Determinants of severity of pain in non-cardiac chest pain patients: A cross sectional study

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Abstract

BACKGROUND: This study aims to explore the psychosocial factors related to the severity of pain in patients with non-cardiac chest pain (NCCP), providing insights to support more comprehensive and targeted management strategies.

METHODS: This cross-sectional study was conducted at two university-affiliated hospitals. Patients diagnosed with NCCP, based on physical examination and angiographic findings, completed questionnaires assessing type D personality, cardiac anxiety, fear of bodily sensations, somatization, depression, and pain severity. Univariate and multiple logistic regression analyses were conducted to identify factors influencing pain severity levels.

RESULTS: A total of 156 males and 204 females, with a mean age of 55.76 ± 12.83 years, were divided into low-pain (N = 182) and high-pain (N = 178) groups. Higher education and being female were significantly associated with greater pain severity. Depression, type D personality, somatization, and cardiac anxiety were significantly correlated with pain severity. Multiple logistic regression analysis indicated that self-rated health (OR,: 2.14; 95% CI. :1.18-3.90), depression (OR-11.15; 95% CI-:1.09-1.22), type D personality (OR-: 1.90; 95% CI-: 1.06-3.41), somatization (OR-: 1.03; 95% CI-: 1.01-1.06), and fear of bodily sensation (OR-: 1.90; 95% CI-: 1.06-3.41), were all associated with pain severity.

CONCLUSION: This study concluded that type D personality, fear of bodily sensations, depression, somatization, cardiac anxiety, and poor self-rated health were associated with increased NCCP severity. By controlling the disease and managing related pain earlier, more coherent treatment strategies can be implemented, ultimately improving patients' quality of life.

Keywords: Non-Cardiac Chest Pain; Depression; Type D Personality; Somatization; Anxiety

Introduction

Non-cardiac chest pain (NCCP) is the second most prevalent reason for emergency medical services (EMS) visits and hospital admissions, with a prevalence of 13% in the community[1,2].

NCCP is defined as any type of chest pain without a cardiac cause[3]. The cost of primary care for NCCP patients is estimated to be around $8 billion annually in the United States[4].

The primary symptom of NCCP is chronic pain, which is associated with limited physical activity, absenteeism, unemployment, disability, and frequent EMS and primary care visits. In other words, NCCP disrupts daily activities and quality of life[5]. One of the most critical factors influencing the adverse effects of this chronic pain is its severity, and evidence suggests a bidirectional association between pain severity and psychological factors[6].

Various studies have reported a high prevalence (>50%) of psychological disorders among NCCP patients. These include panic disorder, anxiety, major depression[7], and other psychological conditions such as type D personality, somatization, neuroticism, hypochondriac behavior, obsessive-compulsive disorder, and phobic disorder[8,9]. Research has also shown that NCCP patients tend to experience higher chest pain rates and greater pain severity[3]. Additionally, they use more emotional language than patients with ischemic heart disease[10,11].

While many studies have examined the relationship between pain and psychological factors, few have specifically explored the association between pain severity in NCCP patients and various psychological factors. This study aimed to investigate which psychological factors are most influential in predicting pain severity. Understanding the psychological predictors of pain severity can contribute to more effective pain management and improved quality of life for NCCP patients.

Materials and Methods

Study design and population

This cross-sectional study was conducted from September to December 2019 at two hospitals (Chamran and Khorshid) affiliated with Isfahan University of Medical Sciences (IUMS). Patients who presented to these hospitals with chest pain underwent physical examinations and angiography performed by cardiologists.

A total of 360 patients diagnosed with NCCP who met the inclusion criteria were included in the study. Since all eligible patients within the study setting and timeframe were enrolled (census approach), sample size calculation was not required.

Inclusion Criteria

The inclusion criteria were as follows: over 20 years old, absence of any major mental disorders, no use of psychotherapeutic drugs, no history of cardiac disease and major life-threatening disease. Participants who did not agree to participate in the study were excluded.

A trained nurse interviewed approved participants in a comfortable setting. After explaining the study procedures, the nurse recorded their socio-demographic and lifestyle information. Patients then completed validated Persian questionnaires assessing type D personality, cardiac anxiety, fear of bodily sensations, somatization, depression, and pain severity.

Ethical Approval

The Ethics Committee of IUMS approved the study under the code IR.MUI.MED.REC1398.624. All patients signed a consent form, and the questionnaires remained anonymous.

Sample Size
Study assessments
Socio-demographic factors

Demographic information, including age, sex, education level (categorized as ≥12 years, 6–12 years, and 0–5 years), and marital status (married vs. unmarried, which includes single, widowed, and divorced), was collected through participant interviews.

Lifestyle factors

Lifestyle factors were assessed based

on patients' responses to questions about sexual activity, physical activity, sleep quality and smoking habits. About Sexual activity, participants were asked, "How was your ability to enjoy sex during the last month?" Responses were classified as: "very satisfied", "sometimes satisfied", "rarely satisfied", or "unsatisfied". Participants could also select "Did not engage in sexual activity." Participants were asked whether they engaged in at least 30 minutes of physical exercise each day, with a simple Yes/NO response. For checking sleep quality, patients were asked, "How do you evaluate the quality of your sleep?" and patients' responses were classified as the following options: "very good, good, bad or very bad". Finally, smoking was defined as consuming at least one cigarette per day.

Depression

The Patient Health Questionnaire-9 (PHQ-9) is a widely used tool for diagnosing major depressive disorder. It consists of nine items, each scored on a scale from 0 (not at all) to 3 (nearly every day), with a total score range of 0–27. A higher total score indicates a greater likelihood of severe symptoms and a diagnosis of major depressive disorder[12].

The PHQ-9 has demonstrated strong reliability, with an internal consistency (Cronbach's α) of 0.854 and test-retest reliability of 0.873[13]. In the Farsi version, the Cronbach's α coefficient for PHQ-9 was 0.88, and the one-week test-retest reliability was 0.79[14].

Type D personality

The Type D Personality Questionnaire (DS14) consists of two subscales that assess negative affectivity (NA) and social inhibition (SI), each containing seven items. Participants rate their personality on a 5-point Likert scale ranging from 0 ("False") to 4 ("True"), with maximum scores of 28 for both NA and SI. A Type D personality is diagnosed when participants score above 10 on both subscales[15]. The Persian version of the DS14 demonstrates excellent test-retest reliability, with intraclass correlation coefficients (ICC) of 0.86 for NA and 0.77 for SI. Internal consistency, as measured by Cronbach's α, was reported as 0.84 for NA and 0.80 for SI[16].

Somatization

The Patient Health Questionnaire-15 (PHQ-15) is a validated tool for screening somatoform disorders. Responses are scored on a 3-point Likert scale: 0 ("Not at all"), 1 ("Bothers a little"), and 2 ("Bothers a lot")[17]. Getting a higher score indicates more somatization. The internal compatibility of the Persian version of PHQ-15 with Cronbach's α was 0.80 and the correlation coefficient was 0.77[18].

Cardiac anxiety questionnaire

The CAQ is a self-administered instrument designed to measure heart-focused anxiety. Participants rate their experiences on a 5-point Likert scale, ranging from 0 ("Never") to 4 ("Always"), with higher scores reflecting greater anxiety.

Heart-focused anxiety is defined as "fear of cardiac stimuli and emotions due to perceived negative consequences"[19]. The Persian version of the CAQ has demonstrated excellent reliability, with Cronbach's α for total internal consistency reported at 0.97, and test-retest reliability of 0.86[20].

Fear of body sensations

The body sensations questionnaire (BSQ) is utilized to evaluate fear of bodily sensations in stressful situations, such as sweating, palpitations and dizziness. Items are rated on a 5-point scale, ranging from 1 ("not frightened or worried by this sensation") to 5 ("extremely frighten by this sensation").

The total score is calculated as the mean of all item responses, with higher scores indicating greater fear of bodily sensations[21]. In this study, the BSQ had a Cronbach's α coefficient of 0.96, and an interclass correlation of 0.95.

Self-rated health

Self-rated health (SRH) is assessed using a single-item measure that captures an individual's perception of their overall health. This simple and widely used tool in research

and public health provides a general indication of health status. Participants rate their physical health on a 5-point scale (1 = Excellent to 5 = Poor). In this study, responses were categorized as follows: scores of 1, 2, or 3 were indicative of good self-rated health, while scores of 4 or 5 were categorized as poor self-rated health[22].

Pain characteristics

The short type of McGill pain questionnaire (MPQ) was used, which assessed the severity of pain[23]. This questionnaire consists of 15 descriptive adjectives questions, including 11 sensory questions and four affective questions, and patients respond on a 4-point scale based on the severity of the pain they suffer (0 = none, 1 = mild, 2 = moderate, 3 = severe). Present pain intensity (PPI) is calculated based on the sum of the scores of both sensory and affective units that shows severity of pain. The Persian version of this questionnaire has acceptable reliability and validity[24].

In this study patients categorized into low and high pain severity based on median.

Statistics

Categorical data were summarized as frequencies and percentages, while continuous data were expressed as means with standard deviations (SD). Group comparisons for categorical variables were conducted using the chi-squared test, while continuous variables were analyzed using the independent samples t-test.

To explore relationships between predictors and pain severity scores, both univariate and multiple linear regression analyses were utilized. Results were presented as regression coefficients (β), their standard errors (SE), and 95% confidence intervals (CIs) for β. Similarly, univariate and multiple logistic regression analyses were performed to identify factors influencing pain severity levels. Logistic regression results were reported as odds ratios (ORs) with corresponding 95% CIs. Variables with a P-value below 0.05 in univariate analyses were included in the multiple regression models. Throughout all analyses, a P-value of less than 0.05 was deemed statistically significant.

Results of logistic regression analyses were reported as odds ratios (ORs) with 95% confidence intervals (CIs). In both regression models, variables with a P-value < 0.05 in the univariate analyses were included in the multiple regression models. A P-value < 0.05 was considered statistically significant throughout all analyses. Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) Version 16 (SPSS, Inc., Chicago, IL).

Results

The total number of participants was 360, with a mean age of 55.76± $\pm$ 12.83 years and 156 (45.1%) were male. They were divided into two groups of low and high pain severity that consisted of 159 (45%) and 187 (55%) people, respectively.

Table 1 shows that in the high pain severity group, the number of females (p <0.001), single individuals (p <0.001) and participants who have been educated for more than 12 years (p <0.008) were higher. Also, the level of physical activity in the high pain severity group was higher. While "Very satisfied Sexual life", "Very good Sleep quality", not smoking and good self-rated health were lower (p <0.001). Regarding psychological factors, statistical analysis showed that the score of depression, somatization, cardiac anxiety and fear of bodily sensation were higher in the high pain severity group. The number of type D personality was lower (p <0.001).

Table 2 shows the univariate and multiple logistic regression results for the potential determinants of the severity of pain in NCCP patients. Poor self-rated health (OR: 2.14; 95%CI: 1.18- 3.90) was associated with increasing the risk of severity of pain. Also, the connection of the psychological items was as follows: Type D personality (OR: 1.90; 95%CI: 1.06, 3.41), fear of bodily sensation (OR: 1.90; 95%CI: 1.06, 3.41), depression (OR: 1.15; 95%CI: 1.09, 1.22), somatization (OR: 1.03; 95%CI: 1.01, 1.06) and cardiac anxiety (OR: 1.01; 95%CI: 0.99, 1.03).

Table 3 presents univariate and multiple linear regression analysis results on the

Table 1. Sociodemographic, lifestyle and clinical factors across pain severity of patients with none cardiac chest pain

		Low pain	High pain	P-Value
		N = 182	N = 178	
Sociodemographic factors				
Age		57.81±12.39	53.71±12.97	0.002
Gender	Male	110 (60.4%)	46 (25.8%)	<0.001
	Female	72 (39.6%)	132 (74.2%)	
Marital status	Unmarried	24 (13.2%)	77 (43.3%)	<0.001
	Married	158 (86.8%)	101 (56.7%)	
Educational level	0-5 y	85 (47.2%)	50 (37.9%)	
	6-12 y	71 (39.4%)	46 (34.8%)	0.008
	>12 y	24 (13.3%)	36 (27.3%)	
Life style factors				
Physical activity	Yes	84 (46.2%)	118 (66.7%)	<0.001
	No	98 (53.8%)	59 (33.3%)	
Sexual life	Very satisfied	46 (25.7%)	19 (10.9%)	
	Sometimes satisfied	35 (19.6%)	30 (17.2%)	
	Rarely satisfied	11 (6.1%)	43 (24.7%)	<0.001
	Unsatisfied	11 (6.1%)	25 (14.4%)	
	No	76 (42.5%)	57 (32.8%)	
Sleep quality	Very good	36 (19.8%)	8 (4.5%)	
	Good	94 (51.6%)	70 (39.3%)	<0.001
	Bad	31 (17.0%)	61 (34.3%)	
	Very bad	21 (11.5%)	39 (21.9%)	
Smoking status	No smoker	151 (83.0%)	107 (60.5%)	<0.001
	Current smoker	31 (17.0%)	70 (39.5%)	
Self-rated health	Good	133 (73.1%)	78 (43.8%)	<0.001
	Bad	49 (26.9%)	100 (56.2%)	
Psychological factors				
Depression score		6.72±5.78	14.29±5.31	<0.001
Type D	No	124 (68.1%)	60 (33.7%)	<0.001
	Yes	58 (31.9%)	118 (66.3%)	
Somatization		8.59±4.54	15.95±4.34	<0.001
Cardiac anxiety		26.93±11.20	35.74±11.14	<0.001
Fear of bodily sensation		35.75±17.54	49.55±16.21	<0.001

association of pain level severity's potential predictors. Accordingly, the demographic factors that are stronger predictors of pain severity are as follows; educated for more than 12 years and female. In the case of psychological factors, the following items are more important in being predictors of pain severity; depression (p<0.001), type D personality (p<0.02), somatization (p<0.001) and cardiac anxiety (p<0.001).

Discussion

The findings revealed that type D personality, fear of bodily sensations, depression, somatization, and poor self-rated health were significantly linked to higher severity of non-cardiac chest pain (NCCP) in multiple logistic regression analyses. Furthermore, multiple linear regression

analysis demonstrated that increasing scores for depression, somatization, and cardiac anxiety were associated with a higher likelihood of NCCP. Type D personality also exhibited a significant positive correlation in the linear regression model. Similar associations between pain and psychological disorders have been reported in previous research, as outlined below:

A review study highlighted that pain and depression frequently co-occur, with pain manifesting as a physical symptom in nearly 65% of patients with depression. This comorbidity contributes to less favorable outcomes and greater healthcare utilization. Depression is also one of the most common symptoms in patients with chronic pain, affecting both pain threshold and tolerance[25].

Table 2. Univariate and multiple logistic regression analysis of the association of sociodemographic, life style and clinical factors with pain severity

		Univariate	Multiple
		OR * (95%CI) †	OR (95%CI)
Sociodemographic factors			
Age		0.97 (0.95- 0.99)	0.99 (0.96- 1.02)
Gender	Male	Ref ‡	
	Female	4.34 (2.80-6.86)	1.41 (0.62- 3.18)
Marital status	Unmarried	Ref	
	Married	5.02 (2.98- 8.46)	1.54 (0.64- 3.74)
Educational level	0-5 y	Ref	
	6-12 y	1.10 (0.66- 1.83)	1.28 (0.57- 2.89)
	>12 y	2.55 (1.37- 4.76)	2.72 (0.96- 7.71)
Life style factors			
Physical activity	Yes	Ref	Ref
	No	2.33 (1.52-3.58)	1.36 (0.68- 2.74)
Sexual life	Very satisfied	Ref	Ref
	Sometimes satisfied	2.07 (1.01- 4.28)	1.28 (0.41- 3.96)
	Rarely satisfied	9.64 (4.04- 22.17)	0.88 (0.22- 3.46)
	Unsatisfied	5.50 (2.26- 13.37)	0.96 (0.19- 4.73)
	No	1.82 (0.96- 3.43)	1.72 (0.57- 5.22)
Sleep quality	Very good	Ref	Ref
	Good	3.35 (1.47- 7.66)	1.26 (0.35- 4.56)
	Bad	8.85 (3.67- 21.34)	1.18 (0.29- 4.85)
	Very bad	8.36 (3.29- 21.22)	1.94 (0.46- 8.12)
Smoking status	No smoker	Ref	Ref
	Current smoker	3.19 (1.95- 5.20)	2.35 (0.92- 6.00)
Self-rated health	Good	Ref	Ref
	Bad	3.48 (2.24- 5.41)	2.14 (1.18- 3.90)
Psychological factors			
Depression		1.24 (1.19- 1.30)	1.15 (1.09- 1.22)
Type D	No	Ref	Ref
	Yes	4.20 (2.71- 6.53)	1.90 (1.06- 3.41)
Somatization		1.40 (1.31- 1.50)	1.03 (1.01- 1.06)
Cardiac anxiety		1.07 (1.05- 1.10)	1.01 (0.99- 1.03)
Fear of bodily sensation		1.05 (1.03- 1.06)	1.90 (1.06- 3.41)

*: Odds ratio, †: Confidence Interval, ‡: Reference category

In a multinational study involving approximately 300,000 participants across 47 countries, researchers examined the relationship between depression and pain. The results indicated that compared to individuals without depression, those with subsyndromal depression, brief depressive episodes, or full depressive episodes had significantly higher odds of experiencing severe pain[26].

Regarding NCCP specifically, a review article reported that the prevalence of depression among NCCP patients is higher than that observed in healthy controls. However, it is comparable to the rate of depression seen in individuals with cardiac chest pain[27].

Previous studies are consistent with our findings regarding the association between Type D personality and pain. These studies have highlighted a significant link between Type D personality and the somatization of symptoms, as well as the occurrence of musculoskeletal pain[28].

Furthermore, evidence indicates that individuals with Type D personality traits report a higher prevalence of somatic complaints[29]. Several studies have also established that Type D personality negatively impacts both mental and physical health, leading to an increase in somatic symptoms[30-31].

Specifically, in patients with NCCP, research suggests a notable association between Type D personality and the condition. Screening for

Table 3. Univariate and multiple linear regression analysis of the association of sociodemographic, life style and clinical factors with pain severity score.

		Univariate			Multiple		
		B *	SE †	P	B	SE	P
Sociodemographic factors							
Age		-0.12	0.04	0.003	-0.06	0.04	0.15
Gender	Male	Ref ‡			Ref		
	Female	6.86	1.00	<0.001	2.41	1.03	0.02
Marital status	Unmarried	Ref			Ref		
	Married	6.51	1.12	<0.001	0.82	1.17	0.48
Educational level	0-5 y	Ref			Ref		
	6-12 y	3.58	1.53	0.02	2.39	1.32	0.07
	>12 y	5.26	1.56	0.001	2.87	1.25	0.02
Life style factors							
Physical activity	Yes	Ref			Ref		
	No	3.68	1.04	<0.001	0.52	0.90	0.56
Sexual life	Very satisfied	Ref			Ref		
	Sometimes satisfied	3.10	1.44	0.03	0.42	1.33	0.75
	Rarely satisfied	0.015	1.44	0.92	0.33	1.33	0.80
	Unsatisfied	-5.78	1.53	<0.001	1.16	1.69	0.49
	No	-5.30	1.79	0.003	1.42	1.79	0.43
Sleep quality	Very good	Ref			Ref		
	Good	11.72	1.85	<0.001	2.85	1.68	0.09
	Bad	5.74	1.40	<0.001	1.61	1.30	0.22
	Very bad	1.26	1.54	0.41	1.08	1.39	0.44
Smoking status	No smoker	Ref			Ref		
	Current smoker	4.15	1.15	<0.001	1.70	1.14	0.14
Self-rated health	Good	Ref			Ref		
	Bad	6.90	1.01	<0.001	-1.83	0.97	0.06
Psychological factors							
Depression		-0.89	0.06	<0.001	0.43	0.08	<0.001
Type D	No	Ref			Ref		
	Yes	6.63	0.99	<0.001	2.18	0.95	0.02
Somatization		1.18	0.07	<0.001	0.90	0.10	<0.001
Cardiac anxiety		0.38	0.04	<0.001	0.16	0.04	<0.001
Fear of bodily sensation		0.26	0.02	<0.001	0.05	0.03	0.08

*: Regression coefficients, †: Standard Error of Regression coefficient, ‡: Reference category

Type D personality traits in NCCP patients may be an effective approach to identifying those at higher risk for persistent chest pain[32-34].

Our findings on the relationship between pain severity and somatization align with those of a review article encompassing 57 prior studies. These studies demonstrated a significant association between somatization and chronic pain, highlighting a correlation between somatization levels and pain severity[35].

Additionally, a large population-based study involving 1,658 adults aged 18–65 years provided further support for the hypothesis that widespread chronic pain can represent a manifestation of somatized distress. The study found that higher somatization scores were associated with greater pain severity in patients[36].

Numerous studies support the relationship between anxiety, fear of bodily sensations, and pain severity. Research indicates a high prevalence of cardiac anxiety and moderate levels of fear of bodily sensations among patients with NCCP[21]. A review article noted that individuals seeking medical attention for NCCP are often in the early stages of developing anxiety[37].

Many researchers suggest that anxiety and NCCP have a bidirectional relationship, where each can exacerbate the other. Soares-Filho et al. observed that NCCP patients exhibit higher anxiety levels compared to those with chest pain caused by a known medical condition. This heightened anxiety may stem from uncertainty

surrounding the diagnosis, as well as inadequate communication between healthcare providers and patients regarding the nature of the condition. The less clear the source of the pain, the more severe it tends to be in these individuals[38].

The connection between pain and self-rated health is well-established in the literature. Research consistently demonstrates that chronic pain is linked to poor self-rated health. For example, a study conducted in 2003 found that as the frequency of pain increases, its adverse effect on self-rated health becomes more pronounced[39].

Furthermore, a longitudinal population-based survey reinforced this association, showing that the link between pain and poor self-rated health remains significant even after adjusting for factors such as sociodemographic characteristics, chronic illnesses, depression, illness severity, functional impairments, and healthcare access[6].

A literature review highlighted that psychological conditions such as Type D personality, depression, anxiety, and somatization are often interconnected, particularly in individuals experiencing unexplained pain. These psychological disorders frequently coexist, and their combined presence may increase susceptibility to unexplained pain[30,40]. This synergistic interaction may contribute to the bio-psycho-social model of pain in such individuals.

The proposed mechanism underlying this theory suggests that pain itself can trigger anxiety, which heightens an individual's sensitivity to bodily sensations, leading to increased somatization. Anxiety is more prevalent among NCCP patients compared to those with cardiac chest pain, due to the uncertainty surrounding the origin of their symptoms, potentially exacerbating their pain.

Anxiety can also give rise to other psychological conditions, whose combined effects further intensify pain severity in these patients. Additionally, factors such as genetics, brain chemistry, and neurophysiology are believed to influence pain severity. While the role of heredity remains a subject of debate, research has shown that unexplained pain is common among first-degree relatives. Social and cultural contexts, which shape an individual's perception of and response to physical symptoms, also play a critical role in pain severity[41-43].

Conclusion

It is concluded that Type D personality, fear of bodily sensations, depression, somatization, cardiac anxiety, and poor self-rated health are all associated with increased severity of NCCP. This heightened severity of chest pain often leads patients to perceive their condition as more uncontrollable and less comprehensible compared to those with cardiac-origin chest pain[44]. Furthermore, these factors negatively impact patients' quality of life and contribute to more frequent visits to emergency medical services (EMS).

Strengths and limitation

This study has both notable strengths and limitations. Among its strengths are the relatively large sample size and the application of a diagnostic gold standard to exclude heart disease. However, several limitations should be considered. Firstly, the cross-sectional design of the study prevents the establishment of causal relationships. Secondly, the reliance on self-reported questionnaires introduces the possibility of recall and reporting biases. Thirdly, the generalizability of the findings may be limited, as the sample was drawn from a select number of hospitals within a single city. Additionally, the clinical perspective of the study means there is no absolute guarantee that errors were entirely avoided in diagnosing NCCP among patients presenting with chest pain. Despite this, extensive measures were taken to ensure the highest possible diagnostic accuracy throughout the research process.

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Conflict of interests
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Author's Contributions
Study Conception or Design: HR, MS
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All authors have approved the final manuscript and are responsible for all aspects of the work.

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