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Do depression and pain intensity interfere with physical activity in daily life in patients with Chronic Low Back Pain?

Ivan P.J. Huijnen^{a,*}, Jeanine A. Verbunt^{a,b,c}, Madelon L. Peters^d, Philippe Delespaul^e, Hanne P.J. Kindermans^d, Jeffrey Roelofs^d, Marielle Goossens^d, Henk A.M. Seelen^{a,b}

^a Department of Rehabilitation Medicine, Research School CAPHRI, Maastricht University, P.O. Box 616, 6200 MD Maastricht, The Netherlands

^b Adelante Centre of Expertise in Rehabilitation and Audiology, P.O. Box 88, 6430 AB Hoensbroek, The Netherlands

^c Department of General Practice, Research School CAPHRI, Maastricht University, P.O. Box 616, 6200 MD Maastricht, The Netherlands

^d Department of Clinical Psychological Science, Maastricht University, P.O. Box 616, 6200 MD Maastricht, The Netherlands

^e Mental Health & NeuroSciences (MHeNS), Maastricht University, P.O. Box 616, 6200 MD Maastricht, The Netherlands

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ABSTRACT

Patients with chronic pain may have difficulties estimating their own physical activity level in daily life. Pain-related factors such as depression and pain intensity may affect a patients' ability to estimate their own daily life activity level. This study evaluates whether patients with Chronic Low Back Pain (CLBP) who are more depressed and/or report more pain indeed have a lower objectively assessed daily life activity level or whether they only perceive their activity level as lower. Patients with CLBP were included in a cross-sectional study. During 14 days physical activity in daily life was measured, with both an electronic diary and an accelerometer. Multilevel analyses were performed to evaluate whether a higher level of depression and/or pain intensity was associated with a lower objectively assessed activity level or the discrepancy between the self-reported and objectively assessed daily life activity levels. Results, based on 66 patients with CLBP (mean RDQ score 11.8), showed that the objectively assessed daily life activity level is not associated with depression or pain intensity. There was a moderate association between the self-reported and objectively assessed activity levels ($\beta = 0.39$, $p < 0.01$). The discrepancy between the two was significantly and negatively related to depression ($\beta = -0.19$, $p = 0.01$), indicating that patients who had higher levels of depression judged their own activity level to be relatively low compared to their objectively assessed activity level. Pain intensity was not associated with the perception of a patient's activity level ($\beta = 0.12$, ns).

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1. Introduction

The main aim of many pain rehabilitation programs is to improve a patient's daily life functioning. However, patients with chronic pain often have difficulties estimating their own level of physical activity in daily life [17]. This is supported by studies in which a less pronounced association is found between physical activity based on self-report and objective movement registrations in patients with Chronic Low Back Pain (CLBP) [30,31], whereas other studies report moderate to high associations in healthy individuals [21,23]. For patients with CLBP, a daily life activity measurement based on self-report can result in an incorrect presentation of their actual activity level [10,17].

In patients with chronic pain, several pain-related factors have been reported that have a negative influence on their self-reported

daily life activities. In previous studies, depression and pain intensity were found to be negatively associated with a patient's self-reported activity level [15,17]. However, in studies using objective measures for daily life activities no significant associations were found [11,31]. Furthermore, in patients with CLBP who had a lower score on the mental health domain of the SF-36 quality of life scale, a lower level of physical functioning was found compared to patients with a higher score on mental health, in spite of a comparable level of objective performance in the laboratory [32]. It may therefore be hypothesized that patients with CLBP who are more depressed underestimate their daily life activity level. This means that although depression may be associated with the perception of the level of physical activity this may not be the case for objectively assessed daily life activity level. Another potential influencing factor for a patient's perception of their daily life activity level is pain intensity. Patients with higher levels of pain reported to be less physically active [10,15]. However, in other studies in which physical activity was assessed with objective measures such as

* Corresponding author. Tel.: +31 455282381; fax: +31 455282348.

E-mail address: ivan.huijnen@maastrichtuniversity.nl (I.P.J. Huijnen).

accelerometry, physical capacity or physical performance measures, the association between physical activity and pain intensity appeared to be only weak or non-existent [1,9,19,25,31].

In this study, we test whether patients with CLBP who are more depressed and/or experience more pain have indeed a lower level of objectively assessed activity in daily life or whether they only judge their activity level as lower. We predicted that especially the discrepancy between the self-reported and objectively measured activity level would be influenced by pain and depression, with patients reporting more severe pain and higher levels of depression showing a relative underestimation of their objectively assessed physical activity.

2. Methods

2.1. Participants

This study included a subset of patients participating in a longitudinal cohort study, aiming at defining different activity-related strategies in patients with CLBP and testing a new theoretical model in which the role of self-discrepancies in explaining these different types of activity-related strategies will be evaluated. Inclusion criteria for this study were (a) low back pain: pain localized below the scapulae and above the gluteal folds for longer than 3 months [20], (b) age between 18 and 65, (c) no specific cause or strong suspicion of a specific cause, such as lumbar disc herniation with neurological complaints, major structural back abnormality, evidence of inflammatory, systemic or neoplastic disease, (d) agreement to participate in a daily life study, measuring daily life activity with both an accelerometer and a diary for 14 days. Exclusion criteria were (a) pregnancy, (b) non-fluency in Dutch, and (c) serious psychiatric diseases. Patients in the cohort study were included in two different ways: 81 patients were referred by consultants in rehabilitation medicine in the Southern part of The Netherlands (one rehabilitation centre, six hospital departments of rehabilitation) and 35 patients responded to an advertisement in a local newspaper. In case patients responded to the advertisement the above-mentioned selection criteria were checked by a consultant in rehabilitation medicine, who performed a medical screening according to the clinical guideline for low back pain of the Dutch College of General Practitioners [8]. The Medical Ethics Committee of the Maastricht University/University Hospital Maastricht, The Netherlands, approved the protocol.

2.2. Measures

2.2.1. Disability

Low back disability was assessed using the Roland Disability Questionnaire (RDQ) [26,27]. This questionnaire contains 24 items measuring limitations in different activities in daily life that can be answered by Yes or No. The item scores are summed resulting in total scores ranging from 0 to 24, with higher scores reflecting higher levels of disability. The Dutch version of the RDQ has a high reproducibility and validity and is responsive to change [5,12,18].

2.2.2. Habitual physical activity in daily life

To score the habitual physical activity level, which reflects the level of daily life activities during the last year, the Baecke Physical Activity Questionnaire (BPAQ) was used [2]. The BPAQ consists of three indices of habitual physical activity: the occupational activity index; sport activity index and the leisure time index. The reliability of the BPAQ in patients with LBP appears to be sufficient [16].

2.2.3. Pain intensity

Pain intensity was measured with three 100 mm Visual Analogue Scales (VAS; [24]). Patients were asked to rate their actual pain (at that moment) and their highest and lowest pain levels of the past week on three separate VAS scales. The mean of the three VAS scales was calculated to form a composite score, which was used in further analyses.

2.2.4. Depression

The level of depression was measured by the Beck Depression Inventory II (BDI-II; [4]). The BDI-II contains 21 items scored from 0 to 3. Total scores are obtained by summing the item scores resulting in total scores ranging from 0 (not depressed at all) to 63 (severely depressed). The questionnaire has good psychometric properties and is a valid questionnaire to measure the severity of depression in patients with chronic pain [3,14].

2.3. Physical activity assessment

2.3.1. Diary assessment of physical activity

To assess a patient's perception of his/her activity level an electronic diary was used. This self-assessment technique allows multiple random assessments based on the Experience Sampling Method (ESM) [6,7]. Based on this registration method, activity changes over time can be registered, which can overcome the recall bias of a questionnaire [29]. During a 14-day measurement period patients carried a palm-top computer (type palm m100) during waking hours. Patients were instructed that an alarm (beep) would randomly go off eight times a day and at that moment they had to fill in questions. Diary questions were presented on-screen for completion via a touch screen (50 × 50 mm) and entries were time and date stamped. A total number of 43 questions were included in each momentary assessment. Two self-constructed questions were directed to assess a patient's physical activity level. The first question was "Right now, I am active." Answer categories were presented in seven point Likert scales ranging from 1, "not at all" to 7, "very". The second question was "What was my effort between this and the previous beep?" Answer categories were 1, lying down; 2, sitting; 3, standing; 4, walking; 5, cycling; 6, sports; 7, sports vigorously. The maximum number of completed set of palm-top questions for the measurement period is 112. Patients were instructed to respond to as many beeps as possible.

2.3.2. Accelerometry

Physical activity in daily life was assessed by a tri-axial accelerometer (RT3; Stayhealthy Inc., Monrovia, USA). Subjects were instructed to wear the RT3 during waking hours for 14 consecutive days. The accelerometer was not worn during activities in case of potential damage to the equipment (e.g. contact sports, swimming or taking a shower). To be included as a valid score on physical activity in daily life, at least 5 valid measurement days, including 1 weekend day, had to be available [13]. A valid measurement day was defined as a registration period for at least 600 min (10 h). Acceleration signals from the three measurement directions (the sagittal, the mediolateral and the longitudinal axes of the trunk) were recorded. The 3D resultant of the acceleration signal was calculated and the number of occasions per minute (counts) on which this signal exceeded a predefined threshold was stored in a database within the accelerometer. Data processing was performed using MATLAB software (The Math Works Inc., Natick, MA). An algorithm was designed in which night time was identified and excluded for further analysis. In this algorithm first, a second order zero time lag low pass Butterworth filter was used to reduce signal noise. Next, a predefined threshold was determined

to identify start and endpoints in the activity signal. The original signal counts were used for further data processing. The activity signal was processed at the intervals that lay between subsequent beeps of the electronic diary.

2.4. Procedure

Prior to participation, all subjects were informed about the purpose of the study and signed a written consent form. Participants completed the self-report measures (containing assessment of disability, habitual physical activity, pain intensity and depression) in a paper-based or computerized internet-based questionnaire. Patients were explained that the interest of the study was to evaluate their daily life functioning and factors that influence their functioning. During a 14-day measurement period patients carried the accelerometer and the palm-top computer simultaneously during waking hours. A short training session on handling both the palm-top and the RT3 was given. During the measurement period stand-by assistance to handle technical problems was available.

2.5. Data reduction and analysis

Registration days were only included in case they contained both a valid registration of the accelerometer and the palm-top diary. To check this, first, every day was checked for the availability of a registration time of accelerometer-data of at least 600 min. Subsequently, an additional check was performed on the availability of at least 25 completed ESM reports for all registration days together in which at least 600 min are registered. For all assessment days that fulfilled both criteria, data of the first completed ESM report of that day were excluded from the final data-file, since answering a question concerning activities since the last beep, on that moment would include a timeframe in which patients were sleeping and not wearing the accelerometer. As a result of this, the maximum achievable number of completed ESM reports in the diary was 98.

In order to study if patients who are more depressed and experience more pain, also have a lower objectively measured activity

level, a two-level hierarchical linear regression analysis was performed. In multilevel modelling the repeated observations (in this model the processed activity signal of the accelerometer) are presented as Level 1 units. These observations were organized within Level 2 units, which constitute persons. A critical feature of Level 1 and Level 2 observations are the independency of Level 1 and Level 2 measurements. This method anticipates on the level of variation within and between patients. In the model physical activity based on accelerometry was the dependent variable and depression and pain intensity were the independent variables.

To analyse the association between the level of physical activity assessed by the diary and by the accelerometer again a two-level hierarchical linear regression analysis was performed. Since we have two diary questions measuring physical activity, two different models were built. In both models self-reported physical activity based on the diary was the dependent variable. The independent variable was physical activity assessed with an accelerometry.

In addition, in order to test the influence of both depression and pain intensity on the discrepancy between the self-reported and objectively assessed physical activity levels, these variables were introduced in a multilevel model. This procedure was performed separately for both diary questions on self-reported physical activity. In each model, the self-reported physical activity variable assessed with the diary and the objectively assessed physical activity variable assessed with the accelerometer were first standardized and then subtracted, resulting in a discrepancy score between the self-reported and objectively assessed level of physical activity in daily life. Both discrepancy scores were the dependent variable in two different models and in both models depression and pain intensity were the independent variables.

Multilevel modelling was performed using Stata 10 software (Stata Corp., 2007, College Station, Texas).

3. Results

One hundred and one patients (54 male/47 female) participated in this study and agreed to carry both the palm-top diary and the accelerometer for the assessment of physical activity. Mean age of

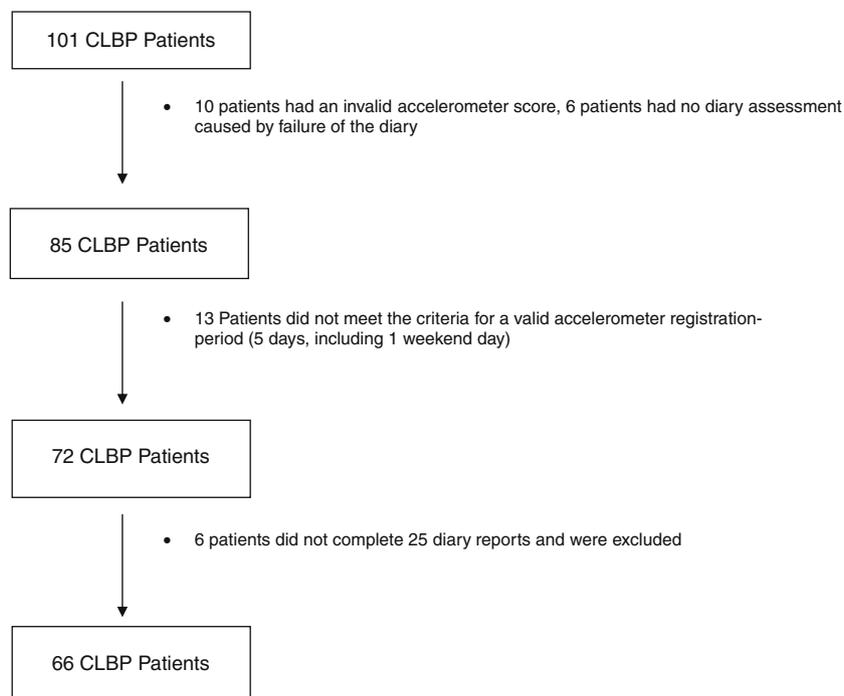


Fig. 1. Flow chart.

Table 1
Characteristics of the study population of patients with CLBP.

Male/female (N)	37/29
Age (years)	48.4 ± 9.9
Work status (N and percentage)	
Paid job	34 (52%)
Sick leave	3 (8%)
Disability payment	11 (17%)
Disability level (RDQ [*])	11.4 (4.5)
Depression (BDI-II ^{**})	11.0 (6.5–15.0)
Habitual activity level (BPAQ ^{***})	8.7 (7.6–9.8)

Normally distributed data are represented by a mean score (SD).

Not normally distributed data are represented by a median score (interquartile ranges).

* RDQ, Roland Disability Questionnaire.

** BDI-II, Beck Depression Inventory II.

*** BPAQ, Baecke Physical Activity Questionnaire.

this group was 47.0 years (SD = 11.0) and 47% had a paid job. Mean disability level was 11.8 (SD = 4.7). In Fig. 1, a flow chart is shown, representing the data of patients that were eventually used for further analysis in the current study. Overall, the 66 patients that met the criteria set for inclusion filled in 73.1% of electronic diary assessments. The median Baecke score of the 66 patients included in the final analyses was 8.7 (interquartile range 7.6–9.8). This score is comparable with scores of healthy Dutch individuals [2]. More characteristics of the 66 patients are presented in Table 1. Patients who did not meet the criteria to be included in the data analysis or dropped out of the final analysis due to failure of the diary or palm-top were not significantly different on gender or habitual physical activity level. However, patients who did not meet the criteria for a valid registration were significantly more disabled ($p = 0.05$). Furthermore, patients who had no registration caused by failure of either the diary or the accelerometer were significantly younger.

In Table 2, the multilevel analysis with the objective measured activity level as the dependent variable and depression, and pain intensity as independent variables is shown. No significant associations were found in this model. The association between the self-reported physical activity score based on the item “Right now, I am active.” and the objectively assessed activity level based on accelerometry was $\beta = 0.21$, $p < 0.01$ (Wald $\chi^2 = 174.94$, $p < 0.01$). The association between the item “What was my effort between this and the previous beep?” in the diary and the objectively assessed activity level was $\beta = 0.39$, $p < 0.01$ (Wald $\chi^2 = 694.75$, $p < 0.01$).

In Table 3, the multilevel analysis with the discrepancy between the self-reported activity score related to the question “What was my effort between this and the previous beep?” and the objectively measured activity level as the dependent variable and depression, and pain intensity as independent variables is shown. A significant association was found between depression and the discrepancy score ($\beta = -0.19$, $p = 0.01$), whereas pain intensity did not contribute significantly. In addition, the second model with the discrepancy between the score on the diary item “Right now, I think I am active.” and the objectively assessed activity level as dependent variable showed similar results. In this last model, the Wald χ^2 appeared to be 7.15, $p < 0.05$. Depression was found to be significantly associated with the discrepancy score ($\beta = -0.22$, $p = 0.01$) whereas pain intensity did not ($\beta = 0.14$, ns).

Table 2
Multilevel analysis with the objective activity in daily life level as dependent variable.

	Wald $\chi^2 = 3.22$, $p = 0.20$				
	Main effects	β	SE	Z	P
Objective activity level	Pain intensity	-0.08	0.06	-1.25	0.21
	Depression	0.10	0.06	1.69	0.09

Table 3
Multilevel analysis with the discrepancy between the self-reported activity level and the objectively assessed activity level as dependent variable.

	Wald $\chi^2 = 6.58$, $p < 0.05$				
	Main effects	β	SE	Z	P
Subjective–Objective activity level	Pain intensity	0.12	0.08	1.54	0.12
	Depression	-0.19	0.08	-2.50	0.01

4. Discussion

This study aimed at evaluating the extent to which higher levels of depression and pain experience are associated with a lower daily life activity level in patients with CLBP. Furthermore, the influence of pain intensity and depression on the discrepancy between the self-reported level of physical activity and the objective measured activity level was tested.

In this study, depression was not associated with the objectively assessed level of physical activity. But patients that were more depressed reported a relatively lower level of physical activity in daily life as compared to their actual level of physical activity. Consequently, depression was significantly associated with the discrepancy between self-reported and objectively assessed physical activity in daily life significantly. This finding seems in accordance with results of a study of Kremer et al. who found that patients who were more depressed underreported their activity level as compared to the observed activity level by staff members [17]. Furthermore, Wittink et al. found that the score on the mental health domain of the SF-36, measuring quality of life, of patients with CLBP was not associated with their performance on a treadmill, although patients with lower scores on the mental health domain reported a higher level of pain intensity and a lower level of physical functioning [32]. In contrast to the lack of association between depression and the objectively assessed daily life activity level in the present and another study [11], several studies reported a negative influence of depression on physical performance and physical capacity testing in patients with CLBP [1,22,28]. However, this negative influence of depression on physical activity measured in a standardized laboratory setting with a performance or capacity test could not be determined when physical activity is measured during actual daily life activities. Based on the findings of this study, it could be hypothesized that a depressed mood can distort a patients' view on his/her own activities. Although depression and actual level of daily life activity are not related, the influence of depression seems especially focussed on the discrepancy between perceived and actual level of physical activity. In interpreting this, it should however be taken into account that the median BDI-II score for depression in the current study was only 11.0 (interquartile range 6.5–15.0), which is below the cut-off score for moderate clinical depression of 20 [14].

Based on the results of the current study, it appeared that pain intensity was not associated with a patient's actual daily life activity level. Furthermore, we hypothesized that a higher score on pain intensity would distort a patient's view of their actual activity level, resulting in a higher discrepancy between actual and perceived level of physical activity. In earlier studies using self-report as outcome measure for physical activity, the association between pain intensity and physical activity was indeed found [10,15]. However, in studies using objective daily life activity measurements or performance testing as outcome assessments for physical activity these results could not be confirmed [1,9,19,25,31]. In the current study, both subjective and objective assessments of physical activity were included. The assumption that a higher level of pain intensity would have a negative impact on the discrepancy

between a patient's perception and the objectified registration of his/her level of physical activity in daily life could however not be confirmed based on these data.

In the current study, a diary assessment was used. A drawback of this assessment is that in one question limited information can be asked for. Therefore, in this study two questions that measure different aspects of physical activity in daily life were evaluated to answer the research questions. One diary question ("What was my effort between this and the previous beep?") asked for the quality of movements (such as walking and cycling), whereas the other question ("Right now, I am active.") asked for the level of intensity.

The current study has some limitations that have to be addressed. The first limitation is the absence of a continuous accelerometer registration due to swimming or being involved in contact sports. This means that the accelerometer has to be taken off which can result in an underestimation of a patient's actual activity level. In the current study, all patients were asked to register when they had to remove the accelerometer. Nine of the 66 patients reported indeed an interruption of their activity registration due to swimming or performing contact sports. Four of them removed the accelerometer for more than 4 h. Since it seemed highly unlikely that they were continuously swimming, imputation would have resulted in an overestimation of a patient's actual activity level. For the other 5 patients, data were imputed with two times the mean score per minute of the previous day which resulted in only a small increase of maximal 3%. Based on this, we eventually decided to abandon imputation for swimming or contact sports.

A second limitation is that the number of patients had to be excluded. The sample size was reduced to 66 patients. The data of 35 patients could not be used for the final analysis: 16 had an invalid RT3 score or problems with the electronic diary, and the data of 19 patients did not meet the predefined data selection criteria. In this study, it appeared that patients who had a registration that did not fulfill the data selection criteria were significantly more disabled. Focusing on this drop-out group revealed that two extreme disability scored 21, with a mean score of 11.4 (SD = 4.5) for the 66 included participants. As a result of this, inclusion of these two patients would disturb a valid presentation of an objective daily life activity level. Even though we used this strict criteria, the sample size in the present study is still higher than in other studies evaluating daily life activities in patients with CLBP [15,19,31].

This study has clinical implications. In evaluating a patient's level of activity based on self-report (for instance, as a part of an anamnesis during a clinical consultation or based on a questionnaire as a part of an assessment tool) differences between the activity level as reported by a patient and his/her actual level of physical activity have to be taken into account. Especially in patients who are depressed, an underestimation of a patient's actual activity level has to be taken in mind. Based on this, generalization of results on physical activity retrieved based on self-report to a situation of daily life functioning should be performed with caution. Furthermore, in evaluating treatment, it is important to measure physical activity in daily life objectively because changes in mood during therapy can also influence a patient's perception over time of his/her activity level.

In summary, in the current study it was shown that patients with CLBP, who had a higher level of depression, underestimated their daily activity level, although their actual activity level did not differ.

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