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Research Article

Analysis of Influencing Factors for Chronic Neck Pain with Cognitive Impairment

Ying Su*

West China Hospital, Sichuan University, Chengdu, China

Abstract

Background: Cervical spondylosis is a common chronic degenerative musculoskeletal disorder. It is based on the degeneration of the cervical intervertebral discs and secondary pathological changes, affecting the surrounding soft tissues, nerve roots, vertebral arteries, sympathetic nerves, and spinal cord. This condition gives rise to a series of clinical symptoms and signs. Pain represents one of the most crucial manifestations. Notably, when pain symptoms endure for over three months, this may give rise to chronic neck pain (CNP). The progression of this chronic neck pain may increase the risk of cognitive impairment (CI). However, to date, predictive markers for chronic neck pain with cognitive impairment (CNP-CI) remain lacking. Previous investigations have demonstrated that routine blood parameters possess predictive utility for Alzheimer's disease. However, the association between these parameters and chronic neck pain with CNP - CI remains elusive. This study was designed to explore the correlations among routine blood indices and to provide evidence regarding the differences between two groups of patients with chronic neck pain, namely those with and without cognitive impairment. Additionally, this study aims to lay the groundwork for longitudinal experimental investigations into effective intervention strategies for patients with chronic neck pain who develop cognitive impairment. *Methods:* This cross-sectional study was conducted in West China Hospital, Sichuan University. Montreal Cognitive Assessment (MoCA) was conducted to divide patients into the CNP-CI or CNP-nCI group. Statistical analysis was performed to examine the differences between chronic neck pain patients with cognitive impairment and those without cognitive impairment. All statistical tests were conducted at a significant level of α=0.05 for two-sided testing. *Results:* The prevalence of chronic neck pain with cognitive impairment in this study demonstrates age-related disparities, with a higher prevalence observed among older individuals (P=0.007). A statistically significant difference in serum calcium was observed between individuals with chronic neck pain and cognitive impairment (*P*=0.046). *Conclusion:* The age and serum calcium may serve as influential factors in the development of chronic neck pain with cognitive impairment. This finding can aid healthcare professionals in implementing early intervention and treatment for individuals experiencing this condition.

Keywords

Cognitive Impairment, Chronic Neck Pain, Serum Calcium, Influencing Factors

*Corresponding author: 13438931272@qq.com (Ying Su)

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1. Introduction

Chronic pain refers to pain that persists or recurs and lasts for more than three months. Chronic pain is a common and complex issue, among which chronic neck pain (CNP) accounts for a large proportion of chronic pain patients. According to epidemiological surveys, the incidence of neck pain among adults worldwide ranges from 30% to 50% [1]. In China, as many as 65% of the population suffer from neck pain-related diseases [2]. Furthermore, the prevalence of chronic neck pain has exhibited an upward trend during the past few years.

Cognition represents the most intricate function of the brain [3]. Dementia is the primary cause of disability in the global population aged 65 and older, including within China, posing significant challenges for policymakers, healthcare professionals, and families [4]. Mild cognitive impairment (MCI) is characterized by subjective and objective evidence of a decline in cognitive function from previous levels, representing a clinical pre-transitional stage between healthy cognitive aging and dementia, impacting 10-15% of individuals aged 65 and older [5]. Although 20-30% of patients with Mild Cognitive Impairment (MCI) may experience a return to normal cognitive function during subsequent follow-up [6]. The annual rate of progression to dementia in individuals with Mild Cognitive Impairment (MCI) ranges from 5% to 10%, significantly surpassing the general population's annual incidence rate of 1% to 2% [7]. Chronic pain and self-assessment have been linked to an increase in objectively measured cognitive deficits [8, 9]. According to a report, an epidemiological analysis of a large community and patients attending pain clinics estimated that at least 50% of individuals with pain reported experiencing cognitive issues [10]. A substantial proportion of patients exhibit cognitive impairments in objective assessments [11].

Among patients with chronic neck pain (CNP), the pain is predominantly mild to moderate and intermittent, evoking resonance at the onset of the disease progression. Subsequently, it evolves into persistent pain, significantly impinging upon the functional activities of the neck and adjacent regions. Beyond the discomfort directly induced by the pain itself, the protracted disease duration and recurrent attacks may also give rise to cognitive impairment [12].

The present study endeavors to delve into the correlations among routine blood indices and furnish evidence regarding the disparities between two groups of patients with chronic neck pain, namely those with and without concomitant cognitive impairment. Moreover, this study aims to establish a foundation for conducting longitudinal experimental investigations into effective intervention strategies for patients with chronic neck pain complicated by cognitive impairment.

2. Materials and Methods

2.1. Ethical Approval

All procedures performed in studies involving human participants were in accordance with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study plan was approved by the Ethics Committee of West China Hospital, Sichuan University (ethics approval number: 2021 review (221)) and registered in the Chinese Clinical Trial Registry (registration number: ChiCTR2100047290).

2.2. Study Design and Study Setting

This study was a single-center, cross-sectional study conducted on chronic low back pain patients at the Department of Pain Medicine, West China Hospital, Sichuan University from October 2020 to February 2023. We conducted an epidemiological survey on eligible chronic low neck pain patients.

2.3. Patients

A total of 46 patients with neck pain were included in the survey after excluding those who did not complete the questionnaire or were deemed ineligible. The final analysis comprised responses from all 46 participants.

The inclusion criteria are as follows: (1) Willing participation in this study and provision of informed consent, with willingness to undergo follow-up; (2) Aged 18 years or older; (3) VAS score > 0; (4) Patients diagnosed with neck spine diseases experiencing pain for a duration exceeding 3 months; (5) Individuals who have not previously participated in other clinical trials.

The exclusion criteria are as follows: (1) Poor general health condition, inability to objectively describe symptoms, or presence of severe infections, respiratory failure, heart failure, etc., hindering active cooperation; (2) Previous diagnosis of dementia, Alzheimer's disease, cerebral ischemia, brain injury, central infection, epilepsy, Parkinson's disease, Huntington's disease amyotrophic lateral sclerosis cerebellar ataxia and other neurological diseases; (3) Refusal to participate.

2.4. Measurement and Data Collection

On the day of admission, this study employed a questionnaire scale to evaluate the Montreal Cognitive Assessment (MoCA) of patients meeting the specified inclusion and exclusion criteria. Based on the MoCA scale scores, participants were stratified into two cohorts: the CNP-CI group characterized by cognitive impairment and the CNP-nCI group without cognitive impairment. Meanwhile, we collect several common demographic factors, including age, gender, height,

weight, body mass index (BMI), and educational level. Additionally, we record the degree of pain (VAS score), duration of pain, main diagnosis, and medications used. Then, we collect the patient's basic vital signs, complete a blood test, check coagulation function, and perform biochemical tests. After extracting and inputting the data, we conduct statistical analysis and interpretation.

Utilizing a custom-designed case report form, the survey encompassed demographic data such as age, gender, body mass index (BMI), and educational attainment. As the study focused on hospitalized patients, we also conducted data collection and analysis of their hematological parameters from routine hospital admission tests.

The assessment of pain intensity in this study was conducted using the Visual Analog Scale (VAS) [13]. Due to its precision, simplicity, and high sensitivity, the VAS scale has been extensively utilized for assessing pain, quality of life, and anxiety. It comprises a 100-millimeter straight line with one end denoted as 0 (indicating complete absence of pain) and the other end marked as 10 (representing unbearable pain). The intermediate section denotes varying degrees of pain. Patients subjectively assess their level of pain by marking the line according to their perception from the left endpoint. In this study, we will consider utilizing centimeters as the unit of measurement for reporting VAS scores within the 0-10 range [14]. A score of 0 indicates absence of pain, while a score of 1-3 denotes mild pain, 4-6 signifies moderate pain, and 7-10 represents severe pain [15].

The study employed the MoCA scale for cognitive impairment screening [16]. The Montreal Cognitive Assessment (MoCA) comprises 28 items, encompassing eight domains of cognitive function: executive function, attention, memory, language abilities, visuospatial skills, abstract thinking, calculation, and orientation. It is scored on a 30-point scale with higher scores indicative of superior cognitive function. The optimal cut-off scores for screening cognitive impairment based on the subject's level of education are as follows: 19 points for those with 6 or fewer years of education, 22 points for those with 7-12 years of education, and 24 points for those with more than 12 years of education [17]. In this study, the duration for patients to complete the MoCA scale was approximately 15 minutes.

2.5. Statistical Analysis

The data for this study was recorded, a database was established, and data analysis was conducted using Excel software and SPSS 27.0 software. Statistical analysis was performed to examine the differences between chronic low back pain patients with cognitive impairment and those without cognitive impairment. All statistical tests were conducted at a significanct level of α=0.05 for two-sided testing.

3. Results

A total of 46 people were surveyed, and data were collected for this study. The average age was 53.02 years (SD = 9.48). In terms of gender distribution, there were 32 female patients (69.57%) and 14 male patients (30.43%). The educational levels of the patients in this study were as follows: 3 (6.52%) were illiterate, 2 (4.35%) had completed primary school, 31 (67.39%) had completed middle school, and 10 (21.74%) had completed college or higher education. The study, in accordance with the BMI classification standard of the World Health Organization, observed the following distribution: 2 patient classified as underweight (<18.5 kg/m^2), accounting for 4.35%; 29 patients classified as normal weight (18.5-24 kg/m^2), accounting for 63.04%; 13 patients classified as overweight (24-28 kg/m^2), accounting for 28.26%; and 2 patients classified as obese (≥28 kg/m^2), accounting for 4.35%. The VAS scores of chronic neck pain patients in this study were categorized as follows: 1-3 points (4 individuals, 8.70%), 4-6 points (30 individuals, 65.21%), and 7-10 points (12 individuals, 26.09%). The detailed general information is presented in Table 1.

Table 1. *General Information of Chronic Low Back Pain Patients.*

Variable	Classification	Total number of people	Percentage Occupied (%)
Gender	Male	14	30.43
	Female	32	69.57
Age (years)	20-39 years	4	8.70
	40-59 years	30	65.21
	60 years old and above	12	26.09
Educational level	Illiterate	3	6.52
	primary School	2	4.35
	middle school	31	67.39

Variable	Classification	Total number of people	Percentage Occupied (%)
	college or higher education	10	21.74
BMI (kg ṁ$^{-2}$)	Emaciated (<18.5)	2	4.35
	Normal (18.5-24)	29	63.04
	Overweight (24-28)	13	28.26
	Obesity (≥28)	2	4.35
Visual Analogue Scale (VAS)	1-3 score	4	8.70
	4-6 score	30	65.21
	7-10 score	12	26.09

Data is presented in frequency and percentage; BMI: Body Mass Index; VAS score: Visual Analog Scale score.

In this survey, 23 patients with CNP-CI were identified, constituting 50% of the total study cohort. The intergroup variations between the two cohorts under investigation are delineated in Table 2. (1) Age: The average age of patients with chronic neck pain and cognitive impairment was 56.70 years (SD=8.65). The prevalence of chronic neck pain with cognitive impairment in this study demonstrates age-related disparities, with a higher prevalence observed among older individuals ([95%CI, 2.11, 12.59]; *P*=0.007) (Figure 1). (2) Gender: There were 14 female patients (60.87%) with chronic neck pain combined with cognitive impairment, while there were 9 male patients (39.13%). The results of this study indicate that there is no statistically significant difference in the prevalence of chronic neck pain combined with cognitive impairment between genders ([95%CI, -0.10, 0.45], *P*=0.208). (3) Educational Level: The prevalence of chronic neck pain combined with cognitive impairment was 4.35% for illiterate patients, 4.35% for those with primary education, 78.26% for individuals with secondary education, and 13.04% for patients with a university degree or higher. This study found no statistically significant difference in the prevalence of chronic pain combined with cognitive impairment across different educational levels ([95%CI, -0.35, 0.52], *P*=0.691). (4) Body Mass Index: This study indicates that there is no statistically significant difference in the prevalence of chronic neck pain combined with cognitive impairment across various body mass index categories ([95%CI, -2.19, 1.00], *P*=0.458). (5) The VAS Score did not show a statistically significant difference in the prevalence of chronic neck pain combined with cognitive impairment ([95%CI, -1.47, 0.34], *P*=0.214). (6) A statistically significant difference in serum calcium was observed between individuals with chronic neck pain and cognitive impairment ([95%CI, 0.01, 0.10]; *P*=0.046) (Figure 2).

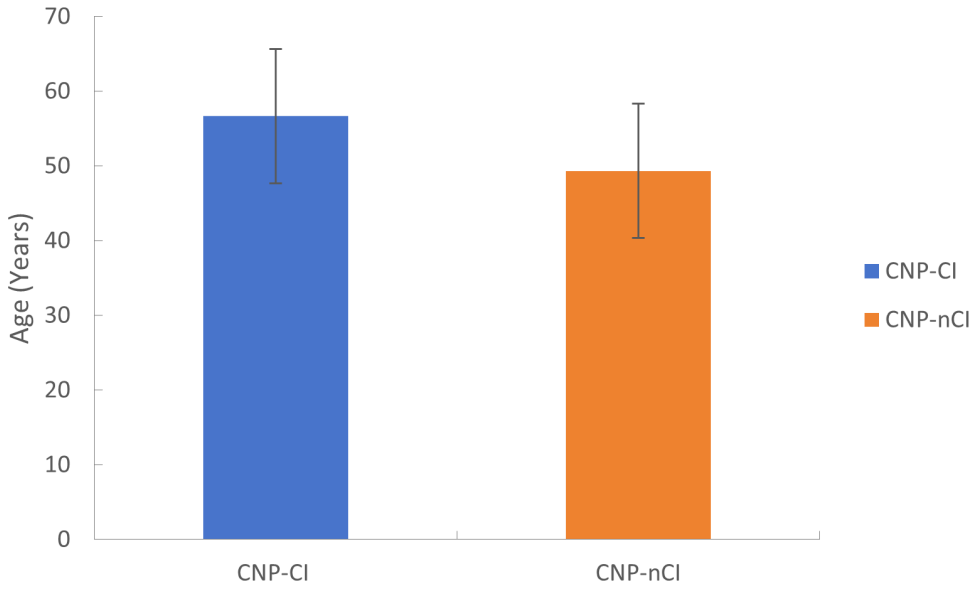

Figure 1. *Comparison of Age Differences Between Two Patient Groups.*

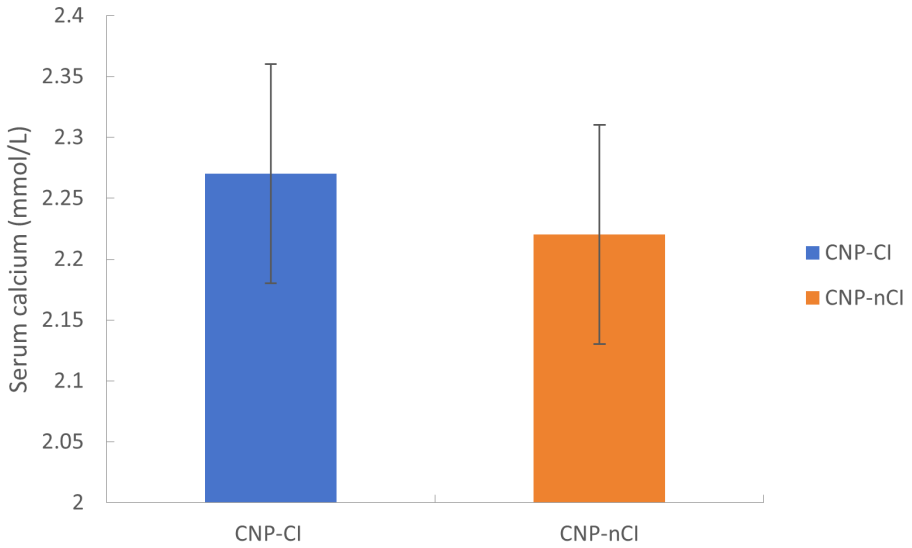

Figure 2. *Comparison of Age Differences Between Two Patient Groups.*

Table 2. *Distinction of Two Groups of Patients.*

	CNP-CI (n=32)	CNP-nCI (n=30)	95%CI	*P*
Gender [n (%)]			(-0.10, 0.45)	0.208
Male	9 (39.13)	15 (65.22)		
Female	14 (60.87)	18 (78.26)		
Age (Years)	56.70 ±8.65	49.35 ±8.99	(2.11, 12.59)	0.007*
Educational level [n (%)]			(-0.35, 0.52)	0.691
Illiterate	1 (4.35)	2 (8.70)		
Primary school	1 (4.35)	1 (4.35)		
Middle school	18 (78.26)	13 (56.52)		
College or higher education	3 (13.04)	7 (30.43)		
BMI (Kg m^{-2})	23.15 ±2.59	22.55 ±2.79	(-2.19, 1.00)	0.458
VAS (Scores)	5.74 ±1.48	5.17 ±1.56	(-1.47, 0.34)	0.214
Pain Duration (Months)	55.43 ±59.77	44.26 ±48.97	(-43.65, 21.30)	0.492
White blood cell count (10^9/L)	6.15 ±3.14	5.64 ±1.74	(-2.02, 1.00)	0.498
Red blood cell count (10^9/L)	4.33 ±0.53	4.21 ±0.58	(-0.46, 0.20)	0.446
Hemoglobin (g/L)	124.78±12.15	124.70 ±17.78	(-12.14, 5.96)	0.495
Platelet count (10^9/L)	179.30 ±55.71	203.39 ±66.25	(-12.29, 60.46)	0.189
Serum calcium (mmol/L)	2.27 ±0.08	2.22 ±0.09	(0.01, 0.10)	0.046*

BMI: Body Mass Index (Body Mass Index); VAS: Visual Analog Scale. *$P < 0.05$.

4. Discussions

Recently, an increasing body of evidence has indicated an association between chronic neck pain and cognitive impairment. Both conditions are prevalent health issues associated with the aging process [12]. Age represents one of the individual risk factors for neck pain. With the advancement of age, the prevalence of chronic neck pain tends to increase [18]. In this study, the prevalence of chronic neck pain accompa-

nied by cognitive impairment demonstrated age - related discrepancies. Specifically, older individuals had a higher prevalence rate (P = 0.007), which is in accordance with the findings of previous studies. Some studies have indicated that neck pain may be associated with serum calcium levels [19]. In this study, a statistically significant difference in serum calcium levels was observed between the group with chronic neck pain complicated by cognitive impairment and the control group. Specifically, the group with chronic neck pain complicated by cognitive impairment exhibited higher serum calcium levels. This finding is in line with previous research. Nevertheless, further investigations are required to elucidate the precise mechanism. Thus, the primary objective of this study is to delve into the age - related relationship between chronic neck pain and cognitive impairment, and to analyze the association between chronic neck pain and serum calcium levels. This study aims to offer novel perspectives and a basis for the clinical diagnosis and treatment of chronic neck pain.

The study has several limitations. Firstly, it is a cross-sectional survey, lacking temporal correlation of disease progression, which weakens the evidence for causal inference. Secondly, potential bias may exist in the data collection for the illiterate group based on educational level due to inadequate communication with patients. Thirdly, the MoCA scale used to assess cognitive state did not include clinical examinations such as imaging and lacked a gold standard for diagnosing cognitive impairment.

5. Conclusions

The age and serum calcium count may serve as influential factors in the development of chronic neck pain with cognitive impairment. This finding can aid healthcare professionals in implementing early intervention and treatment for individuals experiencing this condition. Furthermore, future research should focus on conducting larger-scale surveys and high-quality clinical studies to further investigate the contributing factors of chronic neck pain with cognitive impairment, as well as the diagnostic value and clinical significance of blood plasma biomarkers.

Abbreviations

BMI	Body Mass Index
CNP	Chronic Neck Pain
CI	Cognitive Impairment
MCI	Mild cognitive impairment
MoCA	Montreal Cognitive Assessment
VAS	Visual Analog Scale

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Author Contributions

Ying Su is the sole author. The author read and approved the final manuscript.

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Conflicts of Interest

The authors have no conflicts of interest to declare.

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