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Leisure-time physical activity and disability pension: 9 years follow-up of the HUNT Study, Norway

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The objective of this study was to prospectively examine the association between leisure-time physical activity and risk of disability pension, as well as risk of disability pension because of musculoskeletal or mental disorders in a large population-based cohort. Data on participants aged 20–65 years in the Norwegian Nord-Trøndelag Health Study 1995–1997 (HUNT2) were linked to the National Insurance Database. Cox regression was used to calculate hazard ratios (HR) and 95% confidence intervals for disability pension across physical activity categories. During a follow-up of 9.3 years and 235 657 person-years, 1266 of 13 823 men (9%) and 1734 of 14 531 women (12%) received disability pension. Compared with individuals in the inactive group, those in the highly active group had a 50% lower risk of receiving disability pension (HR for men: 0.50, 0.40–0.64; women: 0.50, 0.39–0.63). After comprehensive adjustment for potential confounders, the risk remained 32–35% lower (HR for men: 0.68, 0.53–0.86; women: 0.65, 0.51–0.83). The associations were stronger for disability pension due to musculoskeletal disorders than mental disorders. In summary, we observed strong inverse associations between leisure-time physical activity and disability pension. Our findings strengthen the hypothesis that leisure-time physical activity may be important for occupational health in reducing disability pension.

Permanent exclusion from working life because of health problems or disability has serious consequences both for individuals and the society (OECD, 2010). For individuals and their families, loss of work because of ill health represents a social and financial loss. At the societal level, it is important to have a high proportion of the workforce fit for work, especially with the challenge of aging populations in most industrialized countries. It is therefore essential to identify factors that can prevent premature exit from work.

Physical activity may be attractive for prevention as it provides substantial benefits for a range of health outcomes, including chronic diseases such as type 2 diabetes, coronary heart disease, some cancers, as well as overall mortality (Wen et al., 2011; Villeneuve et al., 1998; Haskell et al., 2007; Lee et al., 2012; U.S. Department of Health and Human Services, 2008). There is also evidence that leisure-time physical activity promotes good musculoskeletal- and mental health, in addition to increased functional ability (Lahti et al., 2010a; Physical Activity Guidelines Advisory Commitee Report, 2008; U.S. Department of Health and Human Services, 2008).

Leisure-time physical activity and cardiorespiratory fitness have been inversely related to sickness absence in several (van den Heuvel et al., 2005; Bernaards et al., 2006; Proper et al., 2006; van Amelsvoort et al., 2006; Lahti et al., 2010b; Holtermann et al., 2011; Kristensen et al., 2012; Robroek et al., 2013b), but not all (Christensen et al., 2007), previous studies. A recent review on risk factors for disability pension indicated that lack of physical activity was associated with disability pension, although the results were not conclusive (Robroek et al., 2013b). In addition, most previous studies investigating the association between leisure-time physical activity and sickness absence or disability pension have either had small samples, short follow-up periods and/or only included subpopulations (e.g., only men, a narrow age span, or specific disorders or occupations), limiting validity of the results.

The association between physical inactivity and disability pension could be biased because of no- or limited adjustments for potential confounders. As age, marital status, education, smoking, socioeconomic position,

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physical and mental health, body mass index (BMI) and lifestyle behaviors could be related to both leisure-time physical activity and work status (Biering-Sorensen et al., 1999; Bauman et al., 2002; Robroek et al., 2013a,b; Schuring et al., 2013), it is important to take these factors into account when assessing the association between leisure-time physical activity and disability pension. Furthermore, disability pension is usually given after an extensive process of medical examinations, treatments and rehabilitation efforts, and it is possible that the rehabilitation process might influence physical activity. Hence, in order to reduce the risk of reverse causation, it is important to take into account a long rehabilitation time before disability pension is granted (Stover et al., 2012).

We prospectively examined the association between leisure-time physical activity and risk of disability pension in a large population-based cohort in Norway, using comprehensive information on possible confounding factors. We also examined the risk of disability pension because of either musculoskeletal or mental disorders.

Materials and methods

Study population

This prospective observational study is based on data from the second survey of the Nord-Trøndelag Health Study (HUNT2) conducted in 1995–1997. All 92 205 persons aged ≥20 years residing in the county of Nord-Trøndelag were invited to participate and 65 215 (~ 70%) attended the survey. The Nord-Trøndelag County is suggested to be fairly representative of Norway, although lacking major cities. Participants filled in a questionnaire and took part in a medical examination. Further details about the HUNT Study are described elsewhere (Holmen et al., 2003; Langhammer et al., 2012; Krokstad et al., 2013).

The official statutory retirement age in Norway is 67 years of age. To reduce reverse causality, we excluded the two first years of follow-up, including all recipients of disability pension before and during this period. Therefore, in this study we included only those aged 20–65 at baseline (n = 42 996). We excluded all persons with information missing from the variables being used in the analyses, yielding a total number of 28 354 people in analyses of all-cause disability pension, and 27 911 people in analyses of cause-specific disability pension (i.e., musculoskeletal or mental disorders).

Disability pension

Data on disability pension including primary diagnoses were provided by the National Insurance Database and linked to HUNT2 (1995–1997) data using the personal identification number of Norwegian citizens. Disability pension is intended to secure the income of individuals whose earning ability is permanently impaired by at least 50% because of illness, injury or disability. A temporary disability benefit granted for any 4-year period between 2004 and 2010 (when the benefit was available) was also regarded as disability pension. Primary diagnoses were coded according to the International Classification of Diseases versions 9 and 10. We categorized causes of disability pension as musculoskeletal (ICD9:290–319; ICD10: M-diagnoses) or mental (ICD9: 710–739; ICD10: F-diagnoses). Data on contractual early retirement, old-age retirement, emigration and death were collected from national registries and used in censoring the person-years of follow-up. Participants were followed until December 2007 in analyses of all-cause disability pension. Data on cause-specific disability pension allowed follow-up throughout 2006.

Leisure-time physical activity

Participants answered two questions regarding average hours per week of light and hard physical activity performed during leisure time during the last year. Light activity was defined as not sweating or being out of breath, whereas hard activity was defined as being sweat and/or out of breath. The response options for both questions were: 0, < 1, 1–2 and > 3 h per week. The validity of these questions has been examined in a sample of men aged 20–39 years (Kurtze et al., 2007). The question about hard leisure-time physical activity had acceptable validity compared with objective measures of activity, metabolic equivalents and maximal oxygen uptake, whereas light physical activity showed weaker correlations with these objective measures.

Based on the two questions, we classified participants into five categories of physical activity.

1. Inactive. No hard and no light activity.
2. Lightly active. 0–1 h of hard activity and 0–1 h of light activity.
3. Moderately active. 0–1 h of hard activity and at least 1 h of light activity
4. Active. 1–2 h of hard activity. Light activity not considered.
5. Highly active. At least 3 h of hard activity. Light activity not considered.

Covariates

Chronic somatic conditions were categorized from zero to three or more reported of the following conditions: asthma, cardiovascular conditions (stroke, myocardial infarction or angina pectoris), diabetes, thyroid disease (hyperthyroidism, hypothyroidism, goitre or other thyroid diseases), rheumatologic conditions (rheumatoid arthritis, osteoarthritis or ankylosing spondylitis), osteoporosis, epilepsy, cancer, or other long-standing diseases. Traumas (hip fractures or other trauma necessitating hospital admission) were also included, as they may have sequelae.

Somatic symptoms or symptom-based diagnoses was also enumerated, ranging from zero to five reported symptoms; respiratory/cardiac symptoms (cough, dyspnoea, wheezing or palpitations), gastrointestinal symptoms (dyspepsia, nausea, constipation or diarrhea), muscle/joint symptoms (pain or stiffness or diagnoses of fibromyalgia), headache and sleep disturbance (difficulty in falling asleep or waking early often or almost every night). Depression and anxiety were assessed with the hospital anxiety and depression scale, a validated screen for general population samples (Bjelland et al., 2002), and included as continuous scales.

BMI (< 25.0, 25.0–29.9 or ≥ 30.0 kg/m^2) and smoking status (present, former or never smoker) were included as separate covariates. Additional covariates were age (continuous scale) and education (three levels: primary school, high school or college/university; collected from the National Education Database).

Statistic analysis

We used Cox regression (with time on study as the time scale) to calculate hazard ratios (HRs) to compare risk of disability pension because of all causes, musculoskeletal disorders and mental disorders in different leisure-time physical activity categories using those who reported to be inactive as reference. The analysis of all-cause disability pension was stratified by sex. The precision of the estimated associations was assessed by 95% confidence intervals (CIs). To determine if subsequent analyses should be made sex and age specific, we assessed possible statistical interaction in a likelihood ratio test (i.e., departure from a multiplicative effect) by including a product term of leisure-time physical activity and these factors in the regression model. The first 2 years of follow-up were excluded in all analyses to reduce possible influence of reverse causation on the estimated associations, as the average rehabilitation time before disability pension was approximately 2 years in a previous Norwegian study (Stover et al., 2012).

We analyzed the association between disability pension and leisure-time physical activity in three different statistical models: (a) crude model only adjusting for age, (b) model 1 + marital status, education and smoking; (c) model 2 + physical symptoms, somatic health, mental health and BMI. In models 1 and 2, the factors were included under the assumption that they were confounders to the association. In model 3, we added health-related variables, which could be either confounding or mediating factors. Furthermore, in two sensitivity analyses of all-cause disability pension we (a) excluded the first 5 years of follow-up, and (b) excluded persons with serious mental problems (hospital anxiety and depression scale ≥ 8), who reported an injury reducing functional ability, or had a history of cardiovascular disease.

The proportional hazards assumption was assessed by Schoenfeld residuals and graphical procedures. In the analysis of all-cause disability pension, the assumption was not met for education and BMI; hence, these variables were included as time-varying covariates using the *tvc* option in Stata. In the analysis of disability pension because of mental disorders, the proportional hazards assumption was not met for age as a covariate; age was thus controlled for in a stratified model using 5-year age strata. All statistical tests were two-sided, and all analyses were conducted using Stata 12.0 for Windows (StataCorp LP, Texas, USA).

Results

Baseline characteristics are presented in Table 1. During a median follow-up period of 9.3 years and 235 657 person-years for individuals with complete information on all included study variables, 1266 of 13 823 men (9%) and 1734 of 14 531 women (12%) received disability pension. During 210 004 person-years (median follow-up = 8.3 years), a total of 1090 participants received a disability pension because of a musculoskeletal diagnosis and 342 participants received a disability pension because of a mental diagnosis.

There was a statistical interaction between sex and leisure-time physical activity on risk of all-cause disability pension ($P < 0.001$), but not for risk of disability pension because of musculoskeletal disorders ($P = 1.00$) or mental disorders ($P = 0.18$). Therefore, we performed separate analyses for men and women in the analysis of all-cause disability pension. There was no evidence for statistical interaction with age ($P = 0.24$).

Associations between different leisure-time physical activity categories and risk of disability pension because of all causes are presented in Table 2 and Fig. 1. There was an inverse dose–response association between leisure-time physical activity and risk of all-cause disability pension for both sexes (P trend < 0.001). Adjustment for potential confounding variables attenuated the associations. In the fully adjusted analyses, the hazard ratio for all-cause disability pension among those being highly active compared with inactive was 0.68 (95% CI 0.53–0.86) in men and 0.65 (95% CI 0.51–0.83) in women.

Table 3 shows the risk of disability pension because of musculoskeletal or mental disorders associated with leisure-time physical activity. As for risk of all-cause disability pension, leisure-time physical activity was inversely associated with risk of disability pension from both musculoskeletal disorders and mental disorders (P trend < 0.001). However, the HRs suggest that the associations were somewhat stronger for disability pension because of musculoskeletal disorders than because of mental disorders.

The association between leisure-time physical activity and disability pension was similar in sensitivity analyses (web Table S1), which excluded persons who reported mental health symptoms (hospital anxiety and depression scale ≥8), who reported an injury reducing functional ability, or who had a history of cardiovascular disease. Further, the associations between leisure-time physical activity and risk of disability pension were not substantially altered by exclusion of the first 5 years of follow-up (web Table S2)

Discussion

In this large population-based prospective study with 9.3 years of follow-up, there were strong inverse associations between leisure-time physical activity and disability pension in working-age men and women. Although the associations were attenuated with comprehensive adjustment for potential confounding factors, leisure-time physical activity remained substantially associated with risk of disability pension also in the fully adjusted analyses. Compared with inactive individuals, persons who were physically active had about 20–60% reduced risk of disability pension, depending on the level of leisure-time physical activity and adjustment variables included. The associations were stronger for disability pension because of musculoskeletal disorders than because of mental disorders.

The main strengths of this study are the large population-based sample with a long follow-up period. We reduced the possible bias because of reverse causation by excluding the first 2 years of follow-up, ensuring that workers who already were in a process toward disability pension were excluded from the analyses. Further, information on disability pension was obtained from a high-quality national register, ensuring that dropouts were not a problem. In addition, we were able to perform sensitivity analyses to further reduce possible reverse causation by excluding participants reporting serious preexisting conditions and by excluding the first 5 years of follow-up, which corroborated the findings.

Leisure-time physical activity and baseline health information was based on questionnaires. Physical activity questionnaires have limited reliability and validity

Table 1. Baseline characteristics for the population of men and women by quintiles of physical activity in the Nord-Trøndelag Health Study 1995–1997 (HUNT2)

	Women					Men				
Physical activity level	Inactive *n* = 603	Lightly active *n* = 2045	Moderately active *n* = 6786	Active *n* = 3736	Highly active *n* = 1361	Inactive *n* = 863	Lightly active *n* = 2181	Moderately active *n* = 4613	Active *n* = 3591	Highly active *n* = 2575
Age (mean/SD)	41.2 (11.2)	40.1 (10.5)	40.2 (11.2)	37.4 (10.7)	35.6 (11.9)	40.4 (11.2)	41.2 (10.3)	41.8 (11.1)	40.8 (10.9)	38.0 (11.9)
Education										
Compulsory education or less	147 (24)	268 (13)	770 (11)	258 (7)	106 (8)	157 (18)	267 (12)	516 (11)	304 (8)	237 (9)
Secondary education	398 (66)	1371 (67)	4305 (63)	2322 (62)	862 (63)	638 (74)	1564 (72)	3083 (67)	2290 (64)	1795 (70)
College/university	58 (10)	406 (20)	1711 (25)	1156 (31)	393 (29)	68 (8)	350 (16)	1014 (22)	997 (28)	543 (21)
BMI (mean/SD)	26.4 (5.0)	26.1 (4.6)	25.7 (4.2)	25.0 (3.8)	24.5 (3.5)	26.7 (4.0)	26.7 (3.5)	26.4 (3.4)	26.2 (3.1)	25.6 (3.0)
HADS Anxiety (mean/SD)	5.0 (3.9)	4.6 (3.4)	4.4 (3.2)	4.2 (3.1)	4.4 (3.3)	4.2 (3.4)	4.1 (3.1)	3.9 (2.9)	3.9 (2.9)	4.0 (3.0)
HADS Depression (mean/SD)	3.8 (3.2)	3.4 (3.0)	2.8 (2.7)	2.3 (2.4)	2.2 (2.6)	4.1 (3.3)	3.7 (2.9)	3.2 (2.7)	2.9 (2.6)	2.7 (2.6)
No. somatic conditions (%)										
0	352 (58)	1324 (65)	4481 (66)	2501 (67%)	889 (65)	503 (58)	1270 (58)	2655 (58)	2051 (57)	1484 (58)
1	200 (33)	557 (27)	1802 (27)	992 (27)	378 (28)	284 (33)	715 (33)	1509 (33)	1232 (34)	885 (34)
2	44 (7)	128 (6)	402 (6)	195 (5)	68 (5)	55 (6)	153 (7)	359 (8)	242 (7)	169 (7)
≥ 3	7 (1)	36 (2)	101 (1)	48 (1)	26 (2)	21 (2)	43 (2)	90 (2)	66 (2)	37 (1)
Smoking										
Never	213 (35)	928 (45)	3271 (48)	1998 (53)	782 (57)	326 (38)	979 (45)	2090 (45)	1905 (53)	1546 (60)
Previous	111 (18)	392 (19)	1437 (21)	802 (21)	256 (19)	194 (22)	552 (25)	1231 (27)	891 (25)	549 (21)
Current	279 (46)	725 (35)	2078 (31)	936 (25)	323 (24)	343 (40)	650 (30)	1292 (28)	795 (22)	480 (19)

Data are means (SD) or n(%).

BMI, body mass index; HADS, hospital anxiety depression scale; SD, standard deviation.

Table 2. Hazard ratios (95% CI) for all-cause DP in men and women aged 20–65 (first 2 years of follow-up excluded)

	Number of DPs	IR of DP per 1000 py	Model 1	Model 2	Model 3
Men					
Inactive	118	17	1.00	1.00	1.00
Lightly active	252	14	0.79 (0.63, 0.98)	0.89 (0.72, 1.11)	0.89 (0.72, 1.11)
Moderately active	468	12	0.66 (0.54, 0.81)	0.79 (0.65, 0.97)	0.82 (0.67, 1.00)
Active	265	9	0.49 (0.40, 0.61)	0.66 (0.53, 0.82)	0.70 (0.56, 0.87)
Highly active	163	7	0.50 (0.40, 0.64)	0.63 (0.50, 0.80)	0.68 (0.53, 0.86)
Women					
Inactive	129	28	1.00	1.00	1.00
Lightly active	321	19	0.71 (0.58, 0.88)	0.79 (0.64, 0.97)	0.78 (0.63, 0.95)
Moderately active	876	16	0.57 (0.47, 0.68)	0.66 (0.55, 0.79)	0.71 (0.58, 0.85)
Active	283	9	0.38 (0.31, 0.46)	0.46 (0.37, 0.57)	0.52 (0.42, 0.64)
Highly active	125	11	0.50 (0.39, 0.63)	0.60 (0.47, 0.77)	0.65 (0.51, 0.83)

Physical activity groups relative to the inactive group. Model 1, adjusted for age; model 2, adjusted for age + marital status, education and smoking; model 3, adjusted for model 2 + physical symptoms, somatic health, mental health and body mass index.
CI, confidence interval; DP, disability pension; IR, incidence rate; py, person-years.

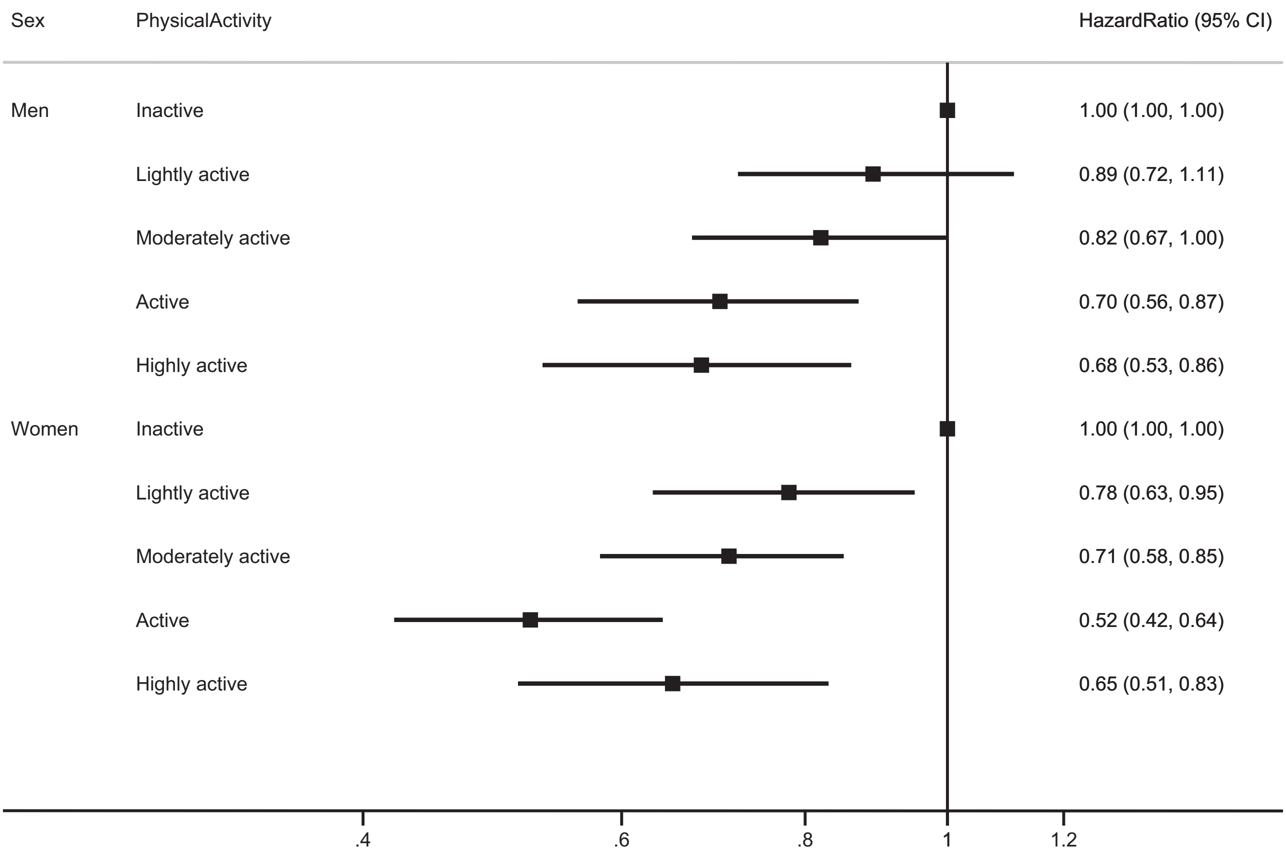

Fig. 1. Hazard ratios for all-cause disability pension adjusted for age, marital status, education, smoking, physical symptoms, somatic health, mental health and body mass index. The HUNT Study 1995–1997 (HUNT2). CI, confidence interval.

compared with laboratory methods; particularly for light-intensity activities, the most common form of physical activity (Shephard, 2003). Still, they are useful for crude categorization of population activity levels (Shephard, 2003). Nevertheless, accelerometers could have provided a more objective measure of leisure-time physical activity, and a cycle or treadmill test would have given information about physical fitness. Further, leisure-time physical activity levels were only reported at baseline, and we have no information on possible changes during the follow-up period. This study investigated the association between physical activity performed during leisure-time and disability pension, and therefore, we cannot infer anything about the effects of physical activity performed in other contexts (e.g., occupational activity).

The results from our study are in line with previous evidence of the protective influence of leisure-time

Table 3. Hazard ratios (95% CI) for DP because of musculoskeletal and mental disorders in persons aged 20–65 (first 2 years of follow-up excluded)

	Number of DPs	IR of DP per 1000 py	Model 1	Model 2	Model 3
Musculoskeletal					
Inactive	105	10	1.00	1.00	1.00
Lightly active	211	7	0.66 (0.52, 0.83)	0.75 (0.60, 0.95)	0.72 (0.57, 0.91)
Moderately active	478	6	0.54 (0.44, 0.67)	0.65 (0.52, 0.80)	0.65 (0.52, 0.80)
Active	194	4	0.37 (0.30, 0.47)	0.49 (0.38, 0.62)	0.52 (0.41, 0.66)
Highly active	102	4	0.41 (0.31, 0.53)	0.51 (0.39, 0.68)	0.54 (0.41, 0.71)
Mental					
Inactive	24	2	1.00	1.00	1.00
Lightly active	74	2	1.05 (0.66, 1.66)	1.16 (0.73, 1.84)	1.26 (0.79, 1.99)
Moderately active	164	2	0.84 (0.55, 1.29)	0.96 (0.62, 1.48)	1.18 (0.76, 1.83)
Active	50	1	0.42 (0.26, 0.68)	0.50 (0.30, 0.82)	0.65 (0.40, 1.07)
Highly active	30	1	0.50 (0.29, 0.86)	0.57 (0.33, 0.98)	0.72 (0.42, 1.24)

Physical activity groups relative to the inactive group. Model 1, adjusted for age; model 2, adjusted for age + marital status, education and smoking; model 3, adjusted for model 2 + physical symptoms, somatic health, mental health and body mass index.
CI, confidence interval; DP, disability pension; IR, incidence rate; py, person-years.

physical activity on work disability (Lahti et al., 2010b, 2012, 2013; Robroek et al., 2013a). Using the first wave of the cohort we used (HUNT1; 10 years earlier), Krokstad et al. (2002) reported that physically inactive persons were only at higher risk of disability pension in the age group of 50–66 years. We found no evidence that age at baseline modified the association between leisure-time physical activity and risk of disability pension. Another study using the first wave of the HUNT Study, found evidence of an inverse association between leisure-time physical activity and disability pension because of low back pain (Hagen et al., 2002).

A Finnish study investigated the association between cardiorespiratory fitness and disability pension among 1300 middle-aged men with 11 years of follow-up. In line with our results, these authors reported an inverse dose–response relation between fitness and disability pension, also after adjustment for several confounders. Further, a recent Finnish study, reported inverse associations between leisure-time physical activity and disability pension in 6300 middle-aged public sector employees (80% women), which were followed for 6 years (Lahti et al., 2013). A study with 4 years of follow-up on workers aged 50 and older in several European countries, reported that lack of physical activity was a strong predictor for disability pension after adjusting for several potential confounders, including health complaints (Robroek et al., 2013b). Similarly, other studies reported physical inactivity to be a risk factor for disability pension (Biering-Sorensen et al., 1999; Suominen et al., 2005; Friis et al., 2008), whereas some studies did not observe any association even in crude analyses (Krause et al., 1997; Ropponen et al., 2011).

Not surprisingly, leisure-time physical activity was more strongly associated with disability pension because of musculoskeletal disorders than mental disorders. Although leisure-time physical activity is associated with both musculoskeletal and mental health, there is stronger experimental evidence for the benefits of leisure-time physical activity on musculoskeletal health (Physical Activity Guidelines Advisory Commitee Report, 2008). In contrast, the study by Lahti et al. (2013) reported similar associations between leisure-time physical activity and disability pension because of musculoskeletal and mental disorder. However, the study comprised a more homogenous sample of mainly female middle-aged public sector workers employed by the city of Helsinki.

It is possible that the association between leisure-time physical activity and disability pension could be mediated and not confounded by the health variables added in model 3. Although poor health is likely to limit physical activity levels, observational and experimental evidence have shown that physical activity improves health-related quality of life, psychological and somatic health and BMI (Physical Activity Guidelines Advisory Commitee Report, 2008; U.S. Department of Health and Human Services, 2008). It was recently suggested that the lower risk of disability pension and sickness absence could be explained by the documented benefits of physical activity and/or physical capacity on (a) health-related variables such as quality of life, well-being, metabolic health, reduced pain and fatigue, and (b) theoretically, improved physical capacity – as a consequence of higher activity levels, should improve work capacity, and reduce relative workloads (Fimland et al., 2013). Both these possible effects of physical activity may improve work ability, which in turn could reduce the proportion of workers becoming recipients of sickness benefits (Fimland et al., 2013).

Although there were evidence of effect measure modification between men and women for the association between leisure-time physical activity and disability pension, our results indicated an inverse association between leisure-time physical activity and work disability for both men and women. Some indications of sex differences were also reported by Lahti et al. (2013); however, in both studies, the sex differences were relatively small, and the overall findings are that physical activity is associated with reduced risk of disability pension.

Work disability and disability pension has major consequences at the individual and societal level. In our sample, 9% of men and 12% of women became recipients of disability pension during the follow-up period. On average ~ 10% of the working-age population in Norway is granted disability pension. Considering our results, measures to increase physical activity with even a small increase in activity for those who are inactive could have great potential for reducing disability pensions on a large scale, particularly because of musculoskeletal disorders. Persons who are only lightly active could benefit from increasing the volume or intensity of physical activity.

In summary, we observed strong inverse associations between leisure-time physical activity and disability pension. The associations were weakened, but generally maintained when comprehensively adjusting for potential confounders. Hence, our findings provide additional support for the hypothesis that leisure-time physical activity may be important for occupational health in reducing disability pension.

Perspectives

There is compelling evidence that physical activity is beneficial for a range of health outcomes, but whether leisure-time physical activity reduce the risk of disability pension is not clear. Most previous studies have either had small samples, short follow-up periods, only included subpopulations (e.g., only men, a narrow age span or specific occupations), or had limited ability to adjust for possible confounding factors. In this large population-based cohort study in Norway, linked with a national registry on incident disability pension, we observed an inverse dose-dependent association between physical activity and risk of disability pension during 9 years follow-up. The associations persisted even after comprehensive adjustments for potential confounders. Persons who reported to be highly physically active had half the risk of disability pension compared with inactive persons. The associations were stronger for disability pension because of musculoskeletal disorders than mental disorders. This suggests that leisure-time physical activity could be an important factor in reducing disability pension in the general work force, and that even a small increase in physical activity for those who are inactive could reduce the risk of disability pension.

Key words: absenteeism, exercise, prospective studies, mental disorder, musculoskeletal disease.

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Author contribution

M. S. F., R. J. and J. H. B. planned the study. M. S. F., G. V. and J. H. B. analyzed the data. M. S. F. drafted the article. All authors interpreted the results, critically revised the article and approved the final version. M. S. F. and J. H. B. are the guarantors of the study.

Supporting information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Table S1. Hazard ratios (95% CI) for all-cause disability pension (DP) in men and women aged 20–65 with follow-up of 9.3 years (first 2 years excluded), excluding persons reporting serious mental disorders, reporting an injury reducing functional ability, or having a history of cardiovascular disease. Physical activity groups relative to the inactive group.

Table S2. Hazard ratios (95% CI) for all-cause disability pension (DP) in men and women aged 20–62 with 6.3 years of follow-up (first 5 years excluded). Physical activity groups relative to the inactive group.

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