ORIGINAL RESEARCH

Chronic Neck Pain and Its Association with Neck Disability

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Abstract

Objective: To assess the relationship of pain intensity, and duration of pain with the degree of neck disability in patients with chronic neck pain.

Methods: A cross-sectional study was conducted among 384 patients, (females-77.6%) aged 20-69 years, diagnosed with chronic neck pain (>3 months). Pain intensity was measured using a 101-point numeric rating scale. Pain duration was recorded in months. Pain radiating into the arms was considered positive when the participant reported that the pain extended beyond the neck region into one or both arms. Neck disability was assessed using the Modified Oswestry Low Back Pain Disability Index (MODI). The correlation and strength of associations of pain intensity, and pain duration with neck disability were assessed and further analysed for each of the subgroup (socioeconomic and health related factors: leisure time physical activity, BMI, pain radiating to arm, cervical intervertebral disc degeneration) to determine the possible variations across the subgroups.

Results: A strong positive correlation was found between pain intensity and neck disability (r=0.63). There was no significant correlation found between neck pain duration and degree of neck disability due to neck pain. Patients aged 40-69 years, who have sedentary leisure time and moderate or severe cervical intervertebral disc degeneration revealed a strong positive correlation between intensity of pain and neck disability, whereas patients who were overweight or obese exhibited a very strong positive correlation.

Conclusion: Pain intensity is a strong indicator for measuring the neck disability, while pain duration is a poor indicator.

Keywords: Chronic neck pain, pain intensity, pain duration, neck disability, visual analog scale

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Introduction

Neck pain is one of the most common musculoskeletal disorders worldwide (1,2,3) contributing significantly to disability (4), a crucial outcome in terms of public health and from a clinical point of view (5). Chronic musculoskeletal pain is a significant cause of long-term, severe physical disability, which affects more than 20% of the adult population (6). Unemployment rates are typically double for people with some health issues or disability related to chronic pain (7).

The disability and other comorbidities associated with neck pain can have a significant impact on quality of life of an individual (8). Chronic neck pain is one of the most common neuromusculoskeletal problems which leads to chronic disability of patients and similar to other pain-related conditions, could be associated with the psychological status of patients (9). Even though neck pain is closely associated with disability due to chronic neck pain, (10) some were of the view that there is no direct association between intensity of pain and the disability (5). Due to the contradictory perspectives presented in the literature, the aim of the present study was to determine the association of pain intensity, and duration of pain with degree of neck disability in patients with chronic neck pain to fulfill the research gap.

Methods

A cross-sectional study was conducted among 384 patients aged 20-69 years, diagnosed with chronic neck pain attended to the rheumatology clinic at the Colombo South Teaching Hospital (CSTH).

Definition of chronic neck pain

Neck pain is "a pain perceived anywhere in the posterior region of the cervical spine, from the superior nuchal line to the first thoracic spinous process" (11,12,13) Chronicity was defined as pain on at least 4 days of the week for at least three months (14).

Ethical clearance

The ethical approval for this study was obtained from the Ethics Review Committee, University of Sri Jayewardenepura (ERC/FMS 4/18 and ERC/FMS 45/20), Ethics Review Committee, Colombo South Teaching Hospital (Registration numbers PL/MO/2019 and PL/MO/2020) and Education, Training and Research division, Ministry of Health, Sri Lanka (ETR/AC/M3/36/2021). Written informed consent was obtained from all subjects prior to enrollment in the study

Sampling method

Patient recruitment was done by convenient sampling method.

Sample size

Sample size was calculated using following formula.

Where, n is the sample size, z is the selected critical value of desired confidence level, p is the estimated proportion of an attribute that is present in the population, and e is the desired level of precision.

Assuming the maximum variability, which is equal to 50% (p=0.5) and taking 95% confidence level with ±5% precision, the calculation for required sample size was as follows,

p=0.5; (1-p)=(1-0.5)=0.05; e=0.05; z=1.96

Therefore,

$$n = \frac{(1.96)^2 (0.5)(0.5)}{(0.05)^2}$$

384.16=384

Inclusion criteria for patients

Patients with chronic neck pain (lasting more than 3 months), both male and female, aged between 20 and 69 years.

Exclusion criteria for patients

The following groups of patients were excluded from the study: those with neck pain for less than 3 months, a history of neck trauma, diagnosed metabolic bone diseases (e.g., osteoporosis, osteomalacia), neoplasia (e.g., metastases, multiple myeloma), a history of neck surgery, bone infections (tuberculosis, osteomyelitis, abscess in the vertebral column), abnormalities of the congenital or developmental cervical spine, chronic lumbar pain, diagnosed lumbar disc degeneration, autoimmune diseases, rheumatoid arthritis, Pregnant females, patients with age less than 20 years and above 69 years were also excluded from the study.

All participants who met the inclusion criteria but were not in proper mental or physical health conditions to answer the questionnaire, or who did not provide consent, were excluded.

Neck pain variables

The intensity of pain was measured using a 101-point numeric rating scale, ranging from 0 (no pain) to 100 (worst possible pain). Patients were asked to score the average intensity of pain experienced over the last 7 days. The score was calculated by measuring the distance in millimeters between 0 and the marked pain score using a vernier caliper, which was then presented as a percentage (15). Intensity of neck pain was further categorized as mild (1-25), moderate (26-50), severe (51-75), and worst possible (76-100) based on the modified Jensen and Brugger scale (2003) (16).

Duration of pain experienced by the participants was recorded in terms of the number of months they had been experiencing the symptoms at the time of data collection.

Pain radiating into the arms was considered positive when the participant reported that the pain extended beyond the neck region into one or both arms.

Disability due to chronic neck pain was assessed using the Modified Oswestry Low Back Pain Disability Index (MODI) (17,18). MODI is a validated neck pain specific disability questionnaire with ten items which assess pain and its impact on the activities of

daily living including intensity of pain, personal care (washing, dressing, etc.), ability of lifting weight, reading, headaches, concentration on work, ability to do usual work, driving, sleeping disturbance and ability to do recreation activities. Each item has six responses where higher values represent greater disability. Sum of responses was calculated and presented as a percentage.

Scoring system

- For each section the total possible score is 5.
- If the first statement is marked the section score is = 0
- If the last statement is marked the section score is = 5
- The final mark was given as a percentage.
- The final score = (total score / (5 x number of questions answered) x100%
- Disability score; 0= no disability; 100= total disabled
- Disability due to chronic neck pain was interpreted based on the classification used by Nadri and Fasih in 2016 as follows: mild (0%-20%), moderate (21%-40%), severe (41%-60%), disabling (61%-80%), and severely disabling (81%-100%) (19).

Socioeconomic data (age, gender and level of education) and health related factors (leisure time physical activity, body mass index and radiation of pain into arm) were obtained from the interviewer administered questionnaire. Level of education was categorized into primary (≤ grade 5), secondary (grade 5- GCE A/L or equivalent) and tertiary (any level of education beyond high school). Leisure time physical activity during the past twelve months was analyzed and categorized as sedentary, moderate, moderate regular, and regular (20). For the purpose of analysis, moderate and moderate regular were considered as one category, i.e., ‘moderate or moderate regular’.

Body mass index was categorized as underweight <18.5, normal weight 18.5 – 22.9, overweight 23.0 – 24.9 and obese ≥ 25. For the purpose of analysis, overweight or obese were considered as one category. Pain radiating into the arms was considered positive when the participant reported that the pain extended beyond the neck region into one or both arms.

Cervical intervertebral disc degeneration (CIDD) was graded using the lateral X-ray of cervical spine and scoring system developed by Walraevens et al., 2009 (21) (Table 1). The X-ray measurements such as height at the mid-point of the intervertebral disc at the target level, height at the mid-point of the normal adjacent level, length of osteophytes and anteroposterior diameter in the middle of corresponding vertebral body on lateral X-rays of the cervical spine were taken by the software “AutoCAD 2014” (Figure 1 and Figure 2). These X-ray measurements and endplate sclerosis were independently evaluated by two consultant radiologists, both blinded to the clinical details of the patients. The average of the measurements was then obtained.

Table 1: The scoring system for grading cervical intervertebral disc degeneration developed by Walraevens et al. (2009)

Feature	Grade	Score
1. Height loss of middle disc height compared to a normal middle disc height at an adjacent level	0% <=25% >25% - <=50% >50% - <=75% >75%	0 points 1 point 2 points 3 points 4 points
2. The size of anterior osteophytes with respect to the anterior posterior (AP) diameter of the corresponding vertebral body	No osteophytes <=1/8 AP diameter >1/8 - <=1/4 AP diameter >1/4 AP diameter	0 points 1 point 2 points 3 points
3. Endplate sclerosis	No sclerosis Detectable Definite	0 point 1 point 2 points
4. Overall degree of disc degeneration= 1+2+3	0 point (no degeneration) 1-3 points (mild degeneration) 4-6 points (moderate degeneration) 7-9 points (severe degeneration)	

Figure 1: Lateral X-ray of the cervical spine showing height loss of intervertebral disc.
AB: disc height at the mid-point of normal adjacent level, CD: disc height at the mid-point of target level; Height loss of intervertebral disc (CD/AB). XY: length of osteophytes, PQ: anteroposterior diameter in the middle of corresponding vertebral body; size of anterior osteophytes (XY/PQ)

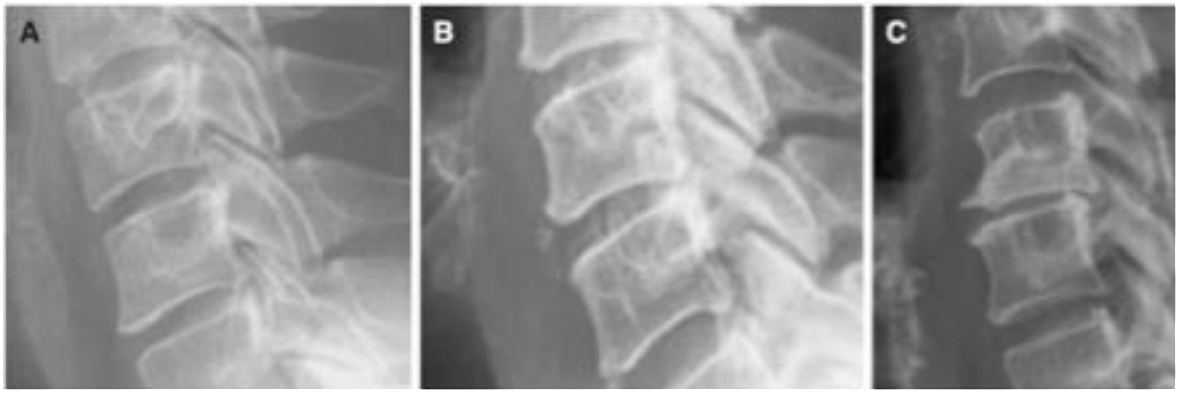

Figure 2: Lateral X-ray of cervical spine showing Endplate sclerosis.
A. No endplate sclerosis, B. Just detectable endplate sclerosis, C. Endplate sclerosis is definitively present

Statistical Analysis

Data were entered into the computer using SPSS statistical package and rechecked for errors of data entry. 95% confidence interval (CI) was used for population parameter estimation. Descriptive statistics were calculated to summarise the sample characteristics. Both univariable and multivariable analyses were carried out. The chosen significance level was 0.05.

Pearson correlation was used to measure the relationship of intensity pain and pain duration with degree of neck disability due to chronic neck pain and was further calculated for each of the subgroups (socioeconomic and health related factors) to determine the possible variations across the subgroups. For each correlation, the correlation coefficient (r), its 95% confidence interval, and its p-value were presented. A result was considered statistically significant if $p < 0.05$. According to Wahyuni and Purwanto, 2020 the correlation coefficients were interpreted as 0.80-1.000 = very strong, 0.60 – 0.799 = strong, 0.40 – 0.599 = moderate, 0.20-0.399 = weak and 0.00–0.199 = very weak (22). The logistic regression model was used to measure the association of neck disability and pain intensity or pain duration for each of the socioeconomic and health related variables.

Results

This cross-sectional study comprised 384 patients with chronic neck pain of whom 298 were females and 86 were males. The age range of the study population was 20-69 years. The mean age was 51.86 ±11.88 years, with the majority of patients (335/384; 87.2%) in the age range of 40-69 years.

The mean pain duration among patients was 33.51 ± 43.89 months. Of the 384 patients, 83.1% (319/384) reported pain radiating into the arms, with 47.04% of these cases involving the right arm. A significant number of patients reported severe or worst possible pain, with 51% (196/384) experiencing severe pain and 37.5% (144/384) reporting the worst possible

pain. The mean intensity of pain was 71.86 ± 12.13.

Of the patients, 42.2% (162/384) experienced severe disability, while 45.6% (175/384) were classified as disabled. There were no cases of mild disability. The mean disability score was 58.69 ± 12.07 (Table 2).

Table 2: Sample characteristics

Variable	N= 384 (%)
Age	
20-29	15 (3.9%)
30-39	34 (8.8%)
40-49	112 (29.2%)
50-59	107 (27.9%)
60-69	116 (30.2%)
Mean (SD)	51.86±11.88
Gender	
Male	86 (22.4%)
Female	298 (77.6%)
Educational Level	
Primary	55 (14.3%)
Secondary	312 (81.3%)
Tertiary	17 (4.4%)
Leisure time physical activity	
Sedentary	322 (83.8%)
Moderate or moderate regular	49 (12.8%)
Regular	13 (3.4%)
Body mass Index (BMI)	
Underweight (<18.5)	8 (2.1%)
Normal weight (18.5-22.9)	121 (31.5%)
Overweight or obesity (>23.0)	255 (66.4%)
Mean	24.83± 3.82
Pain Intensity	
Moderate (26-50)	44 (11.5%)
Severe (51-75)	196 (51.0%)
Worst possible (76-100)	144 (37.5%)
Mean ± SD	71.86 ± 12.13
Pain Duration (months)	33.51 ± 43.89
Radiation of Pain into Arm	
Yes	319 (83.1%)
No	65 (16.9%)
Severity of Disability	
Mild (0%-20%)	0 (0%)
Moderate (21%-40%)	47 (12.2%)
Severe (41%-60%)	162 (42.2%)
Disabled (61%-80%)	175 (45.6%)
Mean ± SD	58.69 ± 12.07
CIDD	
Grade 0 and 1(Non or mild)	138 (35.9%)
Grade 2 and 3 (Moderate or severe)	246 (64.1%)

Correlation of intensity pain and pain duration with degree of neck disability due to chronic neck pain

Pearson correlation coefficient showed a significant strong positive correlation between intensity of pain and neck disability among patients with chronic neck pain (r= 0.630, p=0.04, 95% Confidence Interval (CI) (Figure 3). However, generally a weak positive correlation was seen between pain duration and neck disability due to chronic neck pain.

Among the patients aged 40-69 years, there was significant strong positive correlation between intensity of pain and neck disability (r=0.62, p=0.00, 95% CI), with a significant weak positive correlation between pain duration and neck disability (r=0.35, p=0.00, 95% CI). Patients who have sedentary leisure time, exhibited the same pattern with a correlation of 0.71, p=0.00, 95%CI for intensity of pain and 0.21, p=0.00, 95% CI for duration of pain. Patients who were overweight or obese showed significant very strong positive correlation between intensity of pain and neck disability (r= .81, p=0.00, 95% CI), while a significant weak positive correlation was observed between pain duration and neck disability (r=0.32,p=0.00, 95% CI). Patients who have moderate to severe CIDD revealed significant strong positive correlation between intensity of pain and neck disability (r=0.72, p=0.00, 95% CI) though moderate positive correlation between pain duration and neck disability (r=0.46, p=0.00, 95% CI) (Table 3).

Association of intensity pain and pain duration with degree of neck disability due to chronic neck pain

The logistic regression model for association of intensity of pain and pain duration with the degree of neck disability showed inconsistent patterns within the subgroups. Strongest associations were found for sedentary leisure time physical activity, overweight or obese and moderate or severe CIDD. Pain duration was weakly associated with degree of neck disability within most of the subgroups with no statistically significant difference (Table 4).

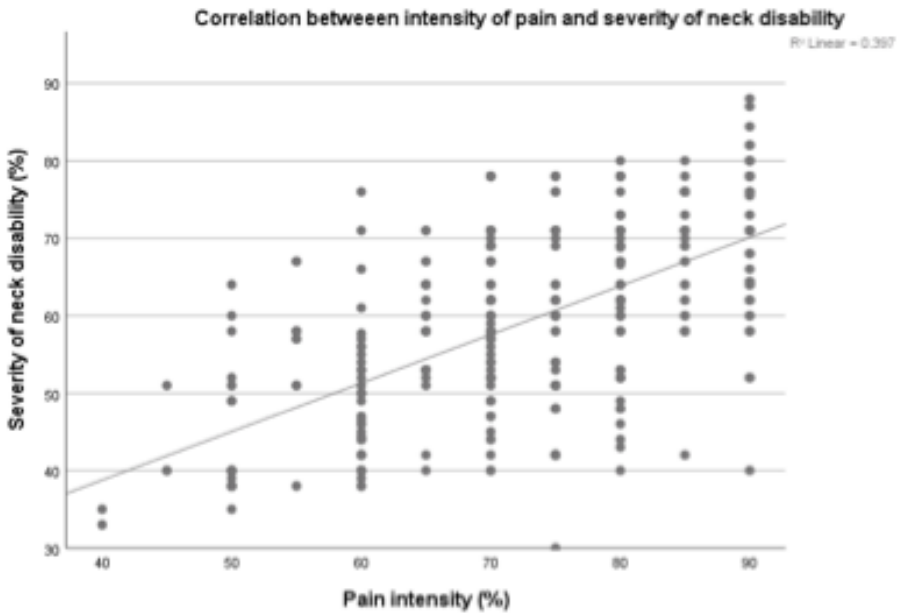

Figure 3: Correlation between intensity of pain and severity of neck disability X axis showed pain intensity and Y axis showed severity of neck disability

Table 3: Pearson correlation coefficient of intensity pain and pain duration with degree of neck disability due to chronic neck pain for socioeconomic and health related factors

Variable	n	Intensity of pain vs degree of neck disability (r)	95% CI	p-value	Pain duration vs degree of neck disability (r)	95% CI	p-value
Socioeconomic factors							
Age							
Age 20-39	49	0.41	[0.12, 0.64]	0.00	0.35	[0.08, 0.58]	0.02
Age 40 - 69	335	0.62	[0.54, 0.69]	0.00	0.35	[0.23, 0.46]	0.00
Gender							
Male	86	0.52	[0.33, 0.67]	0.00	0.32	[0.12, 0.49]	0.00
Female	298	0.63	[0.55, 0.70]	0.00	0.31	[0.19, 0.42]	0.00
Educational Level							
Primary	55	0.53	[0.29, 0.71]	0.00	0.28	[0.03, 0.50]	0.03
Secondary	312	0.56	[0.47, 0.63]	0.00	0.25	[0.13, 0.36]	0.00
Tertiary	17	0.56	[0.05, 0.85]	0.03	0.25	[-0.28, 0.66]	0.36
Health related factors							
Leisure time physical activity							
Sedentary	322	0.71	[0.64, 0.77]	0.00	0.21	[0.08, 0.34]	0.00
Moderate or moderate regular	49	0.45	[0.18, 0.66]	0.00	0.24	[0.00, 0.46]	0.05
Regular	13	0.44	[-0.28, 0.85]	0.01	0.25	[-0.42, 0.77]	0.43
Body mass Index (BMI)							
Underweight (<18.5)	8	0.51	[-0.31, 0.90]	0.04	0.31	[-0.42, 0.82]	0.36
Normal weight (18.5-22.9)	121	0.51	[0.37, 0.63]	0.00	0.31	[0.17, 0.44]	0.00
Overweight or obesity (>23.0)	255	0.81	[0.75, 0.86]	0.00	0.32	[0.18, 0.45]	0.00
Radiation of Pain into Arm							
Yes	319	0.61	[0.53, 0.68]	0.00	0.41	[0.30, 0.51]	0.00
No	65	0.62	[0.45, 0.75]	0.00	0.24	[0.00, 0.46]	0.05
CIDD							
Grade 0 and 1(Non or mild)	138	0.41	[0.23, 0.57]	0.00	0.45	[0.28, 0.60]	0.00
Grade 2 and 3 (Moderate or severe)	246	0.72	[0.65, 0.78]	0.00	0.46	[0.36, 0.55]	0.00

Table 4: Logistic regression model for association of intensity of pain and pain duration with degree of neck disability due to chronic neck pain for each of sociodemographic and health related factors

Variable	Intensity of pain OR (95% CI)	Pain duration OR (95% CI)
Neck disability	3.2 (1.5-6.2)*	**1.0 (1.1–1.2)***
Sociodemographic factors		
Age 20-39	1.5 (1.1-1.4)*	1.0 (1.0-1.0)n.s
Age 40 - 69	2.6 (1.7-3.5)***	1.8 (1.0-2.1)**
Gender		
Male	1.8 (1.2-2.5)**	1.0 (1.2-1.4)n.s.
Female	2.4 (01.2-3.4)***	1.1 (1.0-1.0)n.s.
Educational level		
Primary	2.8 (1.5-4.6)***	1.0 (1.0-1.0)n.s
Secondary	1.7 (1.0-2.1)*	1.5 (1.0-2.1)n.s
Tertiary	2.5 (0.7-6.0)n.s.	1.2 (1.1-1.0)n.s
Leisure time physical activity		
Sedentary	3.5 (1.1-4.1)***	2.0 (1.0-1.0)n.s
Moderate or moderate regular	1.4 (1.1-1.7)*	1.8 (1.0-2.0)*
Regular	1.0 (1.1-1.5)*	1.5 (1.0-1.7)n.s.
Body mass Index (BMI)		
Underweight (<18.5)	1.6 (1.1-2.5)*	1.2 (1.0-1.0)n.s
Normal weight (18.5-22.9)	1.5 (1.0-2.3)*	1.0 (1.0-1.1)n.s.
Overweight or obesity (>23.0)	3.2 (1.2-4.5)***	1.1 (1.0-1.0)*
Radiation of Pain into Arm		
Yes	1.6 (1.2-2.8)*	1.0 (0.7-1.4)n.s
No	1.5 (1.3-2.7)n.s.	1.1 (1.0-1.0)n.s
CIDD		
Grade 0 and 1(Non or mild)	2.8 (1.2-4.5)*	1.1 (1.0-1.0)
Grade 2 and 3 (Moderate or severe)	3.5 (1.3-4.7)**	1.5 (1.3-2.5)n.s

*** P\0.001, *P\0.05, **P\0.01, n.s. Not significant

Discussion

Musculoskeletal disorders are prevalent worldwide. Epidemiological studies (23) have revealed that neck pain is a serious public health problem in the general population, with the highest burden in Philippines, United States, and United Kingdom in 2019 as reported (23), leading to severe health issues and to disability in the general population (24).

In the present study, a significant strong positive correlation (r=0.630, p=0.04) was observed between intensity of pain and neck disability among the patients with chronic neck pain using visual analogue scale (VAS) and neck disability index (NDI). The findings were

in line with other studies that have been reported, most of these using different methods to measure intensity of pain and neck disability.

Seven hundred patients referred for clinical radiology for X-rays of the cervical spine (25) and 80 consecutive patients who were referred from a hospital physiotherapy clinic (26) had been studied using the same methods as in the present study (VAS and NDI). Strong correlation (r=0.65) between intensity of pain and neck disability had been found in both studies.

A moderate and strong correlation (r=0.55, r= 0.63) had been observed in the study conducted among 218 chronic neck pain patients who were recruited from two physiotherapy departments using VAS and the Northwick Park Neck Pain Questionnaire (NPQ) (27) and strong correlation had been found in 185 native Persian-speaking patients with neck pain using VAS and the Iranian-versions of the neck disability index (NDI-IR) (r =0.71) (28). Another study using 11-box numerical rating scales and Copenhagen Neck Functional Disability Scale showed similar results (29).

Seventy-one patients with neck pain of at least 15 days duration demonstrated a fair to moderate correlations using VAS and three different neck disability measures (Neck Disability Index (NDI), Neck Pain and Disability Scale (NPDS), Northwick Park Neck Pain Questionnaire (NPQ)) (NDI: r = 0.46, NPDS: r = 0.47, NPQ: r = 0.55) (30).

These different observations between present study and previous studies are most likely due to the methods used to assess disability and the study populations.

Variations in correlation coefficient were observed across the different subgroups in the present study. Patients aged 40-69 years (r=0.62), who have sedentary leisure time (r=0.71) and moderate or severe CIDD (r=0.72) showed significant strong positive correlation between intensity of pain and neck disability, whereas patients who were overweight or obese (r=0.81) revealed significant very strong positive correlation. A study conducted by Rene and Hartvigsen in 2008 demonstrated a moderate positive correlation between intensity of pain and neck disability with correlation coefficient r=0.57 for male and r=54 for female patients who engage in light leisure time physical activity (2h/week). For older patients (50–71 years) a similar moderate positive correlation was observed (r= 0.52 for male and r=0.56 for female) (29).

In the present study, the logistic regression model showed intensity of pain is associated with neck disability in all subgroups with the strongest associations for sedentary leisure time physical activity, overweight or obesity and moderate or severe CIDD. Conversely, pain duration was weakly associated with the degree of neck disability within most of the subgroups and with no statistically significant difference. A similar pattern observed in a regression analysis, where intensity of pain associated with disability across various variables socioeconomic, health and physical, comorbidity, and variables related to neck pain (29). A study conducted in lumbar region exhibited that lumbar disc degeneration was

not associated with intensity of pain or neck disability (15).

Pain duration was not associated with neck disability which shows that pain duration is a poor indicator of the degree of neck disability (29).

Limitations of the study

This study has several limitations. This was a single-center study, which may limit the external validity of the findings. The use of a convenience sample may restrict generalizability, and the wide age range of participants could have introduced variability in physical, functional, and mental health factors. These differences may have influenced both pain perception and disability levels, introducing variability into the results. Despite these limitations, the study provides valuable insights into the relationship of pain intensity and pain duration with neck disability and offers a valuable foundation for future research with larger and more representative samples.

Conclusion

This study demonstrates that a higher pain intensity is associated with greater neck disability among chronic neck pain patients. Furthermore, patients aged 40-69 years, who have sedentary leisure time and moderate or severe CIDD revealed a strong positive correlation between intensity of pain and neck disability, whereas patients who were overweight or obese showed a very strong positive correlation. Future research is required to explore interventions targeting on pain management and disability reduction, to improve the quality of life for individuals suffering from chronic neck pain.

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