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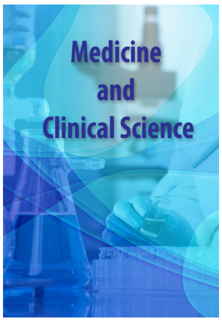
Original Article



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Physical activity, sedentary time and the psychological variables, pain-acceptance, fear-avoidance and self-efficacy after an interdisciplinary pain rehabilitation program – a pilot study

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Abstract

Background: Objective evaluation of physical activity (PA) and sedentary time (ST) is poorly researched in interdisciplinary pain rehabilitation (IPR) of chronic pain.

Purpose: The aim of this study was to evaluate PA and ST levels by accelerometry, as well as any correlation with the psychological variables pain-acceptance, fear-avoidance and self-efficacy after an IPR program.

Patients and methods: Analyses were conducted on 12 women participating in an IPR program. Measurements were made with accelerometer ActiLife GT3X and psychological questionnaires for pain-acceptance, fear-avoidance and self-efficacy before (M1), after the program (M2) and after follow-up (M3).

Results: There were no significant changes in PA or ST at group level between measurements. The median sedentary level was 67% of wearing time per day at all measurements. The distribution of time at M3 spent, in low PA was 2.1-8.4 hours/day, and in moderate-to-vigorous physical activity 2-62 min/day. Pain-acceptance and fear-avoidance were significantly improved at M3. There were no significant correlations between PA, ST and the psychological variables.

Conclusion: Most participants seemed to adhere to their existing management strategies with low PA level and high ST. PA and ST should be emphasized in pain rehabilitation and low active/high sedentary persons need to be identified early for targeted individualized treatment.

Introduction

Chronic pain causes major care-seeking, frequent sickness-leave and a significant socioeconomic burden for society [1,2]. Chronic pain is usually defined as pain lasting for more than three months. The reported prevalence of chronic pain is in western countries approximately 20% [3]. About one third of primary care visits in Sweden are related to pain, of which more than half are related to chronic [4].

Pain is a subjective experience affecting cognitive, emotional, behavioral and social aspects of individuals [5]. Pain is defined as ”an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage” [6]. The sensory element includes perception of pain intensity, duration and location. The emotional element focuses on the emotional impact of the pain experience and the cognitive aspect relates to past experiences and thoughts, which dictate choice of behaviors due to pain. The sensory element of pain seems to dominate during the acute phase of pain while the other elements are prominent during its chronic phase [7].

The traditional biomedical model fails to explain pain persisting in spite of absence of identifiable damage [8]. A biopsychosocial model has been introduced, based on a multifactorial perspective where psychological, biological and social factors interact with pain signals, to address this inadequacy [9]. Several psychological factors have been linked to the perception of and adjustment to chronic pain, that is, both included in pain perception and giving rise to secondary effects that may adversely affect patients with chronic pain struggling to become more active and participate in daily life [10,11].

Interdisciplinary Pain Rehabilitation (IPR) based on the biopsychosocial model,

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have been shown to be to date the most effective treatment of chronic pain conditions. IPR consists of psychological interventions combined with physiotherapy and training in daily life activities to increase physical functioning, activity levels and individual's participation in society [12].

Acceptance can be described as a non-judgmental way to acquire experiences, both negative and positive and is based on the Acceptance and Commitment Theory (ACT). ACT in pain rehabilitation aims to improve function and reduce the impact of pain in daily life by promoting a life in the direction of personal values [13]. Increased pain-acceptance have been associated with less pain-related anxiety, higher rating of mental well-being, less numerous of health care visits and reduced intake of analgesics [14,15] and to be a major predictor of functional impairment [16]. The ability to perform activities despite the presence of pain has also been linked with pain-acceptance [17,18].

The fear-avoidance model is widely used to explain how psychological factors affect the development and experience of chronic pain and disability. Fear-avoidance, that is pain-related fear, anxiety and expectations about increased pain, leads to avoidance of activities and increased disability in chronic pain. Catastrophizing thoughts related to pain is a central part of the fear-avoidance theory and could be described as a cognitive magnification of the severity and impact of pain [19-21]. High levels of fear-avoidance, catastrophizing and low pain-acceptance have been found to predict disability and interference in daily life for individuals with chronic pain [22].

Self-efficacy, defined as an individual´s own belief in the ability to cope with a specific task even in the presence of difficulties [23] has been shown to be important to become physically active [24]. Rating of poor self-efficacy for physical activity has been found to be a consistent independent predictor of long-term poor outcome of disability and pain [25].

Physical inactivity, defined as less than 150 minutes of weekly physical activity at a moderate intensity level or less than 75 minutes high-intensity physical exercise, has been identified the fourth main risk factor for global mortality [26]. The general health-promoting effects of regular physical activity (PA) is well documented, as well as its effect in the primary and secondary prevention of several chronic diseases and premature death. Research on sedentary behavior, defined as any awake behavior characterized by an energy expenditure ≤ 1.5 metabolic equivalents (METs), while in a sitting, reclining or lying posture [27] and its relation to health outcomes is relatively new compared to PA. Recently, however, there has been a major development of research on sedentary behavior where dose-response relationships between sedentary time (ST) and several health outcomes have been systematically investigated. New evidence has emerged showing that higher levels of sedentary behavior increase the risk of cardiovascular disease (CVD) and cancer mortality from all causes, as well as the incidence of CVD, cancer and type 2 diabetes. The WHO 2020 recommendations for PA includes for the first-time global guidelines for sedentary behavior [28].

Patients with chronic pain have in general high levels of physical disability and difficulties in daily activities [29], also associated with significant functional limitations, low levels of PA [30] and high levels of ST [31], indicating a possible strong influence on patients´ health and their overall quality of life, increasing risk of developing a range of comorbid health conditions [32]. There are multiple barriers for patients to participate and maintain PA and exercise [33]. PA requires a performance of activity in spite the presence of pain or increasing pain linking the psychological and behavioral components to the PA treatment. This connection is important for the treatment outcome [34].

PA is one of the main components in the rehabilitation of chronic pain [35]. Optimizing treatment strategies and increasing knowledge on the impact of psychological variables for the outcome of PA treatment is needed.

At most IPR units in the country, physical behavior is currently being evaluated with the recommended Social Welfare Board´s three questions about physical exercise, everyday activity and sedentary time. However, self-reports validity is questioned as self-reports are often prone to selective recall and social desirability biases, likely to result in over-estimation of PA [36,37], underestimation of ST [38] and rarely provide data on total PA or ST [37].

A primary aim of this study was to objectively evaluate the PA level and sedentary levels of patients after discharge from an IPR program. A secondary aim was to evaluate changes in the pain-acceptance, fear-avoidance and self-efficacy as well as any correlations with physical activity, sedentary time after an IPR program.

Material and methods

This is a correlation-based experimental non-controlled pilot study using accelerometers to measure PA and ST and self-report questionnaires to measure pain-acceptance, fear-avoidance and self-efficacy prior to and after discharge from an IPR program and at follow-up. The study protocol was approved by the regional ethical committee of Lund University, diary number 2018/340, modified and reapproved 20190517, diary number 2019-03244.

The interdisciplinary pain rehabilitation program

The study was performed at a Pain Rehabilitation unit in southern Sweden. This is a specialist unit offering multi-professional pain assessment and IPR for patients with chronic pain. Patients are referred from primary care and from other specialist units for examination and assessment of their pain condition. Approximately 30% of the patients undergoing examination are judged to benefit from an IPR program. The IPR inclusion criteria were having a medical examination and a pain diagnosis, being assessed to benefit from an IPR program, as well as being able to understand Swedish and to participate on a full-time basis in different daily activities. Exclusion criteria were pronounced psychiatric illness or acute crisis, active and known abuse of narcotics, alcohol or drugs, previously extensive rehabilitation measures without sustainable improvement and imminent socio-economic difficulties.

About 200 individuals undergo IPR annually. The IPR is team-based and delivered to groups up to 10 participants. The program consists of a starting-up-phase with 3 meetings during 3 weeks and an intensive-phase during 5 weeks, 3-4 days a week and a follow-up (2 days) 9 weeks after discharge. The program includes physical, practical (daily activities/ working situations) and psychological training. The physical and activity-based training are individualized in small groups. The rehabilitation plan is based on individually goals and are the guiding principle throughout the IPR program.

The main purpose of the IPR is to improve patients´ pain management strategies, including ability to work, optimize level of PA and increase health-related quality of life as well as the ability to participate in various everyday activities. The physiotherapist in the program is expected to guide patients to increased activity and participation in normal life by improving body functions and increasing PA according to the patient's own goals and resources. Psychological aspects such as past experiences, beliefs, assumptions, perceptions, motivation and actions are as important as the physical function in the physiotherapeutic intervention [39]. All physiotherapeutic actions are linked to the patients´ own activity-related goals aiming to improve their resources to gain as much as possible independency and secure implementation and maintenance of new behavior.

Subjects

The study group consisted of patients from 4 consecutive groups undergoing an IPR program during August 2018 to March 2019. A total of 38 persons were assessed for participation in the rehabilitation program in these four groups. Out of the 38 persons assessed for participation in IPR during the period, 22 women accepted to participate and were included in the present study (Figure 1).

Procedure

Written information about the study and informed consent approval document was sent to each participant two weeks before IPR program. At the first day at the unit a brief follow-up of the study-information was presented, the basic ethical principles were reviewed, and the consents were collected. At the third day in IPR, at discharge from IPR and at the nine-week follow up the questionnaires were filled in and the accelerometers were distributed. At the same time verbal information and guidance on administration and management of the accelerometers and training diary were reviewed and written information was handed out together with the accelerometer and training diary. Measurements with accelerometers were performed one week before and one week after the program, as well as one week after the program's follow-up.

The participants were instructed to wear the monitor on their right hip attached by an elastic belt during all waking hours for 7 consecutive days. Placing the accelerometers around the waist has demonstrated high validity [40]. The participants were instructed to remove the monitor while bathing or swimming and when sleeping. All participants were instructed to fill in a training diary for all physical activities and longer periods of ST, but especially for swimming activities and bicycling.

Outcome measurements

Primary outcomes

PA and ST were measured with an accelerometer ActiLife GT3X, with a sampling frequency of 30 Hz and epoch lengths of 60 seconds. An accelerometer is a small portable sensor, which measure accelerations along the axis of motion and has been shown to measure PA with a high reliability for individuals with chronic diseases [41]. Accelerometers give a total measurement for all physical activities as well as a measure for intensity, duration and frequency (activity pattern) and for ST [42]. The accelerometers were initialized as described by the instruction manual [43]. The device records changes in acceleration in 1-minute epochs and these are recorded in counts which give the summation of total PA per day (counts/day). The accelerometer value of the total PA varies depending on the frequency, duration and intensity of the acceleration. The measurements were categorized as follows: sedentary time (ST), light PA (LPA), moderate PA (MPA) and vigorous PA (VPA). To determine the total time in all health-enhancing PA combined moderate to vigorous physical activity category was made (MVPA). The cut-off points for LPA were set to 101-1951 counts, the cut-points for MVPA were set to 1952-5724 and very vigorous to 5725-9498 counts per minute respectively (44). ST was classified as activity below a level of 100 counts per minute [45].

To ensure that accelerometer data were representative of an entire day and week, data for respondents with at least 4 days with ≥10 hours per day of valid wear time were included in the analysis [46,47]. Non-wear time were validated according to Choi et al. algorithm [48]. Accelerometer analyzes were calculated on wearing time between 06.00-23.00.

Secondary outcomes

Pain-acceptance was measured with the Chronic Pain Acceptance Questionnaire short form (CPAQ-8), which has demonstrated good psychometric properties and sensitivity to rehabilitation changes [49]. The form consists of 8 questions with the two subscales "commitment to activity" and "willingness to feel pain." Response options available on a scale from 0-6 (never true - always true). Total score for each subscale between 0-24 points giving a total score of 48 points, higher scores indicating higher pain-acceptance [50, 51].

Fear-avoidance beliefs was measured with the Tampa Scale of Kinesiophobia, the Swedish version TSK-SV [52]. This questionnaire has 17 questions between one to four points with options from "do not agree with" to agree entirely "(four questions are inverted). Total score between 17-68 points. Higher points indicate higher fear-avoidance. The measured error margin is three points, a value between 34 and 40 (37 ± 3), indicates an increased risk of fear-avoidance/kinesiophobia. A minimum of three points is required to count as a significant change [53].

Self-efficacy was measured with the Swedish Exercise Self-Efficacy Scale (ESES-S). It is a six-item questionnaire with a total score between 0-60 points, exploring confidence in performing exercise in the presence of difficulties. It has shown to have a moderate test–retest reliability and a respectable internal consistency in a rheumatoid arthritis population. Construct validity was partially supported [54].

Data processing

The accelerometer data was analyzed and processed in the ActiLife program 5.10.0 (Actigraph inc., Pensacola, FL) by Maria Hagströmer, Leg Physiotherapist, Professor (Sophiahemmet University, Stockholm) at 20190610, after which data was exported to an encrypted USB memory for further analysis in Lund. The data was stored on an encrypted USB memory and handed over personally by undersigned author of the study.

Demographic variables were obtained from the Swedish Quality Registry for Pain Rehabilitation (SORP) to which the unit is affiliated (Table 2). Data processing and analysis was performed in SPSS version 25 (Statistical Package for the Social Sciences, Chicago, II). The choice of statistical method has been based on how the variables were operationalized. Due to small sample size and not normally distributed data non-parametric tests were used. The result is reported with median value and spread. The significance level was set to 0.05. When comparing whether there was a statistically significant difference in results before and after program, Wilcoxon's signed rank test was used. To analyze correlations, bivariate analyzes were performed with Spearman's rank correlation test. Individual analyzes were also made due to the clinical value and to gain a deeper knowledge of individual changes regarding PA and ST and correlations with the psychological variables. Descriptive statistics have been used in these analysis.

Results

The results are based on the twelve participants who fulfilled the IPR and the three measurements (M1, M2 and M3), see flowchart of participation in Figure 1. Median (min-max) age and BMI 11g/m^2, for individual values see Table 2.

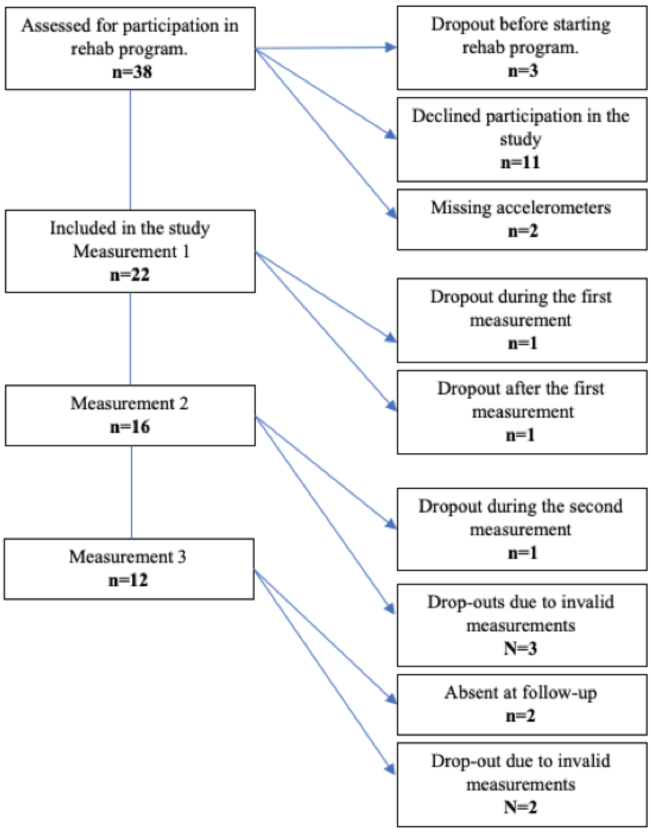


Figure 1. *Flowchart describing the inclusion of participants in the rehab program and in the study as well as the drop outs during the intervention and at follow up. Measurement 1 (M1) = baseline measurement, measurement 2 (M2) = measurement after the intervention and measurement 3 (M3) = measurement at the follow up after 9 weeks.*

Physical activity

At group level there were no significant changes regarding LPA, MPA or MVPA between the three measurements (Table 1). The median value for LPA for the whole group was 3,9 hours/ day (approximately 30% of wearing time) and the MVPA level around 15 minutes/day (approximately 2% of wearing time) at all measurements. The median value for vigorous PA was zero (Table 1).

Table 1. *Accelerometer data at baseline (M1), after intervention (M2) and at follow up (M3). Values are presented in median (min-max) for wearing time (WT), steps/day, sedentary time (ST), light physical activity (LPA), moderate physical activity (MPA), vigorous physical activity (VPA) and for moderate-to-vigorous physical activity (MVPA).*

	M 1 (n=12)	M 2 (n=12)	M 3 (n=12)
Variable	Median (min-max)	Median (min-max)	Median (min-max)
WT (min/day)	861 (761-983)	845 (771-889)	858 (743-936)
Steps/day	5764 (2021-9886)	6115 (1756-10511)	6246 (1797-10926)
ST (min/day)	548 (473-715)	562 (408-713)	549 (414-691)
LPA (min/day)	254 (138-488)	245 (118-426)	235 (124-506)
MPA (min/day)	17 (1-46)	16 (0.7-53)	15 (2-62)
VPA (min/day)	0 (0-4.3)	0 (0-0.3)	0 (0-6.4)
Total MVPA (min/day)	17 (1-46)	16 (0.7-53)	15 (2-62)
Total MVPA (min/week)	117 (6-324)	110 (4-266)	108 (11-431)
% in ST/day	67 (49-82)	67 (48-85)	67 (44-83)
% in LPA/day	30 (15.6-50.2)	30 (14.2-50.3)	30 (16.3-54)
% in MVPA/day	2 (0.12-5.3)	2 (0.1-6.4)	2 (0.2-7.5)

There were large differences of % spent in LPA, MVPA and ST between the participants and also large differences in the individual changes between the three measurements M1, M2 and M3 (Fig 2. a, b and c). Regarding LPA, there was a six-hour- difference between participants (2.1-8.4 hours/day) at M3. Removing the outlier value of 54% (8.4 hours), there was still a 4-hour-difference between participants in LPA per day (2.1-6.2 hours/day) (table 2). Regarding MVPA, there was a one-hour-difference in MVPA per day (2-62 minutes) and a 7-hour-difference in the total MVPA for the whole week (11-431 minutes) (Table 1).

Four participants increased their LPA with more than 3% in average per day (>25 min/day) between M1 and M3, while two participants reduced their LPA by over 5% in average per day (>42 min/day) (Table 2).

One third of the group (3/12) made increases between 8-13% of the total MVPA for the whole week, while two participants decreased their total MVPA per week with 5% respectively 10% between M1and M3 (Table 2). Four out of 12 had 1% and less of MVPA per day (<10 min) and three of them less than 0.7% per day (<5 minutes) in all measurements (table 2). These participants also had the highest levels of ST (between 70-83%) and among the lowest levels of LPA at M3 (table 2).

With reference to the PA-recommendations, five participants reached the recommended 150 minutes per week of MVPA at M3, four of them in conformance with the recommendation already at M1. With a focus on bouts of 10 minutes of continuous activity at MVPA level, only one participant reached the recommendation.

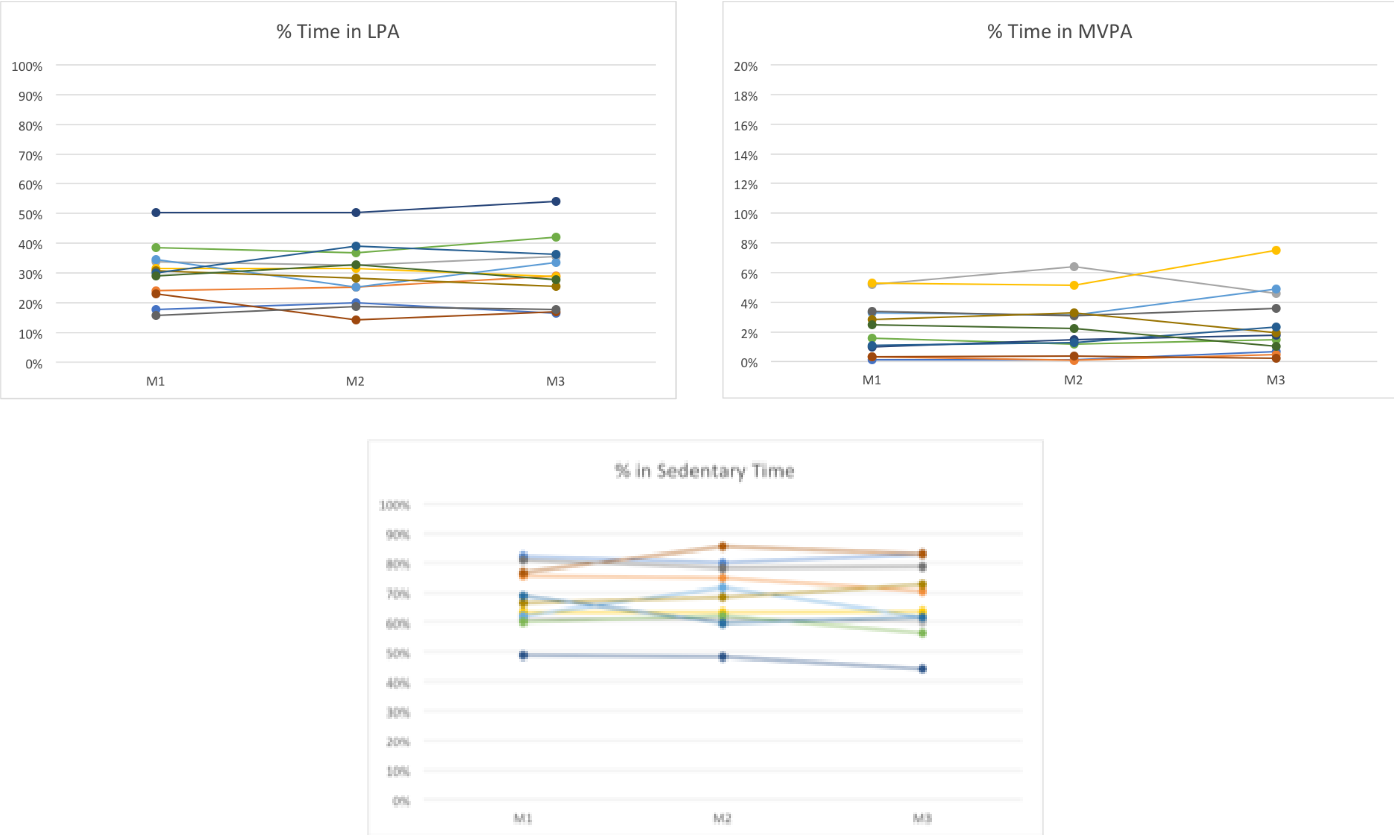


Figure 2. Measurement for each of the participants (indicated by dots and lines) at baseline (M1), after intervention (M2) and at follow up (M3) as (a). Percentage average time in light physical activity (LPA) per day. (b). Percentage average time in moderate to vigorous physical activity (MVPA) per day. Note; the Y-axis maximum is 20% in this figure. (c). Percentage average time in sedentary per day.

Table 2. For each of the participants (Part.), age (yrs) and BMI (kg/m2) is presented. Results from the accelerometer data are presented for each of the participants at baseline (M1, at post intervention (M2) and at follow up (M3); wearing time (WT) in min/day, % of sedentary time/day (%ST), % of time/day in light physical activity (%LPA) and % of time/day in moderate-to-vigorous physical activity (%MVPA). Results in points are also presented for each of the participants at M1, M2 and M3 from the questionnaires; Chronic Pain Acceptance Questionnaire short form (CPAQ-8), the Tampa Scale (TSK-SV) and the Exercise Self-Efficacy Sale (ESES-S).

Part.	Age	BMI	WT			%ST			%LPA			%MVPA			CPAQ-8			TSK-SV			ESES-S		
			M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3
1	61	43,6	867	771	778	82	80	83	18	20	16	0.1	0.1	0.7	19	21	20	33	30	31	36	23	20
2	45	40,0	839	772	794	76	75	70	24	25	29	0.3	0.1	0.5	16	24	22	32	27	21	33	33	28
3	36	23,7	854	830	872	61	61	60	34	33	35	5	6	4	25	34	35	35	31	30	18	41	36
4	66	24,6	874	843	820	63	63	64	31	31	29	5	5	8	33	33	34	29	32	26	45	47	48
5	42	21,7	805	851	874	62	72	62	35	25	34	3	3	5	18	21	27	41	41	37	20	16	18
6	62	21,3	868	881	884	60	62	56	38	37	42	2	1	1	25	26	28	25	28	30	52	37	38
7	38	24,9	970	846	936	49	48	44	50	50	54	1	1	2	19	28	22	33	33	36	19	12	24
8	60	33,1	802	834	818	77	85	83	23	14	17	0.3	0.4	0.2	19	22	24	31	27	31	27	35	27
9	41	23,1	879	865	878	81	78	79	16	19	18	3	3	3	20	29	30	29	20	25	22	37	38
10	50	22,5	761	794	747	66	68	73	31	28	25	3	3	2	16	20	21	39	43	38	12	19	23
11	46	23,4	983	853	934	69	60	62	30	39	36	1	1	1	33	37	33	29	19	22	41	35	30
12	51	35,8	793	889	844	69	65	71	29	33	28	2	2	1	24	30	31	26	25	18	24	40	30

Sedentary level

There were no significant changes in ST at group level between the measurements (Table 1). The median value at group level was basically unchanged with 67% (9.2 hours/day) of ST both at M1 and M3, with a slight increase at M2 (9.4 hours/day). There was a range of 4,6 hours ST between participants at M3 (6.9-11.8 hours/day). Removing the outlier-value with 44% of ST (6.9 hours) there was a difference of 3.8 hours between participants. Half of the group (6/12) had over 70% of ST (almost 10 hours) at M3. Three participants had over 75% both at M1 and at M3 of which two had 83% at M3 T 2)

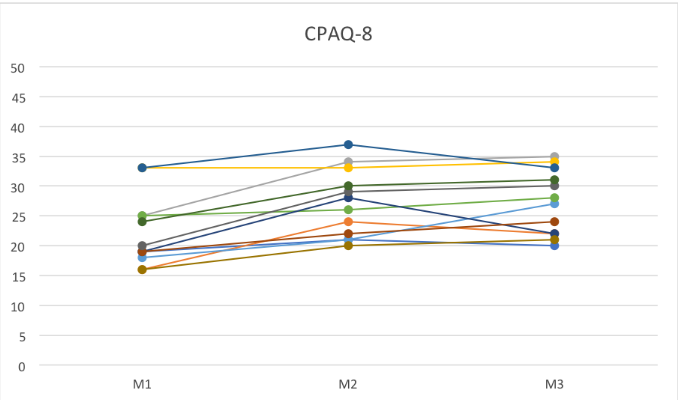
Pain-acceptance, fear-avoidance and self-efficacy; results from questionnaires

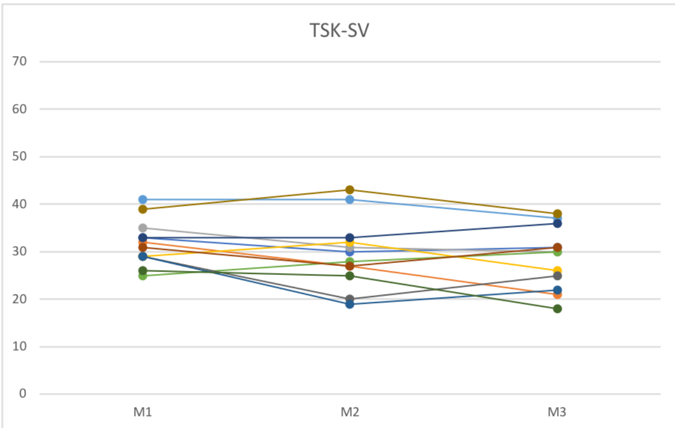
There was a significant improvement in the acceptance score after IPR (p = 0.0004). The median acceptance score was 20 prior to IPR and 28 at follow-up. All but one participant, increased their acceptance scores at M3 (figure 3a). There was a significant decrease in the score of fear-avoidance at follow up (p = 0.03). Regarding self-efficacy the median score increased though non-significant at M2 and decreased at M3, although still higher than M1 (Table 3).

Table 3. Results from the three questionnaires, CPAQ-8, TSK-SV and ESES-S at baseline (M1), after intervention (M2) and at follow up (M3). Values are median (min-max) points

	M1 (n=12)	M2 (n=12)	M3 (n=12)
	Median (min-max)	Median (min-max)	Median (min-max)
CPAQ-8	20 (16-33)	27 (20-37)*	28 (20-35)*
TSK-SV	32 (25-41)	29 (19-43)	30 (18-38)*
ESES-S	26 (12-52)	35 (12-47)	29 (18-48)

CPAQ-8 = Chronic Pain Acceptance Questionnaire Short Form (0-48p). TSK-SV = The Tampa Scale for Kinesiophobia (17-68p). ESES-S = Exercise Self-Efficacy Scale (6-60p)
*= significant change (Wilcoxon Signed Rank Test); all other values non-significant





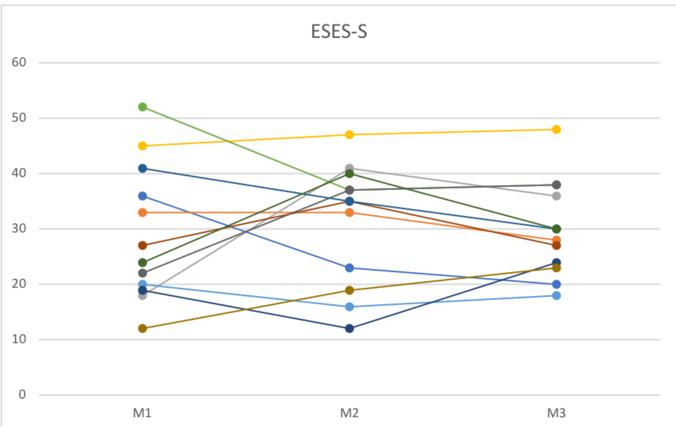


Figure 3. Results in points at baseline (M1), after intervention (M2) and at follow up (M3) for each participant (indicated by dots and lines) for **(a).** Chronic Pain Acceptance Questionnaire short form (CPAQ-8) **(b)**. Tampa Scale (TSK-SV). **(c)**. Exercise Self-Efficacy Scale (ESES-S).

There were large differences in scores of pain-acceptance, fear-avoidance and self-efficacy between the participants and also large differences in the individual changes between the three measurements M1, M2 and M3 (Figure 3. a, b and c).

Descriptive covariance between pain-acceptance, fear-avoidance, self-efficacy and level of physical activity and sedentary time

There were no significant correlations between PA, ST and the psychological variables.

However, participants with the highest levels of MVPA also rated the highest for pain-acceptance at M3. They also rated high scores for self-efficacy (30 and over) and low values for fear-avoidance (30 and under) at M3, with one exception (table 2). Participants rating the largest increases in pain-acceptance also reported the largest increases in MVPA, with the highest levels of MVPA and pain-acceptance both at M1 and M3. They also had among the lowest values for ST approximately 60-64% of ST, with one exception, having 79% ST at M3 (table 2). The low active/high sedentary participants, making very low or no improvements also scored the lowest values for pain-acceptance both at M1 and M3, although still increasing their acceptance scores at M3. Participants making the largest impairments in MVPA, LPA and ST at M3, nevertheless increased their pain-acceptance scores at M3.

Discussion

Most participants seemed to maintain their baseline management strategies. However, there was an individual difference of six hours between the participants regarding LPA (2.1-8.4 hours/day), a 1-hour difference in MVPA (2-62 minutes/day) and a 4.6-hour difference in ST per day, which shows and confirms the heterogeneity of a group of chronic pain patients. The group as a whole had a low level of PA and was highly sedentary with a median value of 67% ST per day. Three out of 12 were extremely low active/highly sedentary at all measurements. The scores for pain-acceptance and fear-avoidance were significantly improved at M3, but there were no correlations between PA, ST and the psychological variables.

Physical activity and sedentary time

The IPR program seemed to have a small effect of the changes in coping strategies for PA and ST. Nevertheless, there were two participants having quite a low level of MVPA at M1, making significant improvements at M3, one of them reaching the recommended level of 150 minutes of MVPA per week at M3. The increases in MVPA were also related to increased LPA and lower ST in both cases. A higher level of MVPA however, is not always or automatically correlated to a more active lifestyle [55]. In this study there was one person reaching the recommendation for >150 minutes of MVPA per week and also having 30 minutes of MVPA per day and still being sedentary almost 80% of the day. This is a well-known behavior in PA research in many countries including Sweden [55]. In a population-based survey of PA, Norway and Sweden had the highest percentage of reaching the PA recommendations and at the same time the highest levels of ST, showing that PA and ST are not behaviors inverse of each other but may coexist [55].

Regarding LPA level in this study, there was a six-hour-difference per day between participants at M3, making a huge difference between a high sedentary and a more active daily lifestyle. However, the health benefits have usually been researched and linked to MVPA and the benefits from LPA has eventually been underestimated [56]. Recently, more research has focused on the benefits of LPA in reducing ST. Associations have been found between LPA and a significant reduction in mortality risk with all causes and cardiovascular disease (CVD), if replacing 30 minutes of ST per day with LPA [56]. This is also confirmed in a meta-analysis by Ekelund et al, concluding that levels of total PA at any intensity and less time spent in sedentary are associated with a substantially reduced risk for premature mortality. Maximal risk reductions have been seen at about 375 minutes/day of LPA and 24 minutes/day of MVPA [57].

In present study, the median value of LPA was 235 minutes/day and of MVPA 15 min/day, which were significantly lower levels compared to other studies of chronic pain conditions [58-60]. The levels of LPA and MVPA were also significantly below the above recommended reference values for reduced risk of premature mortality. Four participants reached 24 minutes of MVPA per day and 2 participants reached 375 minutes of LPA per day at M3. There were 2 participants replacing more than 30 minutes of ST with LPA. Four participants increased LPA by approximately 20 minutes, mainly in favor of reduced ST at M3, of which one belonged to those with extremely low PA/high ST. The effect of substituting ST with LPA can be substantial and clinically relevant, if the amount of time exchanged is sufficient. From a clinical and health perspective, a replacement of 30 minutes ST with LPA could be considered a significant change, as well as a reduced risk of premature mortality [56]. The 375 minutes of LPA could be a recommended reference value to work towards in health prevention/promotion purposes in general but also in the rehabilitation of chronic pain patients.

In this study 5 persons (42%) reached the recommendation of 150 minutes of total MVPA per week at M3, when calculated on total time. This is a considerably lower percentage compared to other accelerometer studies of chronic pain [59,60], even though the results vary [58]. However, when calculated percentages based on the time in MVPA bouts of >10 minutes continuous activity, which is recommended by the WHO [26], only one participant reached the PA recommendation at M3. The low prevalence of adherence to the WHO PA recommendation is well-known and confirmed in many studies, although considerably higher in this study both compared to other chronic pain conditions (>80%) [58-60] and a European normal population (>70 %) [55,61]. Although in the 2003–2004 National Health and Nutrition Examination Survey accelerometer study (NHANES USA), approximately 97% of the participants did not meet the physical activity recommendations when accounting for continuous >10 min MVPA bouts [62]. However, the new guidelines for PA for Americans (2018) have recently changed their recommendations and the MVPA is no longer required to occur in bouts of 10 minutes [63].

Evidence whether time in MVPA has a protective effect on all-cause mortality independent of ST is inconclusive. In the National Health and Nutrition Examination Survey accelerometer study, they found statistically significant risk reductions for all-cause mortality from substituting ST with MVPA. A daily increase of 10 minutes of MVPA, equivalent to approximately half the recommended dose of PA for health, reduced the risk of cardiovascular disease (CVD) mortality by almost 40% [64]. Further evidence in other studies have also been found for significant survival benefits in replacing ST by MVPA, but without statistically significance for all-cause mortality [56]. In present study 3 participants increased daily MVPA by more than 10 minutes per day at M3, which in this context could be considered as a clinically significant result for a reduced risk of CVD mortality. Two of them were below the previously recommended level of 30 minutes of MVPA per day at M1. A daily increase of 10 minutes of MVPA with an ongoing gradual increase, could be a distinct and clinically relevant recommendation to work with in the physical rehabilitation, together with the replacement of 30 minutes of ST with LPA (with the goal of reaching the recommended 375 minutes LPA per day).

Although the variation in present group was high, the PA level was in general low and the group was highly sedentary, even after the rehabilitation. There was no change in ST at group level between the measurements, nor when looking at the individual results did the sedentary level change significantly. The median value for ST was 67% (9.2 hour) of wearing time per day at all measurements. Although there was a 4.6-hour difference between the participants, it was only one person standing out with a lower value of 44%, while half of the group (6 persons) had over >70% of wearing time (almost 10 hours). Three persons were extremely sedentary with approximately 80% of ST per day (more than 11 hours/day), without changing ST behavior by the rehabilitation. These values were significantly higher compared to other accelerometer studies of chronic pain conditions, where participants were considered having a very high level of sedentary lifestyle and accumulated around 61-62% of ST [59,60,65,66]. These results are comparable to a normal population in Europe, where participants spent an average of 61% of ST per day and approximately 20% gathered more than 10 hours of ST per day [55]. Although there are also accelerometer studies of chronic pain populations with more similar result to this study [67].

When comparison with other studies measuring PA and ST, there are major differences in the result depending on whether the study result is based on self-reported PA and ST or objective methods been used (accelerometry). Self-reports are prone to bias recall and social desirability, which often result in overestimation of PA [36,37] and underestimated ST [38]. Most of the current evidence on associations between PA, ST and health outcomes are primarily based on longitudinal studies using self-reported data, which have shown low accuracy and the magnitude of the association between PA level and mortality is likely to be underestimated. This limitation can be overcome using device-based methods (accelerometer) when analyzing PA, ST and associations with mortality. In several recent studies objective measurements (accelerometer) have been used, which has resulted in new evidence and associations regarding PA, sedentary levels and health outcomes, which significantly have changed the estimations and guidelines in this subject [57,62].

In a recent meta-analysis containing the very latest accelerometer research, the results showed a significantly higher risk of death from 9.5 hours per day or more for time spent sedentary [57]. In present study half of the group had almost 10 hours or more spent in ST (>70%) and 10 out of 12 (83%) had 8.4 hours or more (>60%) of ST. According to Ekelund et al, the dose-response relations between ST and mortality gradually increases from about 7.5 to 9 hours and is more pronounced at more than 9.5 hours [57]. This implies that that 83% in present study-group had an increased risk level for premature death with serious health consequences and for half of the group the risk was even more pronounced. Three persons (25%) had approximately 11.2 hours or more of ST per day at M3 and could be counted as extremely highly sedentary with a substantial detrimental impact on health and significant increased risk of premature death. Worth noting and of great clinical value is that significant risk reduction has been found for those who are the least active by reducing and replacing ST with LPA. "Higher levels of total physical activity, at any intensity, and less time spent sedentary, are associated with substantially reduced risk for premature mortality" [57].

Pain-acceptance, fear-avoidance and self-efficacy and covariance with level of physical activity and sedentary time

There was a significant increase in the rating of pain-acceptance at M2 and M3. The median value in this group before program was comparable to the average value for all participants before entering IPR during 2018, but the value was significantly higher after the program. All participants except one (that was unchanged) increased their values for pain-acceptance between M1 and M3. Despite significantly increased pain-acceptance at group level, the result for PA and ST did not change significantly at group level.

Acceptance Commitment Therapy (ACT) in chronic pain rehabilitation implies a focus shift from symptom reduction to identifying valuable directions in life and appropriate strategies to achieve the goals supporting these values. The motivation for behavior change is based on one´s own defined values and not following a professional´s advices or recommendation [68]. Not everyone has PA as an important and valued activity and therefore may not be motivated to change or increase their PA, especially not if the pain increases. This could be a problem from a clinical point of view, but in order to address the concept of ACT, while working with the physical aspects in pain rehabilitation, other motivational and valued factors need to be taken into account, such as health aspects, increased physical function and capacity as well as decreased fatigue. There are most often other valued and important activities, (physical demanding) that require a certain physical capacity, which makes the PA a tool to achieve other goals as well. The purpose is to improve function and reduce the impact of pain in daily life to make it possible to live a life in the direction of the personal values [13]. Maybe these relationships need to be further clarified in the physical part of the IPR program to increase the general activity level. There is also an important health aspect to consider. Most people probably value their health highly. However, to enhance motivation to be more physically active and less sedentary, there may be a need for increased knowledge about PA and ST and their correlation to health and unhealthy effects. Although knowledge is not enough to change behavior, it is known to be an important factor for motivation and has been described necessary for the implementation of physical activity and physical exercise by chronic pain patients themselves [69].

Subjects who were rating the highest values for pain-acceptance at M3 also had the highest levels of MVPA at M3, those rating the largest increases in pain-acceptance were also making the largest increases in MVPA as well as the highest levels of MVPA at M3. There seemed to be a correlation between higher pain-acceptance and higher levels of PA when looking into individual results, even though there were no correlation at group level. This correlation is confirmed in other studies [70,71]. Although ACT as a standalone therapy has not been shown to be effective in enhancing physical activity [70], showing the importance of working with the physical aspects together with ACT in a pain management program, if the purpose of the rehabilitation is to increase physical capacity and activity.

Being active and working towards defined values despite pain and/or increased pain or discomfort is a part of the ACT concept and could be connected to the physical flexibility and willingness to stay active in valued activities despite pain or increased pain. This could also be linked to an individual´s self-efficacy, that is believe in one´s own ability to perform an activity. Although there were no correlations between PA, ST and self-efficacy in present study, there was a tendency that those with the higher level of PA, also rated higher scores of self-efficacy. Value-based interventions have proven effective in enhancing exercise-related cognitions and important in the maintenance of a new physical behavior in the long term. Increased self-efficacy is related to overcoming barriers as well as ability to make action plans and dealing with difficulties related to exercise and has proven important in the adoption and maintenance of a physically active lifestyle [70,72]. Even though the results regarding self-efficacy were inconsistent in this study, there is a relatively large body of evidence confirming that higher levels of self-efficacy are related to better functioning, greater physical functioning, participation in physical activity, work status and highlights its key role in adapting to chronic pain [73,74].

Being able to stay active despite pain can also be associated with the fear-avoidance model. Avoiding activities increasing pain is a congenital defense mechanism and serves as a protective and survival function, it is a very normative and a culturally endorsed behavior. When the pain is prolonged and become chronic, the pain physiology is transformed, and quite different mechanisms are involved in the pain experience. The reaction of avoiding painful stimuli is a very normal and human behavior and to be able to interpret the pain signals for chronic pain in a non-threatening way, you need to have sufficient knowledge about the pain physiology [75].

There was a significant decrease in the rating of fear-avoidance at M3 (p=0.03), although the levels of fear-avoidance were significantly lower at M1, compared with the general pain patient in the IPR program at the unit during 2018 [76]. Due to the low values in the group, fear-avoidance had a very low impact on the result. Three persons had higher scores of fear-avoidance at M3, but they did not belong to the low active/high sedentary group. The fear-avoidance model includes worrying fearful or catastrophic thoughts or expectations that movements or actions will lead to increased harm or/and increased pain levels. However, the result in this group may reflect a pain-related avoidance that is not related to fear. This result corresponds with other studies, showing that avoiding activity in the presence of pain (or anticipated pain) is not always linked to fear or catastrophizing, but rather a consideration of the pros and cons (benefits or injuries) and a deliberate consideration and unwillingness to experience more pain [77,78].

To our knowledge this is the first time that PA an ST levels are followed within an IPR program in our country, using an objective measurement. Accelerometers give a total measurement for all physical activities as well as a measure for intensity, duration and frequency [42] and has been shown to measure PA and ST with a high reliability for individuals with chronic diseases [41]. At present, the unit in the study evaluates the PA- and ST-level with three questions from the Social Welfare Board´s three questions about physical exercise, everyday activity and sedentary time [79]. These questions ask for the total time of ST, PA and daily exercise for one week and are designed to capture step-by-step improvements even among those who are least active [80]. However, it is well researched that self-reports are often prone to recall and social desirability biases, which is likely to result in over-estimation of PA [36,37], underestimation of ST [38] and rarely provide data on total PA or ST [37]. This also poses a problem when researching the relationship between physical activity and health-related results, when interpreting the results based on the recommendations for PA, it is complicated since the recommendation for PA largely are based on self-reported studies. This means that the overestimation of PA in the questionnaires has already been considered in the recommendations. The recommendations for PA are likely to change, based on future large-scale longitudinal studies using objective measurement related to health-related results [55].

Recommended guidelines for accelerometer studies have been used in this study. This also allows comparisons with other accelerometer studies [47]. Regarding intensity thresholds, the Freedsons cut-off points were used, in order to be able compare with other accelerometer studies [44], as these are the most common cut-off points used. The result in different studies is greatly affected depending on which cut points used. Intensity thresholds are influenced by participant age, physical capacity and activities performed and there is currently no consensus about standard intensity thresholds and the result can be misleading depending on the intensity thresholds used [57]. In the meta-analysis by Ekelund et al, LPA was divided into two categories, lower light PA and higher LPA, where it was discussed whether the higher level of LPA could be regarded as MVPA intensity for the older ages (>60) [57], which maybe also could apply for people with chronic pain as well as obesity and other comorbidities. Further research is needed in identifying intensity thresholds for light and moderate intensity physical activity for older adults based on relative intensity (ie % maximal cardiorespiratory fitness) [57], this may also be relevant for different chronic conditions.

Despite the advantages of objective assessment of PA and ST using accelerometry, there are some limitations with this method. Accelerometer located on the hip do not capture all PA such as biking, upper movements and is not waterproof and therefore not measuring PA in water [56]. In order to cover up for these activities in present study, a training diary was used, and the participants were requested to fill in activities such as swimming and biking. For several of the participants it was difficult to remember filling in the diary and they might have forgotten to fill in some activities, which may have affected the result. There were some registrations in the diary at M1 and M2, for example swimming and biking. There was no registration for PA at M3.

There are several confounders that may have affected the result greatly during the week the measurements were performed. The actual participation itself in a study dealing with PA as well as wearing the accelerometer and keeping an exercise diary, probably will affect the physical behavior and the result in the study. It can also be assumed that those who chose to participate in a study that performs physical activity, are those who are most physically active and interested in PA, which may have resulted in a more active group than an average pain patient group. A larger study group would have been desirable to investigate significant differences in physical behavior and being able to draw more solid conclusions. Though it could be considered as a strength and of great clinical value, the possibility of analyzing individual results to some extent. It might even be of greater clinical relevance, due to the large individual differences in the PA level between participants. It is well known that behavioral changes at the individual level, rarely follow the average changes [72]. This indicates the importance of including individual level analyzes in future research.

Secondary findings

It seemed like the IPR program had a very small impact on the sedentary behavior in general, but especially in those with the highest proportion of ST. Being classified as a low active/high sedentary person has been shown to have a clear association to age as well as overweight [55]. This was partially confirmed in this study regarding overweight. One third of the group had over 30 in BMI, which fully coincided with the extreme low active/high sedentary group, however it was not related to older age. Several studies have shown that a higher BMI correlates with a reduced ability to perform physical activities such as everyday activities, walk in stairs and ability to carry things partly due to impaired mobility, reduced balance, age and pain [81,82]. It was also related to lower walking ability, lower oxygen uptake and weak thigh muscles [83]. The load increases significantly on joints and muscles because of the heavyweight to carry and also due to a lower anaerobic threshold, which results in a significant increased physical requirement to perform even lighter physical activities as in normal walking [84]. This might give an explanation and display the difficulties and challenges in being physical active and maintain PA especially in this group. Most of all in joint-loading physical activities such as walking, which primarily is measured by the accelerometer. However, when controlling for other physical activities reported in diaries, there were additional physical activities recorded (bicycling and swimming) for a few participants, mainly at the M1, but not in M3. These patients appear to require specialized guidance in their PA and physical exercise, and it seems that current methods of physical rehabilitation need to be further developed and tailored to individual needs, in order to improve health, function and activity level.

Analyzes of sedentary breaks showed an average of 4.7 (2-8.0) breaks per day, which seems extremely low. The result indicates that the group was considerably sedentary for continuous long periods with few breaks and when active, the activity continued for longer consecutive periods followed by long periods of sedentary time, which is also confirmed in other studies [85]. This also corresponds with the clinical experience from pain rehabilitation, where many pain patients are describing a very irregular activity pattern with periods of intense activity followed by long recovery. Periods of continuous/prolonged sedentary bouts are linked to higher health risks compared to the same amount of sedentary time accumulated in shorter bouts, that is, not only the total time spent in sedentary periods that is harmful, but there is a great health benefit in often interrupting longer periods of ST. However, currently there are no guidelines for sedentary behavior [57]. It would be of great clinical value to further explore and deepen the knowledge of activity patterns throughout the day, analyzing periods of continuous uninterrupted time in PA and ST.

Although the variation was large in the group, the PA level was in general low and the sedentary level high. Only one person stood out and could be counted as a person with a higher level of LPA and a lower level of ST per day. This is interesting because in pain rehabilitation contexts, patients are often referred to, or assessed as "persisters" with a high activity level in relation to their pain condition [86]. It is worth noting that in a group of 12 persons there was only one person who could be considered to have a higher level of LPA and a lower sedentary level (<6h). Individuals with chronic pain are in general less physical active and have a higher sedentary level, than persons without pain [65]. The issue may instead be a matter of an irregular activity level. This is also confirmed in a study by Huijnen et al, where chronic pain patients, assessed as "avoiders" or "persisters" did not differ in physical behavior objectively measured by accelerometry. It seems important to be attentive to, although a patient present a persistent activity-related behavioral style, this may not necessarily be reflected in their actual daily life activities [86]. This result may instead reflect the perceived effort of being active with pain, leading to the experience of being more active than you actually are. It may also require more energy to do an activity with pain [69]. It is of great importance to examine and objectively assess the activity level carefully prior to rehabilitation, being aware of although a description of a persistent activity level, may not necessarily correspond to reality [86].

Conclusion

Most participants seemed to adhere to their existing management strategies, with low PA level and high ST. PA and ST should be emphasized in pain rehabilitation and low active/ high sedentary persons need to be identified early for targeted individualized treatment. .

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Disclosure

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