

Work-related physical fatigue and leisure time
physical exercise in relation to risk of chronic
pain in neck and shoulders:
The HUNT study, Norway

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Master degree thesis

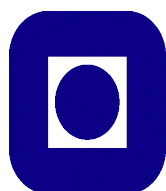
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Abstract

Background: It is documented that high physical work demands is associated with increased risk of chronic neck/shoulder pain, while regular physical exercise reduces the risk. However, there is limited knowledge about the combined effect of work-related physical fatigue and leisure time physical exercise on risk of chronic pain in neck/shoulders. The first objective of this study was to investigate if work-related physical fatigue and leisure time physical exercise represent independent risk factors for chronic pain in neck/shoulders. The second objective was to investigate the combined effect of work-related physical fatigue and leisure time physical exercise on risk of chronic pain in neck/shoulders.

Methods: The study comprise data on 6,374 women and 8,293 men who participated in the first (1984-86) and second wave (1995-97) of the Nord-Trøndelag Health Study (HUNT) and who reported no chronic pain or physical impairment at baseline in 1984-86. The relative risk (RR) of chronic pain in neck/shoulders at follow-up, associated with work-related physical fatigue and leisure time physical exercise at baseline (HUNT 1) were estimated using a general linear model.

Results: At follow-up, 1,972 (30.9%) women and 1,900 (22.9%) men reported chronic neck/shoulder pain. Work-related physical fatigue was dose-dependently associated with risk of chronic neck/shoulder pain in both women and men (P-trend <0.001). Women and men who experienced work-related physical fatigue “often/always” had RR’s of 1.39 (95% CI 1.17-1.64) and 1.39 (95% CI 1.18-1.64), respectively. Women who reported to be physically active two hours or more per week had a RR of 0.85 (95% CI 0.70-1.03) compared to inactive women. The corresponding RR among men were 0.83 (95% CI 0.70-0.98). The combined analysis showed no interaction between work-related physical fatigue and leisure time physical exercise (P=0.27). However, stratified analysis showed that physically active individuals with work-related physical fatigue “often/always” had lower risk of pain in neck/shoulders compared to inactive individuals with the same level of work-related physical fatigue (P=0.01).

Conclusion: This prospective study indicates that women and men who experience “often/always” work-related physical fatigue have an increased risk of developing chronic pain in neck/shoulders. Regular physical exercise can to some extent reduce the negative effect of frequent work-related physical fatigue on risk of chronic neck/shoulder pain.

1.0 Introduction

Chronic musculoskeletal pain in the neck/shoulders is a major economic and social burden to the community, and in the western societies it is one of the main causes of sick leave, reduced quality of life, and disability [1-5]. Muscle pain presents as localized, regional or widespread pain and is commonly characterized as chronic when the duration exceeds three months [2, 6]. It is difficult to estimate the precise extent of the problem, because reported prevalence and incidence rates differ substantially between studies [7]. A review reported that the 12-month prevalence of neck pain range from 14% up to 78% and that the 12-month prevalence of shoulder pain range from 5% to 47% [8]. A telephone survey of approximately 46,000 persons conducted in 16 countries in Europe showed that nearly 20% of the adult population suffers from chronic pain [9]. Similar numbers from Norway indicates that approximately one third of the Norwegian population suffers from chronic pain, and one in six of those suffers from localized neck/shoulder pain as the main pain afflicted area [10]. According to a relatively recent study by Harkness and co-workers [11], chronic neck/shoulder pain seems to be more common now than 40 years ago, i.e., it was shown that pain in the shoulder and generalized musculoskeletal pain had increased from two to fourfold the last 40 years [11].

Physical work demands are considered a risk factor for chronic neck/shoulder pain. Exposure to sustained awkward postures such as neck and trunk held in prolonged flexion or rotation, prolonged sitting, forceful or repetitive tasks, overhead work, and monotonous work have been associated with increased risk of chronic neck/shoulder pain [3, 12-22]. Results from a two-year prospective study by Andersen and co-workers [17] emphasize this association, and indicated that highly repetitive work predicted neck/shoulder pain. At baseline, the prevalence rates of regional pain varied among different occupational groups, where skilled workers in industrial work places had the lowest rate of neck/shoulder pain (22%), whereas occupations with high physical work demands such as kitchen and cleaning workers had high levels of neck/shoulder pain (49%) [17]. Ariëns and co-workers [23] did a study on high physical and psychosocial load at work and sickness absence due to neck pain. They quantified work load by means of video recording, and found work-related neck flexion and neck rotation to significantly increase risk for sickness absence due to neck pain. Only a small reduction of time spent with the neck flexed or rotated during working hours, gave a lower risk for sickness absence.

The prevalence of chronic neck/shoulder pain increases markedly with age, affects more women than men, and is often related to various lifestyle factors, such as obesity and physical inactivity [24-30]. A review article [31] has shown somewhat inconsistent results

regarding the influence of physical exercise on the prevention of chronic neck/shoulder pain, while other prospective studies have found a significant association between physical exercise and a lower risk of chronic neck/shoulder pain [25, 29]. Results from a prospective study by Holth and co-workers [29] showed a 35% reduced risk of chronic musculoskeletal pain among persons who had a moderate physical activity level during leisure time compared to inactive persons. Furthermore, hours of leisure time physical exercise are inversely associated with risk of chronic pain in neck/shoulders, according to a study by Nilsen and co-workers [25]. Women and men who were physically active for one to two hours per week had 12-13% reduced risk of neck/shoulder pain, compared to inactive women and men. By increasing the amount of exercise, the results indicated a further reduced RR for neck/shoulder pain in men [25]. Being physically active by participating in sports activities for at least 10 months a year had a favorable effect on neck/shoulder symptoms and on sickness absence due to neck or upper limb symptoms [27]. The latter study also showed that individuals who maintained their sporting activities throughout the year (≥ 10 months) with a moderate frequency (≤ 3 hours/week) had a more favorable effect on reducing the risk of neck/shoulder symptoms, compared to individuals who had a higher mean frequency of sporting activities (≥ 3 hours/week), but fewer active months per year (≤ 9 months) [27].

Studies investigating the combined effect of work-related physical fatigue and leisure time physical exercise on risk of chronic neck/shoulder pain are limited. A prospective study by Hanvold and co-workers [32] found that among technical school students entering working life there was a high prevalence of pain in neck/shoulders. The results suggested that a high level of physical exercise outside working hours gave a lower risk of neck/shoulder pain at three year follow-up. However, no large prospective study has investigated the association between work-related physical fatigue, leisure time physical exercise and chronic neck/shoulder pain in the adult working population. To the best of our knowledge, no previous study has used a proxy variable on physical work demands where the individuals' physical capacities were taken into account. Studies in the past have used title, profession or observed work demands as an exposure variable, whereas in this current study, the participants own feeling of fatigue are the main exposure. The purpose of the current study was therefore to investigate if work-related physical fatigue increases the risk of chronic pain in neck/shoulders and if leisure time physical exercise modifies this association.

2.0 Methods

2.1 Study population

In Nord-Trøndelag County in Norway, all inhabitants aged 20 years or older have been invited to participate in a large health survey. The Nord-Trøndelag Health Study (HUNT) has been carried out in three waves, the first in 1984-86 (HUNT 1), the second in 1995-97 (HUNT 2) and the third in 2006-08 (HUNT 3). The current study is based on data from HUNT 1 and HUNT 2.

Of 87,285 eligible persons, 77,216 (89%) accepted the invitation to participate in HUNT 1. The participants filled out a questionnaire and underwent a clinical examination that included measurement of blood pressure, height, body mass, and blood glucose levels. At the examination, the participants were given a second questionnaire to complete at home. At HUNT 2 in 1995-97, 94,187 persons were invited to participate and 66,215 (70%) accepted the invitation. The questionnaires and the examinations were quite similar to the ones in HUNT 1, only more thorough. More detailed information about the HUNT-studies can be found at <http://www.ntnu.edu/hunt>.

For the purpose of the present study, all participants who had been part of both HUNT 1 and HUNT 2 were included, which gave a total of 45,925 persons (24,357 women, 21,568 men). We excluded a total of 10,020 women and 3,105 men who reported to be unemployed or who reported domestic work only, and 524 women and 1,124 men who reported some sort of physical impairment. Moreover, to obtain a study sample without chronic pain at baseline we excluded 2,463 women and 2,347 men who reported chronic pain with duration >10 years, i.e., at the time of HUNT 1, 2,896 women and 4,246 men without information on physical exercise, 87 women and 74 men without baseline information on musculoskeletal pain, 1,986 women and 2,379 men without data on physical work demands, and 7 women without information on weight. Thus, the prospective analyses were based on a total of 6,374 women and 8,293 men.

The study has been approved by the Regional Committee for Ethics in Medical Research, and each participant in the study signed a written consent upon participation.

2.2 Outcome variable

Chronic musculoskeletal pain

The first questionnaire in HUNT 2 included questions about musculoskeletal pain, adopted from the Standardized Nordic Questionnaire [33]. 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?”. If responding “yes”, the participants were asked to indicate the pain location, by answering the question: “Where did you have pain and/or stiffness?” Those answering neck, shoulders or upper part of back were combined in the present study, given the label “neck/shoulder”.

2.3 Exposure variables

Work-related physical fatigue

In the HUNT 1 questionnaire the participants were asked “Is your work so physically demanding that you are often physically worn out after a day’s work?” The question had four response options: “yes, nearly always”, “quite often”, “seldom” or “never or almost never”. For the purpose of the present study, “yes, nearly always” and “quite often” were collapsed into one variable defined as “often/always” work-related physical fatigue, “seldom” as “seldom”, and “never or almost never” has been defined as “never” work-related physical fatigue.

Physical exercise

At HUNT 1 the participants were given a questionnaire and asked to complete questions regarding their physical exercise level. This included questions on frequency, duration, and intensity of leisure time physical exercise, such as walking, skiing, swimming and working out. The first question regarded frequency, and had five response options: “never”, “less than once a week”, “once a week”, “2-3 times a week”, and “ ≥ 4 times per week”. Those answering “never” or “less than once a week” were classified as inactive. Those who exercised once a week or more were also asked to answer questions on duration (“less than 15 minutes”, “16-30 minutes”, “30 minutes–1 hour”, “more than 1 hour”) and average intensity (“no sweating or heavy breathing”, “sweating and/or heavy breathing” or “nearly exhausted”). Based on information on frequency and duration, the average number of hours spent on physical exercise per week was calculated. For the purpose of this calculation the response option “2-3 times per week” was counted as 2.5 times per week, and “ ≥ 4 times per week” was counted as 5 times per week, whereas the response option “<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. People were then classified as inactive, < 1.0 hours/week, 1.0-1.9 hours/week, and ≥ 2 hours/week.

2.4 Statistical analyses

Baseline characteristics of the study population are presented using descriptive statistics including mean, standard deviations, and percentages. For the main analyses, a generalized linear model for the binominal family (log link) was used to estimate the relative risk (RR) of chronic pain in neck and shoulder between categories of work-related physical fatigue and leisure time physical exercise. Participants who were classified as inactive and those who reported “never” having work-related physical fatigue were used as the reference group in the main analyses. The main analyses were stratified by gender and adjusted for age (continuous), BMI (continuous), smoking status (never, former, current), and education level (≤ 9 years, 10-12 years, ≥ 12 years, or unknown). In addition, analysis of work-related physical fatigue and physical exercise was adjusted for physical exercise (inactive, <1 hour/week, 1.0-1.9 hours/week, or ≥ 2 hours/week) and work-related physical fatigue (“never”, “seldom”, “often/always”). In the combined analysis, participants classified as physically active and “never” having work-related physical fatigue were used as the reference group.

The precision of the estimated relative risks (RRs) was assessed by 95% confidence intervals (95% CI). To test for trends across categories of work-related physical fatigue and leisure time physical exercise the categories were treated as ordinal variables in the regression model. Potential effect modification between work-related physical fatigue and leisure time physical exercise was assessed by an interaction test where a product term of these factors was included in the regression model. All analyses were conducted using SPSS 19.0 for Windows (SPSS, Chicago, ILL, USA).

3.0 Results

At 11-year follow-up, 1,972 (30.9%) women and 1,900 (22.9%) men reported chronic neck/shoulder pain. Table 1 presents baseline characteristics of the study population, according to work-related physical fatigue stratified by gender. A higher percentage of participants with “often/always” work-related physical fatigue were inactive compared to participants who had “never” or “seldom” work-related physical fatigue. This was the case for both women and men. The participants who stated to have “never” or “seldom” work-related physical fatigue, had higher education level and were less likely to be a current smoker than those who had “often/always” work-related physical fatigue. The mean age and BMI were quite similar between the different levels of work-related physical fatigue in both women and men. Table 2 presents baseline characteristics of the study population according to physical exercise, stratified by gender. The characteristics from table 2 are similar to table 1.

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

Characteristic	Never	Seldom	Often/always
		Women	
No. of participants	871	2,531	2,972
Mean age (SD), years	40.8 (11.9)	41.7 (11.7)	42.3 (11.7)
Mean BMI ^a (SD)	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)	374 (14.9)	358 (12.4)
Inactive ^b , no. (%)	75 (13.9)	269 (17.6)	440 (25.7)
		Men	
No. of participants	1,461	3,249	3,583
Mean age (SD)	42.8 (11.1)	43.0 (12.5)	41.1 (12.4)
Mean BMI ^a (SD)	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 ^b , no. (%)	144 (14.3)	467 (21.4)	735 (30.5)

Abbreviations: SD, standard deviation, BMI, body mass index

^a Weight (kg)/height (m)²

^b Less than 1 physical exercise session per week

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

Characteristic	Active ^a	Inactive ^b	
		Women	
No. of participants	2,993	784	
Mean age (SD), years	42.5 (12.3)	43.2 (12.1)	
Mean BMI ^c (SD)	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. (%)	1,271 (42.5)	440 (56.1)	
		Men	
No. of participants	4,256	1,346	
Mean age (SD), years	42.0 (12.5)	43.1 (12.0)	
Mean BMI ^c (SD)	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. (%)	1,671 (39.3)	735 (54.6)	

Abbreviation: SD, standard deviation, BMI, body mass index

^a 1 hour or more of physical exercise per week

^b Less than 1 physical exercise session per week

^c Weight (kg)/height (m)²

Table 3 shows the ageadjusted and multiadjusted RRs of chronic pain in neck/shoulders associated with work-related physical fatigue. The P-trend (<0.001) was significant both among women and men, indicating a dose-dependent effect between work-related physical fatigue and risk of pain in neck/shoulders. In specific, women and men who reported “often/always” work-related physical fatigue had RRs of 1.39 (95% CI 1.17-1.64) and 1.39 (95% CI 1.18-1.64), respectively, compared to woman and men with “never” work-related fatigue. There was no significant increase in risk of neck/shoulder pain when increasing work-related physical fatigue from “never” to “seldom”, the results were similar for both women (RR 1.03 95% CI 0.87-1.22) and men (RR 1.02 95% CI 0.87-1.21).

Table 3. Relative risk of chronic pain in neck and shoulders at 11 years follow-up associated with work-related physical fatigue at baseline

Gender and work-related physical fatigue	No. of persons	No. of cases	Age-adjusted RR ^a	Multi-adjusted RR ^b	95% CI	P-trend
Women						
Never	871	216		1.00 (ref)		
Seldom	2,531	671	1.07	1.03	0.87, 1.22	
Often/always	2,972	1,085	1.48	1.39	1.17, 1.64	<0.001
Men						
Never	1,461	254		1.00 (ref)		
Seldom	3,249	641	1.13	1.02	0.87, 1.21	
Often/always	3,583	1,005	1.62	1.39	1.18, 1.64	<0.001

Abbreviations: RR, risk ratio, CI, confidence interval

^a Adjusted for age (continuous)

^b Adjusted for age (continuous), BMI (continuous), smoking (never, former, current, unknown), education (≤ 9 years, 10-12 years, ≥ 12 years, unknown), and frequency of physical exercise (inactive, <1 hour/week, 1.0-1.9 hours/week, or ≥ 2 hours/week).

Table 4 shows the risk of chronic pain in neck/shoulders associated with level of leisure time physical exercise. There was no dose-dependent association between risk of neck/shoulder pain and level of physical exercise (P-trend ≥ 0.19) neither in women nor men. Men who exercised two hours or more per week had a lower risk of chronic neck/shoulder pain (RR 0.83, 95% CI 0.70-0.98) compared to inactive men. This was not the case among women exercising two hours or more per week (RR 0.85, 95% CI 0.70-1.03).

Table 4. Relative risk of chronic pain in neck and shoulders at 11 years follow-up associated with leisure time physical exercise (hours/week) at baseline

Gender and physical exercise (hours/week)	No. of persons	No. of cases	Age-adjusted RR ^a	Multi-adjusted RR ^b	95% CI	P-trend
Women						
Inactive	784	282		1.00 (ref)		
<1	2,597	817	0.87	0.92	0.79, 1.01	
1-1.9	2,037	597	0.81	0.89	0.75, 1.05	
≥2	956	276	0.80	0.85	0.70, 1.03	0.88
Men						
Inactive	1,346	369		1.00 (ref)		
<1	2,691	638	0.87	0.93	0.81, 1.10	
1-1.9	2,602	556	0.78	0.88	0.76, 1.02	
≥2	1,654	337	0.75	0.83	0.70, 0.98	0.19

Abbreviations: RR, risk ratio, CI, confidence interval

^a Adjusted for age (continuous)

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

The combined effect of work-related physical fatigue and leisure time physical exercise on risk of chronic pain in neck/shoulders is shown in table 5. There was no interaction between work-related physical fatigue and physical exercise (P= 0.27). However, in stratified analysis it was observed that active individuals with “often/always” work-related physical fatigue had significantly lower risk of pain in neck/shoulders than inactive individuals with same level of work-related physical fatigue (P=0.01). In specific, physically active persons with “often/always” work-related physical fatigue had a 26% lower risk (RR 1.39, 95% CI 1.19-1.63) of chronic neck/shoulder pain compared to physically inactive persons with same level of work-related physical fatigue (RR 1.65 95% CI 1.37-1.98).

Table 5. The combined effect of work-related physical fatigue and physical exercise on risk of chronic pain in neck/shoulders

Work-related physical fatigue	Active ^a		Inactive ^b		P-Value ^d
	Multi-Adjusted ^c RR	95% CI	Multi-Adjusted ^c RR	95% CI	
Never	1.00 (ref.)		1.06	0.75, 1.46	0.68
Seldom	1.07	0.91, 1.26	1.05	0.84, 1.31	0.79
Often/always	1.39	1.19, 1.63	1.65	1.37, 1.98	0.01

^a 1 or more hours of physical exercise per week.

^b Less than 1 hour of physical exercise per week.

^c Adjusted for age (continuous), smoking (never, former, current, unknown), education (≤9 years, 10-12 years, ≥12 years, or unknown), and BMI (continuous).

^d P value comparing active and inactive persons within each category of work-related physical fatigue.

4.0 Discussion

The main objective of this study was to investigate the association between work-related physical fatigue and leisure time physical exercise on future risk of chronic neck/shoulder pain and, second, to investigate the combined effect of work-related physical fatigue and leisure time physical exercise on risk of chronic neck/shoulder pain. The current results indicate a dose-dependent association between work-related physical fatigue and risk of chronic neck/shoulder pain. Women and men who reported to be “often/always” work-related physical fatigue had a significantly higher risk of chronic neck/shoulder pain at 11-years follow-up, compared to participants who “never” experienced work-related physical fatigue. The result from the combined analysis indicated no interaction ($p=0.27$) between work-related physical fatigue and leisure time physical exercise. However, it was observed that physically active individuals with “often/always” work-related physical fatigue had significantly lower risk of pain in neck/shoulders at follow-up, compared to physically inactive individuals with same level of work-related physical fatigue.

Earlier studies have not investigated the prospective association between work-related physical fatigue and neck/shoulder pain but have, however, investigated different work-related physical factors and risk of neck/shoulder pain [12, 14, 15, 17, 23, 34-36]. Associations have been shown between risk of neck/shoulder symptoms and different physical work demands, such as heavy lifting and lifting above shoulder level, awkward postures, repetitive work, monotonous work, and sitting position. Luime and co-workers [36] found work in awkward postures, prolonged work in the same position and poor to fair general health to be risk factors for incidence and recurrence of neck complaints. The latter study used a questionnaire to quantify the participants physical work load, similar to the current study. However, they asked for physical workload only, not work-related physical fatigue, which makes direct comparison between the current study and the abovementioned study difficult. Although, one might assume that work in awkward postures and prolonged work in the same position, in combination with poor general health are factors that could lead to a feeling of work-related physical fatigue. Several cross-sectional studies [13, 19, 20, 22] also present results on the association between work-related physical factors and occurrence of chronic neck/shoulder pain. The results of these studies point to similar work demands as mentioned above, however, cross-sectional studies cannot determine the cause and effect relation between chronic neck/shoulder pain and physical risk factors. As mentioned above, the current study found a dose-dependent association between work-related physical fatigue and neck/shoulder pain. On the other hand, the HUNT data do not allow assessment of

different physical work exposures. The participants in our study were classified into categories of work-related physical fatigue instead of categories with more specific physical work demand exposures (e.g., lifting, walking, sitting, and so on). Thus, the use of different variables and study design in previous studies makes it difficult to directly compare the results of these studies to our results. Nevertheless, work-related physical fatigue may be regarded as a proxy variable of physical work demands. According to this assumption, the results of the current study are in line with previous findings.

Unlike other similar studies in the past, the present study used work-related physical fatigue as a proxy variable for physical work demands. To our knowledge, the most used measures of physical work demands in previous studies are questionnaires where they ask for the subjects' professions, and/or video recording of workplaces and work tasks. The limitation of such measures may be the lack of incorporating the physical capacity of the worker in the exposure variable. Studies discuss whether or not there are reasons to believe that physical work demands will affect individuals differently related to physical capacity [4]. An imbalance between exposure to work-related physical factors and physical capacity could be a risk factor for developing chronic neck/shoulder pain, or physical capacity could be an effect modifier or an intermediate variable of the relation between exposure to work-related physical factors and the risk of neck/shoulder pain. It is natural to think that low physical capacity, irrespective of work exposure, might also be a risk factor for neck/shoulder pain. In studies, muscle strength, muscle endurance and joint mobility are examples of measures of physical capacity, which can be quantified by different physical tests. Hamberg-van Reenen and co-workers [4] did a systematic search of articles investigating the relation between physical capacity and future neck/shoulder pain. Their results showed that very few studies have looked at the relation between physical capacity measures and the risk of neck/shoulder pain. In total they found three studies, and stated that there were inconclusive evidence for a relation between muscle strength or endurance of the neck/shoulder muscles and the risk of neck/shoulder pain. One could assume that a young individual and an older individual with similar physical work demands probably would not feel equally tired or exhausted after a day's work. Thus, using subjective reports of work-related physical fatigue may be more sensitive in detecting the "true" association between individual physical capacity and risk of neck/shoulder pain, than using e.g., job category as exposure variable.

The combined effect of work-related physical fatigue and leisure time physical exercise on future risk of developing chronic neck/shoulder pain in a general adult working population has to our knowledge not been subject to studies in the past. Hanvold and co-workers [32] investigated the association between risk of neck/shoulder pain and occupational and individual risk factors among technical school students entering working life. They collected data on self-reported pain in combination with factors such as mechanical exposure and leisure time physical exercise at baseline. They found that students who reported to be physically active two to three times per week or more had a significantly lower risk of pain two years later compared to less physically active persons. The preventive effect of physical exercise on risk of neck/shoulder pain is somewhat similar to the finding in our study. However, Hanvold and co-workers investigated pain prevalence on young individuals transitioning from school to working life, and not in a general adult working population. Work related factors and physical exercise as predictors of shoulder pain have been investigated by Miranda and co-workers [15]. In addition to physically strenuous work, a higher age, obesity and mental stress were identified as risk factors for incident shoulder pain. Their results indicated that some types of physical exercise such as dancing increased the risk of shoulder pain, whereas jogging significantly decreased the risk. Thus, it is possible that some types of exercise have a more beneficial effect on risk of neck/shoulder pain than others. Unfortunately, there is no information about type of exercise in the HUNT study.

A study by Ruzic and co-workers [37] indicate that an increased level of occupational physical activity does not improve physical fitness in general. Almost 500 men between 20 and 60 years were part of the study. The subjects that had more physical workload at their workplace had less strength, poorer balance, and were less flexible than the subjects that had lower physical workload. Many employees that are engaged in manual labour may be reluctant to participate in recreational sports because they feel exhausted after a day at work, or they might assume that they have had enough physical exercise at the workplace. However, the problem that arises here concerns the quality of the physical activity performed at the workplace. Physical activity performed in a workplace setting may not have adequate intensity, duration and volume to induce positive changes in a person's physical capacity. Moreover, physical activity at work is a matter of necessity for a person, whereas physical activity in leisure time is performed by option, and might therefore be more attractive, joyful, and thereby performed with higher intensity. The current study clearly indicates that performing leisure time physical exercise should be recommended also among those who experience frequent work-related physical fatigue.

4.1 Strengths and limitations

The prospective design and the large and unselected population are obvious strengths to the current study. Despite these strengths, some limitations should be considered in the interpretations of the results. Incident cases of chronic neck/shoulder pain were assessed at the follow-up survey (i.e., HUNT 2) among those who chose to participate in both studies. Hence, if people who were physically inactive or who had “often/always” work-related physical fatigue chose not to participate in the follow-up study (HUNT 2), the observed RR may be underestimated. Second, misclassifications of leisure time physical exercise cannot be ruled out since physical exercise was assessed by a single baseline measure without follow-up information [38]. The questionnaire-based nature of the data allows for subjective interpretation leading to possible misclassifications. In addition, it should be noted that the HUNT data do not allow for evaluation of the relative importance of different types of exercise (e.g., strength, flexibility, and cardiorespiratory) in preventing development of chronic neck/shoulder pain. However, validation studies have shown that questionnaires may be useful in classifying people into broad categories of physical exercise (e.g., active or inactive), but less appropriate for quantifying energy expenditure [39]. The physical activity questionnaire has both been evaluated for validity and for reliability by comparing physical activity data from the HUNT 1 questionnaire with several measures related to physical activity, and by a test-retest design, respectively [40]. However, it should be noted that this study was conducted on a small sample of young adult males, and may not be representative for the population as a whole. In retrospect, we see that participants who were at or above the retirement age at HUNT 1 should have been excluded from the study sample in a sensitivity analysis, since the aim of the study was to examine the association among working individuals only. However, it was only 28 individuals who were ≥ 68 years at HUNT 1 and who were still working, either parttime or fulltime.

5.0 Conclusion

This prospective study indicates that women and men who experience “often/always” work-related physical fatigue have an increased risk of chronic pain in neck/shoulders. Importantly, leisure time physical exercise can, to some extent, reduce the adverse effect of frequent work-related physical fatigue on risk of neck/shoulder pain. Thus, to be physically active during leisure time should also be recommended among workers who experience that their work induces physical fatigue.

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