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BRIEF COMMUNICATION

Validation of the Dutch version of the VascuQol questionnaire and the Amsterdam linear disability score in patients with intermittent claudication

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Abstract
Purpose To assess the reliability and validity of the Dutch version of the vascular quality of life questionnaire (VascuQol) and the AMC Linear Disability Score (ALDS) in patients with stable intermittent claudication (IC).
Methods During a 5-month period we performed a prospective study in which we included every patient with stable IC, who visited our vascular surgery outpatient clinic and consented to participate. Forty consecutive patients filled in the Dutch VascuQol, the ALDS, and Short Form-36 (SF-36). Twenty patients filled in the same questionnaires after 4 weeks. Internal reliability consistencies were expressed as Cronbach's α. Test–retest reliability was expressed as intraclass correlation coefficients (ICC). Construct validity was expressed as Spearman rho correlations between SF-36 and relevant domains of Dutch VascuQol and the ALDS.
Results Internal reliability consistencies were, respectively, good and excellent for the total scores of VascuQol, SF-36, and ALDS (Cronbach's α. 0.87, 0.89, and 0.92). Test–retest reliability was excellent for the total VascuQol scores [ICC 0.91 (95% CI, 0.78–0.96)], and for the ALDS [ICC 0.90 (95% CI, 0.76–0.96)]. Spearman correlations between VascuQol, ALDS, and SF-36 domains varied from $r = 0.34$–0.79.
Conclusion The Dutch VascuQol is a valid and reliable questionnaire for assessment of Qol in patients with IC. This study confirms the good clinimetric properties of the ALDS for assessing disability in patients with IC.

Keywords Intermittent claudication · Quality of life · Functional status · Validation

Abbreviations

IC	Intermittent claudication
PAD	Peripheral arterial disease
ABPI	Ankle-brachial pressure index
HS	Health Status
Qol	Quality of life
FS	Functional status
SF-36	Short Form 36
VascuQol	Vascular quality of life questionnaire
CLI	Critical limb ischemia
ADL	Activities of daily life
ALDS	AMC linear disability score item bank
IRT	Item response theory
PTA	Percutaneous transluminal angioplasty
ICC	Intraclass correlation coefficient

Introduction

Patients with intermittent claudication (IC) due to peripheral arterial disease (PAD) experience a limitation in their daily activities [1]. The severity of the disease and functional impairment of patients with IC are usually quantified by measuring ankle-brachial pressure index (ABPI) in rest and after exercise, and walking distance on a treadmill. However, there are disadvantages to the sole use of these parameters because they do not reflect patient's perceptions

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of their functional impairment [2–4]. Assessment of health status (HS), quality of life (Qol), and functional status (FS) in addition to the measurement of ABPI and walking distance may therefore be more relevant to assess the impact of PAD, especially for research purposes.

HS expresses the impact of a disease on the level of physical, psychological, and social functioning of an individual. HS can be measured through generic instruments such as the Short Form 36 (SF-36). Measuring HS does not take into account the perception of the patient of his HS. The latter can be defined as Qol. Objective assessment of functioning (HS) and subjective appraisal of functioning (Qol) are therefore complementary [3, 5, 6]. For patients with PAD, disease-specific instruments to measure Qol have been developed such as the Vascular Quality of life questionnaire (VascuQol) [7]. The VascuQol was developed and validated in English-speaking patients with IC and critical limb ischemia (CLI) and has been translated into other languages. Although the Dutch version of the VascuQol confirmed the better responsiveness than generic instruments in patients treated for PAD, there is no known formal evaluation of its validity [8].

Measuring FS is a different method to assess a patient's disability, as HS and Qol instruments do not focus on activities of daily life (ADL) [9]. A recently developed generic instrument to measure FS is the AMC Linear Disability Score item bank (ALDS). The ALDS uses the item response theory (IRT) to measure FS of patients with a wide range of stable, chronic diseases [10–12]. In a previous study in patients with IC and CLI, we already demonstrated a high internal consistency of the ALDS and a strong correlation with the VascuQol activity domain [9].

The purpose of our study was to assess the reliability and validity of the Dutch version of the VascuQol and the ALDS in patients with stable IC.

Methods

Patients

Between March 2009 and July 2009 we performed a prospective cohort study on all consecutive patients with stable IC, who visited our vascular surgery outpatient clinic and gave verbal consent to participate. Stable IC was defined as symptoms present for at least 3 months. Inclusion criteria were: an ABPI <0.90, and/or a reduction of 0.15 or more after exercise, and planned conservative treatment. Patients with insufficient knowledge of the Dutch language or who were scheduled for a percutaneous transluminal angioplasty (PTA) or surgery were excluded.

Assessments

All patients completed a set of questionnaires in Dutch (VascuQol [7], ALDS [[9, 10, 13, 14], Appendix] and the SF-36 [3, 5]) and all were asked to complete these again after 4 weeks. The patients who completed the questionnaires at both occasions will be referred to as group A and patients who did not complete the questionnaires twice as group B.

VascuQol

The VascuQol consists of 25 items, subdivided into five domains: pain, symptoms, activities, social well-being, and emotional well-being. Each item has 7 possible responses, ranging from 1 (worst possible) to 7 (best possible), respectively [7].

ALDS

The ALDS consists of 77 items. Based on clinical relevance and adapted to the disability level of this patient group, a selection of 28 items was made for our study (Appendix). The scores were linearly transformed into values between 0 and 100 to facilitate interpretation. Lower scores correspond with more disability [9].

SF-36

The SF-36 consists of 36 items which evaluate eight different health domains on the general health status of patients. The SF-36 has been validated for use in Dutch [3, 5].

The time needed to complete each questionnaire was recorded. The questionnaires were completed by means of interviews by one of the authors (SvW). Ethical exemption for this study was obtained from AMC Medical Ethics Review Committee.

Analysis

Reliability

Cronbach's α was calculated to measure the internal consistency of each questionnaire. Internal consistency reliability refers to the statistical coherence of the scale items, and is expressed as Cronbach's α coefficient, which is based on the average correlation of items within a scale [15, 16]. Internal consistency is considered to be acceptable if $\alpha \geq 0.6$, satisfactory if $\alpha \geq 0.7$, good if $\alpha \geq 0.8$, and excellent if $\alpha \geq 0.9$ [16]. Values of Cronbach's α for the ALDS were obtained using a specific IRT method that allows for missing item responses [11]. Test–retest reliability was expressed as intraclass correlation coefficient

(ICC) of absolute agreement based on a two-way mixed model with 95% confidence interval. An ICC $\geq$ 0.7 indicates a good reproducibility.

Construct validity

Construct validity refers to whether a new instrument corresponds with existing instruments measuring the same construct. Since there is no reference standard for construct validity, one has to rely on correlations between related domains of different instruments to indicate construct validity. One would expect moderate to good correlations between the activities, pain, and emotional domains in the VascuQol with the physical, pain, and the mental health domains in the SF-36 [7]. Similar correlations could be expected between the physical functioning and physical component of the SF-36 and ALDS. The construct validity was expressed as Spearman's rho correlation coefficient [12].

The Mann–Whitney test was used to compare means between groups. Differences between proportions were tested with the χ^2 test or Fisher's exact test where appropriate. A P value < 0.05 indicated statistical significance in all instances. All analyses were carried out with SPSS 16.0 (SPSS Inc. Chicago, Illinois, USA).

Results

Forty patients were included in this study (demographics are shown in Table 1). The median time (range) to complete the VascuQol, SF-36, and ALDS was 11 (6–20), 9 (5–16), and 3 (1–8) min, respectively. Twenty patients (50%) completed all questionnaires after 4 weeks (group A). Table 2 lists the mean VascuQol, ALDS, and SF-36 scores. There were no significant differences in baseline characteristics, total scores, and specific item scores

Table 1 Characteristics of the total sample [$n = 40$ (%)]

Demographics (number and percentage)	Total sample $n = 40$	Group A $n = 20$	Group B $n = 20$	P value*
Male	25 (63)	12 (60)	13 (65)	0.74
Current smoker	18 (45)	7 (35)	11 (55)	0.31
Diabetes mellitus	12 (30)	6 (30)	6 (30)	1.00
Hypertension	27 (68)	13 (65)	14 (70)	0.35
Hyperlipidemia	19 (48)	12 (60)	7 (35)	0.10
Obesity (BMI[c] $\geq$ 30)	10 (25)	6 (30)	4 (20)	0.47
Renal disease	4 (10)	1 (5)	3 (15)	0.30
COPD[d]	3 (8)	3 (15)	0 (0)	0.08
Cardiovascular history, *n* (%)				
Myocardial infarction	10 (25)	6 (30)	4 (20)	0.47
PTCA[e]	8 (20)	5 (25)	3 (15)	0.44
CABG[f]	7 (18)	3 (15)	4 (20)	0.68
Previous revascularization[a]	17 (43)	10 (50)	7 (35)	0.34
Median (range)				
Age, year (range)	67; 44–87	64; 44–86	70; 45–87	0.29
Walking distance meters (range)[b]	168; 20–500	130; 50–400	200; 20–500	0.19
Mean in percentage (SD)				
ABPI left[g]	66 (21)	67 (20)	64 (23)	0.75
ABPI right[g]	75 (25)	75 (26)	76 (24)	0.87

* Considering χ^2 test or Fisher's exact test for differences between the consenting and non consenting patients where appropriate, $P < 0.05$ was considered to indicate a statistically significant difference

[a] For PAD

[b] Self reported

[c] Body mass index

[d] Chronic obstructive pulmonary disease

[e] Percutaneous transluminal coronary angioplasty

[f] Coronary artery bypass graft

[g] Ankle-brachial pressure index

Table 2 Mean Qol/HS/ADL scores [scores (SD)]

Questionnaire	Assessment 1			Assessment 2
	Total sample $n = 40$	Group A $n = 20$	Group B $n = 20$	Group A $n = 20$
VascuQol[a]				
Summary score	4.6 (0.9)	4.7 (0.9)	4.6 (0.9)	4.6 (0.8)
Activity domain	4.0 (1.1)	4.1 (1.1)	4.0 (1.0)	3.9 (0.9)
Symptom domain	5.0 (1.2)	5.0 (1.3)	5.0 (1.0)	4.8 (1.1)
Pain domain	3.8 (1.1)	3.9 (1.2)	3.8 (1.1)	3.8 (1.3)
Emotional domain	5.3 (1.1)	5.3 (1.1)	5.3 (1.2)	5.4 (1.0)
Social domain	5.5 (1.3)	5.6 (1.3)	5.4 (1.2)	5.6 (1.1)
SF-36[b]				
Physical functioning	45.3 (17.3)	50 (18.6)	40.5 (14.9)	47.5 (17.1)
Role physical	52.5 (41.1)	51.2 (41.7)	53.8 (41.6)	51.3 (41.7)
Bodily pain	49.9 (18.7)	50.5 (16.9)	49.4 (20.7)	48.0 (15.2)
General health	46.9 (20.8)	51.7 (16.4)	42.3 (23.8)	47.3 (14.8)
Vitality	60.3 (19.4)	59.0 (15.4)	61.5 (23.1)	64.0 (13.9)
Social functioning	80.6 (24.0)	84.4 (18.5)	76.9 (28.5)	81.2 (18.4)
Role emotional	85.7 (15.6)	93.3 (17.4)	78.3 (40.9)	96.7 (10.2)
Mental health	80.7 (15.6)	83.2 (11.3)	78.1 (18.9)	81.0 (11.1)
Physical health comp.	32.4 (7.4)	33.2 (7.6)	31.6 (7.4)	31.7 (7.4)
Mental component	56.9 (9.1)	58.2 (4.1)	55.6 (12.1)	58.9 (4.7)
ALDS[c]	79.4 (7.9)	82.5 (6.5)	76.3 (8.1)	82.2 (5.9)

Qol quality of life, *HS* health status, *ADL* Activities of daily life

[a] Vascular quality of life questionnaire

[b] Short Form 36

[c] AMC linear disability score

between the total sample, group A, and group B ($P > 0.05$; Tables 1, 2).

Internal consistency

VascuQol summary score, SF-36 summary score, and the ALDS had good and excellent internal consistency reliability (Cronbach's α coefficient was 0.87, 0.89, and 0.92, respectively) (Table 3). Internal consistency of the VascuQol activity domain was satisfactory, and acceptable for all other domains. The internal consistency was at least satisfactory for most SF-36 domains, except for vitality and bodily pain.

Test–retest reliability

The reproducibility of the VascuQol was good (ICC's between 0.77 and 0.91), except for the social domain. Also, the ALDS had good test–retest reliability (ICC 0.90) (Table 3). Most domains of the SF-36 had excellent ICC's except for the role emotional and the mental component scores.

Construct validity

VascuQol versus SF-36

The pain and the activities domains of the VascuQol correlated moderately with the pain and the physical domains in the SF-36 [$r = 0.57$ ($P < 0.01$) and $r = 0.57$ ($P < 0.01$)], respectively (Table 4). The correlation between VascuQol emotional and SF-36 mental health domain was moderate, $r = 0.59$ ($P < 0.01$).

ALDS versus SF-36

The ALDS correlated moderately and good with the physical component and physical functioning domain of the SF-36, respectively [$r = 0.66$ and $r = 0.76$ ($P < 0.01$)] (Table 4).

Discussion

A prerequisite for every evaluation tool is that it has been shown reliable and reproducible. Our study shows that the

Table 3 Results of reliability analysis

Questionnaire and domains	Cronbach's α ($n = 40$)	ICC ($n = 20$)	(95% confidence interval)
VascuQol[a]			
Summary score	0.87	–	
Activity domain	0.75	0.82	(0.60–0.92)
Symptom domain	0.59	0.90	(0.76–0.96)
Pain domain	0.59	0.91	(0.79–0.96)
Emotional domain	0.69	0.77	(0.51–0.90)
Social domain	0.62	0.47	(0.03–0.75)
Total score	N/A	0.91	(0.78–0.96)
SF-36[b]			
Summary score	0.89	–	
Physical functioning	0.76	0.88	(0.73–0.95)
Role physical	0.84	0.75	(0.46–0.89)
Bodily pain	0.60	0.82	(0.61–0.93)
General health	0.78	0.82	(0.57–0.93)
Vitality	0.67	0.70	(0.37–0.87)
Social functioning	0.78	0.67	(0.33–0.85)
Role emotional	0.90	−0.12	(−0.54–0.34)
Mental health	0.71	0.67	(0.35–0.86)
Physical component	N/A	0.90	(0.74–0.96)
Mental component	N/A	0.34	(−0.12–0.67)
ALDS[c]	0.92	0.90	(0.76–0.96)

ICC intraclass correlation coefficient

[a] Vascular quality of life questionnaire

[b] Short Form 36

[c] AMC linear disability score

Table 4 Cross-sectional construct validity

VascuQol[a]	Total score	Pain	Activities	Symptoms	Emotional	Social	ALDS[c]
SF-36[b]							
Physical functioning	0.60*	0.56*	0.57*	0.23	0.47*	0.38†	0.76*
Role physical	0.69*	0.53*	0.60*	0.41*	0.63*	0.39†	0.27
Bodily pain	0.79*	0.57*	0.79*	0.43*	0.69*	0.22	0.52*
General health	0.28	0.16	0.35†	0.04	0.21	0.23	0.08
Vitality	0.49*	0.37	0.50*	0.30	0.41*	0.17	0.16
Social functioning	0.72*	0.33	0.73*	0.27	0.72*	0.37†	0.34†
Role emotional	0.44*	0.24	0.26	0.41*	0.46*	0.28	−0.00
Mental health	0.54*	0.18	0.50*	0.33†	0.59*	0.29	0.16
Physical component	0.73*	0.57*	0.79*	0.31	0.56*	0.36†	0.66*
Mental component	0.54*	0.16	0.45*	0.37	0.60*	0.35†	−0.12

Spearman rho correlation coefficient

* $P < 0.01$

† $P < 0.05$

[a] Vascular quality of life questionnaire

[b] Short Form 36

[c] AMC linear disability score

Dutch VascuQol is valid and reliable for a cross-sectional survey, and supports the applicability of the VascuQol, also for a language other than the original version in English. We confirmed that the scale items of the VascuQol have acceptable internal consistency reliability. We also found excellent test–retest reliability of the VascuQol in patients with an unchanged disease status. This is important, because this proves that the VascuQol scores are robust. Construct validity of the Dutch version of the VascuQol was indicated by the moderate correlations between VascuQol pain and activities domains and SF-36 pain and physical domains. Correlations between comparable domains of the VascuQol and SF-36 were somewhat better for the physical domains than for the emotional domains. On the other hand, the emotional domain of the VascuQol did have a better responsiveness in the study by de Vries et al. [8] and thus seems to gauge better the concerns of patients with PAD than a generic questionnaire.

Our study not only confirms the internal consistency reliability of the ALDS, but also that the ALDS is consistent in expressing the level of disability in patients with IC. The average ALDS scores in our study were 80 (SD 10) and 79.4 (SD 7.9) in the study of Met et al. [9], respectively. What adds to the robustness of the ALDS is the excellent test–retest reliability. Construct validity of the ALDS was indicated by moderate and good correlations with the physical component and physical functioning domain in the SF-36, respectively. Thus, in this cross-sectional study, the ALDS had reliable clinimetric properties that make it suitable to measure disability or level of ADL in patients with IC. The ALDS can be completed in a very short time, which adds to its applicability in research. Whether the ALDS is also useful for a longitudinal study, to measure changes in disability in patients with IC or CLI, is the subject that is yet to be determined.

We realize that our study has limitations. We tried to minimize bias by including a consecutive series of patients, but not all patients were willing to fill in the questionnaires for a second time. It may be that those patients have a different disease status or Qol than those who did not. Yet, we found no significant differences in baseline characteristics, Qol, and ALDS scores between both groups. Another limitation is the small sample size that results in estimates with a wide confidence interval. This may have led to unreliable estimates for the social domain score of the VascuQol and the role emotional and mental component scores of the SF-36. A larger sample size could also have allowed us to evaluate construct validity by means of validation of the scale structure with confirmatory factor analysis.

In summary, our study shows that the Dutch VascuQol and the ALDS are reproducible, valid, and reliable for the evaluation of Qol and FS in patients with IC and are applicable in a research setting. Future research is necessary for the validation of the Dutch VascuQol and ALDS in view of their longitudinal validity.

Conflict of interest None.

Appendix

See Table 5.

Table 5 ALDS: selection of 28 items for patients with intermittent claudication

	Are you able to	I can carry out the activity	I can carry out the activity with difficulty	I cannot carry out the activity	Not applicable	Linear transformed ALDS score
1	… ride a bike for at least 2 h?	☐	☐	☐	☐	89
2	… vacuum a flight of stairs?	☐	☐	☐	☐	87
3	… carry a shopping bag upstairs?	☐	☐	☐	☐	85
4	… fetch groceries for 3–4 days?	☐	☐	☐	☐	82
5	… go for a walk in the woods?	☐	☐	☐	☐	81
6	… travel by local bus or tram?	☐	☐	☐	☐	78
7	… walk for more than 15 min?	☐	☐	☐	☐	74
8	… walk up a hill or high bridge?	☐	☐	☐	☐	73
9	… to go shopping for clothes?	☐	☐	☐	☐	73
10	… go to a party?	☐	☐	☐	☐	70
11	… sweep the floor?	☐	☐	☐	☐	69
12	… walk up a flight of stairs?	☐	☐	☐	☐	65
13	… go to the bank or post office?	☐	☐	☐	☐	64
14	… walk down a flight of stairs?	☐	☐	☐	☐	62

Table 5 continued

	Are you able to	I can carry out the activity	I can carry out the activity with difficulty	I cannot carry out the activity	Not applicable	Linear transformed ALDS score
15	… go for a short walk (15 min)?	☐	☐	☐	☐	60
16	… cross the road?	☐	☐	☐	☐	58
17	… fetch a few things from the shop?	☐	☐	☐	☐	56
18	… dust?	☐	☐	☐	☐	50
19	… clean a toilet?	☐	☐	☐	☐	48
20	… move between two low chairs?	☐	☐	☐	☐	42
21	… put the washing up away?	☐	☐	☐	☐	40
22	… get in and out of a car?	☐	☐	☐	☐	39
23	… clear the table after a meal?	☐	☐	☐	☐	37
24	… prepare breakfast or lunch?	☐	☐	☐	☐	36
25	… wash up?	☐	☐	☐	☐	31
26	… put long trousers on?	☐	☐	☐	☐	24
27	… get out of bed into a chair?	☐	☐	☐	☐	18
28	… go to the toilet?	☐	☐	☐	☐	17

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