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Physical activity during work and leisure show contrasting associations with fear-avoidance beliefs: cross-sectional study among more than 10,000 wage earners of the general working population

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Abstract

Background and aims: The association between different types of physical activity and fear-avoidance beliefs remains unclear. This study investigates the association between work-related and leisure-time physical activity with fear-avoidance beliefs in the general working population.

Methods: Currently employed wage earners ($n = 10{,}427$) from the 2010 round of the Danish Work Environment Cohort Study replied to questions about work, lifestyle and health. General linear models controlling for lifestyle, psychosocial work factors, education, pain, medication-use and chronic diseases tested associations of work-related and leisure-time physical activity (explanatory variables) with fear-avoidance beliefs (outcome variable, scale 0–100).

Results: The level of fear-avoidance was 41.7 (SD 27.3), 38.0 (SD 26.9) and 54.3 (SD 27.7) among the general working population, a subgroup of pain-free individuals, and a subgroup with back disease, respectively. In the general working population, the level of fear-avoidance among those with low, moderate and high physical activity during leisure were 47 [95% confidence intervals (CI) 45–49], 44 (95% CI 42–46) and 43 (95% CI 41–45), and physical activity at work were 40 (95% CI 39–42), 44 (95% CI 42–46) and 49 (95% CI 48–51), respectively. Individuals with back disease and a high level of physical activity at work showed the overall highest level of fear-avoidance whereas pain-free individuals with a low level of physical activity at work showed the overall lowest level of fear-avoidance.

Conclusions: Physical activity during work and leisure shows contrasting associations with fear-avoidance beliefs. While high physical activity during leisure is associated with lower levels, high physical activity at work is associated with higher levels of fear-avoidance.

Implications: The present results may reflect some deeply rooted negative beliefs about pain and work in the population. On the societal level, campaigns may be a possible way forward as these have shown to improve beliefs about musculoskeletal pain and work.

Keywords: fear-avoidance beliefs; physical activity; general population; chronic pain; back disease.

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1 Introduction

Most people experience some degree of injury or bodily trauma throughout life. However, potentially harmful events often may not lead to actual injury even though pain is experienced as an initial warning signal [1]. Nevertheless, the occurrence of potentially harmful events can lead to affective responses such as fear of pain or anxiety [2]. Researchers have studied these phenomena for more than 30 years [3], especially among people with chronic low-back pain (LBP). This has led to the introduction of the fear-avoidance model of pain [4], which describes fear of pain from a biopsychosocial perspective [5]. The model

proposes that the experience of pain can be perceived as either threatening or non-threatening to the individual. In situations where pain is interpreted as a threat, catastrophizing, hypervigilance and escape and avoidance behaviors often occur. These behaviors increase the risk of disuse, physical disability and depression, which can lead to reduced physical activity [4]. By contrast, when pain is considered non-threatening, the individual will likely remain physically active and engaged in everyday activities, presumably leading to faster recovery [4]. The level of fear-avoidance is commonly assessed by the Fear-Avoidance Beliefs Questionnaire (FABQ); focusing on fear-avoidance in relation to leisure-time (e.g. bending, lifting, walking or driving) and work-related physical activities [6].

Fear-avoidance beliefs have been suggested to contribute to reduced levels of physical activity in individuals with chronic LBP though the exact interaction between fear-avoidance beliefs and physical activity is not fully understood [7]. Additionally, high levels of fear-avoidance have been shown to increase the risk of poor work-related outcomes such as number of sick days and not returning to work [8]. However, investigations concerning fear-avoidance beliefs among the general population are scarce. Buer and Linton [9] showed that fear-avoidance beliefs and catastrophizing not only occur in patients but also in the general population. Furthermore, Houben and colleagues [10] reported levels of fear-avoidance in healthy people that were almost similar to those suffering from acute or chronic pain. From an evolutionary perspective, a certain level of fear-avoidance may be necessary in protecting oneself from danger, whereas higher levels of fear-avoidance beliefs may increase the likelihood of developing chronic pain [11]. Interventions with the goal of improving fear-avoidance beliefs in patients as well as in the general population are therefore warranted.

Engagement in physical activity might be a useful tool to reduce excessive fear-avoidance beliefs in individuals suffering from acute or chronic pain or to prevent the occurrence in healthy individuals [12]. However, an important distinction between leisure-time and work-related physical activities may exist. Whereas leisure-time physical activity is typically voluntary, e.g. engaging in sports or recreational physical activities, many work-related activities are determined by obligatory work tasks. Thus, the psychological component may play a key role in fear-avoidance beliefs dependent on the setting.

The aim of this study is therefore to investigate the associations between work-related and leisure-time physical activity with fear-avoidance beliefs in the general working population. A secondary aim is to test whether the findings are robust among different subgroups (pain-free workers and workers having a back disease) from the general working population.

2 Methods

2.1 Study design

For the present study we used data on work environment and health from the 2010 round of the Danish Work Environment Cohort Study (DWECS) [13]. The DWECS has been repeated every 5 years since 1990 and consists of questionnaires assessing work environment and health in the general working population of Denmark. The questions used for this study are specified below. The reporting of this study conforms to the guideline "Strengthening the Reporting of Observational Studies in Epidemiology" (STROBE) [14].

2.2 Participants

The 2010 questionnaire was sent out to approximately 20,000 working adults of which a total of 10,605 (approximately 53%) replied [15]. In the present study we only included currently employed wage earners ($n = 10{,}427$), i.e. excluding self-employed people. Not all participants filled in all questions, whereas the exact number for each analysis varies. Characteristics of the study population from the general working population are shown in Table 1.

In addition, subgroups from the general working population were defined. The subgroup of "pain-free" individuals had to fulfill all of the following criteria: 1) pain intensity of 0–2 (scale 0–9, where 9 is max) in the low back, hands/wrists, and neck/shoulders, 2) no diagnosed back disease, 3) no use of pain medication for musculoskeletal pain. The subgroup of "back disease" had to fulfill all of the following criteria: 1) diagnosed back disease, and 2) low back pain intensity of at least 5 (scale 0–9, where 9 is max).

2.3 Ethical approval

The study has been notified to and registered by Datatilsynet (the Danish Data Protection Agency; journal number 2007-54-0059). According to Danish law, questionnaire and register-based studies do not need approval by ethical and scientific committees, nor informed consent [16]. All data was de-identified and analyzed anonymously.

Table 1: Demographics, health and work-related characteristics.

	n	Mean (SD)	%
Age (years)	10,427	43.5 (11.7)	
BMI ($kg \cdot m^{-2}$)	10,095	25.4 (4.4)	
Gender			
Men	4,762		45.7
Women	5,665		54.3
Smoking			
No, never	4,897		48.2
Ex-smoker	2,916		28.7
Yes	2,356		23.2
Physical activity, leisure			
Low	1,365		13.4
Moderate	6,853		67.5
High	1,938		19.1
Physical activity at work			
Low	4,744		46.9
Moderate	2,425		24.0
High	2,952		29.2
Psychosocial work factors (0–100)			
Emotional demands	10,154	44.6 (25.1)	
Influence at work	10,085	67.4 (24.0)	
Support from colleagues	9,473	73.1 (21.5)	
Support from leader	9,710	69.7 (25.8)	
Pain intensity (0–9)			
Low back	10,227	2.3 (2.5)	
Arm/hand	10,223	1.4 (2.2)	
Neck/shoulder	10,220	2.4 (2.4)	
Depression			
No	8,938		87.5
Yes	1,272		12.5
Back disease			
No	8,551		83.8
Yes	1,650		16.2
Using pain medication			
No	7,843		76.8
Yes, over-the-counter	1,465		14.3
Yes, doctor prescribed	906		8.9
Fear-avoidance beliefs (0–100)			
Question 1	10,039	48.5 (32.4)	
Question 2	9,824	34.9 (33.7)	
Average question 1 and 2	9,793	41.7 (27.3)	

2.4 Outcome variable

2.4.1 Fear-avoidance beliefs

Fear-avoidance beliefs were assessed by questions from the FABQ [6]. Because the DWECS questionnaire covers several aspects of health and work environment there was a limited number of questions for each category. Thus, only two questions from the FABQ were included in the questionnaire survey. The first question was selected from the physical activity subscale (FABQPA): "Physical activity makes my pain worse"; the second question from the work subscale (FABQW): "I should not do my normal work with my present pain". Both questions have previously been shown to have moderate to high correlation with the full questionnaire in workers with upper extremity injuries ($r = 0.65$ and 0.40, respectively) [17]. Participants replied on a 7-point Likert scale ("Completely Agree" to "Disagree"). For further analyses, the responses were converted to a scale of 0–100, with 0 having low and 100 having high fear-avoidance beliefs and mean value of the two questions was calculated and used for the main analysis. While the Danish version of the FABQ has not been tested for validity or reliability, the Norwegian version has shown to have acceptable factor structure, internal consistency, test-retest reliability and construct validity [18]. It should be mentioned that Danish and Norwegian language as well as culture is almost identical.

2.5 Explanatory variables

2.5.1 Physical activity at work

Physical demands at work were determined by the question "How would you generally describe your physical activity in your main job?". The response was given on a 4-point scale of 1) mostly sedentary work that does not require physical exertion, 2) mostly standing or walking work, which otherwise does not require physical exertion, 3) standing or walking work with some lifting or carrying work and 4) heavy or fast work which is physically strenuous [19]. For subsequent analysis, response category one was considered as "low", two as "moderate" and three and four as "high" physical activity.

2.5.2 Physical activity during leisure time

Leisure time physical activity was assessed by the question: "How much time have you spent on each of the following leisure-time activities during the last year (including commuting to and from work)?". The three subquestions were: Category 1) "Walking, biking or other low-intensity exercise, where you do not get short of breath nor sweat (e.g. sunday walk or low-intensity gardening)?", category 2) "Exercise training, heavy gardening or higher-intensity walking/biking, where you do sweat and get short of breath?", and category 3) "Strenuous exercise training or competitive sports?" [20]. The response categories for each sub-question were: 1) >4 h per week, 2) 2–4 h per week, 3) <2 h per week, or 4) do not perform this activity. For the subsequent analysis of the duration

the categories were recorded to be 5, 3, 1 and 0 h of physical activity per week [20]. For the subsequent analyses, low physical activity was defined as 3 h or less per week of category 1 activities and no category 2 or 3 activities, moderate physical activity was defined as 1–3 h of either category 2 or 3 activities or 5 h of category 1 activities, and high physical activity was defined as 5 h of either category 2 or 3 activities or a combination of 3 h of category 2 and 3 h of category 3 activities.

2.6 Control variables

Control variables were age (continuous, based on the CPR register), gender, body mass index (BMI) (continuous), smoking status ("No, never", "Ex-smoker" and "Yes"), psychosocial work factors (emotional demands, support from colleagues, support from superiors and influence at work) from the Copenhagen Psychosocial Questionnaire (COPSOQ) [21], pain intensity (low back, arm/hand and neck/shoulder), use of pain medication ("No", "Yes, over-the-counter" and "Yes, doctor prescribed"), diagnosed back disease and depression (from DWECS questionnaire) and education (10-level variable based on the first two digits of the variable HFUDD10 from Statistics Denmark) [22]. The reason for controlling for education is that there may be an educational or socio-economic gradient with fear avoidance. The reason for controlling for chronic disease, pain-related variables, smoking, and BMI is that individual health-related factors are likely to influence fear avoidance beliefs. Because physical work demands and psychosocial work factors are also somewhat associated, we chose to control also for psychosocial work factors.

2.7 Statistical methods

Unadjusted descriptive values are presented as means (standard deviation) and frequencies. Using general linear models (Proc GLM, SAS version 9.4) to test associations, least square means and 95% confidence intervals (CI) were calculated with fear avoidance as the dependent variable (outcome variable) and physical activity at work and during leisure as mutually adjusted independent variables (explanatory variables). Model 1 was the minimally adjusted model controlling for age and gender. Model 2 was the fully adjusted model controlling for the same as model 1 and additionally for lifestyle factors (BMI and smoking), psychosocial work factors, pain intensity, use of pain medication, diagnosed back disease, diagnosed depression and education. The same analyses were run on the pain-free subgroup and the subgroup with back disease.

3 Results

Table 1 describes the study population regarding demographics, health and work-related factors. The study population ($n = 10{,}427$) was on average 43.5 years old (SD 11.7) and 68% were moderately physically active during leisure time. In regard to physical activity during work, 47% had mainly low, 24% moderate and 29% had high physical activity. A back disease had been diagnosed in 16% of the respondents and the average pain intensity level (scale 0–9) in the low-back region was 2.3 (SD 2.5).

Table 2 shows the association between physical activity during leisure time and at work with the level of fear-avoidance (scale 0–100) for 1) the general working population, 2) the participants with high pain and back disease and 3) the participants with low or no pain and no back disease. The results presented in Table 2 are explained for the different groups below with respect to the fully adjusted statistical model.

3.1 General working population

The average level of fear-avoidance in the general working population was 41.7 (SD 27.3). The level decreased with an increasing level of physical activity during leisure time (fully adjusted model: main effect $F = 11.5$, $p < 0.0001$). Among those with low, moderate and high physical activity during leisure time fear-avoidance beliefs were 47 (95% CI 45–49), 44 (95% CI 42–46) and 43 (95% CI 41–45), respectively. By contrast, the opposite pattern was seen for physical activity at work (fully adjusted model: main effect $F = 74.3$, $p < 0.0001$). Among those with low, moderate and high physical activity at work, fear-avoidance beliefs were 40 (95% CI 39–42), 44 (95% CI 42–46) and 49 (95% CI 48–51), respectively. Figure 1 illustrates the contrasting association between the two types of physical activity with fear-avoidance.

3.2 Participants with back disease

Among the participants with back disease and high pain the average level of fear-avoidance was 54.3 (SD 27.7). There was a significant main effect of physical activity at work (fully adjusted model: $F = 14.2$, $p < 0.0001$) and a tendency of physical activity during leisure (fully adjusted model: $F = 2.7$, $p = 0.0678$) for fear-avoidance. A high level

Table 2: Fear-avoidance beliefs (scale 0–100) in relation to physical activity during leisure and at work among the general working population, workers with back disease and pain-free workers.

	n	FAB question 1		FAB question 2		FAB	
		Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
		Lsmean (95% CI)	Lsmean (95% CI)	Lsmean (95% CI)	Lsmean (95% CI)	Lsmean (95% CI)	Lsmean (95% CI)
General working population							
Low physical activity, leisure	1,365	56 (55–58)	56 (53–58)	40 (38–42)	39 (37–42)	48 (47–50)	47 (45–49)
Mod. physical activity, leisure	6,853	49 (48–50)	51 (49–53)	35 (34–36)	37 (35–39)	42 (41–43)	44 (42–46)
High physical activity, leisure	1,938	45 (44–47)	47 (45–50)	35 (34–37)	38 (36–40)	40 (39–42)	43 (41–45)
Low physical activity, work	4,744	44 (43–45)	47 (45–49)	30 (29–31)	34 (32–36)	37 (36–38)	40 (39–42)
Mod. physical activity, work	2,425	49 (47–50)	51 (49–54)	35 (33–36)	37 (35–39)	42 (40–43)	44 (42–46)
High physical activity, work	2,952	58 (57–60)	55 (53–58)	45 (44–47)	43 (41–46)	52 (51–53)	49 (48–51)
Back disease							
Low physical activity, leisure	152	66 (60–71)	61 (53–69)	50 (44–55)	45 (37–53)	58 (53–62)	53 (46–59)
Mod. physical activity, leisure	504	60 (57–63)	58 (51–64)	47 (44–50)	46 (39–52)	53 (51–56)	51 (46–57)
High physical activity, leisure	135	55 (49–61)	52 (44–61)	42 (36–47)	39 (31–47)	49 (44–53)	46 (39–52)
Low physical activity, work	297	52 (48–56)	51 (44–57)	35 (31–39)	34 (28–41)	44 (40–47)	42 (37–48)
Mod. physical activity, work	173	62 (57–67)	60 (52–68)	46 (41–51)	44 (37–52)	54 (50–58)	52 (46–58)
High physical activity, work	302	67 (63–71)	60 (53–68)	57 (53–61)	51 (43–58)	62 (59–65)	55 (49–61)
Pain-free							
Low physical activity, leisure	379	50 (46–53)	48 (44–53)	39 (35–42)	34 (29–38)	44 (41–47)	41 (37–45)
Mod. physical activity, leisure	2,238	45 (43–46)	45 (42–49)	33 (31–34)	29 (26–33)	39 (38–40)	38 (35–40)
High physical activity, leisure	741	41 (39–43)	41 (38–45)	33 (31–36)	29 (25–33)	37 (35–39)	35 (32–38)
Low physical activity, work	1,691	41 (39–43)	43 (40–46)	29 (27–31)	27 (23–30)	35 (33–37)	35 (32–38)
Mod. physical activity, work	931	44 (42–46)	45 (42–49)	34 (32–37)	31 (27–35)	39 (37–41)	38 (35–41)
High physical activity, work	699	50 (48–53)	47 (43–51)	41 (38–44)	35 (31–39)	45 (43–48)	41 (38–44)

Model 1 = adjusted for age and gender; Model 2 = model 1 + other lifestyle factors (BMI and smoking), psychosocial work factors, pain intensity (neck/shoulder, arm, low back), pain medication, diagnosed back disease, depression, education.

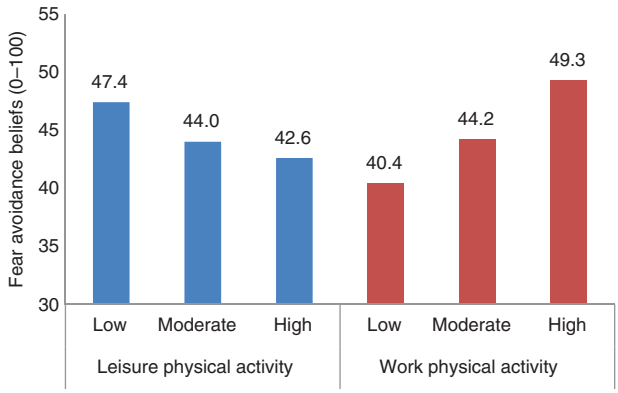

Fig. 1: Contrasting association of physical activity during leisure time and at work with fear-avoidance.

of physical activity during leisure time as well as a low level of physical activity at work were associated with lower levels of fear-avoidance [46 (95% CI 39–52) and 42 (95% CI 37–48), respectively]. A low level of physical activity during leisure time and a high level of physical activity at work were associated with higher levels of fear-avoidance [53 (95% CI 46–59) and 55 (95% CI 49–61), respectively]. Based on the mean values and 95% CI, individuals having back disease and a high level of physical activity during work showed the overall highest level of fear-avoidance.

3.3 Pain-free participants

Pain-free participants exhibited an average level of fear-avoidance of 38.0 (SD 26.9). There was a significant main effect of physical activity at work (fully adjusted model: $F = 9.3$, $p < 0.0001$) and during leisure (fully adjusted model: $F = 4.7$, $p = 0.0091$) for fear-avoidance. The lowest level of fear-avoidance was observed in pain-free individuals with a low level of physical activity during work [35 (95% CI 32–38)]. The highest levels of fear-avoidance in this subgroup were found among those with low levels of physical activity during leisure time and high level of physical activity at work [41 (95% CI 37–45) and 41 (95% CI 38–44), respectively].

4 Discussion

4.1 Main findings

The main finding from this study is that physical activity during work and leisure shows contrasting associations with fear avoidance beliefs. While high physical activity during leisure is associated with lower levels of fear-avoidance, high physical activity at work is associated with higher levels of fear-avoidance. Furthermore, levels of fear-avoidance are higher among workers with back disease but lower in pain-free workers, compared with the general working population.

4.2 Contrasting associations – work and leisure

As a novel finding, physical activity during work and leisure showed contrasting associations with fear avoidance beliefs. This result may be explained by the different requirements of the settings and levels of voluntariness that come along with the activity tasks during leisure and work. Previous research has provided sufficient evidence that engaging in regular physical activity during leisure results in multiple health benefits such as prevention of chronic diseases [23], reduction of musculoskeletal pain [24] and a reduced risk of premature death [23]. Additionally, being physically active might also help to reduce fear-avoidance beliefs as put forward by Nelson and Churilla [7]. Due to the positive association between pain intensity and fear-avoidance in chronic pain patients [25] both could possibly be reduced by active physical therapy [12]. However, this seems to only apply for physical activity during leisure time as we found that higher levels of work-related physical activity were associated with higher levels of fear-avoidance. The finding is in accordance with other findings concerning the negative health effects associated with physically strenuous work. Several studies showed that a high physical workload is associated with a significantly increased risk of developing work-related musculoskeletal disorders and long-term sickness absence [26–29]. Interventions to reduce fear-avoidance beliefs should therefore not only focus on physical activity during leisure time but also include adjustments of working condition or people's beliefs and cognitive-behavioral intentions about work-related physical activity. However, changes in working conditions, e.g. avoidance of monotonous repetitive, unilateral or heavy physical work are likely to be challenging to implement, as these are commonly job specific. Therefore, interventions explaining and concerning beliefs about the pain as well as cognitive behavior to cope with it might be an effective solution [30]. A recent study by Jay and co-workers [31] showed that 10 weeks of physical-cognitive mindfulness training reduced fear-avoidance beliefs about work-related activity by approx. 23% with a small-medium effect size (0.30 Cohen's d) in

a group of female laboratory technicians compared with a reference group.

4.3 High physical work demands and fear avoidance

The differences of fear-avoidance between low and high physical activity categories were approximately 4 points for leisure and 9 points for work. Thus, it may be especially important to intervene on fear-avoidance beliefs among workers with high physical work demands.

4.4 Back disease and fear avoidance

The overall highest level of fear-avoidance in our study was found within the subgroup of individuals with back disease. Individuals with a combination of high levels of physical activity at work, low levels of physical activity during leisure time and the presence of a painful back disease are therefore most likely to exhibit the highest levels of fear-avoidance. Again, a combination of physical training and cognitive therapy may be useful for this group of individuals as suggested by a recent intervention study among nurses' aides, i.e. a job group with high physical work demands, a high prevalence of musculoskeletal pain and low levels of leisure time physical activity [32].

4.5 Pain-free individuals and fear avoidance

Pain-free individuals exhibited the overall lowest levels of fear-avoidance, i.e. approximately 16 points lower than the group with back disease and high pain and 3–4 points lower than the general working population. This is in line with a study by Houben co-workers [10], measuring pain-related fear with a special version of the Tampa Scale for Kinesiophobia (TSK-G) among individuals from the general population (i.e. both with and without back complaints within the previous year). The study showed that total TSK-G scores were only slightly higher among individuals with back complaints compared to those without. From an evolutionary perspective it can be assumed that a certain level of fear-avoidance helps to avoid danger and therefore serves as a protective mechanism in hazardous situations. Previous studies have indicated that fear-avoidance can be learned by direct experience, as a result of instructions or vicarious learning [33]. Meier co-workers [34] found differences in amygdala activity in healthy individuals with high and low levels of fear-avoidance measured by TSK-G when watching video clips of potentially harmful activities for the back. As the amygdala plays a central role in the perception of fear as well as in the generation of learned fear behavior [35] such findings support the idea of learned fear-avoidance beliefs.

4.6 Limitations and strengths

Due to the cross-sectional design we were only able to test associations, i.e. no causal inferences can be drawn from the results. Thus, physical activity may influence fear-avoidance and vice versa. Because the DWECS is a questionnaire-based study the results are based on self-reports and could be prone to bias (e.g. reporting bias). Another limitation is that the question about leisure physical activity concerned the last year, where the question about work concerned work activity in general. However, because most working conditions do not change much in a year, it is plausible that the two questions are comparable. About half (53%) of the invited participants replied to the questionnaire, which is not an unusual response percentage in questionnaire studies. Previously, a non-response analysis found that the response percentage differed between groups. Thus, it was lower for men than women, and lower for job groups of shorter education [36]. A robustness analysis indicated that these differences only to a minor extent influenced job-group specific rating of the working environment [36]. A strength of the study is that the analyses have been controlled for a number of potential confounders such as age, gender, lifestyle, psychosocial work factors, pain intensity, use of pain medication and chronic diseases. As illustrated in Table 2, adjusting for several potential confounders in model 2 narrowed the differences of fear-avoidance beliefs between low and high physical activity categories, highlighting the relevance of controlling for these factors. Because the DWECS included several aspects of work and health, only two out of 16 questions from the FABQ (one each of the FABQ-PA and the FABQ-W) were used in the questionnaire, which could reduce the validity of the individual questions. However, both questions ("I should not do my normal work with my present pain" and "Physical activity makes my pain worse") have previously been shown to have moderate to high correlation with the full questionnaire in workers with upper extremity injuries ($r = 0.65$ and 0.40, respectively) [17]. Furthermore, physical activity during leisure and work showed clear associations with both questions, as well as with the mean value of the two questions. The

high number of participants (n = 10,427) from a representative sample of the Danish working population is an additional strength of this study. The additional analyses among pain-free individuals and individuals with back disease, respectively, further confirm that the contrasting pattern of leisure and work activity with fear-avoidance is robust among different subgroups.

5 Conclusion

In conclusion, our study shows contrasting associations of leisure-time and work-related physical activity with fear-avoidance beliefs in the general working population. This pattern remained robust among pain-free individuals and individuals with back disease, respectively. While high physical activity at leisure is associated with lower levels of fear-avoidance, high physical activity at work is associated with higher levels of fear-avoidance. Fear-avoidance beliefs are more pronounced in the subgroup of individuals with back disease but less in pain-free individuals.

6 Implications

There are some important practical implications of the present study. The present results may reflect some deeply rooted negative beliefs about pain and work in the population. Initiatives to improve such beliefs are warranted. On the societal level, campaigns may be a possible way forward as these have shown to improve beliefs about musculoskeletal pain and work [37].

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Authors' statements

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References

[1] Linton SJ, Shaw WS. Impact of psychological factors in the experience of pain. Phys Ther 2011;91:700–11.
[2] Hasenbring MI, Verbunt JA. Fear-avoidance and endurance-related responses to pain: new models of behavior and their consequences for clinical practice. Clin J Pain 2010;26:747–53.
[3] Lethem J, Slade PD, Troup JDG, Bentley G. Outline of a fear-avoidance model of exaggerated pain perception – I. Behav Res Ther 1983;21:401–8.
[4] Vlaeyen JW, Linton SJ. Fear-avoidance and its consequences in chronic musculoskeletal pain: a state of the art. Pain 2000;85:317–32.
[5] Crombez G, Eccleston C, Van Damme S, Vlaeyen JW, Karoly P. Fear-avoidance model of chronic pain: the next generation. Clin J Pain 2012;28:475–83.
[6] Waddel G, Newton M, Henderson I, Somerville D, Main CJ. A Fear-Avoidance Beliefs Questionnaire (FABQ) and the role of fear-avoidance beliefs in chronic low back pain and disability. Pain 1993;52:157–68.
[7] Nelson N, Churilla JR. Physical activity, fear avoidance, and chronic non-specific pain: a narrative review. J Bodyw Mov Ther 2015;19:494–9.
[8] Wertli MM, Rasmussen-Barr E, Weiser S, Bachmann LM, Brunner F. The role of fear avoidance beliefs as a prognostic factor for outcome in patients with nonspecific low back pain: a systematic review. Spine J 2014;14:816–36.e4.
[9] Buer N, Linton SJ. Fear-avoidance beliefs and catastrophizing: occurrence and risk factor in back pain and ADL in the general population. Pain 2002;99:485–91.
[10] Houben RMA, Leeuw M, Vlaeyen JWS, Goubert L, Picavet HSJ. Fear of movement/injury in the general population: factor structure and psychometric properties of an adapted version of the Tampa Scale for Kinesiophobia. J Behav Med 2005;28:415–24.
[11] Turk DC, Wilson HD. Fear of pain as a prognostic factor in chronic pain: conceptual models, assessment, and treatment implications. Curr Pain Headache Rep 2010;14:88–95.
[12] Mannion AF, Müntener M, Taimela S, Dvorak J. Comparison of three active therapies for chronic low back pain: results of a randomized clinical trial with one-year follow-up. Rheumatology 2001;40:772–8.
[13] Burr H, Bjorner JB, Kristensen TS, Tüchsen F, Bach E. Trends in the Danish work environment in 1990–2000 and their associations with labor-force changes. Scand J Work Environ Health 2003;29:270–9.
[14] von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. J Clin Epidemiol 2008;61:344–9.
[15] Nabe-Nielsen K, Garde AH, Clausen T, Jørgensen MB. Does workplace health promotion reach shift workers? Scand J Work Environ Health 2015;41:84–93.
[16] Committee System on Biomedical Research Ethics. Guidelines about Notification 2011. Available at: http://www.dnvk.dk/English/guidelinesaboutnotification.aspx. Accessed: 26 Oct 2016.
[17] Inrig T, Amey B, Borthwick C, Beaton D. Validity and reliability of the Fear-Avoidance Beliefs Questionnaire (FABQ) in workers with upper extremity injuries. J Occup Rehabil 2012;22:59–70.

[18] Grotle M, Brox JI, Vøllestad NK. Reliability, validity and responsiveness of the fear-avoidance beliefs questionnaire: methodological aspects of the Norwegian version. J Rehabil Med 2006;38:346–53.
[19] Hein HO, Suadicani P, Gyntelberg F. Ischaemic heart disease incidence by social class and form of smoking: the Copenhagen Male Study–17 years' follow-up. J Intern Med 1992;231:477–83.
[20] Calatayud J, Jakobsen MD, Sundstrup E, Casaña J, Andersen LL. Dose-response association between leisure time physical activity and work ability: cross-sectional study among 3000 workers. Scand J Public Health 2015;43:819–24.
[21] Pejtersen JH, Kristensen TS, Borg V, Bjorner JB. The second version of the Copenhagen Psychosocial Questionnaire. Scand J Public Health 2010;38:8–24.
[22] Statistics Denmark. Befolkningens højst fuldførte uddannelse n.d. Available at: http://www.dst.dk/da/Statistik/emner/uddannelse-og-viden/befolkningens-uddannelsesstatus/befolkningens-hoejst-fuldfoerte-uddannelse. Accessed: 6 Nov 2017.
[23] Warburton DER, Nicol CW, Bredin SSD. Health benefits of physical activity: the evidence. Can Med Assoc J 2006;174:801–9.
[24] Moreira-Silva I, Teixeira PM, Santos R, Abreu S, Moreira C, Mota J. The effects of workplace physical activity programs on musculoskeletal pain: a systematic review and meta-analysis. Workplace Health Saf 2016;64:210–22.
[25] Kroska EB. A meta-analysis of fear-avoidance and pain intensity: the paradox of chronic pain. Scand J Pain 2016;13:43–58.
[26] Mayer J, Kraus T, Ochsmann E. Longitudinal evidence for the association between work-related physical exposures and neck and/or shoulder complaints: a systematic review. Int Arch Occup Environ Health 2012;85:587–603.
[27] da Costa BR, Vieira ER. Risk factors for work-related musculoskeletal disorders: a systematic review of recent longitudinal studies. Am J Ind Med 2010;53:285–323.
[28] Lund T, Labriola M, Christensen KB, Bültmann U, Villadsen E. Physical work environment risk factors for long term sickness absence: prospective findings among a cohort of 5357 employees in Denmark. Br Med J 2006;332:449–52.
[29] Andersen LL, Fallentin N, Thorsen SV, Holtermann A. Physical workload and risk of long-term sickness absence in the general working population and among blue-collar workers: prospective cohort study with register follow-up. Occup Environ Med 2016;73:246–53.
[30] Moseley GL, Butler DS. Years of explaining pain: the past, present, and future. J Pain 2015;16:807–13.
[31] Jay K, Brandt M, Jakobsen MD, Sundstrup E, Berthelsen KG, Schraefel M, Sjøgaard G, Andersen LL. Weeks of physical-cognitive-mindfulness training reduces fear-avoidance beliefs about work-related activity: randomized controlled trial. Medicine (Baltimore) 2016;95:e3945.
[32] Rasmussen CDN, Holtermann A, Jørgensen MB, Ørberg A, Mortensen OS, Søgaard K. A multi-faceted workplace intervention targeting low back pain was effective for physical work demands and maladaptive pain behaviours, but not for work ability and sickness absence: stepped wedge cluster randomised trial. Scand J Public Health 2016;44:560–70.
[33] Krypotos A-M, Effting M, Kindt M, Beckers T. Avoidance learning: a review of theoretical models and recent developments. Front Behav Neurosci 2015;9:189.
[34] Meier ML, Stämpfli P, Vrana A, Humphreys BK, Seifritz E, Hotz-Boendermaker S. Fear avoidance beliefs in back pain-free subjects are reflected by amygdala-cingulate responses. Front Hum Neurosci 2015;9:424.
[35] Rosen JB, Donley MP. Animal studies of amygdala function in fear and uncertainty: Relevance to human research. Biol Psychol 2006;73:49–60.
[36] Bach E, Andersen LL, Bjørner JB. Arbejdsmiljø og helbred i Danmark 2010 2010. Available at: http://www.arbejdsmiljoforskning.dk/da/nyheder/arkiv/2011/samlet-rapport-om-arbejdsmiljoe-og-helbred-i-danmark-2010. Accessed: 20 Oct 2016.
[37] Andersen LL, Geisle N, Knudsen B. Can beliefs about musculoskeletal pain and work be changed at the national level? Prospective evaluation of the Danish national Job & Body campaign. Scand J Work Environ Health 2018;44:25–36. doi:10.5271/sjweh.3692.