

Clinical Research Article



# Determinants of depression in non-cardiac chest pain patients: a cross sectional study

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**Background:** Non-cardiac chest pain (NCCP) is a common patient complaint imposing great costs on the healthcare system. It is associated with psychological factors such as depression. The aim of the present study is determining depression predictors in NCCP patients.

**Methods:** The participants of this cross-sectional study were 361 NCCP patients. Patients filled out questionnaires concerning their sociodemographic, lifestyle, and clinical factors (severity of pain, type D personality, somatization, cardiac anxiety, fear of body sensations, and depression).

**Results:** Based on multiple ordinal logistic regression, lack of physical activity (odds ratio [OR], 1.78; 95% confidence interval [CI], 1.09-2.87), sleep quality (OR, 2.98; 95% CI, 1.15-7.69), being a smoker (OR, 1.33; 95% CI, 2.41-4.03), present pain intensity (OR, 1.08; 95% CI, 1.05-1.11), type D personality (OR, 2.43; 95% CI, 1.47-4.03), and somatization (OR, 1.22; 95% CI, 1.15-1.3) were significant predictors of depression in NCCP patients. Additionally, multiple linear regression showed that being unmarried ( $\beta = 1.51$ ,  $P = 0.008$ ), lack of physical activity ( $\beta = 1.22$ ,  $P = 0.015$ ), sleep quality ( $\beta = 2.26$ ,  $P = 0.022$ ), present pain intensity ( $\beta = 0.07$ ,  $P = 0.045$ ), type D personality ( $\beta = 1.87$ ,  $P < 0.001$ ), somatization ( $\beta = 0.45$ ,  $P < 0.001$ ), and fear of bodily sensation ( $\beta = 0.04$ ,  $P = 0.032$ ) increased significantly depression scores in NCCP patients.

**Conclusions:** Physicians should consider the predictors of depression in NCCP patients which can lead to receiving effective psychological consultations and reducing the costs and ineffectual referrals to medical centers.

**Key Words:** Anxiety; Chest Pain; Cross-Sectional Studies; Depression; Life Style; Psychology; Somatoform Disorders; Type D Personality.

## INTRODUCTION

Chest pain is a common patient complaint in cardiac emergency departments [1,2]. Up to 60% of these cases re-

ceive a non-cardiac diagnosis [2].

Non-cardiac chest pain (NCCP) is defined as recurrent angina-like chest pain with no evidence of heart problems after medical examinations which drives patients to follow

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medical consultations and imposes a lot of costs on the patients and the health care system [1-3]. The annual financial burden of NCCP is more than double that of acute myocardial infarction and angina pectoris [3]. In the United States, the costs associated with these medical services are estimated between \$8 and \$13 billion each year [4].

In addition to financial burden and comparable to cardiac disease, NCCP negatively influences the quality of life and everyday life such as interruption of daily activities and occupational disability [5,6]. Several studies have supported the relationship between NCCP and psychological impairment such as depression, anxiety, and somatization [1,5]. It seems that type D personality in these patients is common, which is associated with the occurrence of psychological disorders and increases their risk of depression; however, few studies have considered this relationship [7].

On the other hand, depression is known as a prevalent and serious mental health disorder, and major depression is the third leading cause of illness worldwide, and would rank first in the year 2030 [8]. Depression is commonly comorbid with chronic pain, and NCCP is a type of chronic pain that is of particular clinical importance [9]. Despite the high significance and high comorbidity of depression in NCCP patients, the question is raised, "What are the predictive factors of depression in them?"

Some studies have revealed that pain causes negative coping strategies, disability, and impaired quality of life, which might predispose individuals to symptoms of depression [10,11]. There is also evidence of unhealthy lifestyle, such as decreased physical activity, sleep disturbance, and smoking in both depression and painful situations, which may explain their comorbidity [12-14]. It has been suggested that depression reduces the pain threshold, therefore depressed people report more severe pain [10]. However, there are contradictions in the articles about it; for example, some studies have shown that in depressed patients, the pain threshold may not change or even increases [15].

Considering that depression is a significant factor in exacerbating pain intensity [10], and due to the lack of sufficient evidence regarding the predictors of depression in NCCP patients, the purpose of the present study was to show some of these predictors and clarify the association between depression and NCCP more clearly than before, so that a better understanding of these factors will lead to better treatment management of NCCP patients.

## MATERIALS AND METHODS

### 1. Participants and procedure

This cross-sectional study was conducted from September to December 2019 in two hospitals affiliated at Isfahan University of Medical Sciences (IUMS), Isfahan, Iran. The sample consisted of 361 patients who were diagnosed with NCCP based on physical examinations and angiographic reports. Participants' inclusion criteria were as follows: age more than 20 years old, absence of any sort of major mental disorder, no use of psychotherapeutic drugs, and no history of cardiac disease or other major life-threatening disease. Patients who refused to participate in the study were excluded.

Patients referred to the clinic or emergency department of these two hospitals with chest pain complaints, after electrocardiography, underwent examination by cardiologists and then angiography. If angiography was negative, chest pain was diagnosed as NCCP. Patients who were eligible and agreed to participate in our study were interviewed by a trained nurse in a comfortable room, and then filled out validated Persian questionnaires about sociodemographic and lifestyle factors, severity of pain, type D personality, somatization, cardiac anxiety, fear of body sensations, and depression.

### 2. Ethics

The study was approved by the ethics committee of IUMS (IR.MUI.MED.REC1398.624) and written informed consent was obtained from participants.

### 3. Study instruments and assessment of variables

#### 1) Depression

The Patient Health Questionnaire-9 (PHQ-9) was developed to make a criteria-based diagnosis of major depressive disorders. It comprises nine items that evaluate the presence of the nine criteria of the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) criteria for major depressive disorders in the previous 2 weeks [16]. Each item of the PHQ-9 is rated on a 4-point scale, ranging from 0 (not at all) to 3 (nearly every day), for a total score ranging from 0 to 27. Higher scores indicated an increased severity of symptoms and an increased likelihood of major depressive disorder. Questionnaires with up to two missing values were scored, replacing any missing values with the average score of the completed items.

Depression scores were interpreted as follows: "less than 5", "5 to 15", and "more than 15" represent no depression,

mild to moderate depression, and severe depression, respectively [16]. The internal consistency value of PHQ-9 was 0.854 and the test-retest reliability value of PHQ-9 was 0.873 [17]. About the Farsi version: Cronbach's alpha coefficient for PHQ-9 was 0.88, and one-week test-retest reliability was 0.79 [18].

## 2) Sociodemographic factors

Participants were queried regarding sociodemographic data, including age, sex, educational level ( $\geq 12$  yr, 6-12 yr, and 0-5 yr), marital status (married and unmarried [single, widowed, and divorced]), and socioeconomic status.

Regarding socioeconomic status, a short form of the socioeconomic status questionnaire, developed to determine the socio-economic position of an individual relative to other members of a society, was used.

This questionnaire consists of 6 items including household educational level, household employment status, the number of rooms in the patient's house, car ownership, using a notebook, laptop, or tablet in the house, and whether they traveled abroad for pleasure in the past year. A higher score shows higher socioeconomic status. Internal consistency was Cronbach's alpha 0.642 [19].

## 3) Lifestyle factors

Lifestyle factors were assessed based on patients' personal information about physical activity, sexual life, sleep quality, and smoking habits. Participants were asked if they have half an hour per day of physical activity in the form of yes/no question. Regarding sexual life, the question was, "How was your ability to enjoy sex during the last month?" Patients could choose "very satisfied", "sometimes satisfied", "rarely satisfied", or "unsatisfied" along with the option "having no sex". Sleep quality was assessed using the question, "How do you evaluate the quality of your sleep?" They could choose between "very good", "good", "bad", or "very bad". At the end, patients were asked if they smoke. There were three options were "yes", "have quit", and "have never smoked". If the patient had chosen the options "have never smoked" or "have quit", it was interpreted as no.

## 4) Clinical factors

### (1) Pain characteristics

The short form of McGill pain questionnaire (SF-MPQ) was used. The main component of the SF-MPQ consists of 15 descriptors (11 sensory; 4 affective). Each descriptor is ranked on an intensity scale of 0 = none, 1 = mild, 2 = mod-

erate, 3 = severe. The score range in this questionnaire is 0 to 45 [20]. The present pain intensity of the McGill pain questionnaire is included to provide overall intensity scores [21]. About the Persian version, internal consistency was found by Cronbach's alpha 0.840 and intraclass correlation coefficient (ICC) resulted in 0.912 for the total pain score [22].

### (2) Type D personality

The Type D Scale-14 (DS14) was used to assess negative affectivity (NA), social inhibition (SI), and type D personality. Subjects rated their personality on a 5-point Likert scale ranging from 0 = false to 4 = true. The NA and SI scales can be scored as continuous variables (range, 0-28) to assess these personality traits in their own right. A cutoff of 10 on both scales is used to classify subjects as type D (*i.e.*, NA > 10 and SI > 10) [23]. The Persian version of DS14 showed test-retest stability for both NA and the SI subscales with ICC values 0.86 and 0.77, and the internal consistency based on Cronbach's alpha coefficients for the aforementioned subscales as 0.84 and 0.75 respectively [24].

### (3) Somatization

The Patient Health Questionnaire-15 (PHQ-15) is a self-administered scale used to screen for somatoform disorders. It is scored using a 3-point Likert scale: not bothered at all, bothered a little, and bothered a lot [25]. The internal consistency of the Persian version of PHQ-15 was with a Cronbach's alpha of 0.80. The correlation coefficient of PHQ-15 score was 0.77 [26].

### (4) Cardiac anxiety

The cardiac anxiety questionnaire is a self-report questionnaire, designed to measure heart-focused anxiety, rated on a 5-point Likert scale ranging from 0 (never) to 4 (always). Heart-focused anxiety was defined as "the fear of cardiac-related stimuli and sensations because of their perceived negative consequences" [27]. In the case of Farsi version; the total and subscale internal consistency were both measured as Cronbach's alpha of 0.97 and the test-retest reliability was 0.86 [28].

### (5) Fear of body sensations

The body sensations questionnaire (BSQ) is used to measure fear of body sensations, such as palpitations, dizziness, and sweating [29]. Items are rated on a 5-point scale from 1 to 5, ranging from "not frightened or worried by this sensation" to "extremely frightened by this sensation".

The total score is computed as the mean value of all items. Higher scores indicate more fear of body sensations [29]. In our study the BSQ was with a Cronbach's alpha of 0.96 and ICC coefficient was 0.95.

#### 4. Statistical analysis

Analyses were made with SPSS version 16 (SPSS Inc., Chicago, IL). Categorical variables were reported as frequency and percentage, while quantitative variables were reported as mean and standard deviation. Categorical variables were compared between groups by using the chi-squared test and analysis of variance (ANOVA) for continuous data. Post hoc tests were performed after significant ANOVA and chi-squared tests, and Bonferroni correction for *P* values was conducted for addressing the multiple testing.

Univariate and multiple linear regression were used for evaluating the association of potential predictors with depression scores. The results were reported as a regression coefficient ( $\beta$ ), standard error of regression coefficient (SE) and 95% confidence interval (95% CI) for  $\beta$ . Ordinal logistic regression in the form of univariate and multiple models were used for the association of potential predictors of depression levels. In this modeling approach, depression as a dependent variable was considered an ordinal categorical data, categorized based on a predefined cut of values, representing the levels of depression disorder as "no depression", "mild to moderate depression" and "severe depression". We evaluated the proportional odds assumption when fitting ordinal logistic regression using a chi-squared score test and graphical approach. The results of ordinal logistic regression were reported as an odds ratio (OR) and 95% CI for OR. In both regression analyses, those variables with *P* < 0.05 in univariate analyses were entered in multiple models. A *P* value < 0.05 was considered statistically significant.

## RESULTS

In this study, 361 NCCP patients were included with a mean age of  $55.8 \pm 12.8$  years and 43.3% of them were males. Among study participants, 26.1% did not have depression, 38.4% had mild to moderate depression and 35.6% had severe depression (Table 1). Also, mean score of depression score was calculated to be  $10.5 \pm 6.7$ .

Table 1 presents the results of a comparison of sociodemographic, lifestyle, and clinical factors across the categories of depression. Female (*P* < 0.001) and married (*P* < 0.001) NCCP patients experienced higher levels of depression. Greater physical activity (*P* < 0.001), satisfactory sexual activity (*P* < 0.001), no smoking (*P* < 0.001),

and better sleep quality (*P* < 0.001) in NCCP patients were significantly associated with lower levels of depression. Type D personality was significantly prevalent among NCCP patients with higher levels of depression compared to those who were not depressed. Also, the mean scores of somatization (*P* < 0.001), anxiety (*P* < 0.001), fear of body sensations (*P* < 0.001), and pain intensity (*P* < 0.001) were significantly higher among depressed NCCP patients than non-depressed ones.

Table 2 shows the results of univariate and multiple ordinal logistic regression for the potential determinants of depression levels in NCCP patients. Among the lifestyle factors, lack of physical activity (OR, 1.78; 95% CI, 1.09-2.87), smoking (OR, 1.33; 95% CI, 2.41-4.03), and lower sleep quality (OR, 3.12; 95% CI, 1.52-6.41) increased the risk of depression in our study of NCCP patients. Among clinical factors, the type D personality (OR, 2.43; 95% CI, 1.47-4.03), higher somatization scores (OR, 1.22; 95% CI, 1.15-1.31), and pain intensity (OR, 1.08; 95% CI, 1.05-1.11) were significant risk factors for depression in these patients. We also investigated the association of the interaction of type D personality and clinical factors with depression levels. In both univariate and multiple regression models, the significant association was seen in the interaction of type D personality and somatization.

Table 3 presents the results of univariate and multiple linear regression analyses on the association of the potential predictors of depression scores. Single (*P* = 0.008) and non-physically active (*P* = 0.013) NCCP patients showed higher depression scores than married and physically active people. Also, those with a good quality of sleep (*P* = 0.029) were less likely to have higher depression scores. NCCP patients with type D personality showed higher depression intensity (*P* < 0.001), and somatization scores increased (*P* < 0.001). Also, fear of body sensations (*P* = 0.032) were positively associated with higher depression scores in which the mean change in depression score was  $\beta = 0.45$  for a one unit increase in somatization scores, and a one unit increase in fear of body sensations increased the mean score of depression with  $\beta = 0.04$ . Among the investigated associations of the interaction of type D personality and clinical factors with depression score, we observed a significant association for the interaction of type D personality and somatization.

## DISCUSSION

The present study was based on multiple regression analysis of investigated predictors of depression in NCCP patients. Predictive factors related to lifestyle were physical activity, smoking, and sleep quality. In the case of clinical

**Table 1.** Sociodemographic, lifestyle and clinical factors across depression level of patients with no cardiac chest pain

Variable	No depression (n = 93, 26.1%)	Mild to moderate depression (n = 137, 38.4%)	Severe depression (n = 127, 35.6%)	P value <sup>a</sup>
Sociodemographic factors				
Age (yr)	57.2 ± 13.0	55.4 ± 12.1	55.3 ± 13.3	0.499
Sex				< 0.001 <sup>b</sup>
Female	30 (32.3)	79 (57.7)	93 (73.2)	
Male	63 (67.7)	58 (42.3)	34 (26.8)	
Marital status				< 0.001 <sup>b</sup>
Unmarried	10 (10.8)	32 (23.4)	58 (45.7)	
Married	83 (89.2)	105 (76.6)	69 (54.3)	
Educational level				0.189
>12 yr	13 (14.6)	23 (18.4)	24 (25.3)	
6-12 yr	34 (38.2)	53 (42.4)	28 (29.5)	
0-5 yr	42 (47.2)	49 (39.2)	43 (45.3)	
Socioeconomic score	7.8 ± 3.5	7.6 ± 3.9	7.8 ± 3.7	0.882
Lifestyle factors				
Physical activity (0.5 hr/d)				< 0.001 <sup>b</sup>
No	39 (42.4)	74 (54.0)	88 (69.3)	
Yes	53 (57.6)	63 (46.0)	39 (30.7)	
Sexual life				< 0.001 <sup>b</sup>
No	35 (38.9)	57 (41.9)	41 (33.1)	
Unsatisfied	5 (5.6)	10 (7.4)	21 (16.9)	
Rarely satisfied	3 (3.3)	19 (14.0)	32 (25.8)	
Sometime satisfied	19 (21.1)	29 (21.3)	16 (12.9)	
Very satisfied	28 (31.1)	21 (15.4)	14 (11.3)	
Sleep quality				< 0.001 <sup>b</sup>
Very bad	4 (4.3)	24 (17.5)	32 (25.2)	
Bad	11 (11.8)	33 (24.1)	46 (36.2)	
Good	54 (58.1)	66 (48.2)	43 (33.9)	
Very good	24 (25.8)	14 (10.2)	6 (4.7)	
Smoking status				< 0.001 <sup>b</sup>
Current smoker	15 (16.1)	34 (24.8)	52 (41.3)	
No smoker	78 (83.9)	103 (75.2)	74 (58.7)	
Clinical factors				
Present pain intensity	8.9 ± 7.8	17.3 ± 8.8	23.4 ± 7.9	< 0.001 <sup>b</sup>
Type D personality				< 0.001 <sup>b</sup>
Yes	17 (18.3)	69 (50.4)	90 (70.9)	
No	76 (81.7)	68 (49.6)	37 (29.1)	
Somatization	6.4 ± 3.6	12.6 ± 4.7	16.1 ± 4.5	< 0.001 <sup>b</sup>
Cardiac anxiety	26.1 ± 11.6	30.3 ± 11.7	36.2 ± 10.5	< 0.001 <sup>b</sup>
Fear of bodily sensation	31.7 ± 14.4	43.2 ± 18.2	49.8 ± 16.6	< 0.001 <sup>b</sup>

Values are presented as mean ± standard deviation or number (%).

<sup>a</sup>Resulted from analysis of variance and chi-squared test for continuous and categorical data, respectively. <sup>b</sup>Post hoc analysis with Bonferroni correction for multiple testing showed significant differences between all pairwise columns.

factors, somatization, type D personality, fear of body sensations, and pain intensity were significant.

In line with previous studies which have shown that depression is common among NCCP patients [1,5], 73.9% of the NCCP patients in our study, based on the PHQ-9 questionnaire, were suffering from mild to moderate or severe depression (Table 1). It is noteworthy that the level of depression in patients with NCCP is similar to patients who are diagnosed with a heart problem after experiencing chest pain [2]. Depression and NCCP are both associ-

ated with disability and reduced quality of life, so their comorbidity can have a much more negative effect on the patient's condition [5].

Based on the studies that revealed evidence for depression and chronic pain comorbidity, it can be concluded that one of the most important predictors of depression in NCCP patients is pain intensity [10,11], which has also been confirmed by the result of our study. The most important factor in depression is chronic stress, and pain is considered a stressor. A stressor is a stimulus that first

**Table 2.** Univariate and multiple ordinal logistic regression analysis of the association of sociodemographic, lifestyle and clinical factors with depression levels

Variable	Univariate OR (95% CI)	Multiple OR (95% CI)
<b>Sociodemographic factors</b>		
Age	1.01 (0.99-1.02)	-
Sex		
Female	3.42 (2.28-5.13)	1.09 (0.62-1.89)
Male	Ref	Ref
Marital status		
Unmarried	3.88 (2.45-6.14)	1.59 (0.89-2.86)
Married	Ref	Ref
Educational level		
>12 yr	1.53 (0.87-2.70)	-
6-12 yr	1.76 (0.98-3.15)	-
0-5 yr	Ref	-
Socioeconomic score	1.00 (0.95-1.05)	
<b>Lifestyle factors</b>		
Physical activity (0.5 hr/d)		
No	2.24 (1.51-3.33)	1.78 (1.09-2.87)
Yes	Ref	Ref
Sexual life		
No	1.99 (1.13-3.48)	0.97 (0.48-1.95)
Unsatisfied	1.25 (0.72-2.17)	1.15 (0.60-2.23)
Rarely satisfied	0.29 (0.15-0.54)	0.75 (0.34-1.65)
Sometime satisfied	0.34 (0.17-0.70)	0.45 (0.18-1.04)
Very satisfied	Ref	Ref
Sleep quality		
Very bad	8.62 (3.88-19.14)	2.98 (1.15-7.69)
Bad	4.18 (2.30-7.61)	3.12 (1.52-6.41)
Good	1.60 (0.83-3.10)	2.21 (1.00-4.85)
Very good	Ref	Ref
Smoking status		
Current smoker	2.57 (1.66-4.01)	1.33 (2.41-4.03)
Nonsmoker	Ref	Ref
<b>Clinical factors</b>		
Present pain intensity	1.14 (1.11-1.17)	1.08 (1.05-1.11)
Present pain intensity*Type D personality <sup>a</sup>	1.01 (0.96-1.05)	-
Type D personality		
Yes	4.94 (3.24-7.51)	2.43 (1.47-4.03)
No	Ref	Ref
Somatization	1.33 (1.27-1.40)	1.22 (1.15-1.31)
Somatization*Type D personality <sup>a</sup>	1.10 (1.0-1.19)	1.10 (1.01-1.02)
Cardiac anxiety	1.06 (1.04-1.08)	1.01 (0.98-1.03)
Cardiac anxiety*Type D personality <sup>a</sup>	1.01 (0.98-1.05)	-
Fear of bodily sensation	1.04 (1.03-1.06)	1.01 (0.99-1.02)
Fear of bodily sensation*Type D personality <sup>a</sup>	0.98 (0.92-1.04)	-

OR: odds ratio, CI: confidence interval, Ref: reference category.

<sup>a</sup>Interaction between type D personality and clinical factors.

activates the sympathetic system and then stimulates the Hypothalamus-Pituitary-Adrenal (HPA) axis resulting in disruption of the body's state of homeostasis. Excessive HPA axis activity results in neuroendocrine abnormality [10,30]. Meanwhile, long-term stress disrupts the negative feedback of HPA axis in response to the increased level of corticosteroids [10]. This condition leads to an increase in

cortisol, norepinephrine, and other corticosteroids. On the other hand, disrupted HPA axis, as well as hypersecretion of cortisol in depression, is supported by some studies; therefore, the HPA axis plays a pivotal role in depression and accompanying pain [10,30]. There has been evidence for a low threshold of pain in depressed patients, and patients with NCCP also tend to exaggerate their pain, so the

**Table 3.** Univariate and multiple linear regression analysis of the association of sociodemographic, lifestyle and clinical factors with depression score

Variable	Univariate			Multiple		
	B	SE	P	B	SE	P
<b>Sociodemographic factors</b>						
Age	0.03	0.03	0.270	-	-	-
Sex						
Female	4.78	0.67	< 0.001	0.38	0.56	0.507
Male	Ref			Ref		
Marital status						
Unmarried	5.02	0.74	< 0.001	1.51	0.57	0.008
Married				Ref		
Educational level						
>12 yr	2.09	1.03	0.045	-	-	-
6-12 yr	2.49	1.06	0.020	-	-	-
0-5 yr						
Socioeconomic score	0.01	0.09	0.902	-	-	-
<b>Lifestyle factors</b>						
Physical activity (0.5 hr/d)						
No	3.13	0.70	< 0.001	1.22	0.49	0.013
Yes	Ref			Ref		
Sexual life						
No	2.52	0.96	0.008	0.12	0.72	0.864
Unsatisfied	1.12	0.95	0.241	0.36	0.68	0.608
Rarely satisfied	-4.44	1.01	< 0.001	0.87	0.85	0.270
Sometime satisfied	-3.63	1.17	0.002	0.71	0.86	0.404
Very satisfied	Ref			Ref		
Sleep quality						
Very bad	8.05	1.22	< 0.001	2.26	0.96	0.022
Bad	4.96	0.93	< 0.001	2.52	0.70	< 0.001
Good	1.07	1.03	0.304	1.82	0.76	0.029
Very good	Ref			Ref		
Smoking status						
Current smoker	3.17	0.77	< 0.001	0.64	0.61	0.291
No smoker	Ref			Ref		
<b>Clinical factors</b>						
Present pain intensity	0.40	0.03	< 0.001	0.07	0.04	0.045
Present pain intensity*Type D personality <sup>a</sup>	-0.02	0.06	0.809	-	-	-
Type D personality						
Yes	5.17	0.65	< 0.001	1.87	0.52	< 0.001
No	Ref			Ref		
Somatization	0.77	0.04	< 0.001	0.45	0.06	< 0.001
Somatization*Type D personality <sup>a</sup>	0.23	0.09	0.010	0.20	0.09	0.036
Cardiac anxiety	0.21	0.03	< 0.001	0.02	0.02	0.493
Cardiac anxiety*Type D personality <sup>a</sup>	-0.05	0.05	0.388	-	-	-
Fear of bodily sensation	0.17	0.02	< 0.001	0.04	0.02	0.032
Fear of bodily sensation*Type D personality <sup>a</sup>	0.04	0.03	0.195	-	-	-

B: regression coefficients, SE: standard error of regression coefficient, Ref: reference category.

<sup>a</sup>Interaction between type D personality and clinical factors.

association of depression and NCCP has an added effect on reports of pain intensity [1,10].

A study in 2019 indicated that both depression and chronic pain are associated with somatic amplification. Somatic amplification is defined as how a person perceives usual body feelings as pathologically abnormal. The extent to which an individual perceives his or her somatic

sensations as unusual contributes to depression and predisposes him or her to chronic pain [31]. In the same study, it was suggested that NCCP patients focus on their cardiac sensations and are afraid of them. A cognitive behavioral therapy trial regarding these patients has also shown that changes in illness perceptions mediate improvements in depressive episodes [6]. Depressed people are concerned

about the somatic processes of their body, which can be attributed to somatization resulting in complaints of pain [32]. Moreover, NCCP patients report somatization [8]. Overall, NCCP can be the somatic expression of depression. In the same way, our study has shown that somatization and fear of bodily emotions are involved in the relationship between depression and NCCP.

In our study, there was a significant association between type D personality and depression in NCCP patients. It was also mentioned in the paragraph above that somatization predicts depression. On the other hand, somatization is associated with type D personality [33]; therefore, in cases of simultaneous somatization and type D personality, the susceptibility to depression can be greater than when there is only somatization [34]. This type of personality refers to the conjoint effect of NA and SI [33]. As type D personality is known as a risk factor for heart disease, its prevalence among NCCP patients is also high [7,35]. According to a review article, both type D dimensions are associated with higher cortisol levels in response to stress. Perhaps this high level of cortisol is effective in the association between type D personality and depression [35]. In addition, in some type D individuals, changes in the HPA axis are similar to those in depressed patients, and these changes can increase the severity of pain [35].

Regarding the role of lifestyle factors, this study shows that depressed NCCP patients have less physical activity than non-depressed ones. A longitudinal cohort study in 2020 demonstrated that patients with NCCP are less active than the normal population. Inactivity in these patients may interfere with the maintenance of NCCP and also reduce the threshold of pain tolerance [4]. On the other hand, studies represented a bidirectional relationship between depression and physical activity which means depression reduces the level of exercise, and inactivity is a risk factor for depression. A sedentary lifestyle increases the HPA axis and sympathetic system activity and also increases inflammatory factors and all of these events are associated with depression [13]. Also, inflammatory factors such as interleukin (IL)-6, IL-1, and tumor necrosis factor contribute to the development of pain [36].

A recent study has shown that smokers are more prone to develop chronic pain such as NCCP. According to a study in 2016, because nicotine has analgesic effects, these patients tend to smoke to better endure the pain [37]. Also, smoking is considered a risk factor for depression, and depressed patients are more likely to smoke. Factors making smoking common among depressed patients include the genes predisposing individuals to both depression and smoking, social difficulties, and stressful events [12].

Our study showed that NCCP patients who also suffer from depression are susceptible to having poor sleep qual-

ity. A large population-based study demonstrated that sleep disturbances reduce pain tolerance and depressive episodes mediate the relationship between pain and sleep. Meanwhile, the quality of sleep mediates the association between pain and depression. Some neurotransmitters are probably involved in these connections, such as dopamine [14]. On the other hand, more than 80% of depressed patients have disordered sleeping patterns as a debilitating symptom, and more than 50% of individuals with insomnia are depressed [38].

This study has a number of limitations. First, due to the nature of self-report questionnaires, recall and report bias were possible. Second, because of the cross-sectional design of this study, it could not show a cause-and-effect relationship. Third, the sample only included patients from a limited number of hospitals in a city; therefore, the present findings may not be generalized to other patient populations. Also, our study was conducted from a clinical point of view. For this, it was impossible to be 100% sure that no mistake has been made in diagnosing NCCP in patients with chest pain. Of course, we tried to make the diagnoses in this study with high accuracy.

This study also has some strengths. We were able to evaluate a large number of NCCP patients in a relatively short period of time. The mean age of the NCCP patients we studied was similar to studies in larger populations which can be expressed as reflecting “real-world” situations. It is noteworthy that this study is the first study which carefully examines the various predictors of depression among patients with NCCP.

In this study, we examined the factors which can be effective in predicting depression in a patient with NCCP. The most important of these predictors were related to the patient’s psychological state. Our results indicated that type D personality is a strong predictor of depression in these patients. Also, somatization, fear of body sensations, and pain intensity are significant. It has been shown that lifestyle factors can also be considerable in the development of depression, such as physical activity, smoking, and sleep quality.

This study may have provided some interesting new insights into the relationship between NCCP and depression. Due to the importance of NCCP in cardiac departments and primary health care, physicians are advised that in addition to the necessary measures to reduce chest pain, pay attention to the predictors of depression in NCCP patients. It can enable these patients to receive effective psychological consultations, and reduces the costs and the number of ineffectual referrals to medical centers. Also, advice given on lifestyle changes can be effective in preventing or improving depression in these patients. According to our study, daily physical activity, quitting smoking,

and improving sleep quality can be among the subjects of this advice.

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## CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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