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ORIGINAL ARTICLE

Do physical activity level and body mass index predict recovery from persistent neck pain in men and women of working age? A population-based cohort study

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Abstract
Purpose The study sought to examine the gender-specific effects of physical activity level and body mass index on recovery from persistent neck pain (PNP) among citizens of working age in Stockholm, Sweden.
Methods A population-based cohort of 1,730 subjects (18–65) with PNP answered surveys in 2002 and 2007. Prognostic factors were self-reported body mass index (BMI) and physical activity level (PAL) at baseline. Analyses were performed with odds ratios (OR) with corresponding 95 % confidence intervals (95 % CI).
Results Women reporting higher physical activity level had higher odds of recovering from PNP than women with sedentary leisure time (OR of 1.5, 95 % CI 1.0–2.4), but no associations were found in men. No associations were found between BMI and recovery from PNP in any analyses.
Conclusion Physical activity seems to be associated with recovery from PNP in women and should therefore be encouraged. Future studies should continue investigating physical activity and lifestyle factors in relation to recovery from persistent neck pain, since these modifiable factors may be considered in interventions.

Keywords Prognosis · Recovery cohort · Neck pain · Spinal pain

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Introduction

Neck pain represents a large proportion of musculoskeletal disorders [1], with a 1-year prevalence of 30–50 % and a lifetime prevalence of 50 % [2]. The European prevalence of work-related neck pain is reportedly 25 %, and is associated with an economic burden for society [3].

Neck pain, it is proposed, runs an episodic course with varying recovery rather than an absolute resolution of symptoms [4, 5]. It is, however, unclear what determinants are the most important for a good prognosis. Current literature proposes, e.g. individual, work-related, and psychosocial factors, previous history of pain and self-perceived general health [6, 7].

Studies to date have focused on work-related factors in the development and prognosis of NP [8]. Factors assessing physical, health-related, lifestyle and psychosocial determinants are also important [9]. Two health-related lifestyle factors proposed to be important for recovery from spinal pain are physical activity level and overweight expressed as body mass index (BMI). Physical activity level is reportedly an important factor in disease prevention in many disorders [10], and modulates pain [11]. Physical activity level may also modify factors such as well-being and quality of life, associated with the prognosis of spinal pain [11]. Low physical activity has

not been extensively investigated in relation to recovery from neck pain [12].

Only one study has to our knowledge reported on overweight and recovery from NP [13]. It is debated whether obesity or excess weight is associated with risk of developing and recovery from spinal pain. In the US 31 % of all youths are overweight; associated with a lower PAL [14]. In Sweden, the number of obese people has increased by 50 % in the past 25 years [10]. Understanding the association between lifestyle factors, such as overweight and PAL, and recovery from NP is important as the prevalence of these factors is increasing [15]. For this reason, we sought to study the association between such factors and recovery from persistent neck pain among persons of working age in Stockholm, Sweden.

Materials and methods

We used data based on the Stockholm public health cohort with information from two Stockholm County surveys conducted on behalf of Stockholm County Council.

Study population

The target population included residents, 18 to 84 years old, of Stockholm County. Subjects were selected using random samples of equal size from each of 43 strata, comprising 25 municipalities and 18 sub-regions of the municipality. Selected subjects ($n = 49{,}909$) received a baseline postal questionnaire between October 2002 and March 2003. Sixty-two percent ($n = 31{,}182$) responded to the baseline survey and of those 80 % ($n = 23{,}794$) answered the follow-up questionnaire, between March and August 2007.

For our purpose those aged ≤65 years answering both surveys ($n = 19{,}984$) were considered, in order to study persons of working age (Fig. 1). Subjects who at baseline were defined as having persistent neck pain (PNP) ($n = 1{,}730$) were those who answered "yes everyday" to the question: "During the previous 6 months, have you experienced pain in your upper back or neck". The different categories to answer were: (a) no, (b) yes, a couple of days during the last 6 months, (c) yes, a couple of days last month, (d) yes, a couple of days per week and (e) yes, every day.

Ethical considerations

The study was approved by the ethical review board in Stockholm, Sweden (Diary nr. 2009/457-31). Written informed consent, included in the questionnaires, was obtained from each person included.

Questionnaires

Baseline data included the questions regarding demographic characteristics, physical and psychological health, physical and psychosocial work environment, lifestyle factors, socioeconomics, social relations and sick leave included in the survey in 2002. Some additional data (employment) were collected from the Swedish national registers.

Potential prognostic factors

Potential prognostic factors were self-reported physical activity level and body mass index, reported at baseline.

Physical activity level

Physical activity level (PAL) was based on a question included in the baseline survey and categorized into four levels: "During the previous 12 months, how physically active have you been during leisure time? If your activity differs between, e.g. summer and winter, please estimate the average activity".

(1) "You devote yourself to reading, TV, movies or other sedentary activity during leisure time. You walk, cycle or are active in other ways less than 2 h a week", categorized as sedentary.

(2) "You walk, cycle or are active in other ways at least 2 h a week, mostly without sweating. Also include walking or cycling to and from work, Sunday walks, ordinary gardening, fishing, table tennis and bowling", categorized as low.

(3) "You are physically active regularly, 1–2 times a week at least 30 min each session with running, swimming, tennis, badminton or other activity that makes you sweat", categorized as moderate.

(4) "You devote yourself to, e.g. running, swimming, tennis, badminton, aerobic exercise or similar on average at least 3 times a week, each session lasting at least 30 min", categorized as high.

These four categories and a dichotomous factor (sedentary vs. low, moderate and high) were used in the analyses. The PAL question has been validated against physical activity as measured with an accelerometer [16].

Body mass index (BMI)

BMI was based on self-reported weight and height and categorized into underweight (BMI < 18), normal weight (BMI 18–25) and overweight and obese (BMI ≥ 25) [17]. It was also dichotomized into under- and overweight vs. normal weight. The BMI is proposed to have high specificity and low sensitivity.

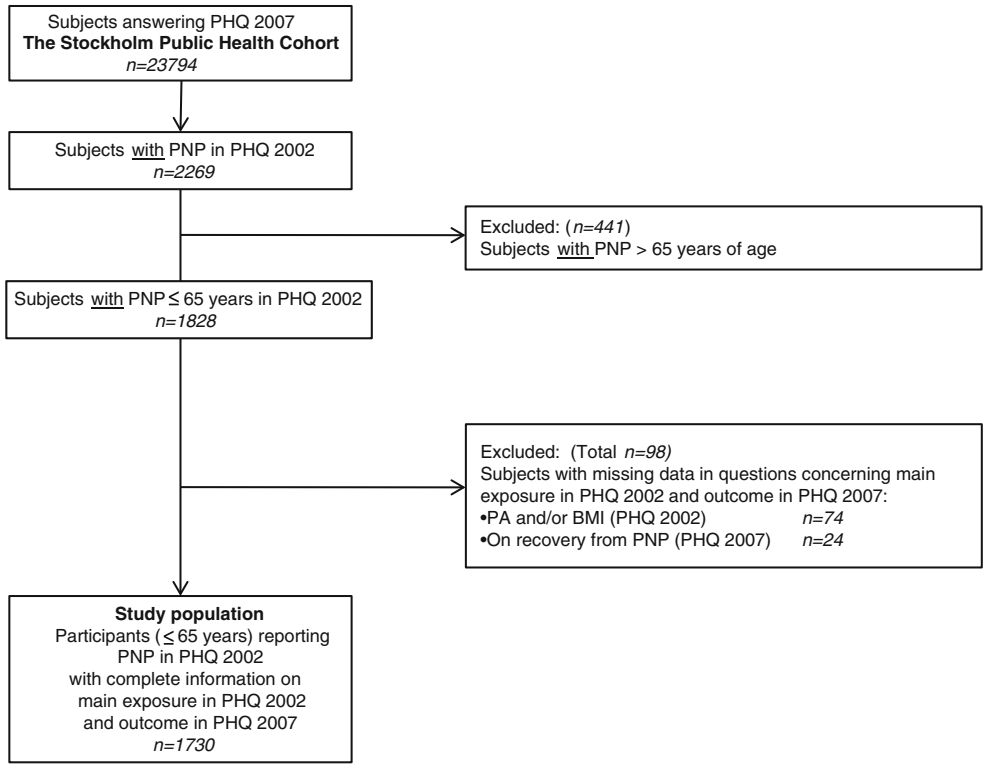

Fig. 1 Inclusion process and progress of subjects into the study population. *PHQ* Public Health Questionnaire, *PAL* self-reported physical activity level, *BMI* body mass index, *PNP* persistent neck pain

Outcome

Outcome was recovery from PNP based on two questions in the follow-up survey in 2007. Subjects with PNP answering "No" to both the following questions were defined as recovered: "During the past 5-year period have you had neck pain for at least three consecutive months that has bothered you considerably?", and "During the past 5-year period have you had neck pain, on at least 7 consecutive days but less than 3 consecutive months, that has bothered you considerably?"

Potential confounders

Potential confounders were chosen from the baseline survey guided by knowledge from prior research and also by clinical considerations [6, 18].

Potential confounders analyzed were: age (continuous), smoking habits (daily/not daily), alcohol (none, low, moderate, high), back pain the previous 6 months (no pain, 2 days in total, on average 2 days per month, 2 days per week, every day), chronic illness or handicap (yes/no), socioeconomic class (unskilled worker, skilled worker, lower non-manual worker, intermediate non-manual worker, higher non-manual worker, self-employed), current occupation (employed, self-employed, un-employed, disability or retirement pension, leave of absence, student), marital status (married/unmarried or registered partnership, divorced, widow/widower), country of birth (Sweden/abroad), time with housework per day (almost no time, approx 30 min, 1–2 h, 3–5 h, >5 h), main physical workload past 12 months (sedentary, light, moderate, heavy), sick leave during the last 12 months (no sick leave, 1–7 days, >8 days), time spent at computer per day (>half day/less than half day), psychological well-being (reduced/good psychological well-being). BMI (<18, 18–25 and ≥25) was considered a potential confounder for the associations between PAL and recovery from PNP, and PAL (sedentary, low, moderate and high) was considered a potential confounder for the association between BMI and recovery from PNP.

Statistical methods

Means and standard deviations (SD) were reported to describe the distribution of the continuous variables, and proportions (%) to describe the categorical variables in Table 1.

Analyses

To study the associations between prognostic factors and outcome, odds ratios (OR) with corresponding 95 % confidence intervals (95 % CI) were estimated using logistic regression models. Altogether eight models were built, for men and women separately, for the analyses of the factors PAL and BMI (categorized and dichotomous).

Table 1 Baseline characteristics for persons ($n = 1{,}730$) with persistent neck pain at baseline by physical activity level (sedentary/active) and bodyweight (BMI <25/≥25) for men and women presented as number and percent, *n* (%)

Characteristics	Physical activity level				Body mass index			
	Men ($n = 495$)		Women ($n = 1{,}235$)		Men ($n = 495$)		Women ($n = 1{,}235$)	
	Sedentary ($n = 117$)	Active ($n = 378$)	Sedentary ($n = 246$)	Active ($n = 989$)	BMI < 25 ($n = 178$)	BMI ≥ 25 ($n = 317$)	BMI < 25 ($n = 706$)	BMI ≥ 25 ($n = 529$)
Age mean (SD)	48 (12)	50 (12)	46 (12)	48 (12)	47 (13)	51 (11)	45 (12)	49 (11)
Physical activity (sedentary)	–	–	–	–	39 (22)	78 (25)	99 (14)	147 (12)
Bodyweight BMI ≥ 25	39 (33)	139 (37)	147 (60)	382 (38)	–	–	–	–
Chronic disease or trauma (yes)	75 (64)	250 (66)	147 (60)	582 (59)	117 (66)	208 (66)	383 (54)	346 (65)
Back pain every day, last 6 months	51 (44)	155 (41)	119 (48)	376 (38)	63 (35)	143 (45)	253 (36)	242 (46)
Alcohol moderate/high	13 (11)	33 (9)	33 (13)	127 (13)	148 (8)	32 (10)	94 (13)	66 (12)
Smoker daily	37 (32)	76 (20)	64 (26)	209 (21)	45 (25)	68 (21)	163 (23)	110 (21)
Birthplace outside Sweden	38 (32)	79 (21)	83 (34)	207 (21)	33 (19)	84 (26)	161 (23)	129 (24)
Current occupation[a]	48 (41)	164 (43)	133 (54)	613 (62)	117 (66)	207 (65)	451 (64)	295 (56)
Socioeconomic class[b]	62 (53)	194 (51)	95 (39)	452 (46)	79 (44)	177 (56)	343 (49)	285 (54)
House work ≥1 h a day	31 (26)	179 (47)	156 (63)	747 (75)	74 (42)	136 (44)	505 (72)	398 (75)
Sick leave >7 days last year	33 (28)	100 (26)	84 (34)	327 (33)	44 (25)	91 (29)	212 (30)	199 (38)
Main physical workload (heavy)	17 (14)	61 (16)	22 (9)	78 (8)	25 (14)	53 (17)	56 (8)	44 (8)
Computer work ≥3/4 a day	32 (27)	95 (25)	74 (30)	352 (36)	52 (29)	75 (24)	266 (38)	160 (30)
Psychological well-being (reduced)	40 (34)	111 (29)	118 (48)	619 (63)	117 (66)	218 (69)	430 (61)	307 (58)

Sedentary active <2 h per week, *Active* activity >2 h per week

[a] Current occupation: employed or self-employed

[b] Socioeconomic class: based on occupation and education

In a first step, crude association between the factors PAL and BMI, respectively, and recovery from PNP were performed. In a next step potential confounding factors as described above were added, one at a time, to the crude regression models. If a factor changed the crude estimate by 10 % or more, it was considered a confounder and entered in the final model as described by Rothman [19].

The factors physical activity level and BMI were both tested for confounding in the models.

Statistical analyses were run with STATA® statistical software system version 11.

Results

A description of the study population ($n = 1{,}730$) reporting PNP at baseline is presented in Table 1. Twenty-nine percent ($n = 502$) were defined as recovered at follow-up.

Seventy-nine percent of the study population reported a PAL of more than 2 h per week at baseline (men 76 % and women 80 %). Regarding BMI, 49 % of the sample reported a BMI ≥25 (men 64 % and women 43 %).

The final, adjusted model for PAL included for men the variables smoking habits and socioeconomic class, and for women main physical workload, sick leave and time spent at a computer. The final adjusted model for BMI included for men the variables socioeconomic class, main physical workload, sick leave and computer time per day and, for women, no confounders. Age was not included in the final models as it was not found to be a confounding factor in any of the models. BMI did not confound the associations in the PA models and PA did not confound the associations in the BMI models. The crude and adjusted gender-specific ORs with 95 % CIs are presented in Tables (2, 3).

Overall results showed low-to-moderate associations between recovery from persistent neck pain and physical activity level in both men and women (Table 2). A somewhat stronger association to recovery was shown for women reporting a higher PAL in relation to a sedentary. The OR for dichotomized physical activity level, where a sedentary leisure time was compared to an active PAL in women, was 1.5 (95 % CI 1.0–2.4). BMI was not a prognostic factor in recovery from PNP in either gender (Table 3).

Discussion

We sought to investigate the effects of two lifestyle factors: physical activity level (PAL) and body mass index (BMI), on recovery from persistent neck pain (PNP). Associations,

Table 2 Association between physical activity level (PAL) and recovery from persistent neck pain (PNP), presented with odds ratios (OR) and 95 % confidence intervals (95 % CI)

PAL	Men ($n = 495$)			Women ($n = 1,235$)		
	Cases[a]/non cases	Crude OR (95 % CI)	Adjusted OR (95 % CI)	Cases[a]/non cases	Crude OR (95 % CI)	Adjusted OR (95 % CI)
Sedentary <2 h/week	83/34	Referent	Referent	185/61	Referent	Referent
Low PAL	175/65	0.9 (0.5–1.5)	0.9 (0.5–1.5)	456/178	1.2 (0.8–1.7)	1.6 (1.0–2.5)
Moderate PAL	52/28	1.3 (0.7–2.4)	0.7 (0.4–1.5)	155/67	1.3 (0.9–2.0)	1.5 (1.0–2.6)
High PAL	32/26	2.0 (0.9–3.8)	1.5 (0.7–3.1)	90/43	1.4 (0.9–2.3)	1.4 (0.8–2.6)
Active PAL (low/high) vs. sedentary	259/119	1.1 (0.7–1.8)	0.9 (0.6–1.5)	701/288	1.2 (0.9–1.7)	1.5 (1.0–2.4)

[a] Number of exposed cases/non-cases

Table 3 Association between body mass index (BMI) and recovery from persistent neck pain (PNP), presented with odds ratios (OR) and 95 % confidence intervals (95 % CI)

BMI	Men ($n = 495$)			Women ($n = 1,235$)		
	Cases[a]/non cases	Crude OR (95 % CI)	Adjusted OR (95 % CI)	Cases[a]/non cases	Crude OR (95 % CI)	Adjusted OR (95 % CI)
Normal (BMI > 18 < 24.9)	173/77	Referent	Referent	272/101	Referent	Referent
Underweight (BMI < 18)	49/18	1.2 (0.7–2.2)	1.0 (0.5–2.2)	110/46	0.9 (0.6–1.3)	0.9 (0.6–1.3)
Overweight (BMI 25–30)	117/56	1.3 (0.7–2.4)	1.2 (0.5–2.6)	483/193	1.0 (0.7–1.4)	1.0 (0.7–1.4)
Obese (BMI >30)	3/2	1.8 (0.3–11.7)	0.7 (0.6–8.8)	21/9	1.0 (0.4–2.4)	1.0 (0.4–2.4)
BMI > 18–24.9 vs. BMI < 18 and > 25	342/153	1.1 (0.8–1.7)	1.2 (0.7–1.9)	886/349	1.0 (0.8–1.3)	1.0 (0.8–1.3)

[a] Number of exposed cases/non-cases

but weak, were found between levels of physical activity and recovery from PNP in active women compared to those with sedentary leisure time, indicating a positive prognostic effect, whereas BMI was not a prognostic factor. No associations were found in men.

Physical activity is commonly considered to be associated with good health. In our study, leisure physical activity in contrast to sedentary lifestyle seemed to associate with recovery from PNP in women. Among persons with NP little is known from previous studies of the potential positive effects of physical activity on prognosis of NP, and high-quality studies are scarce. A Dutch study [20] summarized that active time was associated favorably with neck-and-shoulder symptoms and with sickness in a working cohort. This was also found in two other studies [21, 22] reporting positive associations between physical activity level and neck pain. Hildebrandt and colleagues [21] suggested that in a sedentary working situation, higher PAL seems to be positive for spinal pain. Work-related PAL was not investigated in the present study.

Our results lacked associations between BMI and recovery from PNP. Yang et al. (2007) also concluded that neither under- nor overweight was associated with delayed recovery from whiplash injury [13]. In addition, another study from our group reported low associations between BMI and recovery from persistent low-back pain [23]. Our results dispute the view that being overweight may affect recovery from spinal pain. Still, overweight is an important growing issue that should be taken into consideration in health care [24]. In addition, positive associations between physical activity and overweight are reported, implying the importance of such lifestyle factors [11]. Further, excess weight or obesity may be a marker of disability and depression and a risk factor for developing spinal pain [25].

Strengths of our study are the prospective study design where prognostic factors were assessed before the outcome, and the large sample of persons with PNP reported in the general population. Important for the validity is also the large number of potential confounders assessed, even if the importance of unmeasured and residual confounding factors cannot be ruled out.

Some limitations need to be addressed. Our results may be confounded by indication such as whether women with sedentary leisure time had worse NP at baseline than those with higher PAL. If they did, this may cause overestimation of the effect of PAL in our study. On the other hand, the effect of PAL may be underestimated if women with

higher baseline PAL had worse NP than those with sedentary leisure time. Further, PAL varies over time, and possible changes in physical activity level from baseline to follow-up may have misled us.

The factors BMI and PAL were measured through self-assessments. This may be related to misclassification of exposure which may have biased the results. However, the physical activity question employed is useful for categorising adults into different levels of physical activity [16]. BMI is widely used as a baseline exposure measurement in longitudinal cohort studies of spinal pain. Even so, when self-reported, weight and height tend to be under- or over-estimated, leading to under- or over-estimation of BMI [26]. Here, the lack of association between BMI and recovery may be due to such a non-differential misclassification of exposure.

The present study indicated that higher PAL was associated with recovery from PNP in women. To date, there is no consensus on what recovery from NP really means. Persons with NP may report themselves recovered more because they are able to redefine personhood or their life goals [5, 27]. Such potential misclassification of recovery would be non-differential, however, and would probably not bias our results. The definition of recovery in our study was: not reporting neck pain for more than seven consecutive days during the past 5 years. However, there is a risk for a non-differential misclassification of outcome bias due to the 5-year recall period which if present may dilute the associations between recovery and PAL and BMI, respectively.

To our knowledge, there are few studies on associations between BMI and PAL, respectively, and recovery from PNP in the general working population. Our findings indicate that clinicians and health care providers should promote physical activity for persons with PNP, at least the women. Further, our results call into question the hypothesis common among clinicians that overweight is related to poor recovery from neck pain.

Conclusion

The present study indicates that physically active leisure time in comparison with sedentary is associated with recovery from persistent neck pain in women but not in men. For BMI no such associations were found for either gender. Future studies should continue examining lifestyle factors related to recovery from persistent neck pain, since, if they are found important, are modifiable and may be considered in interventions.

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Conflict of interest None.

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