Eur Spine J (2009) 18:371–381
DOI 10.1007/s00586-008-0823-6

ORIGINAL ARTICLE

The association between prevalent neck pain and health-related quality of life: a cross-sectional analysis

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Received: 21 August 2008 / Accepted: 25 October 2008 / Published online: 20 November 2008

Abstract The aim of this study was to examine the association between grades of neck pain severity and health-related quality of life (HRQoL), using a population-based, cross-sectional mailed survey. The literature suggests that physical and mental HRQoL is worse for individuals with neck pain compared to those without neck pain. However, the strength of the association varies across studies. Discrepancies in study results may be attributed to the use of different definitions and measures of neck pain and differences in the selection of covariates used as control variables in the analyses. The Saskatchewan Health and Back Pain Survey was mailed to 2,184 randomly selected Saskatchewan adults of whom 1,131 returned the questionnaire. Neck pain was measured with the Chronic Pain Questionnaire and categorized into four increasing grades of severity. We measured HRQoL with the SF-36 Health Survey and computed the physical and mental component summary scores. We built separate multiple linear regression models to examine the association between grades of neck pain and physical and mental summary scores while controlling for sociodemographic, general health and comorbidity covariates. Our crude analysis suggests that a gradient exists between the severity of neck pain and HRQoL. Compared to individuals without neck pain, those with Grades III–IV neck pain have significantly lower physical (mean difference = −13.9/100; 95% CI = −16.4, −11.3) and mental (mean difference = −10.8/100; 95% CI = −13.6, −8.1) HRQoL. Controlling for covariates greatly reduced the strength of association between neck pain and physical HRQoL and accounted for the observed association between neck pain and mental HRQoL. In the comorbidity model, the strength of association between Grades III–IV neck pain and PCS decreased by more than 50% (mean difference = −4.5/100; 95% CI = −6.9, −2.0). In the final PCS model, Grades III–IV neck pain coefficients changed only slightly from the comorbidity model (mean difference = −4.4/100; 95% CI = −6.9, −1.9). This suggests that comorbid conditions account for most of the association between neck pain and PCS score. It was concluded that prevalent neck pain is weakly associated with physical HRQoL, and that it is not associated with mental HRQoL. Our cross-sectional analysis suggests that most of the observed association between prevalent neck pain and HRQoL is attributable to comorbidities.

Keywords Quality of life · Neck pain · Cross-sectional

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Introduction

Neck pain is a public health problem associated with significant disability [8, 12]. In 1996, the total cost of neck pain in The Netherlands was estimated at $686 million (US) [4]. In Saskatchewan, neck pain is highly prevalent, with 67% of adults having experienced neck pain during their lifetime and 54% reporting to have had neck pain in the previous 6 months. More importantly, almost 5% of adults are significantly disabled by neck pain during any 6 months period [8].

Common during the most productive years of a person's life, neck pain is believed to impact on one's general health and health-related quality of life (HRQoL). HRQoL is a global construct that encompasses physical, social and psychological functioning, work role functioning, and vitality [2, 35]. We found five cross-sectional studies examining the association between neck pain and HRQoL in clinical populations [9, 11, 15, 17, 18]. These studies used the SF-36 Health Survey or a translated or derived version. Their findings suggest that patients with neck pain have worse physical and mental HRQoL compared to those without neck pain [9, 11, 17, 18].

Two general population studies were found examining the association between neck pain and health status [10, 13]. Ektor-Andersen et al. found that self-experienced health decreased with increasing pain in the shoulder-neck area [10]. Hagen et al. compared HRQoL indicators in individuals with various musculoskeletal conditions and reported that 69% of those with neck pain were very/fairly satisfied with life [13]. Both studies assessed health status with different, single, non-validated questions; providing a questionable measurement of HRQoL.

The results reported in previous studies need to be tested in a large, population sample with attention given to measurement and selection biases in a proper analysis. Therefore, the aim of this cross-sectional study is to examine the association between grades of neck pain severity and HRQoL in a population-based sample of adult Saskatchewan residents. Measuring the association between neck pain and HRQoL is important for three reasons. First, it helps to quantify the potential impact of neck pain on HRQoL. Second, it provides insights to clinicians as to the contribution of neck pain to the overall health status of a patient. Third, when appraised at the population level, it offers a view of the overall burden of neck pain on the HRQoL of individuals.

Materials and methods

Study design and sample

We used data from the Saskatchewan Health and Back Pain Survey, a population-based cohort study of the distribution and determinants of spinal disorders in Saskatchewan, Canada [8]. Saskatchewan is a Canadian province of approximately one million inhabitants with a universal health care system. The data used in this analysis was collected in September 1995.

The survey targeted all noninstitutionalized Saskatchewan residents aged 20–69 years who held a valid Saskatchewan Health Services card on 31 August, 1995 ($N = 593{,}464$). We excluded inmates of provincial correction facilities, residents under the Office of the Public Trustee, foreign students and workers holding employment or immigration visas, and residents of special care homes.

The Saskatchewan Health Insurance Registration File (HIRF) served as the sampling frame. Saskatchewan Health estimates that more than 99% of the Saskatchewan population is included in the HIRF. Participation in the survey was voluntary. To ensure anonymity, Saskatchewan Health sent a letter informing eligible residents that they were randomly selected to participate in a health and back pain survey. The University of Saskatchewan Advisory Committee on Ethics in Human Experimentation approved the survey.

A random sample of 2,184 subjects was obtained. The sampling strategy and sample size estimate for the survey are described in detail elsewhere [8]. The randomization from the HIRF provided a sample representative of the Saskatchewan population in terms of age, gender, and location of residence. A total of 1,131 subjects (55%) participated [8].

Main independent variable: neck pain

A mannequin diagram included in the questionnaire defined neck pain as pain located between the occiput and the third thoracic vertebrae. We measured the severity of neck pain in the previous 6 months using the Chronic Pain Questionnaire [27, 29]. The Chronic Pain Questionnaire is a valid and reliable instrument consisting of a seven-item, self-report, Guttman scale that accounts for the different dimensions of pain [27–33]. It has good psychometric properties in the general population as well as with patients with low back pain, headache and temporomandibular joint disorders. The questionnaire has demonstrated good internal consistency. Cronbach's alpha was 0.91, and the item-total correlations were all high [24, 27–33]. The questionnaire provides five mutually exclusive ordered grades of pain derived from the severity of pain intensity and disability reported by a subject in the previous 6 months (Table 1). In this analysis, Grades III and IV neck pain were combined because of the small number of subjects in these respective categories [7].

Table 1 Classification of chronic neck pain grade

Grade	Interpretation
0	No chronic pain
I	Low pain intensity/low disability
II	High pain intensity/low disability
III	High disability/moderately limiting
IV	High disability/severely limiting

Outcome: health-related quality of life (HRQoL)

The Medical Outcomes Study SF-36 standard English-Canadian version 1.0 was used to measure self-perceived general health status [39]. The SF-36 is designed to provide a global measure of HRQoL. It comprises eight interrelated health dimensions: physical functioning; role-limitations resulting from physical health problems; bodily pain; general health; vitality (energy/fatigue); social functioning; role-limitations resulting from emotional problems; mental health (psychological distress/psychological well-being); and reported health transition. The SF-36 is a valid and reliable measure for clinical and general populations with a reported intraclass correlation coefficient (ICC) of 0.85 [1, 6, 19, 39].

This analysis uses the physical component summary (PCS) and mental component summary (MCS) measures of the SF-36. Three scales (physical functioning, role-physical, and bodily pain) correlate most highly with the physical component and contribute most to the scoring of the PCS [36, 38]. The mental component correlates most highly with the mental health, role-emotional, and social functioning scales, which contribute most to the scoring of the MCS [36]. The PCS and MCS scales are scored using norm-based methods where the means and standard deviations are derived from the general US population. A linear *T*-score transformation method is used so that both the PCS and MCS have a mean score of 50 with standard deviation of 10 [37].

Higher scores indicate better physical or mental functioning. Reliability estimates for the PCS and MCS scores usually exceed 0.90 [38].

Covariates

The Saskatchewan Health and Back Pain Survey questionnaire included several valid and reliable inventories and specific questions regarding various domains. In the current analysis, these variables are used as covariates to control for factors that may lead to spurious associations between neck pain and HRQoL. Three domains of covariates were used:

1. Sociodemographic characteristics: age, gender, marital status, location of residence, highest educational attainment, household annual income before tax and employment status (full-time, part-time, retired, student, homemaker).
2. General health variables: height and weight were used to compute the body mass index ($BMI = kg/m^2$), exercise (average number of days/week participating in a minimum of 30 min of exercise during the previous 6 months), cigarette smoking [self-report of smoking status was obtained and categorized as nonsmoker, ex-smoker or current smoker (>1 pack/day or <1 pack/day)], medication use and lifetime history of neck injury in a motor vehicle collision (MVA). Previous injury to the neck in a MVA was included in the general health domain because of the possible negative consequences that a traffic injury may have on general health [7].
3. Comorbidities: coexisting health problems may be associated with neck pain or may confound the association between HRQoL and other covariates. A self-report questionnaire inquired about the presence and perceived impact of broad categories of health disorders on one's health using a modified Likert scale. The role of the questionnaire was not to identify specific medical diagnoses. This comorbidity questionnaire has been shown to have good test-retest reliability (ICC = 0.93) and adequate face, concurrent and convergent validity [16, 34]. In this study, the following health problems were investigated: allergies, arthritis, blood problems, breathing problems, cancer, cardiovascular problems, diabetes, digestive problems, genitourinary problems, headaches, high blood pressure, mental/emotional problems and neurological problems.

The presence and severity of low back pain experienced in the previous 6 months was classified into four mutually exclusive categories with the Chronic Pain Questionnaire as previously described for neck pain. Depressive symptomatology present in the week before the survey was measured with the Center for Epidemiological Studies-Depression Scale (CES-D). The CES-D is a 20-item self-report scale designed to measure current level of depressive symptomatology in population epidemiologic research [21]. It is reliable, well validated in various populations and found to have good internal consistency, with reported alpha coefficients > 0.85 [3, 14, 20, 21, 26, 40]. The CES-D is scored from 0 to 60. A score equal to or higher than 16 suggests the presence of depressive symptomatology [5, 21].

Statistical analysis

We built multivariable linear regression models to measure the association between grades of neck pain and the PCS and MCS scores while controlling for other covariates. To detect important associations between the main independent variable and outcomes, a three-step modeling approach was used. First, univariate models were built to obtain crude estimates [regression coefficients; 95% confidence intervals (CI)] of the association between neck pain, covariates and the PCS or MCS. Covariates with a $P \leq 0.25$ were kept for the second phase of the modeling. In the second phase, we built bivariate models that included neck pain and each of the covariates. We kept covariates that led to a 10% change in at least one of the neck pain grade regression coefficients [7, 22]. All important covariates identified in the second step were grouped into three domain-specific models: sociodemographic, general health and comorbidities. In these domain-specific models, covariates that did not change one of the neck pain regression coefficients by more than 10% (when removed from the model) were excluded. For the third phase, we built a model that combined covariates identified in step two. The final model was built by testing that the neck pain grade regression coefficient did not change by more than 10% in the absence of a variable.

In step two of the analysis, we found that depression was associated with better physical HRQoL. We investigated this counterintuitive result and found an interaction between depression and back pain. We included this interaction in the final PCS model.

We conducted a sensitivity analysis to determine whether the change in neck pain regression coefficients from the crude to the final models was related to missing covariate data. We ran a univariate model on the subsample that had no missing covariates of individuals included in the final model. The similarity of results would suggest that the exclusion of subjects with missing data did not bias our results. All statistical analyses were conducted using SAS [23].

Results

Sample characteristics

Baseline characteristics of the study population are presented in Table 2. The mean age of the sample was 44.7 years. The majority were female (53.5%) and most participants were married/common law (75.5%) with over one-third living in large cities. Most were high school graduates (56.6%) and working full-time (49.6%) with an annual household income between \$20,001 and \$40,000 for 34.6% of the sample.

At the time of the survey 22.7% of the sample had neck pain and 28.7% had low back pain. Almost 16% percent of the participants reported having previously injured their neck in a MVA. Overall, 38.6% of the sample experienced Grade I neck pain in the 6 months before the survey, 9.9% experienced Grade II neck pain and 4.8% had Grade III–IV neck pain. The mean PCS score was 47.0 ± 9.4 and the mean MCS score was 50.7 ± 9.7.

Association between neck pain and physical health-related quality of life

The crude, domain-specific and final models for the association between grades of neck pain and PCS score are presented in Table 3. Crude analysis revealed a negative association between those with Grades III–IV neck pain and the PCS score (mean difference = −13.9/100; 95% CI = −16.4, −11.3). Grade II neck pain was also negatively associated with the PCS (mean difference = −6.0/100; 95% CI = −7.9, −4.1) as was Grade I neck pain (mean difference = −1.7/100; 95% CI = −2.9, −0.6) when compared to those with no neck pain. This crude analysis suggests a gradient exists between severity of neck pain and physical HRQoL.

The following covariates were excluded from the domain-specific models: gender, marital status, income, homemaker, blood disorder, cancer, diabetes, high blood pressure, mental/emotional problem, neurological disorder, BMI, number of days of exercise per week, and smoking status.

In the comorbidity model, the strength of association between neck pain and PCS decreased by more than 50% (Table 3). In the final model, the neck pain coefficients changed only slightly from the comorbidity model. This suggests that comorbid conditions account for most of the association between neck pain and PCS score. Our final model suggests that Grade II and Grade III–IV neck pain are weakly associated with physical HRQoL (Table 3).

Association between neck pain and mental health-related quality of life

The crude, domain-specific and final models for the association between grades of neck pain and MCS are presented in Table 4. Crude analysis revealed a negative association between those with Grades III–IV neck pain and the MCS score (mean difference = −10.8/100; 95% CI = −13.6, −8.1). Grade II neck pain was also negatively associated with the MCS (mean difference = −3.7/100; 95% CI = −5.7, −1.7) as was Grade I neck pain (mean difference = −2.4/100; 95% CI = −3.7, −1.2) when compared to those with no neck pain.

Bivariate models excluded BMI, gender, marital status, education, employment status, (full-time, part-time, retired, student, homemaker), allergy, arthritis, breathing, blood disorder, cancer, diabetes, high blood pressure,

Table 2 Baseline sample characteristics by chronic neck pain grade

	Grade 0 ($n = 513$)	Grade I ($n = 425$)	Grade II ($n = 109$)	Grade III–IV ($n = 53$)	Study sample ($n = 1,131$)
Sociodemographic variables					
Age (years) [mean (SD)]	45.83 (13.34)	43.02 (13.16)	44.10 (12.82)	45.08 (12.12)	44.70 (13.23)
Male [*n* (%)]	271 (52.83)	189 (44.47)	39 (35.78)	15 (28.30)	526 (46.51)
Female [*n* (%)]	242 (47.17)	236 (55.53)	70 (64.22)	38 (71.70)	605 (53.49)
Marital status [*n* (%)]					
Married/common law	388 (76.53)	316 (74.88)	82 (75.23)	37 (69.81)	845 (75.45)
Separated/divorced	38 (7.50)	28 (6.64)	10 (9.17)	7 (13.21)	86 (7.68)
Widowed	13 (2.56)	10 (2.37)	5 (4.59)	2 (3.77)	31 (2.77)
Single	68 (13.41)	68 (16.11)	12 (11.01)	7 (13.21)	158 (14.11)
Location of residence [*n* (%)]					
Urban	177 (34.57)	169 (39.86)	34 (31.19)	16 (30.19)	410 (36.32)
Rural	335 (65.43)	255 (60.14)	75 (68.81)	37 (69.81)	719 (63.68)
Annual household income [*n* (%)]					
$0–20,000	90 (19.44)	89 (22.14)	18 (17.31)	7 (14.29)	234 (22.41)
$20,001–40,000	173 (37.37)	95 (23.63)	22 (21.15)	9 (18.37)	361 (34.58)
$40,001–60,000	106 (22.89)	135 (33.58)	33 (31.73)	12 (24.49)	239 (22.89)
Over $60,001	94 (20.30)	83 (20.65)	31 (29.81)	21 (42.86)	210 (20.11)
Education [*n* (%)]					
Less than grade 8	38 (7.50)	15 (3.55)	11 (10.09)	9 (16.98)	79 (7.06)
High School (>grade 8 no grad)	121 (23.87)	84 (19.91)	22 (20.18)	19 (35.85)	255 (22.79)
High school graduate	139 (27.42)	110 (26.07)	29 (26.61)	12 (22.64)	293 (26.18)
Post-secondary	148 (29.19)	140 (33.18)	36 (33.03)	10 (18.87)	342 (30.56)
University graduate	61 (12.03)	73 (17.30)	11 (10.09)	3 (5.66)	150 (13.40)
Unemployed [*n* (%)]					
Yes	30 (5.92)	20 (4.78)	7 (6.60)	8 (15.09)	68 (6.12)
No	477 (94.08)	398 (95.22)	99 (93.40)	45 (84.91)	1,044 (93.88)
Full time worker [*n* (%)]					
Yes	253 (49.90)	222 (53.11)	49 (46.23)	15 (28.30)	552 (49.64)
No	254 (50.10)	196 (46.89)	57 (53.77)	38 (71.70)	560 (50.36)
Part time worker [*n* (%)]					
Yes	74 (14.60)	67 (16.07)	19 (17.92)	6 (11.32)	168 (15.12)
No	433 (85.40)	350 (83.93)	87 (82.08)	47 (88.68)	943 (84.88)
Retired [*n* (%)]					
Yes	70 (13.81)	41 (9.81)	10 (9.43)	5 (9.43)	131 (11.78)
No	437 (86.19)	377 (90.19)	96 (90.57)	48 (90.57)	981 (88.22)
Homemaker [*n* (%)]					
Yes	87 (17.16)	75 (17.94)	19 (17.92)	14 (26.42)	201 (18.08)
No	420 (82.84)	343 (82.06)	87 (82.08)	39 (73.58)	911 (81.92)
Student [*n* (%)]					
Yes	15 (2.96)	23 (5.50)	7 (6.60)	1 (1.89)	46 (4.14)
No	492 (97.04)	395 (94.50)	99 (93.40)	52 (98.11)	1,066 (95.86)
General health variables					
BMI (kg/m^2) [mean (SD)]	26.36 (5.09)	26.44 (4.83)	25.84 (4.29)	28.05 (6.75)	26.42 (5.02)
No. of days of exercise/week [mean (SD)]	2.89 (2.20)	2.77 (2.06)	2.71 (2.20)	2.88 (2.15)	2.82 (2.15)
Cigarette smoking [*n* (%)]					
Never smoked	263 (52.92)	214 (52.20)	26 (24.53)	20 (40.00)	557 (51.05)
Ex-smoker	116 (23.34)	109 (26.59)	34 (32.08)	8 (16.00)	262 (24.01)
Current smoker	120 (24.05)	91 (21.93)	38 (35.85)	23 (45.10)	280 (25.45)

Table 2 continued

	Grade 0 ($n = 513$)	Grade I ($n = 425$)	Grade II ($n = 109$)	Grade III–IV ($n = 53$)	Study sample ($n = 1,131$)
Smoke < 1 pack	81 (16.30)	61 (14.88)	27 (25.47)	11 (22.00)	78 (16.32)
Smoke > 1 pack	37 (7.44)	26 (6.34)	19 (17.92)	11 (22.00)	94 (8.62)
Medication for pain [n (%)]					
Yes	43 (9.19)	63 (14.86)	29 (26.61)	32 (62.75)	178 (16.50)
No	425 (90.81)	361 (85.14)	80 (73.39)	19 (37.25)	901 (83.50)
Neck injury in MVA [n (%)]					
No	467 (92.84)	330 (79.33)	75 (70.09)	35 (67.31)	925 (84.09)
Yes	36 (7.16)	86 (20.67)	32 (29.91)	17 (32.69)	175 (15.91)
Outcomes					
Physical component summary (PCS) [mean (SD)]	49.04(8.78)	47.30(8.49)	43.05(9.43)	35.18(10.06)	47.04(9.43)
	$n = 491$	$n = 413$	$n = 105$	$n = 50$	$n = 1,086$
Mental component summary (MCS) [mean (SD)]	52.45 (8.78)	50.03 (9.67)	48.76 (10.08)	41.60 (11.61)	50.66 (9.71)
	$n = 491$	$n = 413$	$n = 105$	$n = 50$	$n = 1,086$
Comorbidities allergy [n (%)]					
Absent	318 (63.47)	222 (53.62)	59 (55.14)	24 (46.15)	638 (57.84)
No/min. impact on health	135 (26.95)	142 (34.30)	32 (29.91)	13 (25.00)	331 (30.01)
Mod./severe impact on health	48 (9.58)	50 (12.08)	16 (14.95)	15 (28.85)	134 (12.15)
Arthritic disorder [n (%)]					
Absent	390 (78.31)	285 (69.51)	74 (69.81)	24 (45.28)	788 (72.10)
No/min. impact on health	73 (14.66)	79 (19.27)	15 (14.15)	10 (18.87)	181 (16.56)
Mod./severe impact on health	35(7.03)	46 (11.22)	17 (16.04)	19 (35.85)	124 (11.34)
Blood disorders [n (%)]					
Absent	490 (96.65)	404 (96.19)	99 (92.52)	46 (88.46)	1,068 (95.70)
No/min. impact on health	14 (2.76)	15 (3.57)	5 (4.67)	5 (9.62)	40 (3.58)
Mod./severe impact on health	3 (0.59)	1 (0.24)	3 (2.80)	1 (1.92)	8 (0.72)
Breathing disorders [n (%)]					
Absent	377 (74.95)	283 (68.19)	68 (63.55)	28 (53.85)	772 (69.86)
No/min. impact on health	100 (19.88)	101 (24.34)	29 (27.10)	10 (19.23)	245 (22.17)
Mod./severe impact on health	26 (5.17)	31 (7.47)	10 (9.35)	14 (26.92)	88 (7.96)
Cancer [n (%)]					
Absent	483 (95.27)	405 (96.20)	101 (94.39)	47 (90.38)	1,065 (95.34)
No/min. impact on health	20 (3.94)	15 (3.56)	5 (4.67)	4 (7.69)	45 (4.03)
Mod./severe impact on health	4 (0.79)	1 (0.24)	1 (0.93)	1 (1.92)	7 (0.63)
Diabetes [n (%)]					
Absent	473 (94.22)	388 (94.87)	94 (89.52)	40 (80.00)	1,019 (93.06)
No/min. impact on health	23 (4.58)	18 (4.40)	8 (7.62)	6 (12.00)	59 (5.39)
Mod./severe impact on health	6 (1.20)	3 (0.73)	3 (2.86)	4 (8.00)	17 (1.55)
Digestive disorders [n (%)]					
Absent	396 (78.42)	302 (72.60)	68 (64.15)	20 (38.46)	806 (72.68)
No/min. impact on health	81 (16.04)	79 (18.99)	23 (21.70)	13 (25.00)	200 (18.03)
Mod./severe impact on health	28 (5.54)	35 (8.41)	15 (14.15)	19 (36.54)	103 (9.29)
Genitourinary disorders [n (%)]					
Absent	405 (79.41)	296 (70.98)	66 (61.11)	27 (50.94)	814 (72.81)
No/min. impact on health	83 (16.27)	92 (22.06)	28 (25.93)	15 (28.30)	224 (20.04)
Mod./severe impact on health	22 (4.31)	29 (6.95)	14 (12.96)	11 (20.75)	80 (7.16)
Hypertension [n (%)]					
Absent	426 (84.52)	359 (86.51)	91 (85.85)	34 (65.38)	931 (84.18)
No/min. impact on health	59 (11.71)	39 (9.40)	13 (12.26)	9 (17.31)	123 (11.12)

Table 2 continued

	Grade 0 ($n = 513$)	Grade I ($n = 425$)	Grade II ($n = 109$)	Grade III–IV ($n = 53$)	Study sample ($n = 1,131$)
Mod./severe impact on health	19 (3.77)	17 (4.10)	2 (1.89)	9 (17.31)	52 (4.70)
Headache [*n* (%)]					
Absent	296 (58.50)	153 (36.87)	19 (17.76)	8 (15.09)	485 (43.69)
No/min. impact on health	164 (32.41)	188 (45.30)	50 (46.73)	10 (18.87)	428 (38.56)
Mod./severe impact on health	46 (9.09)	74 (17.83)	38 (35.51)	35 (66.04)	197 (17.75)
Cardiovascular disorders [*n* (%)]					
Absent	451 (88.95)	350 (84.34)	90 (84.91)	31 (59.62)	941 (84.85)
No/min. impact on health	41 (8.09)	53 (12.77)	10 (9.43)	12 (23.08)	123 (11.09)
Mod./severe impact on health	15 (2.96)	12 (2.89)	6 (5.66)	9 (17.31)	45 (4.06)
Mental problems score [*n* (%)]					
Absent	411 (80.91)	310 (74.40)	76 (71.03)	23 (44.23)	843 (75.88)
No/min. impact on health	77 (15.16)	77 (18.55)	18 (16.82)	15 (28.85)	192 (17.28)
Mod./severe impact on health	20 (3.94)	28 (6.75)	13 (12.15)	14 (26.92)	76 (6.84)
Neurological disorder [*n* (%)]					
Absent	475 (93.50)	384 (92.75)	96 (90.57)	44 (83.02)	1,024 (92.25)
No/min. impact on health	29 (5.71)	26 (6.28)	5 (4.72)	8 (15.09)	71 (6.40)
Mod./severe impact on health	4 (0.79)	4 (0.97)	5 (4.72)	1 (1.89)	15 (1.35)
Depressive symptomatology					
Absent (CES-D score $\leq$ 15)	411 (85.98)	321 (77.54)	73 (68.22)	19 (38.00)	845 (78.68)
Present (CES-D score $\geq$ 16)	67 (14.02)	93 (22.46)	34 (31.78)	31 (62.00)	229 (21.32)
CES-D total score [mean (SD)]	7.69 (7.88)	10.80 (9.28)	13.62 (9.99)	21.80 (12.82)	10.17 (9.51)
Chronic back pain grade [*n* (%)]					
Grade 0	199 (39.72)	89 (20.99)	18 (16.82)	5 (9.62)	318 (28.65)
Grade I	229 (45.71)	242 (57.08)	39 (36.45)	9 (17.31)	530 (47.75)
Grade II	41 (8.18)	51 (12.03)	36 (33.64)	5 (9.62)	136 (12.25)
Grade III–IV	32 (6.39)	42 (9.91)	14 (13.08)	33 (63.46)	126 (11.35)

cardiovascular disorder, and neurological disorder variables from the domain-specific models.

The final model, adjusted for important sociodemographic, general health and comorbidity covariates produced regression coefficients for the neck pain grades with confidence intervals that included 0. Thus, there is no association between chronic neck pain and MCS when adjusted for important covariates.

Sensitivity analysis

A sensitivity analysis suggested that our results were not due to missing covariate data. The exclusion of subjects with missing data produced similar estimates and did not bias our results (Table 5).

Discussion

The purpose of this study was to quantify the potential impact of neck pain on HRQoL by examining the association between grades of neck pain severity and the physical and mental subscales of the SF-36 Health Survey. This population-based sample of Saskatchewan adult residents suggests neck pain is weakly associated with physical HRQoL, but is not associated with mental HRQoL. Although grade of neck pain appeared to be associated with both PCS and MCS in the crude analyses, the multivariate adjustment of covariates indicates that these associations were largely attributable to other variables, mainly comorbid conditions.

The validity of our results is supported by the use of a large cross-section of Saskatchewan adults and the ability to adjust for many potential confounders in the multiple regression analyses. Few population studies have examined the association between neck pain and physical and mental HRQoL. Most have only provided information on physical HRQoL [11, 18]. Studies that have provided information on both PCS and MCS scales did not account for the grade (intensity and disability) of neck pain but examined the duration, location of symptoms (axial or radicular) and did not account for comorbid conditions [9].

Table 3 Physical component summary (PCS) linear regression models

Model	Main independent variable	β	Standard error	95% CI
Crude ($n = 1{,}059$)	Intercept	49.04	0.40	48.26, 49.82
	Chronic neck pain			
	Grade III–IV	−13.86	1.31	−16.42, −11.29
	Grade II	−5.99	0.95	−7.85, −4.14
	Grade I	−1.74	0.59	−2.89, −0.59
	Grade 0	0		
Domain-specific sociodemographic ($n = 1{,}051$)[a]	Intercept	51.49	0.78	49.96, 53.01
	Chronic neck pain			
	Grade III–IV	−12.73	1.28	−15.25, −10.21
	Grade II	−6.00	0.92	−7.82, −4.19
	Grade I	−2.20	0.58	−3.34, −1.06
	Grade 0	0		
General health ($n = 996$)[b]	Intercept	49.73	0.40	48.94, 50.52
	Chronic neck pain			
	Grade III–IV	−9.58	1.34	−12.21, −6.95
	Grade II	−4.15	0.93	−5.97, −2.32
	Grade I	−0.70	0.58	−1.84, +0.44
	Grade 0	0		
Comorbidities ($n = 967$)[c]	Intercept	52.63	0.54	51.57, 53.68
	Chronic neck pain			
	Grade III–IV	−4.49	1.25	−6.94, −2.04
	Grade II	−2.61	0.84	−4.26, −0.97
	Grade I	−0.24	0.52	−1.25, 0.77
	Grade 0	0		
Final ($n = 916$)[d]	Intercept	53.57	0.83	51.95, 55.20
	Chronic neck pain			
	Grade III–IV	−4.36	1.26	−6.85, −1.88
	Grade II	−2.32	0.84	−3.98, −0.67
	Grade I	−0.20	0.53	−1.23, 0.83
	Grade 0	0		

[a] Adjusted for education

[b] Adjusted for medication for pain, neck injury in MVA

[c] Adjusted for allergy, arthritis, cardiovascular disorders, genitourinary disorders, depressive symptomatology, chronic back pain grade

[d] Adjusted for education, medication for pain, neck injury in MVA, allergy, arthritis, genitourinary disorders, depressive symptomatology, chronic back pain grade

With regards to comorbid conditions, only one other study found by these authors included as extensive a list of comorbidities [11]. Fanuele et al. found the five comorbidities that lowered the PCS the most included congestive heart failure, chronic obstructive pulmonary disease, renal failure, rheumatoid arthritis and lupus. They concluded that the presence of comorbidities in neck and back pain patients add to the burden of spinal conditions on functional status; results consistent with our findings [11].

The main limitation of our study is its response rate of 55%. A previous analysis suggests that non-respondents differ from respondents [8]. To examine selective response on the basis of demographic characteristics, Côté et al. compared the distribution of respondents and nonrespondents within each age group, gender, marital status, and location of residence categories. Subjects aged 40–69, women, and married individuals were more likely to respond to the questionnaire. Only one quarter of reserve residents responded. Thus, a selective response pattern was noted [8].

Selective response bias introduced by the presence of neck pain has also been evaluated using a method described by Tennant and Badley [25]. This method involved computing and comparing 95% CIs for the prevalence of Grade I, II, and III–IV neck pain in respondents and non-respondents from three consecutive response waves. Results from this analysis suggested that the survey may

Table 4 Mental component summary (MCS) linear regression models

Model	Main independent variable	β	Standard error	95% CI
Crude (n = 1,059)	Intercept	52.45	0.42	51.61, 53.28
	Chronic neck pain			
	Grade III–IV	−10.84	1.40	−13.58, −8.10
	Grade II	−3.68	1.01	−5.67, −1.70
	Grade I	−2.41	0.63	−3.65, −1.18
	Grade 0	0		
Domain-specific sociodemographic (n = 982)[a]	Intercept	48.51	1.25	46.05, 50.97
	Chronic neck pain			
	Grade III–IV	−10.05	1.42	−12.84, −7.26
	Grade II	−3.12	1.02	−5.12, −1.13
	Grade I	−1.83	0.64	−3.09, −0.57
	Grade 0	0		
General Health (n = 947)[b]	Intercept	51.98	0.64	50.72, 53.24
	Chronic neck pain			
	Grade III–IV	−7.48	1.56	−10.55, −4.41
	Grade II	−1.63	1.06	−3.72, 0.45
	Grade I	−1.54	0.67	−2.84, −0.23
	Grade 0	0		
Comorbidities (n = 1,020)[c]	Intercept	54.87	0.63	53.64, 56.10
	Chronic neck pain			
	Grade III–IV	−4.59	1.56	−7.65, −1.54
	Grade II	−0.85	1.06	−2.93, 1.24
	Grade I	−1.28	0.64	−2.54, −0.03
	Grade 0	0		
Final (n = 867)[d]	Intercept	48.22	1.43	45.41, 51.03
	Chronic neck pain			
	Grade III–IV	−1.97	1.62	−5.15, 1.21
	Grade II	0.65	1.07	−1.44, 2.75
	Grade I	−0.37	0.67	−1.68, 0.94
	Grade 0	0		

[a] Adjusted for age, income

[b] Adjusted for number of days of exercise/week, current smoker, medication for pain, neck injury in MVA

[c] Adjusted for digestive disorders, headache, genitourinary disorders, chronic back pain grade

[d] Adjusted for age, income, number of days of exercise/week, current smoker, medication for pain, neck injury in MVA, digestive disorders, headache, genitourinary disorders

have appealed to subjects who suffered from neck pain on the day of the survey and to those with Grade II neck pain [8]. However, the exclusion of subjects with missing data was not associated with bias as evidenced by the sensitivity analysis.

Conclusions

To our knowledge, this study presents a unique finding, as past studies describing the relationship between neck pain and HRQoL have typically not assessed severity of neck pain or controlled for sociodemographic, general health, and comorbidity factors. This analysis advances knowledge of the potential confounders of the associations between neck pain and PCS and MCS measures of HRQoL; mainly the important contribution made from comorbid conditions. This has implications for future epidemiologic studies of neck pain which should measure and control for comorbid diseases when investigating possible associations. These results are also useful for the clinician assessing the treatment and prognosis of patients with significant neck pain.

Table 5 Sensitivity analysis

Model	Main independent variable	β	Standard error	95% CI
PCS crude (n = 1,059)	Intercept	49.04	0.40	48.26, 49.82
	Chronic neck pain			
	Grade III–IV	−13.86	1.31	−16.42, −11.29
	Grade II	−5.99	0.95	−7.85, −4.14
	Grade I	−1.74	0.59	−2.89, −0.59
	Grade 0	0		
PCS crude (n = 916)	Intercept	48.90	0.44	48.04, 49.76
	Chronic neck pain			
	Grade III–IV	−14.18	1.39	−16.91, −11.45
	Grade II	−5.77	0.99	−7.70, −3.83
	Grade I	−1.34	0.63	−2.57, −0.10
	Grade 0	0		
MCS Crude (n = 1,059)	Intercept	52.45	0.42	51.61, 53.28
	Chronic neck pain			
	Grade III–IV	−10.84	1.40	−13.58, −8.10
	Grade II	−3.68	1.01	−5.67, −1.70
	Grade I	−2.41	0.63	−3.65, −1.18
	Grade 0	0		
MCS Crude (n = 867)	Intercept	52.09	0.49	51.13, 53.05
	Chronic neck pain			
	Grade III–IV	−10.30	1.57	−13.39, −7.21
	Grade II	−3.08	1.10	−5.24, −0.93
	Grade I	−1.87	0.70	−3.24, −0.50
	Grade 0	0		

This analysis suggests that neck pain of increasing severity should not be seen in isolation but rather as one of several comorbid conditions that are potentially experienced by a patient.

The information provided in this cross-sectional analysis warrants further investigation into the association between grade of neck pain and HRQoL by means of a prospective research design that would inform causality. Future research should address the associations between neck pain and comorbidities that may tend to aggregate in subjects with poorer health status and chronic diseases.

Acknowledgments We would like to thank the Chiropractors' Association of Saskatchewan for funding the Saskatchewan Health and Back Pain Survey and Selahadin Ibrahim, Stella Chan and Amber Bielecky for their assistance with data analysis. The University of Saskatchewan Advisory Committee on Ethics in Human Experimentation approved the survey.

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