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ORIGINAL REPORT

RELIABILITY AND VALIDITY OF THE PAD QUESTIONNAIRE: A MEASURE TO ASSESS PAIN-RELATED DECLINE IN PHYSICAL ACTIVITY

Jeanine A. Verbunt, MD, PhD

From the Rehabilitation Foundation Limburg, Hoensbroek, The Netherlands

Objective: **To examine the reliability and validity of the physical activity decline (PAD) score: a measure for assessing a decline in the level of physical activity in patients with chronic pain.**
Design: **This study was embedded in a prognostic cohort study based on an inception cohort of patients with subacute low back pain.**
Patients: **Sixty-two patients who developed chronic pain participated in this study.**
Methods: **Internal consistency was expressed by Cronbach's alpha and the test-retest reliability was based on an intraclass coefficient (ICC) score. Construct validity was determined using a Pearson correlation coefficient with disability (Quebec Back Pain Disability Scale), a change in physical activity level (ΔBPAQ) as external criteria for convergent validity. The level of physical activity (Physical Activity Rating Scale) was used as external criterion for discriminant validity.**
Results: **The internal consistency (Cronbach's alpha = 0.92) and reliability (ICC = 0.93) of PAD were shown to be good. The construct-validity of the PAD questionnaire appeared to be adequate, with Pearson coefficients of $r = 0.45$ ($p < 0.01$; a change in BPAQ), $r = 0.55$ ($p < 0.01$; disability) and $r = 0.03$ ($p = 0.74$; physical activity). Based on the fact that 38.7% of the patients had the lowest score of 0, the presence of a floor-effect in the PAD score must be considered.**
Conclusion: **The reliability and validity of the PAD questionnaire in its original Dutch version appears to be good. Further research is warranted regarding the presence of a floor-effect.**

Key words: physical activity, pain, psychometric properties.

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Correspondence address: J. A. Verbunt, Rehabilitation Foundation Limburg, PO Box 88, NL-6430 AB Hoensbroek, The Netherlands. E-mail: j.verbunt@srl.nl

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INTRODUCTION

Activity intolerance is a problem often reported by patients with chronic low back pain (CLBP). As a result of the back pain, they perceive a disabling reduction in their level of physical activity. Although this reduction in activity is a frequently reported complaint of patients in clinical practice, in scientific studies addressing physical activity in daily life of patients with pain, activity reduction is not unanimously confirmed. Most studies focusing on this subject compared the level of physical activity of patients with that of healthy individuals. Although Nielens & Plaghki (1) indeed reported a mean level of physical activity of patients with CLBP that was lower than that of healthy controls, Protas (2) and Verbunt et al. (3) reported patient activity levels similar to that of healthy individuals.

If, however, patients report activity intolerance and associated disability, it is unlikely that they compare their physical activity level with that of others, which was the strategy in most studies. It seems more likely that their evaluation of the impact of pain is based on a comparison between their current level of physical activity and their habitual level of physical activity before the back pain started. In making such a comparison, their judgement is likely to be based on a decline in the level of their daily activities due to pain rather than on their actual physical activity level. Physical activity decline (PAD) can be defined as a person's decrease in level of physical activity compared with their activity level before the onset of pain, as perceived by the patient. Therefore, in accordance with clinical practice, research on the role of physical activity and disability in back pain might benefit from the assessment of the individual's *decline* in level of physical activity over time (PAD) due to a pain problem, rather than his or her *actual* level of physical activity.

In an earlier study, the concept of a PAD was used in patients with subacute low back pain (4). In this study, PAD was assessed by questionnaire. Patients were asked to rate how often they had performed 20 activities in the last 2 weeks. In addition, they were asked to indicate, for every activity, if they would have performed this specific activity more often if they did not have back pain. The total score for all 20 activities represents the PAD score. It was shown that patients who were afraid of injury perceived a higher decline in their habitual activity level after pain onset and consequently felt more disabled. PAD appeared to be a mediator in the association fear of injury and disability in patients with subacute pain. Based on this finding, PAD seemed to fit in the concept of the fear avoidance model; a theoretical model explaining why patients with more fear of injury feel more disabled based on avoidance of activities that they think that will be harmful (5). In this study it was also found that a low level of physical activity or of physical fitness are not necessarily disabling, whereas a large decline in physical activity after the onset of back pain is disabling. This research finding, together with the analogy of PAD with a patient's daily life situation, seem to favour the validity of the

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concept of PAD. However, although this measure for a PAD was used in the presented study in 2005, the psychometric properties of the PAD questionnaire are still unknown.

The purpose of the current study was to evaluate the psychometric properties of the original Dutch version of the PAD questionnaire, as expressed by its internal consistency, test-retest reliability, construct validity and the presence of floor- and ceiling-effects in patients with CLBP.

METHODS

Patients

Patients participating in the current study all had chronic non-specific low back pain. They all participated in a prognostic cohort study on low back pain, as reported by Bousema et al. (6). In this cohort study, 124 patients who had had non-specific low back pain for only 4–7 weeks were included based on referral from their general practitioner or in response to an advertisement in a local newspaper. A detailed description of the inclusion procedure is presented in Bousema et al. (6). All cohort patients were followed during the first year after the onset of pain. After one year, 106 of the 124 initial cohort participants attended the follow-up assessment. Of the total number of patients, 67.9% (62/106) reported still having back pain one year after inclusion. These 62 patients with CLBP eventually formed the study population of the current study (Fig. 1). All patients gave their informed consent to participate in the study. The experimental protocol was approved by the medical ethics committee of the Rehabilitation Foundation Limburg and the Institute for Rehabilitation Research, Hoensbroek, The Netherlands.

In order to measure a decline in the level of physical activity, a new score for a PAD was introduced: the PAD score. The PAD score is calculated based on the scores on an instrument, added to an existing assessment instrument scoring the level of physical activity level: the Physical Activity Rating Scale (PARS; 7).

Physical activity level

The level of physical activity in daily life was measured used the PARS (7). In the PARS 20 different regular daily activities are presented. Examples of activities are: 1 hour walking, 4 hours working, climbing 2 stairs and 1 hour shopping. For each activity, patients are asked to indicate how frequently they had performed the specified activity in the last 2 weeks using the following response categories: never, seldom (1–2 times a week), occasionally (3–4 times a week), often (5–6 times a week) and very often (daily). The unweighted mean score of the 20 items is calculated to represent the total PARS score.

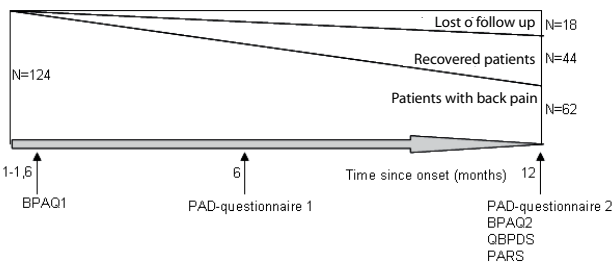

Fig. 1. The first year after the onset of pain: the number of patients in pain and the timing of the assessment instruments. PAD: physical activity decline; QBPDS: Quebec Back Pain Disability Scale; PARS: Physical Activity Rating Scale.

Physical activity decline

For the measurement of a decline in the level of physical activity a dichotomous scale was added to the PARS to give a PAD score. After rating their level of physical activity on one of the 20 activities presented in the PARS, an additional question was asked per item: patients were asked if they would have performed this specific activity more often if they did not have back pain. If the answer was yes for a specific item, the score for that item was 1. If the answer was no, the score for that item was zero. The total sum score for 20 activities resulted in the PAD score presenting a decline in the level of physical activity after the onset of pain as perceived by the patient. The theoretical range of the PAD score is 0–20. The PAD score was calculated twice for patients with CLBP: 6 and 12 months after the onset of the current pain-episode as a result of which patients were included in this study. The original PARS with the additional PAD score in the Dutch language were used in this study. In the appendix, a version of the PARS with an additional PAD score translated into English is presented.

Fig. 1 gives an overview of the timing of the different assessment instruments.

Statistical analysis

Reliability: test- retest reliability. To assess the test-retest reliability of the PAD score, an intraclass coefficient (ICC) with 95% confidence interval was calculated between 2 PAD scores in the chronic phase of pain (6 and 12 months after pain onset).

Reliability: internal consistency. Internal consistency indicates the degree of homogeneity among the items in an instrument. Internal consistency of the PAD score was calculated using Cronbach's alpha.

Validity: construct validity. Due to the absence of a gold standard to measure a decline in activity, construct validity was examined. Construct validity is concerned with the extent to which a particular measure relates to other measures consistent with theoretically derived hypotheses for the constructs that are being measured (8). The construct validity of the PAD was determined by comparing the score on the PAD questionnaire 12 months after pain onset with 3 criterion variables.

Two criterion variables are used to address convergent validity of the PAD questionnaire.

1. Change in the habitual activity level (ΔBPAQ). To assess a change in the habitual activity level the Baecke Physical Activity Questionnaire (BPAQ) was performed twice: in the subacute phase of back pain (BPAQ1) onset and after 12 months (BPAQ2) (9). The BPAQ consists of 3 indices of habitual physical activity: the occupational activity index; the sport activity index; and the leisure-time activity index. The test-retest reliability of the subscales of the BPAQ was assessed as 0.80 for the work, 0.90 for the sport, and 0.74 for the leisure-time index in healthy individuals (9). Validity of the BPAQ in healthy individuals was assessed based on a comparison with the criterion variable labelled water technique, resulting in an r of 0.69 ($p < 0.001$) (10). In patients with CLBP the test-retest reliability of the 3 subscales of the Baecke varied from 0.77 to 0.90 (11). The time-frame of the BPAQ is one year. To score the BPAQ1, patients had to recall their physical activity level during one year directly before the current back pain episode started. For this purpose the original BPAQ was transformed in the past tense. To calculate a change in the habitual activity level one year after the onset of pain BPAQ2 is subtracted from BPAQ1, resulting in ΔBPAQ.

2. Pain-related disability. Low back pain disability was assessed using the Quebec Back Pain Disability Scale (QBPDS) 12 months after the onset of pain (12). The QBPDS contains 20 items. Each item is scored from 0 (No difficulty performing this activity) to 5 (Impossible to perform this activity) and the final QBPDS score is expressed with a higher number indicating greater disability. The test-retest reliability

of the QBPDS appeared to be 0.92 in its original version (12) and 0.90 in the Dutch version (13). The construct validity of the QBPDS Dutch version appeared to be 0.80 as tested with its criterion variable Roland Disability Questionnaire (13).

In addition, discriminant validity is tested by comparing the PAD score with the score on PARS expressing the physical activity level.

To evaluate the construct validity of the PAD score, Pearson's correlation coefficients between PAD and, consecutively, ΔBPAQ, QBPDS and PARS were calculated.

Floor- and ceiling- effects. Floor- and ceiling-effects were considered for the total PAD score if more than 15% of the respondents achieved the highest or lowest possible score (14). The presence of floor- and ceiling-effects may influence the reliability, validity and responsiveness of an instrument.

In addition, per PAD item, the percentage of patients who answered positively was calculated in order to evaluate PAD items of low discriminant value.

All statistical analyses were performed using SPSS software (SPSS Inc., Chicago, IL, USA) version 14.

RESULTS

Population

A total of 62 patients developed CLBP and the data for these patients were used for establishing psychometric properties of the measure for the PAD score. The demographic characteristics of the participating patients are presented in Table I. The demographic characteristics of patients who entered the study referred by a general practitioner or in response to an advertisement did not differ significantly. Therefore, data were pooled.

Reliability

Test-retest reliability. The ICC of both PAD scores was 0.93, with a 95% confidence interval of 0.88–0.96.

Internal consistency. The Cronbach's alpha of the total PAD score was 0.92, indicating that the internal consistency was adequate.

Table I. *Characteristics of patients who developed chronic low back pain (n = 62)*

	n (%)
Gender	
Male	32 (51.6)
Female	30 (48.4)
Education	
Primary school	5 (8.1)
Lower vocational	20 (32.3)
Intermediate vocational	23 (37.1)
Higher vocational	12 (19.4)
University	2 (3.1)
Employment status	
Paid job	44 (71.0)
Sick leave*	8 (18.2)
Disability pension (full or partial)	5 (8.1)

*Percentage and number of patients on sick leave expressed as a percentage of 44 patients with a paid job.

Construct validity

Results concerning the construct validity of the PAD questionnaire are presented in Table II.

The association between PAD and ΔBPAQ was significant, with a Pearson correlation coefficient of 0.45 ($p < 0.01$). The Pearson correlation coefficient expressing the association of PAD with QBPDS was even higher (0.53 $p < 0.01$). The association between PARS and PAD appeared to be insignificant, with a score of 0.05 ($p = 0.74$).

Floor- and ceiling-effects

Twenty-four (38.7%) of the total number of patients scored 0 on the PAD questionnaire, which is the lowest possible score. These score indicated that these patients showed no decline in activity. Only 2 patients (3.2%) scored the highest possible score, which is 20.

Per item analysis revealed that only 2 of the 20 items were scored positive by less than 15% of the respondents. These items were item 8: "travelling by train or bus for one hour" and item 12: "reading a newspaper".

DISCUSSION

Based on the results of this study of the psychometric properties of the PAD score, it can be concluded that this questionnaire has adequate reliability and validity. However, in the current version of the PAD score, a possible floor-effect has to be considered.

Methodological considerations

A first shortcoming of this study is the fact that no gold standard is available for measuring the validity of the PAD score. As a result of this, the construct validity of the PAD score was calculated. However, based on the fact that the current study was embedded in a prognostic cohort study, differences in Baecke score before and after the onset of pain could be calculated, resulting in a score that is, in theory, close to the concept of PAD. This calculation of a change in BPAQ score before and after the onset of pain would not have been possible in a cross-sectional study. Because this study is implemented in a prognostic cohort study there was the opportunity to test the construct validity of the PAD score.

Table II. *Construct validity of physical activity decline (PAD); association of PAD with the criterion variables ΔBPAQ, QBPDS and PARS (n = 62)*

	PAD	ΔBPAQ	QBPDS	PARS
PAD	–	0.45**	0.53**	0.05
ΔBPAQ	–	–	0.40**	–0.06
QBPDS	–	–	–	–0.02
PARS	–	–	–	–

*$p < 0.05$; **$p < 0.01$.

ΔBPAQ: a change in physical activity level; QBPDS: Quebec Back Pain Disability Scale; PARS: Physical Activity Rating Scale.

A second shortcoming of this study is the rather small final population of 62 patients with CLBP. However, again, the current study could only be performed as a part of the original cohort study. For the calculation of ΔBPAQ a longitudinal study design in which patients were included in the short term after the onset of pain was necessary. From this perspective, the number of 62 patients out of a cohort of 124 is rather high.

A third shortcoming is the fact that the 2 assessments of the PAD score have a time interval of 6 months, which is a rather long period for reliability analysis. However, based on the ICC of 0.93 between both PAD assessments, it can be concluded that the PAD score does not vary much over time in a condition in which patients are already in a state of chronic pain. After having pain for some months, patients often find a way of dealing with the influence of pain on their activities, without any classification of the fact whether this is disabling or not. Bearing in mind the result of the reliability analysis, in our opinion the interval of 6 months between both assessments of the PAD score does not influence negatively the quality of the reliability analysis.

In this study the psychometric properties of the PAD score were evaluated and, based on the current analyses, it was shown that its internal consistency and reliability appeared to be good. However, in the validity analysis it was shown that PAD had only a moderate association with its criterion variables testing convergent validity: disability ($r = 0.53$) and activity change ($r = 0.45$). PAD appeared to have the highest association with disability. However, although the constructs of PAD and disability share many similarities, they are not identical. Disability has been defined by the World Health Organization (WHO) as any restriction or lack of ability to perform an activity in the manner or within the range considered normal for a human being (15). Pain-related disability questionnaires focus therefore on both a decrease in capacity in the performance and altered performance of regular activities of daily living in patients with pain. The concept of a PAD is defined as a decrease in the level of physical activity relative to a person's activity level before the onset of pain as perceived by the patient. PAD is therefore focused only on an individual change in the intensity of the physical activity level. If, for example, an activity can still be performed despite great difficulties due to back pain, this will influence a disability score, but will not influence PAD. Compromised performance of an activity can be disabling, but does not necessarily influence the PAD score. In our opinion, "activity intolerance" as reported by patients is better represented based on the concept of PAD compared with the concept of disability.

Although hypothesized before the start of the study as most important criterion variable, the association of the PAD score with the ΔBPAQ score was only 0.45. This could suggest that the influence of a patient's perception on changes in the activity level do not necessarily agree fully with real physical changes in the activity level based on physiological changes. This discrepancy between reported functioning and actual functioning was also addressed by Kremer et al. (16) They compared the level of physical activity as reported by patients with CLBP and as reported by their therapists simultaneously (16). Patients significantly underestimated their level of activity. In line with this finding, Schmidt (17) found that CLBP patients have difficulty in judging their own performance in an experimental setting. Patients were less capable of estimating their physiological level of exertion during a performance test than do healthy controls. Linton (18) found a relationship between the level of physical activity and pain intensity in global interview self-reports, but this relationship gradually disappeared when the measure of the level of physical activity became more overt and objective. Vendrig & Lousberg (19) confirmed this finding. The studies of Vendrig & Lousberg (19) and Linton (18) addressed assessment of physical activity based on self-report. When interpreting the data of the current study, the discrepancy between objective and self-report findings on physical activity and changes in physical activity have to be considered: data reflect a decline in activity as perceived by the patient instead of a decline in activity based on physiological changes. However, at this moment no objective measurement technique to assess a change in the level of activity other than self-report is available.

Based on the non-significant score of $r = 0.05$, it appeared that the discriminant validity of the PAD score is adequate. The PAD score measures a decline in activity instead of the actual level of physical activity.

A remarkable finding in this study is the fact that 38.7% of the patients had the lowest possible PAD score of 0. This finding could imply that a high number of patients in fact perceived no decline in their activity level. This finding would be in line with earlier studies in which no difference was shown between the physical activity level of patients with CLBP and healthy individuals (2, 3). An alternative explanation for the high number of patients scoring 0 could be the presence of a floor-effect in the PAD score, which implies that the PAD score is not sensitive enough to score a minimal decline in activity. Based on the results of the current study, no definite explanation can be given for the high number of 0-scores. Further research is warranted

Clinical implications

During a consultation in rehabilitation medicine it is important to objectify the daily activity level of a patient with pain. It is however also important to know the perceived change in a patients activity level as a result of pain, in order to be able to judge the impact of pain on a patient's daily life. With the PAD score a decline in activity due to pain can be assessed. It is, however, important in the current version of the PAD score to consider the possibility of the presence of a floor-effect in its scoring when interpreting the results.

Further development

Based on results of this study, the PAD score seems to be a promising score for assessing a decline in the level of physical activity in daily life of patients in pain. However, the assessment based on the PAD score needs further development. In particular, the possibility of a floor-effect within the measure has to be considered in a revised version of the PAD score. A further improvement could be a differentiation of the level of decline per item using a range score instead of using a

dichotomous variable per item. Another improvement could be the removal of non-discriminating items out of the total PAD score: *post hoc* analyses revealed that only 2 of the 20 items were scored positive by less than 15% of the respondents. These items were item 8: "travelling by train or bus for one hour" and item 12: "reading a newspaper". A revised version might consider excluding these items from the 20 items expressing the total PAD score. Further research to develop a final version of the PAD score is warranted.

In conclusion, the PAD questionnaire seems a promising instrument to assess a decline in the level of physical activity in daily life in patients with CLBP. Based on the results of this study the test-retest reliability, the internal consistency, and the convergent and discriminant validity of the PAD score are adequate. However, in the current version of the PAD score the presence of a floor-effect has to be considered. Further research is therefore warranted.

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APPENDIX

Questionnaire for Physical Activity Decline in pain (translated from Dutch)

In the following list a number of daily activities are presented. We ask you to indicate how often you performed these activities during *the last 2 weeks*. Mark 1 answer for every activity (do not skip any activity). You can choose 1 of the following possibilities:

I did not do this
I did this seldom (1–2 times a week)
I did this occasionally (3–4 times a week)
I did this often (5–6 times a week)
I did this very often (Every day)

We also want to know for every activity if you would have performed it more often without back pain.

Examples:

• Due to her back, Miss X seldom cycles. Before the onset of her back pain, she cycled every day. In answering this question, Miss X marks the answer YES. (She would have cycled more often if she did not have to consider her back).

• Mr Y goes shopping twice a week, regardless of his back complaints. He marks the answer NO. (He does not consider his back and goes shopping with the same frequency as before his back pain started.)

How often did you perform the following activities *during the last 2 weeks:*

	Never	Seldom 1–2 × times per week	Occasionally 3–4 × times per week	Often 5–6 × times per week	Very often Daily	Would you have performed this specific activity more often if you did not have to consider your back pain?
1 hour walking	☐	☐	☐	☐	☐	☐ yes ☐ no
4 hours working	☐	☐	☐	☐	☐	☐ yes ☐ no
Climbing 2 stairs	☐	☐	☐	☐	☐	☐ yes ☐ no
Doing the dishes for 30 minutes	☐	☐	☐	☐	☐	☐ yes ☐ no
Cut the grass for 15 minutes	☐	☐	☐	☐	☐	☐ yes ☐ no
Cycling for 1 hour	☐	☐	☐	☐	☐	☐ yes ☐ no
Driving a car for 1 hour	☐	☐	☐	☐	☐	☐ yes ☐ no
Travelling by train or bus for 1 hour	☐	☐	☐	☐	☐	☐ yes ☐ no
Visiting someone	☐	☐	☐	☐	☐	☐ yes ☐ no
Receiving visitors at your home	☐	☐	☐	☐	☐	☐ yes ☐ no
Swimming for 15 minutes	☐	☐	☐	☐	☐	☐ yes ☐ no
Reading a newspaper	☐	☐	☐	☐	☐	☐ yes ☐ no
Watching television for 2 hours	☐	☐	☐	☐	☐	☐ yes ☐ no
Having a day out (6–8 hours)	☐	☐	☐	☐	☐	☐ yes ☐ no
Shopping for 1 hour	☐	☐	☐	☐	☐	☐ yes ☐ no
Cleaning the car	☐	☐	☐	☐	☐	☐ yes ☐ no
1 hour cooking	☐	☐	☐	☐	☐	☐ yes ☐ no
Vacuum cleaning for 15 minutes	☐	☐	☐	☐	☐	☐ yes ☐ no
Household activities for 1 hour	☐	☐	☐	☐	☐	☐ yes ☐ no
10 minutes jogging or sports	☐	☐	☐	☐	☐	☐ yes ☐ no