The association between work-related physical fatigue, leisure time physical exercise, and risk of low back pain

The HUNT study, Norway

Master degree Thesis

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Abstract

Objectives: It is well documented that high physical work demands is associated with increased risk of chronic low back pain (LBP) while regular physical exercise reduce the risk. However, there is limited knowledge about the combined effect of physical work demands and leisure time physical exercise on risk of LBP. The objective of this study was to investigate whether work-related physical fatigue increases the risk of chronic LBP and if leisure time physical exercise alters this association.

Methods: The study population consisted of 8,293 men and 6,374 women who were vocationally active and who had participated in the Nord-Trøndelag health study in 1984-1986 (HUNT 1) and 1995-1997 (HUNT 2). Risk ratios (RR) of LBP in HUNT 2 associated with work-related physical fatigue and leisure time physical exercise was estimated by a general linear model. Precision of the estimated risk ratios was assessed by 95% confidence intervals (CI).

Results: At follow-up (HUNT 2) 1,267 women and 1,253 men reported chronic LBP. A dose-dependent association was found between work-related physical fatigue and risk of LBP (P-trend <0.001) both among women and men. In specific, women and men who reported to be "often/always" fatigued had multiadjusted RRs of 1.64 (95% confidence interval [95% CI] 1.33-2.03) and, 1.43 (95% CI 1.18-1.74) respectively, compared with those who reported to be "never" fatigued. The different measures of physical exercise showed a weak dose-dependent protective effect on LBP both among women (P-trend <0.16) and men (P-trend <0.14). Analysis of physical exercise showed that women and men who exercised for ≥2 hours per week had a RRs of 0.87 (95% CI 0.70-1.09) and 0.86 (95% CI 0.70-1.04), respectively, referring inactive individuals. Combined analysis showed that individuals who were physically active and reported to be "often/always" fatigued had 30% lower risk (P-value 0.02) than inactive individuals with similar level of work-related physical fatigue.

Conclusion: Work-related physical fatigue is associated with increased risk of chronic LBP in a dose-dependent manner. Leisure time physical exercise can, to some extent, reduce the adverse effect of work-related physical fatigue on risk of chronic LBP.

Introduction

Low back pain (LBP) is a major health problem in the Western societies and is one of the most common types of chronic musculoskeletal pain (Brooks, 2006, Krismer and Van Tulder, 2007). Chronic musculoskeletal pain affects millions of people and is a burden on individuals, the health system and the social care system (Brooks, 2006). It is one of the most common causes of sick leave, work disability and early retirement (Andersen et al., 2012, Ihlebæk et al., 2002, Morken et al., 2003, Karahan et al., 2009). Moreover, LBP is one of the most significant contributors to years lived with disability (YLDs) (Vos et al., 2013) as well as disability-adjusted life years (DALYs) (Murray et al., 2013).

Inconsistent prevalence rates of LBP has been published with estimated ranging from 22% to 65% in the general adult population (Cimmino et al., 2011, Hoy et al., 2012). Among adults in the general population, it has been estimated that 70-85% will experience at least one episode with acute LBP at some time point during their lives (Henchoz and Kai-Lik So, 2008). For some individuals the pain may become chronic i.e. pain that last more than 3 months is usually considered chronic (Cimmino et.al 2011).

With the aging population, the absolute number of people with chronic LBP is likely to increase substantially over the coming decades and several studies investigate risk factors to provide clues about how to prevent and treat chronic LBP. High physical work demands has been considered a main risk of musculoskeletal pain (Murtezani et al., 2011, Tamrin et al., 2007). One cross-sectional study found that the prevalence of LBP among industrial workers were 61,6% (Murtezani et al., 2011). Heavy lifting and manual materials handling, working in awkward postures, and whole-body vibration, are well established risk factors for LBP (Miranda et al., 2008, Van Nieuwenhuyse et al., 2006). Although workers are often exposed to multiple risk factors, studies has found that working with the trunk in a bent and twisted position and highly repetitive work constitute the most significant risk factors for LBP(Andersen et al., 2007, Van Nieuwenhuyse et al., 2006, Miranda et al., 2008).

Incidence of LBP increases markedly with age and can be affected by lifestyle factors, such as physical exercise, obesity and work-related physical fatigue (Dijken et al., 2008, Hoy et al., 2012). Regular physical exercise and maintenance of normal body weight reduce the risk of chronic musculoskeletal pain (Nilsen et al., 2011, Mork et al., 2010, Haskell et al., 2007). In a prospective cohort study, moderate physical exercise at baseline was associated with 53% lower risk of chronic widespread musculoskeletal complaints at follow-up 11 years later (Holth et al., 2008). Among personnel in the Royal Norwegian Navy a physically active lifestyle was associated with fewer musculoskeletal disorders (Morken et al., 2007). Nilsen and colleagues (2011) found that a relatively small amount of physical exercise lowers the risk of chronic LBP, and that increasing number of hours of exercise per week were associated with further reduction in risk of chronic LBP (Nilsen et al., 2011).

Despite the large number of people who are suffering from LBP, the understanding of its mechanisms is still limited. Musculoskeletal pain have been considered to be somehow related with physical capacity were low muscle strength and low cardiovascular endurance are reported as risk factors for LBP. (Dijken et al., 2008, Murtezani et al., 2011). The demands at work and capacity of the worker to perform work-related activities play a role in the development of chronic LBP.

Little is known about the combined effect of physical exercise, work-related physical fatigue and risk of chronic LBP in the general population. One study has investigated the effect of physical work demands and leisure time physical exercise on risk of chronic LBP. Murtezani and co-workers (2011) found that the prevalence of LBP was significantly associated with physical exercise among industrial workers in a cross-sectional study. However, no large prospective studies have investigated whether physical exercise compensate or aggravate the risk of chronic LBP associated with high work-related physical fatigue.

The main objective of the present study was to examine the association between work-related physical fatigue and risk of chronic LBP and if leisure time physical exercise alters this association. It was hypothesized that (1) work-related physical fatigue increases the risk of chronic LBP, and (2) that leisure time physical exercise can compensate for the possible unfavorable effect of work-related physical fatigue on risk of chronic LBP.

Materials and methods

The HUNT Study

Data from the Nord-Trøndelag Health study (HUNT) is used in the current study. HUNT is a population based health study from one of Norway's 19 counties. All residents in the Nord-Trøndelag county aged older than 20 years have been invited to participate. The HUNT Study has been carried out in three waves, the first in 1984-1986 (HUNT 1), the second in 1995-1997 (HUNT 2), and the third in 2006-2008 (HUNT 3). The currents study is based on data from HUNT 1 and HUNT 2. All 87,285 eligible persons were mailed an invitation for health examination and health questionnaires in HUNT 1. Off these, 77,216 (89%) returned the questionnaires, and attended the medical examination. At the examination, a second questionnaire, which included questions on physical exercise, were given to complete and return from home. HUNT 1 focused on quality of life, blood pressure, diabetes, and lung diseases. At HUNT 2, 94,187 persons were invited to participate, and 66,215 (70%) accepted the invitation. The procedure on HUNT 2 was similar to those described for HUNT 1. Although, both the questionnaire and the clinical examination were more comprehensive in HUNT 2. Results from the medical examination was not included in the present study. For more detailed information about selection procedures, participation, and questionnaires used in the HUNT study can be found at http://www.ntnu.edu/hunt.

Study populations

For the purpose of the present study, we selected all 24,357 women and 21,568 men who had participated in HUNT 1 and HUNT 2 (45,925 persons). Of these, we excluded 3,105 men and 10,020 women who reported not working or working full time housework in HUNT 1, 2,379 men and 1,986 women who had no information on work-related physical fatigue, and 7 women without information on body mass. Moreover, we excluded 1,124 men and 524 women who reported being physically impaired at baseline or who had no information on this variable, 4,246 men and 2,896 women without baseline information on physical exercise, and 74 men and 87 women without information on musculoskeletal pain. To obtain a study sample of person without musculoskeletal pain at baseline (i.e., at the time of HUNT 1), we excluded participants who reported that the pain had lasted for 10 years or more 2,347 men and 2,463 women, leaving a total of 14,4667 (8,293 men and 6,374 women) for eligible statistical analysis.

Exposure variables

Work-related physical fatigue, was measured in HUNT 1 by the question: "Is your work so physically demanding that you are often physically worn out after a day's work?" Response options were "Yes, nearly always", "Quite often", "Seldom", and "Never, or almost never". Participants who reported "Yes, nearly always" and "Quite often" were classified as "often/always" work-related physical fatigue, participants who reported "Seldom" were classified as "Seldom" work-related physical fatigue, and participants who reported "Never, or almost never" were classified as "Never" work-related physical fatigue. This reduced number of combinations gave larger groups and thereby increased statistical power.

Information about leisure time physical exercise was obtained from three questions in the HUNT 1 questionnaire that included information about frequency, duration, and intensity. The frequency question "How often do you exercise?" had 5 response options (0, <1, 1, 2-3, or >4 times per week). Participants who reported no exercise or less than 1 exercise session per week were classified as inactive. Participants who reported exercising once a week or more were also asked about the average duration per exercise session (<15, 16-30, 30-60, or > 60 minutes) and the average exercise intensity (no sweating or heavy breathing, sweating and/or heavy breathing, or exhausted). Based on information on frequency and duration, we calculated the average number of hours spent on physical exercise per week. For the purpose of this calculation the response option "2-3 times per week" was counted as a 2,5 times per week, and > 4 times per week was counted as 5 times per week, whereas the response options " >15 minutes" was counted as 10 minutes, "15-30 minutes" was counted as 25 minutes, "31-60 minutes" was counted as 45 minutes, and "> 60 minutes" was counted as 75 minutes.

When using frequency in the analyses of physical exercise and risk of chronic LBP, it was calculated into inactive, <1.0 hours per week, 1.0-1.9 hours per week, and ≥ 2.0 hours per week. In the analyses where the variable inactive/active is used we calculated 1.0-1.9 and ≥ 2.0 hours per week as active persons.

Outcome variable

The questions about musculoskeletal symptoms were adopted from the Standardized Nordic Questionnaire (Kuorinka et al., 1987). In the first questionnaire at HUNT 2, the participants were asked: "During the last year, have you had pain and/or stiffness in your muscles and limbs that lasted for at least 3 consecutive months?" with response options "Yes" and "No". If answering yes, the participants were asked to indicate the affected body area. Participants who reported chronic LBP was analyzed in this study.

Other variables

Several variables were used to adjust for potential confounding. Based on a priori considerations and availability of information, the variables used to control for confounding were age (continuous), smoking (never, former, current, or unknown), education (≤9 years, 10-12 years, ≥12 years, or unknown) and BMI (continuous). Standardized measurement of body height and body mass obtained at the baseline examination in HUNT 1 was used to calculate BMI as mass (kg) divided by the square of height (m^2).

Statistical analyses

Descriptive statistics, including number, means, percentages, and standard deviations were calculated to describe the study population. For the main analysis a generalized linear model for the binomial family (log link) was used to estimate risk ratio (RR) for chronic LBP associated with work-related physical fatigue and physical exercise. Participants who reported "seldom" and "often/always" work-related physical fatigue were compared with the reference group of "never" work-related physical fatigue. In the analysis of physical exercise, participants reporting different levels of exercise were compared to a reference group of inactive subject, i.e., those reported being active less than once a week. The main analyses were stratified by gender and precession of RRs were estimated by 95% confidence intervals (CI). Trend tests across categories of work-related physical fatigue were calculated by treating the categories as ordinal variables. An analyses of the combined effect of work-related physical fatigue and physical exercise for relative risk on chronic LBP, using participants who was active (≥1 hour/week) and "never" work-related physical fatigue as references. The effect of physical exercise within each category of work-related physical fatigue was tested in subsequent stratified analysis. Potential effect modification between work-related physical fatigue and physical exercise was assessed by an interaction test were a product term of these factors were included in the regression model. The multivariable models were adjusted for age (continuous), smoking (never, former, current and unknown), education (≤9 years, 10-12 years, ≥12 years, or unknown), and BMI (body mass index, continuous). Additionally we adjusted for work-related physical fatigue ("often/always", "seldom", "never") and frequency of physical exercise (inactive, <1, 1-1.9, ≥2) in the full models. All statistical analyses were performed using SPSS (Statistical Package for the Social Sciences.

Ethics

Each participant in the HUNT study signed a written consent upon participation. The study was approved by the Regional Committee for Ethics in Medical Research.

Results

Table 1 and 2 presents baseline characteristics of the study population according to work-related physical fatigue and leisure time physical exercise. There was more inactive persons in the "often/always" work-related fatigue group compared with the "seldom" and "never" group, both among women and men (Table 1). Age and BMI was relatively similar between groups of work-related physical fatigue (Table 1). The relative proportion of participants reporting to be "often/always" fatigued after work was higher among inactive individuals (Table 2). At follow-up, (at HUNT 2) 1,267 (20.2%) women and 1,253 (15.5%) men reported chronic LBP.

Table 1 Baseline characteristics of the study population according to work-related physical fatigue

Characteristic	Never	Seldom	Often/always
Women, no	871	2,531	2,972
Mean age (SD), years	40.8 (11.9)	41.7 (11.7)	42.3 (11.7)
Mean BMI (SD), kg/m^2	23.4 (3.2)	23.8 (3.4)	24.2 (3.6)
Current smoker No (%)	229 (26.4)	784 (31.2)	956 (32.5)
Education >12 yr No (%)	231 (26.9)	371 (14.9)	358 (12.4)
Inactive[a] (%)	75 (13.9)	269 (17.6)	440 (25.7)
Men, no	1,461	3,249	3,583
Mean age (SD), years	42.8 (11.1)	43.0 (12.5)	41.1 (12.4)
Mean BMI (SD) kg/m^2	24.7 (2.6)	25.0 (2.8)	25.0 (2.9)
Current smoker No (%)	311 (21.3)	906 (27.9)	1181 (33.1)
Education >12 yr No (%)	650 (45.5)	524 (16.6)	225 (6.4)
Inactive[a] (%)	144 (14.3)	467 (21.4)	735 (30.5)

BMI, body mass index SD, standard deviation
[a]Less than 1 physical exercise session per week

Table 2 Baseline characteristics of the study population according to leisure time physical exercise.

Characteristics	Active[a]	Inactive[b]
Women, no	2,993	784
Mean age (SD), years	42.5 (12.3)	43.2 (12.1)
Mean BMI (SD), kg/m^2	23.9 (3.5)	24.6 (3.9)
Current smoker No (%)	807 (27.1)	320 (41.2)
Education >12 yr No (%)	511 (17.5)	50 (6.5)
Often/always work-related physical fatigue No (%)	1271 (42.5)	440 (56.1)
Men, no	4,256	1,346
Mean BMI (SD), kg/m^2	42.0 (12.5)	43.1 (12.0)
Mean BMI (SD)[c]	24.8 (2.6)	25.5 (3.2)
Current smoker No (%)	993 (23.4)	577 (43.1)
Education >12 yr No (%)	849 (20.4)	94 (7.1)
Often/always work-related physical fatigue No (%)	1671 (39.3)	735 (54.6)

BMI, body mass index SD, standard deviation
[a]1 or more hours of physical exercise per week
[b]Less than 1 physical exercise session per week

Table 3 shows the age-adjusted and multi-adjusted RR of chronic LBP at follow-up associated with work-related physical fatigue at baseline. There was a dose-dependent association between work-related physical fatigue and risk of chronic LBP, with P-trend <0.001 for both women and men. For women who reported “seldom” and “often/always” work-related physical fatigue, multiadjusted RRs were 1.18 (95% CI 0.95-1.45) and 1.64 (95% CI 1.33-2.03), respectively. The corresponding RRs among men were 1.07 (95% CI 0.88-1.30) and 1.43 (95% CI 1.18-1.74), respectively.

Table 3 Relative risk of chronic pain in the low back associated with work-related physical fatigue at baseline

Gender and work-related physical fatigue	No.of persons	No. of cases	Age-adjusted[a]	Multiadjusted RR[b]	95 % CI	P trend
Women						
Never	871	120		1.00		
Seldom	2,531	430	1.23	1.18	0.95, 1.45	
Often/always	2,972	717	1.75	1.64	1.33, 2.03	<0.001
Men						
Never	1,461	169		1.00		
Seldom	3,249	429	1.14	1.07	0.88, 1.30	
Often/always	3,583	655	1.58	1.43	1.18, 1.74	<0.001

[a] Adjusted for age (continuous)
[b] Adjusted for age (continuous), smoking (never, former, current or unknown), education (≤9 years, 10-12 years, ≥12 years or unknown), BMI (continuous) and leisure time physical exercise hours/week (inactive, <1, 1-1.9, ≥2)

Table 4 shows the age-adjusted and multi-adjusted RR of chronic LBP at follow-up associated with physical exercise at baseline. There was a weak dose-dependent protective effect on LBP both among women (P-trend <0.16) and men (P-trend <0.14). Women who exercised < 1, 1.0-1.9 and ≥ 2 hours per week had multiadjusted RRs for LBP of 0.88 (95% CI 0.70-1.09), 0.82 (95% CI 0.67-1.00), and 0.87 (95% CI 0.70-1.09) respectively, compared to inactive women. The corresponding RRs for men were 0.89 (95% CI 0.75-1.06), 0.87 (95% CI 0.73-1.05), and 0.86 (95% CI 0.70-1.05). Table 5 shows the combined effect of work-related physical fatigue and leisure time physical exercise on risk of chronic LBP. There was no evidence of statistical interaction between work-related physical fatigue and leisure time physical exercise (P -value 0.247). However stratified analysis within categories of leisure time physical exercise showed that physically active persons with “often/always” work-related physical fatigue had lower risk of chronic LBP than physically inactive persons with same level of work-related fatigue (P-value 0.02). In specific, multiadjusted RR were 1.41 (95% CI 1.16-1.70) among physically active persons with “often/always” work-related physical fatigue, and 1.71 (95% CI 1.38-2.13) among physically inactive persons with same level of work-related fatigue.

Table 4 Relative risk of chronic pain in the low back associated with leisure time physical exercise at baseline

Gender and physical exercise, hours/week	No.of persons	No. of cases	Age-adjusted[a]	Multiadjusted RR[b]	95 % CI	P trend
Women						
Inactive	784	194		1.00		
<1	2,597	522	0.82	0.88	0.73, 1.06	
1-1.9	2,037	364	0.72	0.82	0.67, 1.00	
≥2	1,654	187	0.79	0.87	0.70, 1.09	0.16
Men						
Inactive	1,346	245		1.00		
<1	2,691	407	0.83	0.89	0.75, 1.06	
1-1.9	2,602	367	0.77	0.87	0.73, 1.05	
≥2	1,654	234	0.77	0.86	0.70, 1.04	0.14

[a] Adjusted for age (continuous)
[b] Adjusted for age (continuous), smoking (never, former, current or unknown), education (≤9 years, 10-12 years, ≥12 years or unknown), BMI (continuous) and work-related physical fatigue (“never”, “seldom”, “often/always”)

Table 5 Combined effect of work-related physical fatigue and physical exercise on the risk of chronic low back pain

	Active[a]		Inactive[b]		
Work-related physical fatigue	Multiadjusted RR[c]	95% CI	Multiadjusted RR[c]	95% CI	P value[d]
Never	1.00		0.83	0.53, 1.29	0.60
Seldom	1.03	0.85, 1.25	1.13	0.87, 1.47	0.52
Often/always	1.41	1.16, 1.70	1.71	1.38, 2.13	0.02

[a]1 or more hours of physical exercise per week
[b]Less than 1 physical exercise session per week
[c]Adjusted for age (continuous), smoking (never, former, current or unknown), education (≤9 years, 10-12 years, ≥12 years or unknown), BMI (continuous).
[d]*P* value comparing active and inactive persons within each category of work-related physical fatigue.

Discussion

The purpose of this study was to examine if work-related physical fatigue increases the risk of chronic LBP and if leisure time physical exercise can compensate for the possible unfavorable effect of work-related physical fatigue. The main finding was a dose-dependent association between work-related physical fatigue and risk of LBP, both among women and men. Women and men who reported to be often/always work-related physical fatigued had a significantly higher risk of LBP at follow-up compared to participants who never experienced work-related physical fatigue. The independent effect of physical exercise on risk of chronic LBP was rather weak. In the combined analyses there was no evidence of statistical interaction (P-vaule 0.247) between work-related physical fatigue and leisure time physical exercise. Moreover, it was observed that physically active persons with often/always work-related physical fatigue had significantly lower risk of chronic LBP, compared to physically inactive persons with same level of work-related physical fatigue. Thus, leisure time physical exercise can to some extent reduce the adverse effect of frequent exposure to work-related physical fatigue.

Studies investigating the combined effect of work-related physical fatigue, physical exercise and risk of LBP are limited. However, several studies have investigated the association between physical work demands and physical exercise on risk of chronic LBP. Participants in HUNT 1 were not directly asked about work demands, instead they answered a question on how physically fatigued they were after a working day. Therefore we used work-related physical fatigue as a proxy variable for physical work demands. We believe that a subjective perception of physical work demands is presented in this variable, instead of an objective. To our knowledge questionnaire is the most use method for measuring work demands and work tasks. The limitation of such measures do not consider the individuals own physical capacity, just how hard one type of work is.

Concerning the possible mechanisms of LBP there has been an interest in the relation between physical work demands and risk of chronic LBP for a long time. Prolonged work in awkward position, heavy lifting and manual materials handling are well established risk factors of LBP (Andersen et al., 2007, Miranda et al., 2008, Van Nieuwenhuyse et al., 2006). A prospective study found that 21% of industrial workers who at baseline had not experienced LBP, developed LBP during the 1-year follow-up and that exposure to heavy lifting and whole-body vibration was associated with the incidence of LBP (Miranda et al., 2008). Additionally, a prospective study also investigated the influence of physical work-related factors and the occurrence of LBP among healthcare workers (Van Nieuwenhuyse et al., 2006). The results showed that after 1-year follow up 12,6% had developed LBP and that it was an increased risk associated with work in a twisted position. The studies by Miranda (2008) and Van Nieuwenhuyse (2006) is in line with Andersen and colleagues (2007) who examined the effect of work-related physical factors on risk of LBP. They found that the main risk factors for LBP was heavy lifting and prolonged standing (Andersen et al., 2007). It can be assumed that work in awkward postures and heavy lifting would lead to a feeling of work-related physical fatigue, even though the authors do not ask for a subjective feeling of work-related physical fatigue.

Several cross-sectional studies have investigated the occurrence of LBP and the association with work-related physical factors such as heavy lifting and manual handling, working in awkward postures, and whole-body vibration. One cross-sectional study found that 61% among hospital workers had experienced LBP within the last 12 months and that 78,3% of these reported that their LBP had begun after starting their work (Karahan et al., 2009). Murtezani and colleague's (2011) study the prevalence of LBP in industrial workers were LBP was found in 61.6% of workers. The main work-related physical factors associated with LBP were extreme trunk flexion, lifting and pushing or pulling heavy loads, and exposure to whole body vibration (Murtezani et al., 2011). This cross-sectional study can to a certain extent be compared to the prospective studies mentioned above. Moreover, cross-sectional studies cannot determine the cause and effect relation between chronic LBP and physical risk factors. Additionally, it can be discussed whether it is meaningful to assess the separate effects of work demands only, as is often done in epidemiology, knowing that work-related exposure may be affected as a multidimensional problem, i.e., workers are rarely exposed to whole body vibration alone, without being affected by awkward work postures or lifting.

In the current study there was a dose-dependent association between work-related physical fatigue and risk of LBP. Since the HUNT study do not allow assessment of different physical work exposures, the participants in the present study were classified into categories of work-related physical fatigue instead of groups of more specific physical work demand exposures. Because we used work-related physical fatigue as a proxy variable of physical work demands it makes it difficult to accurate compare the results of previous studies to our study. However, both the current study and previous studies indicate that heavy physical work demands increase the risk of chronic LBP.

The exact physiological mechanisms between LBP and work-related physical fatigue are not well understood. Nevertheless, there are reason to believe that physical work demands will affect individuals differently, and based on the findings from the present studies, physical capacity may be an important factor to consider. An imbalance between exposure to work-related physical factors and physical capacity might be a risk factor of LBP, or physical capacity could be an intermediate variable of the relation between exposure to work-related physical factors and the risk of LBP. It is conceivable that physical capacity, irrespective of work exposure, might also be a risk factor of LBP. Physical capacity can be measured by different physicals tests, and examples of physical capacity is muscle strength, muscle endurance and joint mobility. Hamberg's-van Reenen's and colleagues (2007) did a systematic research of studies investigating the relationship between physical capacity and future LBP. They found only three studies that indicated the relation between physical capacity and risk of chronic LBP. All in all they found inconclusive evidence for a relation between muscle strength and risk of chronic LBP. On the other hand a prospective study by Hamberg-van Reenen and colleagues (2006a) found that reduced low back muscle endurance is a predictor for LBP (Hamberg-van Reenen et al., 2006a, Hamberg-van Reenen et al., 2006b). Another study among workers in a large food production plant found that those who scored low muscle strength in a physical test had higher incidence of LBP compared to workers who scored high on muscle strength (Harbin and Olson, 2005). Regarding endurance exercise a study confirm that LBP was inversely associated with walking or bicycling (Sjolie, 2004). It appears that physical exercise may lead to improved physical capacity which consequently reduces the risk of LBP and helps the back to function better.

Previous studies have shown that physical exercise reduce the risk of chronic musculoskeletal pain (Henchoz and Kai-Lik So, 2008, Morken et al., 2007). Morken and colleagues have reported that musculoskeletal pain in the Royal Norwegian Navy was rather low because of their high physical activity level at work (Morken et al., 2007). Studies have reported inconclusive findings regarding the association between risk of LBP and physical exercise. This may due to the different descriptions of physical exercise in terms of type, intensity, frequency and duration. However, previous studies based on HUNT have reported that physical exercise reduce the risk of chronic LBP (Nilsen et al., 2011). In our study we found a weak relation between leisure time physical exercise and reduced risk of chronic LBP. Nevertheless, we found that men who reported the highest amount of leisure time physical exercise had reduced risk of chronic LBP compared to men who were physically inactive. Since the question about physical exercise used in HUNT 1 only included duration, frequency and intensity we could not include information about specific type of leisure time physical exercise. Future studies should include more detailed information about type of exercise to enable a more thorough assessment.

To our knowledge no other prospective studies have investigated the combined effect of work-related physical fatigue and leisure time physical exercise on risk of LBP. However, the cross-sectional study by Murtezani and collegaues (2011) found that LBP was significantly and inversely associated with physical activity. There was a significant difference between frequent physical activity and LBP where the prevalence among inactive was higher compared to those who reported being physically active every day. Additionally, the study reported that the main work-related physical factors were extreme trunk flexion, lifting & pushing or pulling heavy loads, and exposure to whole body vibration (Murtezani et al., 2011). Although this is a cross-sectional study it is somewhat similar to the findings in our study, that people who are inactive and reported often/always work-related physical fatigue have a higher risk of LBP compared to physically active persons in the same group of work-related physical fatigue. This indicate that physical exercise in leisure time seems to protect against chronic LBP among workers with heavy physical work demands. Workers with physically demanding jobs may probably assume they have enough physical activity at work. However, a study by Ruzic and colleagues (2003) investigated the possible influence of high physical loading in the workplace on the physical fitness of employees in the Republic of Croatia. They reported that physical demands at work is not related to better physical fitness. Therefore we can recommend that persons should participate in leisure time physical exercise, although they have a physical demanding job (Ruzic et al., 2003).

This study has several strengths, including the large and unselected population and the prospective design. The study focus on how physically tired the workers were after a working day, other studies focusing on the physical working conditions that individuals are most exposed to in relation to LBP. Based on this we did not adjust for type of work such as manual or non-manual occupations. Moreover, we adjusted for BMI, education and smoking. These lifestyle factors is associated with risk of LBP (Hoy et al., 2012). Individuals who reported often/always work-related physical fatigue were more likely to be current smokers, have low education, and higher BMI. Another HUNT study found that high BMI is associated with risk of chronic LBP (Nilsen et al., 2011). This is consistent with Dijken and colleagues (2008) who investigated LBP, and lifestyle factors. They reported that people with LBP were more likely to be smokers, have high BMI and less education, compared to people without LBP. It seems that these factors affects the risk of LBP and was therefore considered as possible confounders in the current study.

The questions on chronic musculoskeletal pain used in HUNT 2 have acceptable reliability and validity (Kuorinka et al., 1987). Physical activity in terms of intensity, frequency and duration has not been well defined in some studies. In our study the question on physical exercise has been evaluated for validity and reliability by comparing physical activity data from HUNT 1 with several measures related to physical activity, and by a test-retest design, respectively (Kurtze et al., 2008). However, it should be noted that this validation study was conducted on a small sample of young adult males. Nevertheless studies has shown that questionnaires on physical exercise may be useful in classifying people into broad categories, but less appropriate for quantifying energy expenditure (Shephard, 2003).

It is well established that LBP is a multi-dimensional problem that may also include psychosocial factors, (e.g., low social support) and it can be an important confounding factor but were not included in the current analysis. (O’Sullivan, 2005). This can be supported by a recent review showing only marginally increased risk of LBP associated with low social support (Hauke et al., 2011). Finally, misclassification of leisure time physical exercise and work-related physical fatigue cannot be ruled out. Moreover, both variable were only assessed on baseline without follow-up information. Therefore, the development of chronic LBP could be affected by changes of exercise level and physical work demands during the follow-up period.

Conclusion

This prospective study indicates that work-related physical fatigue is positively associated with risk of chronic LBP among adult women and men. There was a weak inverse relation between leisure time physical exercise and risk of chronic LBP. Moreover, leisure time physical exercise can, to some extent, compensate for the unfavorable effect of heavy physical work fatigue on risk of chronic LBP. Thus, workers who frequently experience work-related physical fatigue should be encouraged to be physically active during leisure time to reduce risk of chronic LBP.

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