Eur J Vasc Endovasc Surg (2009) **37**, 56–61

Validation of the Dutch version of the Walking Impairment Questionnaire

M. Verspaget [a], S.P.A. Nicolaï [a], L.M. Kruidenier [a], R.J.Th.J. Welten [a], M.H. Prins [b], J.A.W. Teijink [a,*]

[a] *Department of Surgery, Atrium Medical Centre, Heerlen, The Netherlands*
[b] *Department of Epidemiology, Maastricht University/KEMTA, Maastricht, The Netherlands*

Submitted 22 August 2008; accepted 5 October 2008
Available online 12 November 2008

KEYWORDS
Walking Impairment Questionnaire;
Peripheral arterial disease;
Intermittent claudication

Abstract *Objectives:* The Walking Impairment Questionnaire (WIQ) is a frequently used questionnaire to evaluate patients with intermittent claudication (IC). The aim of this study is to validate the Dutch WIQ for the European situation using the metric system.
Design: Validation study.
Materials: After translation and cultural adaptation of the WIQ, 130 patients with IC completed the Dutch WIQ, the RAND-36, and the EuroQol questionnaire. Walking distances were determined by treadmill testing.
Methods: Correlations between the WIQ, the two quality of life questionnaires, and walking distances were calculated to determine validity. Reliability and internal consistency were determined using the intraclass correlation coefficient (ICC) and Cronbach's alpha, respectively.
Results: Significant correlations were found between the WIQ and the absolute claudication distance (ACD) (0.52), EuroQol (0.33) and seven domains of the RAND-36. Test–retest reliability expressed by the ICC was 0.89. The internal consistency determined by Cronbach's alpha was 0.92 for the total WIQ score. Furthermore, a lower WIQ score corresponds to a shorter ACD.
Conclusions: This study shows that the Dutch version of the WIQ using the European metric system is a valid, reliable and clinically relevant instrument for assessing walking impairment in patients with intermittent claudication.

* Corresponding author. J.A.W. Teijink, MD, PhD, Atrium Medical Centre, PO box 4446, 6401 CX Heerlen, The Netherlands. Tel.: +31 45766599; fax: +31 45 5766881.
E-mail address: j.teijink@atriummc.nl (J.A.W. Teijink).

1078-5884/$34
doi:10.1016/j.ejvs.2008.10.001

Introduction

Peripheral arterial disease (PAD) is a common manifestation of atherosclerosis affecting the abdominal aorta and peripheral arteries. The classic symptom of symptomatic PAD is intermittent claudication, which describes pain in one or both calves that relieves in rest and starts with walking. Intermittent claudication often results in an impairment of walking ability which can interfere with personal, social or occupational factors in daily life. Usually, treadmill testing is performed to assess the severity of walking impairment.[1] However, treadmill testing is time consuming, often not available and inconvenient. For this reason, Regensteiner (1990) developed the Walking Impairment Questionnaire (WIQ).[2] The WIQ is a short, easy to fill out questionnaire and evaluates the degree of walking impairment in patients with intermittent claudication on three domains; walking distance, walking speed and the ability to climb stairs. These three domains represent common daily activities that are frequently impaired in patients with symptomatic PAD and contribute to the degree of walking impairment. The WIQ is validated in the English and Spanish language in United States customary units (distances expressed as feet).[2–4] The goal of this study is to determine if the culturally adapted WIQ to the European metric situation in the Dutch language is a valid instrument for measuring walking impairment in patients with intermittent claudication.

Materials and methods

Patients and study design

One hundred and thirty consecutive patients with symptomatic PAD (according to Fontaine stage II) were included from a vascular outpatient clinical setting. Inclusion criteria were patients with a maximal walking distance $<$750 m assessed by a treadmill test. Exclusion criteria were patients unable to walk on a treadmill, patients with PAD according to Fontaine stage I, III or IV, patients with severe cardiopulmonary co morbidities (NYHA 3 or 4), patients with other co morbidities limiting walking ability or patients with insufficient knowledge of the Dutch language. Informed consent was obtained and the study was approved by the medical ethical committee of the Atrium Medical Centre Parkstad.

The concurrent validity was determined by comparing the WIQ with the walking distances defined as the absolute claudication distance (ACD) and functional claudication distance (FCD). The ACD represents the maximal possible walking distance. The FCD is defined as the moment the patient prefers to stop and would stop walking in daily life. A treadmill test with a constant speed of 3.2 km/h, starting at 0% incline increasing 2% every 2 minutes was performed to asses ACD and FCD.[5] To determine the construct validity patients were asked to fill out the WIQ and two quality of life questionnaires (RAND-36, EuroQol). For the test–retest reliability 30 patients filled out a second WIQ 2 days after filling out the first one.

WIQ

The WIQ is a short, easy to fill out disease specific questionnaire validated in patients with intermittent claudication.[2–4] It contains three domains measuring three important factors of walking impairment in symptomatic PAD patients; walking distance, walking speed and the ability to walk stairs.

The WIQ was translated according to Beaton's guidelines for the process of translation and cross-cultural adaptation of self-report measures.[6] The WIQ was independently translated into Dutch by two bilingual translators with the Dutch mother tongue and then translated back by two native English-speaking translators. Inconsistencies in translation among translators were resolved by discussion.

Cultural adaptation was necessary since the American WIQ investigates the walking distance domain with standard sized living blocks as reference for the distance of 300 feet (91.4 m). In Europe ''standard'' sized living blocks are not a common phenomenon, which implicates an impaired applicability of the directly translated WIQ regarding the European situation. Furthermore, United States customary units (feet) were translated into meters of the metric system. The authors formed a review committee which examined the translations and agreed on a final version which was culturally applicable and reflected the intent of the instrument.

For each domain separately, a sub score of the Likert items was calculated with a Likert scale.[7] The total WIQ score was the mean of the three subscores.

RAND-36

The RAND-36 is more commonly known as the Short Form 36 (SF-36), which uses a slightly different scoring algorithm than the SF-36.[8] The RAND-36 is a multidimensional generic quality of life questionnaire assessing change in health and eight health domains: physical functioning, social functioning, physical role impairment, emotional role impairment, mental health, vitality, pain and general health experience. The change in health is evaluated in a separate question with standardised response choices. The scores are summed up and transformed to a scale ranging from 0 to 100 for every domain separately. A higher score means a better health condition. In our study a validated Dutch RAND-36 was applied.[9–11]

EuroQol

The EuroQol is a short questionnaire containing five questions with three possible answers. Each question encloses one quality of life dimension: mobility, self care, daily activities (e.g. work, study, domestic and creative activities), pain or other complains and fear or depression. A formula converts the quality of life description into a total quality of life score which is based on judgements of the total general population.[12]

Measurements methods

A test is useful when it measures what it is intended to measure (validity) and when the results stay consistent across repeated measurements over time (reliability).

To determine the reliability of the WIQ, internal consistency and test–retest reliability were calculated. The internal consistency measures the degree of homogeneity of a scale based on the correlation between each of the items and the correlation between the items and the total score. The test–retest reliability is estimated by performing the questionnaire twice. The correlation between the two questionnaires is used as a quantitative measure. In this study the patient was asked to fill out a second WIQ 2 days separated from the first WIQ; a period long enough not to remember the exact answers from the first time and short enough not to expect a therapy effect.[13]

Validity was determined by measuring the concurrent and construct validity. Concurrent validity measures the extent to which a new test correlates with a golden standard measuring the same construct, walking impairment. In this study, the correlation between the WIQ and the ACD and FCD assessed by a treadmill test were calculated.

The construct validity is determined if a golden standard is absent and compares the WIQ with other tests measuring the same construct. We compared the WIQ with two quality of life questionnaires, the RAND-36 and EuroQol, measuring the same construct, walking impairment.

Statistical evaluation

Walking distances and the ankle brachial index (ABI) were presented as median and inter-quartile-range (IQR) since they were not normally distributed. Means are reported to enable the comparison of results of this study with results known from the literature. The internal consistency was measured by calculating the Cronbach's alpha. A widely accepted cut-off is set between 0.7 and 0.9 for a set of items to be considered a scale.[14] Test–retest reliability was assessed by the intraclass correlation coefficient (ICC) of absolute agreement based on a two way mixed model with 95% confidence interval (CI).[15]

Correlations between the WIQ, the two quality of life questionnaires and treadmill walking distances were determined using Spearman correlation coefficients. Statistical analysis was performed with SPSS version 15.0 for windows.

Table 1 Baseline socio-demographic and clinical characteristics of the study participants ($n = 130$)

	Analysed population ($n = 130$)
Age (years) – mean (SD)	64.5 (10.1)
Men – *n* (%)	82 (63)
Body mass index – mean (SD)	27.1 (4.6)
Current smokers – *n* (%)	78 (60)
Former smokers – *n* (%)	46 (35.4)
Never smoked – *n* (%)	6 (4.6)
Packyears – mean (SD)	38 (24.1)
Hypertension – *n* (%)	87 (66.9)
Diabetes mellitus – *n* (%)	33 (25.4)
Coronary heart disease – *n* (%)	28 (21.5)
Stroke or transient ischaemic attack (TIA) – *n* (%)	18 (13.8)
Chronic obstructive pulmonary disease – *n* (%)	34 (26.2)
Ankle brachial index	
Median (IQR)	0.70 (0.57 – 0.83)
Mean (SD)	0.70 (0.18)
Peripheral vascular intervention – *n* (%)	47 (36.2)
Percutaneous transluminal angioplasty – *n* (%)	44 (33.8)
Bypass – *n* (%)	12 (9.2)
Thrombo endarteriectomy – *n* (%)	6 (4.6)
Total score WIQ – mean (SD)	0.43 (0.22)
Functional claudication distance	
Median (IQR)	165 (110 – 230)
Mean (SD)	194.2 (123.3)
Absolute claudication distance	
Median (IQR)	240 (160 – 360)
Mean (SD)	272.1 (151.3)

Results

Study population

One hundred and thirty patients with symptomatic PAD were included in this study with a mean age of 64.5 (SD 10.1). Sixty-three percent of the patients included were

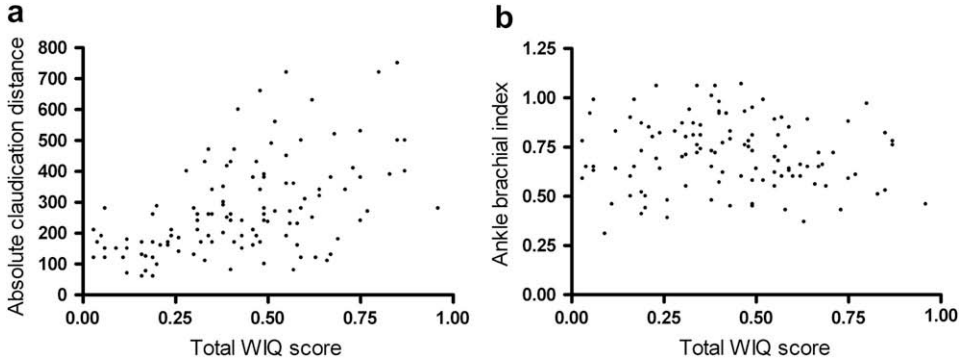

Figure 1 (a) The total WIQ score plotted against the absolute claudication distance. (b) The total WIQ score plotted against the ankle brachial index.

Table 2 Test–retest reliability ($n = 30$)

WIQ	Baseline mean (SD)	Retest mean (SD)	Change of scores mean (SD)	Test–retest (intraclass correlation coefficient)	95% confidence interval
Distance	0.35 (0.26)	0.37 (0.25)	0.01 (0.18)	0.785	0.56–0.90
Speed	0.39 (0.22)	0.47 (0.25)	−0.04 (0.15)	0.797	0.60–0.91
Stair climbing	0.54 (0.31)	0.53 (0.27)	−0.06 (0.19)	0.751	0.51–0.88
Total score	0.43 (0.22)	0.44 (0.22)	−0.03 (0.11)	0.890	0.76–0.95

male. Forty-four (33.8%) patients underwent a percutaneous transluminal angioplasty (PTA), 12 (9.2%) patients received a bypass and six (4.6%) patients had a thrombo endarteriectomy (TEA), previously. While several patients underwent more than one vascular intervention, a total of 47 (36.2%) patients had (multiple) peripheral arterial surgery in their history. The median lowest ABI was 0.70 (IQR 0.57– 0.83) and the median FCD and ACD were 165 m (IQR 110– 230) and 240 m (IQR 160– 360) , respectively. The mean total score of the WIQ was 0.43 (SD 0.22). Other baseline socio-demographic and clinical characteristics of the patients are shown in Table 1. In Fig. 1a,b the total WIQ scores of the individual patients are plotted against the ACD and the ABI, respectively.

Internal consistency and reliability

At baseline all patients filled out the WIQ with a mean total score of 0.43 (SD 0.22). The internal consistency was 0.91 for the distance domain, 0.81 for the speed domain, 0.86 for the stair climbing domain, and 0.92 for the total WIQ score. This implicates a sufficient homogeneity of all the individual domains as well as the total questionnaire. Thirty patients completed the WIQ at baseline and 2 days later to determine the test–retest reliability expressed by the ICC. For the individual WIQ domains the ICC varies between 0.75 and 0.80, the ICC of the total WIQ score was highest (0.89) indicating a good test–retest reliability. Table 2 summarizes these results.

Validity

The concurrent validity as determined by the correlation between the WIQ and the FCD and ACD showed a fairly strong association. The correlation coefficients were 0.52 for the total WIQ score compared with the ACD and 0.48 between the WIQ and the FCD. Correlation coefficients for all WIQ domains are presented in Table 3.

Table 3 Concurrent validity; Spearman correlation coefficients between WIQ, functional claudication distance and absolute claudication distance with p-values ($n = 130$)

WIQ	Functional claudication distance	Absolute claudication distance
Distance	0.43 (<0.01)	0.45 (<0.01)
Speed	0.45 (<0.01)	0.43 (<0.01)
Stair climbing	0.32 (<0.01)	0.37 (<0.01)
Total score	0.48 (<0.01)	0.52 (<0.01)

The walking distances in relation to the total WIQ scores divided into tertiles are given in Table 4. Lower scores of the WIQ correspond with shorter walking distances and higher scores with longer walking distances.

The construct validity based on the correlation between the WIQ and other questionnaires measuring the same construct, showed highest Spearman correlation coefficients between the WIQ and the RAND-36 for the subscales physical functioning (rho 0.70) and pain (rho 0.35). Correlation coefficients between the WIQ and the EuroQol varied between 0.26 and 0.33. Table 5 presents a detailed overview of the correlations of all WIQ domains, RAND-36 and EuroQol.

Discussion

Our results demonstrate that the Dutch version of the WIQ, using the European metric system, is an internally consistent, reliable and valid questionnaire for the evaluation of walking impairment in patients with intermittent claudication. This implies that the Dutch WIQ can easily (with the forward–backward method according to Beaton) be translated for other European countries without further need for cultural adaptation.

By comparing our results with the literature we found that none of the prior studies calculated a total WIQ score, which means there are no directly comparable results available. For the concurrent validity (total WIQ score compared with treadmill testing), we found a correlation coefficient of 0.52 for the ACD. Regensteiner et al. developed and validated the WIQ in the English language in a small population of 26 patients and reported a significant correlation of 0.68 between the distance domain of the WIQ and the ACD.[2] Quantitative measures (ABI, ACD and self-selected treadmill pace) were compared with qualitative measures (WIQ and SF-36) by Myers et al.[16] Correlations of 0.43, 0.41 and 0.39 were reported for the WIQ distance, speed and climbing the stairs domains, respectively in

Table 4 Tertiles of the WIQ compared with the mean functional claudication distance and absolute claudication distance ($n = 130$)

WIQ total score in tertiles	Functional claudication distance (m) – mean (SD)	Absolute claudication distance (m) – mean (SD)
0.00 – 0.33	128.7 (65.3)	178.9 (81.9)
0.34 – 0.51	198.1 (106.7)	295.0 (133.2)
0.52 – 0.96	263.4 (161.3)	351.9 (181.0)

Table 5 Construct validity; Spearman correlation coefficients between WIQ, EuroQol and RAND with *p*-values ($n = 130$)

		WIQ distance	WIQ speed	WIQ stairs	Total
RAND-36					
Functional status	Physical functioning	0.513 (<0.01)	0.557 (<0.01)	0.615 (<0.01)	0.697 (<0.01)
	Social functioning	0.091 (0.32)	0.144 (0.11)	0.117 (0.19)	0.108 (0.25)
	Role impairment (physical)	0.228 (0.01)	0.281 (<0.01)	0.244 (<0.01)	0.273 (<0.01)
	Role impairment (emotional)	0.140 (0.13)	0.210 (0.02)	0.187 (0.04)	0.197 (0.03)
Welbeing	Mental health	0.188 (0.04)	0.191 (0.04)	0.159 (0.08)	0.184 (0.05)
	Vitality	0.202 (0.03)	0.222 (0.02)	0.241 (<0.01)	0.251 (<0.01)
	Pain	0.338 (<0.01)	0.351 (<0.01)	0.267 (<0.01)	0.352 (<0.01)
General evaluation	General health experience	0.262 (<0.01)	0.215 (0.02)	0.169 (0.06)	0.267 (<0.01)
Health	Change in health	0.165 (0.07)	0.143 (0.12)	0.207 (0.02)	0.181 (0.05)
EuroQol		0.324 (<0.01)	0.287 (<0.01)	0.256 (<0.01)	0.328 (<0.01)

comparison with the ACD. Furthermore, the WIQ is validated in a heterogeneous group of patients with and without PAD and correlations of 0.56 between the WIQ distance score and the 6-minute walk score, and correlations of 0.53 between the WIQ speed score and the 4 min usual pace score were reported.[3] A possible explanation for the slightly lower correlation coefficients found in our study in comparison with Regensteiner et al.[2] could be the cultural adaptation in which ''American feet'' were translated into meters and where ''standard size living blocks'', which are not a common phenomenon in Europe, could not be incorporated into the Dutch questionnaire as a reference for the distance.

A limitation of our study is the fact that the WIQ was compared with walking distance as measured on a treadmill and not with the actual walking distance of a patient in daily life. Although treadmill testing has face validity for walking ability, great variation between the subjective walking distance and the walking distance as measured on a treadmill[17,18] has been demonstrated. Hence, the real golden standard for determining the concurrent validity would be a test with a patient walking on the street. However, the American College of Sports Medicine recommend to evaluate PAD patients with a graded or a gradual ramp protocol on a treadmill.[1] In our study we partially covered this problem by additionally measuring the construct validity.

The correlation coefficients representing the construct validity between the WIQ and the RAND-36 were 0.70 and 0.35 for the subscales physical functioning and pain, respectively. The correlation between the total WIQ score and the EuroQol was 0.33. We found comparable results for the separate WIQ domains in the literature.[4,16]

Our study shows that the WIQ can be of use in properly designed clinical trials evaluating therapy effect in PAD patients and in an outpatient clinical setting to evaluate the degree of walking impairment. This is demonstrated by dividing total WIQ scores into tertiles, where lower scores of the WIQ correspond with shorter walking distances and higher scores with longer walking distances. This implies that the WIQ gives an impression of functional capacity. It would be interesting to know if the Dutch WIQ is able to detect the effect of conservative or invasive therapy.

We conclude that the Dutch version of the WIQ using the European metric system is a valid and reliable instrument for assessing walking impairment in patients with intermittent claudication.

References

1 *American College of Sports Medicine. ACSM's guidelines for exercise testing and prescription*. 7th ed. Baltimore: Lippincott Williams and Wilkins; 2006.

2 Regensteiner JG, Steiner JF, Panzer RJ, Hiatt WR. Evaluation of walking impairment by questionnaire in patients with peripheral arterial disease. *J Vasc Med Biol* 1990;**2**(3):142—52.

3 McDermott MM, Liu K, Guralnik JM, Martin GJ, Criqui MH, Greenland P. Measurement of walking endurance and walking velocity with questionnaire: validation of the walking impairment questionnaire in men and women with peripheral arterial disease. *J Vasc Surg* 1998;**28**(6):1072—81.

4 Collins TC, Suarez-Almazor M, Petersen NJ, O'Malley KJ. A Spanish translation of the Walking Impairment Questionnaire was validated for patients with peripheral arterial disease. *J Clin Epidemiol* 2004;**57**(12):1305—15.

5 Gardner AW, Skinner JS, Cantwell BW, Smith LK. Progressive vs single-stage treadmill tests for evaluation of claudication. *Med Sci Sports Exerc* 1991;**23**(4):402—8.

6 Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine* 2000;**25**(24):3186—91.

7 Likert R. Technique for the measurement of attitudes. *Arch Psychol* 1932;**140**:1—55.

8 http://www.sf-36.org/faq/generalinfo.aspx.

9 Ware Jr JE, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care* 1992;**30**(6):473—83.

10 van der Zee KI, Sanderman R. *Het meten van de algemene gezondheidstoestand met de RAND-36: een handleiding*. Groningen: Noordelijk centrum voor gezondheidsvraagstukken/Rijksuniversiteit Groningen; 1993.

11 Aaronson NK, Muller M, Cohen PD, Essink-Bot ML, Fekkes M, Sanderman R, et al. Translation, validation, and norming of the Dutch language version of the SF-36 Health Survey in community and chronic disease populations. *J Clin Epidemiol* 1998;**51**(11):1055—68.

12 The EuroQol Group. EuroQol — a new facility for the measurement of health-related quality of life. *Health Policy* 1990;**16**(3):199—208.

13 Streiner DL, Norman GR. *Health measurement scales; a practical guide to their development and use*. New York: Oxford University Press; 2003.
14 Bland JM, Altman DG. Cronbach's alpha. *BMJ* 1997;**314**(7080): 572.
15 McGraw KO, Wong SP. Forming inferences about some intraclass correlation coefficients. *Psychological Methods* 1996;**1**(1):30—46.
16 Myers SA, Johanning JM, Stergiou N, Lynch TG, Longo GM, Pipinos II. Claudication distances and the Walking Impairment Questionnaire best describe the ambulatory limitations in patients with symptomatic peripheral arterial disease. *J Vasc Surg* 2008;**47**(3):550—5.
17 Siggaard-Andersen J, Petersen FB. Intermittent claudication. A comparison between subjective and measured claudication walking distance. *Angiology* 1968;**19**(7):426—34.
18 Watson CJ, Phillips D, Hands L, Collin J. Claudication distance is poorly estimated and inappropriately measured. *Br J Surg* 1997; **84**(8):1107—9.