unsupervised exercise training, the advice to quit smoking, and antiplatelet medication.

ABI, WALKING DISTANCE, QOL, AND DEPRESSIVE SYMPTOMS AT BASELINE

Patients with an ABI of 0.50 or less had significantly poorer QOL with regard to mobility ($P = .02$) and working capacity ($P = .03$) than patients with an ABI higher than 0.50. No differences were found in depressive symptoms. Patients with a short PFWD did not differ in QOL or depressive symptoms compared with patients with a PFWD longer than 40 m. Patients with a limited MWD (≤130 m) were more impaired in their QOL with regard to level of independence ($P = .003$), mobility ($P = .01$), activities of daily living ($P = .04$), and working capacity ($P = .008$) than patients with an MWD longer than 130 m. Patients did not differ in depressive symptoms.

Table 1. Characteristics of 150 Patients With Intermittent Claudication[a]

Characteristic	Value
Age, mean (SD), y	64.1 (9.5)
Ankle brachial index, mean (SD)	0.62 (0.15)
Pain-free treadmill walking distance, mean (SD), m	120.3 (155)
Maximum treadmill walking distance, mean (SD), m	384.4 (325)
M/F sex	97/53 (64.7/35.3)
Diabetes[b]	26 (17.3)
Tobacco use[b]	85 (56.7)
Hypertension[b]	63 (42)
Hyperlipidemia[b]	84 (56)
Cardiac disease[b]	47 (31.3)
Carotid disease[b]	17 (11.3)
Renal disease[b]	6 (4)
Pulmonary disease[b]	11 (7.3)

[a] Values are number of patients (percentage), unless otherwise indicated.
[b] Society for Vascular Surgery/North American Chapter of the International Society for Cardiovascular Surgery grading system[5] for cardiovascular risk factors. All risk factors were recoded as absent = 0, present = 1, 2, or 3; except for smoking, which was coded as absent = 0 or 1, present = 2 or 3.

TYPE-D PERSONALITY, QOL, AND DEPRESSIVE SYMPTOMS AT BASELINE

Results showed that 34.9% of patients had a type-D personality. Patients with type-D personality had significantly poorer QOL scores on all aspects than patients without type-D personality. In addition, depressive symptoms were present in 38.3% of patients with type-D personality vs 4.3% of patients without type-D personality (**Table 2**).

DETERMINANTS OF QOL AND DEPRESSIVE SYMPTOMS AT 6 MONTHS' FOLLOW-UP

We determined the influence of PAD severity (ABI, PFWD, and MWD) and type-D personality on QOL and depressive symptoms at 6 months' follow-up after controlling for age, sex, and cardiovascular risk factors. Type-D personality, but not PAD severity, was an independent predictor of all QOL aspects and depressive symptoms (**Table 3**). Furthermore, some cardiovascular risk factors also predicted these outcomes. For example, low overall QOL and general health was independently predicted by type-D personality, diabetes, and smoking.

QOL AND DEPRESSIVE SYMPTOMS AT 6 MONTHS AS A FUNCTION OF ABI AND TYPE-D PERSONALITY

To illustrate the effect of type-D personality on QOL and depressive symptoms at 6 months' follow-up, we first stratified patients according to their ABI (≤0.50 or

Table 2. Scores on the Abbreviated WHOQOL-100 and the CES-D in PAD Patients With and Without Type-D Personality at Baseline[a]

	Patients With PAD		
Test	Type-D Personality	Non–Type-D Personality	*P* Value
WHOQOL-100 physical health	11.7 (2.0)	14.1 (2.4)	< .001
Pain and discomfort[b]	13.4 (1.9)	11.5 (2.7)	< .001
Energy and fatigue	10.5 (2.5)	13.3 (3.0)	< .001
Sleep and rest	13.9 (4.4)	16.4 (3.7)	< .001
WHOQOL-100 level of independence	11.3 (2.0)	13.7 (2.6)	< .001
Mobility	10.4 (2.1)	11.9 (2.8)	.001
Activities of daily living	11.8 (2.3)	14.7 (3.1)	< .001
Dependence on medication or treatment[b]	12.3 (2.7)	10.6 (3.7)	.002
Working capacity	11.4 (3.2)	14.8 (3.6)	< .001
WHOQOL-100 separate facets			
Overall quality of life and general health	12.0 (2.5)	14.4 (2.8)	< .001
Negative feelings[b]	11.6 (2.6)	8.4 (3.0)	< .001
Participating in and opportunities for recreation/leisure	11.9 (2.7)	14.9 (2.7)	< .001
CES-D depression (sum score ≥ 4), %	38.3	4.3	< .001

Abbreviations: CES-D, Center for Epidemiological Studies Depression Scale; PAD, peripheral arterial disease; WHOQOL-100, World Health Organization Quality of Life Assessment Instrument-100.
[a] Values are mean score (SD), unless otherwise indicated.
[b] Scores are inversed, ie, high scores indicate low quality of life.

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Table 3. Predictors of Impaired Quality of Life and Depressive Symptoms at 6 Months (Multivariate Analyses)

Predictor	Odds Ratio (95% Confidence Interval)			
	Physical Health	Level of Independence	Overall Quality of Life	Depressive Symptoms
Patient characteristic				
Age	0.98 (0.92-1.03)	1.03 (0.97-1.09)	0.99 (0.93-1.05)	1.00 (0.93-1.06)
Female sex	3.32 (1.25-8.83)[a]	1.92 (0.72-5.12)	2.74 (0.94-8.00)	2.20 (0.74-6.47)
Disease severity				
ABI ≤ 0.50	0.61 (0.20-1.85)	1.01 (0.35-2.93)	0.68 (0.21-2.22)	0.50 (0.14-1.74)
MWD ≤ 130 m	0.53 (0.16-1.78)	0.45 (1.34-1.54)	0.47 (0.12-1.78)	1.78 (0.50-6.34)
PFWD ≤ 40 m	1.29 (0.40-4.23)	1.38 (0.43-4.39)	1.93 (0.55-6.73)	1.27 (0.34-4.67)
Risk factor				
Diabetes	3.26 (1.08-9.85)[a]	2.74 (0.91-8.24)	3.35 (1.05-10.63)[a]	1.39 (0.38-5.09)
Smoking	1.43 (0.54-3.79)	1.62 (0.61-4.33)	3.14 (1.03-9.62)[a]	2.10 (0.67-6.62)
Hypertension	1.60 (0.61-4.21)	1.22 (0.45-3.29)	2.21 (0.76-6.45)	0.62 (0.20-1.92)
Hyperlipidemia	1.29 (0.50-3.31)	3.50 (1.24-9.82)[a]	2.39 (0.82-6.96)	3.10 (1.02-9.35)[a]
Cardiac disease	1.51 (0.56-4.12)	1.92 (0.73-5.04)	2.82 (0.97-8.18)	0.84 (0.28-2.54)
Carotid disease	4.65 (1.29-6.78)[a]	2.33 (0.62-8.75)	2.64 (0.65-10.68)	2.57 (0.60-11.06)
Renal disease	0.68 (0.08-5.84)	1.49 (0.21-10.45)	1.61 (0.21-12.19)	3.48 (0.36-34.19)
Pulmonary disease	1.34 (0.26-6.95)	1.17 (0.22-6.32)	0.79 (0.10-6.51)	0.32 (0.03-3.85)
Type-D personality	3.94 (1.60-9.67)[b]	4.26 (1.69-10.73)[b]	4.72 (1.73-12.88)[b]	8.55 (3.01-24.25)[c]

Abbreviations: ABI, ankle brachial index; MWD, maximum treadmill walking distance; PFWD, pain-free treadmill walking distance.
[a] $P < .05$.
[b] $P < .01$.
[c] $P < .001$.

>0.50), and then, according to their type-D personality status. No significant differences were found in QOL and depressive symptoms at 6 months' follow-up between patients with PAD with an ABI of 0.50 or less and patients with PAD with an ABI greater than 0.50 (**Figure**). However, at 6 months' follow-up, patients with type-D personality reported more depressive symptoms (Figure A), significantly lower overall QOL and general health (Figure B), poorer physical health (Figure C), and lower levels of independence (Figure D) than patients without type-D personality.

COMMENT

In the present study, we examined whether individual differences in personality would predict impaired QOL and depression at 6 months' follow-up. Results demonstrated that type-D personality independently predicted QOL and depressive symptoms above and beyond the severity of PAD.

Previous studies have shown that indices of PAD severity (ABI and PFWD) may be associated with the degree of functional impairment.[8,31] However, the association between disease severity indices and patient-based outcomes, such as QOL or depressive symptoms, is rather weak.[9,10,16,32] Identifying the determinants of adverse patient-based health outcomes, such as impaired QOL or depressive symptoms, is important because of their impact on the health care system. In patients with cardiac disease, it has been shown that poor perceived health status independently predicts death and hospitalization.[33-35] In patients with PAD, it has recently been found that impaired health status is an independent predictor of invasive treatment.[36] Furthermore, psychological factors, such as chronic stress and depression, have been clearly associated with the development and progression of coronary artery disease.[37] McDermott and colleagues[16] already showed that depressive symptoms were associated with a greater impairment in lower extremity functioning, but they also indicated the need to determine the way in which these depressive symptoms may lead to impaired physical functioning.

The present findings demonstrate the need to study risk factors that may predict poor QOL and depressive symptoms in patients with PAD above and beyond traditional indices of disease severity, such as ABI and walking distance. Breek and colleagues[9] showed that comorbidity had a significant impact on QOL in patients with PAD. We found that comorbidities such as diabetes or hyperlipidemia independently predicted QOL in patients with PAD. Furthermore, our results showed that type-D personality was retained as an independent predictor of poor QOL and depressive symptoms, even after controlling for disease severity and cardiovascular risk factors, indicating a stable effect of personality. These findings indicate the importance of including personality in research on PAD to identify patients who are at increased risk of adverse patient-based health outcomes. To our knowledge, only a few studies have included personality characteristics in research on PAD.[38-40] Results from the Edinburgh Artery Study[38] showed that social deprivation and personality factors like hostility were directly associated with baseline ABI and indirectly associated with progression of atherosclerosis. In addition, Deary and colleagues[39] argued that a hostile personality might be an independent risk factor for PAD. Preliminary evidence in a combined sample of patients with PAD and healthy controls suggests that type-D personality may be associated with impaired health status above and beyond the impairment already related to having PAD.[40] The results from the present prospective study are not only consistent with but also elaborate on these cross-sectional

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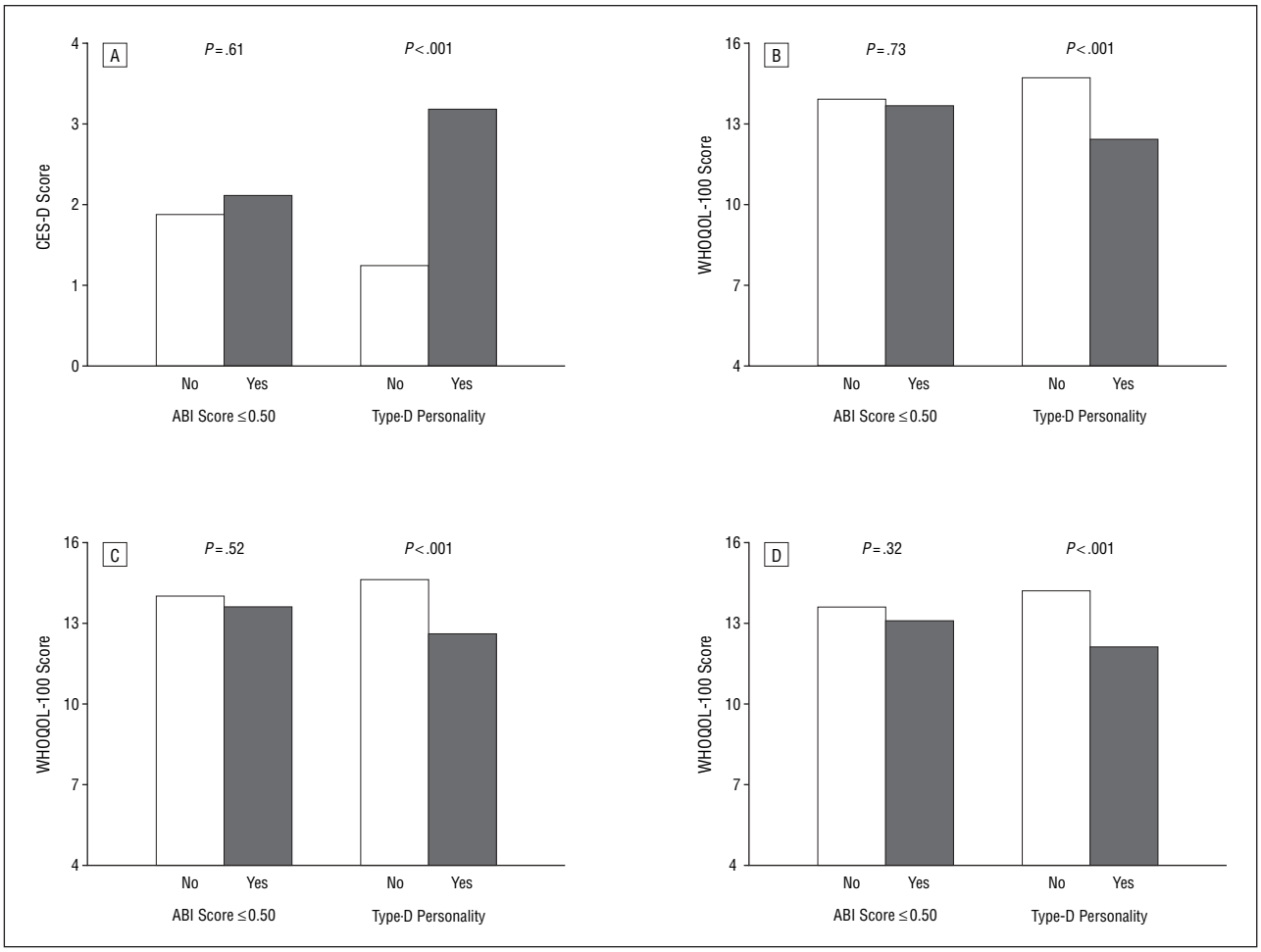

Figure. Depressive symptoms (A), overall quality of life (B), physical health (C), and level of independence (D) at 6 months' follow-up, stratified by a low ankle brachial index (ABI) or type-D personality. CES-D indicates Center for Epidemiological Studies Depression Scale; WHOQOL-100, World Health Organization Quality of Life Assessment Instrument-100.

findings. Type-D personality had an independent effect on adverse patient-based health outcomes, such as poor QOL and depressive symptoms. As is already shown in cardiac patient groups[33-35] and in patients with PAD,[36] impaired health-related QOL is associated with adverse health outcomes like hospitalization. Despite these findings, the influence of personality is still often ignored, whereas age and sex are traditionally included in cardiovascular research as individual difference variables.

This study has some limitations. First, patients with ischemic rest pain or tissue loss were not included. This could be an explanation for the finding that disease severity had no influence on QOL and depressive symptoms. By including patients with critical limb ischemia, a more heterogeneous patient group could be obtained, possibly leading to a greater effect of disease severity on QOL and depressive symptoms. Second, 6 months is a relatively short follow-up period for measuring QOL and depressive symptoms. However, the effect of type-D personality on QOL and depressive symptoms was stable and in accordance with previous studies that used 5- to 10-year follow-up periods.[13,41]

In conclusion, type-D personality independently predicts individual differences in impaired QOL and depressive symptoms in patients with PAD above and beyond PAD severity. These findings indicate the importance of including personality in research on PAD. Type-D personality may help to identify patients with PAD who are at increased risk of adverse health outcomes, such as poor QOL and depressive symptoms.

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