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Original Article *Özgün Araştırma*

THE RELATIONSHIP BETWEEN PROBLEM SOLVING AND COPING WITH CHRONIC MUSCULOSKELETAL PAIN IN MEDICAL STUDENTS: A CROSS-SECTIONAL STUDY

Tıp Fakültesi Öğrencilerinde Problem Çözme ve Kronik Kas İskelet Sistemi Ağrısıyla Baş Etme Arasındaki İlişki: Kesitsel Çalışma

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ABSTRACT

Objective: The purpose of this study is to assess the relationship between problem-solving and coping with chronic musculoskeletal pain in medical students.

Material and Methods: A total of 245 medical students (140 female, 105 male) were included in this cross-sectional study, conducted between January 2024 and March 2024. Participants were recruited for the study via an online questionnaire using a snowball sampling technique. Coping with chronic musculoskeletal pain was evaluated using the Pain Coping Inventory (PCI). Problem solving was assessed using the Problem Solving Inventory (PSI).

Results: The prevalence of chronic musculoskeletal pain among medical students was 80.8%. The median active coping subgroup score of the PCI was 2.0 (IQR, 1.63-2.38). The mean passive coping subgroup score of the PCI was 2.10±0.49. The mean PSI score was 86.7±18.8. The PSI scores were negatively correlated with the PCI active coping subscale score (r=-0.159, p=0.025) and positively correlated with the PCI passive coping subscale score (r=0.210, p=0.003) in individuals with chronic musculoskeletal pain. Multivariate regression analysis showed that PSI score was the only factor associated with the PCI active coping score in the participants with chronic musculoskeletal pain (B=-0.004, p=0.024) (R^2=0.026). The PSI score (B=0.006, p=0.001) and VAS score (B=0.045, *p*=0.016) were factors associated with the PCI passive coping score (R^2=0.079).

Conclusion: Problem-solving skills may influence the use of coping strategies for musculoskeletal pain. The development of problem-solving abilities, and even the teaching of such abilities from an early age, may prove beneficial in the management of chronic musculoskeletal pain.

Keywords: *Musculoskeletal pain, pain coping, problem solving, medical student*

ÖZ

Amaç: Bu çalışmanın amacı tıp fakültesi öğrencilerinde kronik kas iskelet sistemi ağrısıyla baş etme ve problem çözme arasındaki ilişkiyi değerlendirmektir.

Gereç ve Yöntemler: Ocak 2024 ile Mart 2024 arasında yürütülen bu kesitsel çalışmaya toplam 245 tıp öğrencisi (140 kadın, 105 erkek) dahil edildi. Katılımcılar kartopu örnekleme tekniği kullanılarak çevrimiçi bir anket yoluyla çalışmaya alındı. Kronik kas-iskelet ağrısıyla baş etme, Ağrıyla Başetme Envanteri (ABE) kullanılarak değerlendirildi. Problem çözme becerisi Problem Çözme Envanteri (PÇE) kullanılarak değerlendirildi.

Bulgular: Tıp fakültesi öğrencileri arasında kronik kas iskelet sistemi ağrısı prevalansı %80.8 idi. ABE'nin aktif başa çıkma alt grup ortanca skoru 2,0 idi (IQR, 1.63-2.38). ABE'nin pasif baş etme alt grup puanı ortalaması 2.10±0.49 idi. Ortalama PÇE skoru 86.7±18.8 idi. Kronik kas iskelet sistemi ağrısı olan bireylerde PÇE skorları ile ABE'nin aktif baş etme alt ölçek skoru arasında negatif korelasyon (r=-0.159, p=0.025), ABE'nin pasif baş etme alt ölçek puanı ile arasında ise pozitif korelasyon (r=0.210, p=0.003) mevcuttu. Çok değişkenli regresyon analizi, kronik kas iskelet sistemi ağrısı olan katılımcılarda PÇE skorunun ABE'nin aktif baş etme skoruyla ilişkili tek faktör olduğunu gösterdi (B=-0.004, p=0.024) (R^2=0.026). Bunun yanı sıra, PÇE skoru (B=0.006, p=0.001) ve vizüel analog skala skoru (B=0.045, p=0.016) ABE'nin pasif baş etme skoruyla ilişkili faktörlerdi (R^2=0.079).

Sonuç: Problem çözme becerileri, kas iskelet sistemi ağrılarıyla baş etme stratejilerinin kullanımını etkileyebilir. Problem çözme becerilerinin geliştirilmesi ve hatta bu becerilerin erken yaştan itibaren öğretilmesi, kronik kas iskelet sistemi ağrılarının yönetiminde faydalı olabilir.

Anahtar Kelimeler: *Kas iskelet sistemi ağrısı, ağrıyla baş etme, problem çözme, tıp fakültesi öğrencisi*

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INTRODUCTION

Musculoskeletal conditions are commonly characterized by pain and are a leading cause of disability worldwide (1). They are also associated with reduced range of joint motion, reduced ability to work, and reduced participation in society (1,2). Approximately 1.71 billion individuals globally are affected by musculoskeletal conditions (2).

Training competent, qualified, and professional physicians is one of the main goals of medical schools (3). To achieve these goals, students are exposed to stress, hard work, and long clinic training periods (3). Medical students are required to attend lengthy lectures and may be required to stand for extended periods during practical lessons, which may result in poor posture and musculoskeletal pain (MSP) (3). MSP is reported as common in medical students in the literature (4). Although there are several studies in the literature investigating the prevalence of MSP in medical students, there is a lack of knowledge about chronic musculoskeletal pain (CMSP) (3,4). It is of significant importance to medical students to determine the prevalence of CMSP and to develop effective prevention and management strategies, as this can result in absenteeism from university classes, ineffective learning, and a reduction in quality of life.

Chronic pain is a condition consisting of biological, psychological, and social components (5). Pain coping, which is defined as the thoughts and behaviors used to manage pain and its effects, is one of the psychological factors involved in chronic pain adjustment (5). Pain coping has been reported in the literature to be associated with physical and psychological function (5). The process of problem solving is complex and involves the use of different parts of the brain for different types of problems, including arithmetic, cooperative, complex mathematical, insight, verbal, and so forth (6). Problem solving process is comprised of a series of key steps, including the identification of the problem, the determination of its causes, the generation of potential solutions, the application of the chosen solutions, and the evaluation of their effectiveness (7). This process can be applied in a variety of settings, including personal decision-making and the resolution of complex problems (7). To the best of our knowledge, there are a few studies investigating the relationship between problem-solving and chronic pain (8-10). However, there is a lack of knowledge in the literature regarding the relationship between coping with the CMSP and problem solving skills.

The purpose of this study is to assess the relationship between problem-solving and coping with the CMSP in medical students.

MATERIALS AND METHODS

A total of 245 medical students were included in this cross-sectional study, which was conducted between January 2024 and March 2024. Ethics approval was obtained from the local non-interventional research ethics committee (Date: 13/12/2023, number: 2023.12.11), and all participants signed their consent to participate in the study in the first question of the survey.

Study population

Two hundred and forty five medical students (140 female, 105 male) aged 18 years and over included in the study. Participants were recruited for the study via an online questionnaire using a snowball sampling technique. The general principles of snowball sampling involve identifying index individuals, collecting information about the research subject, and asking them to refer other suitable participants to the study. After other individuals follow the same path, the research may either be terminated or advanced to subsequent stages (11). Individuals with inflammatory rheumatologic diseases, liver failure, renal failure, neurologic disorders, psychosis, and malignancy were excluded. Sociodemographic variables including age, sex, height (cm), weight (kg), BMI (kg/m^2), year of medical school, cigarette use, alcohol use, frequency of physical activity (day/week), and nighttime sleep duration (hour/day) were reported. CMSP was defined as musculoskeletal pain that persists or recurs for more than 3 months (12). The subjects were queried as to whether they had CMSP. The presence and musculoskeletal regions (neck, shoulders, upper back, elbows, wrists/hands, lower back, hips/thighs, knees, and ankles/feet) of CMSP were recorded. History of taking sick leave from school due to MSP, history of medication due to MSP, limitation of activities in daily living due to MSP, and history of musculoskeletal surgery were noted. Pain severity was assessed using a 10-cm visual analog scale (VAS). A score of 0 defined as the absence of pain, while a score of 10 was reported as the worst possible pain intensity.

Questionnaires

Pain Coping Inventory (PCI)

Coping with CMSP was evaluated using PCI which was designed by Kraaimat and Evers (13). Turkish validation and reliability of the PCI was performed by Hocaoğlu et al. (14). Turkish version of the 22-item PCI consists of six subscales (pain transformation, distraction, relaxing thinking, retreating, worrying, and resting) and active and passive coping strategies, reflecting cognitive and behavioral approach to chronic pain (14,15). Active pain coping strategies include pain transformation, distraction, relaxing thinking, and passive coping strategies include retreating, worrying, and resting strategies (14,15). Each item is scored between 1 (hardly ever) and 4 (very often) (14,15).

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Higher mean scores on each subscale indicate greater use of that subscale's coping strategy (13,15).

Problem Solving Inventory (PSI)

The PSI was used to assess problem-solving (16). The PSI consists of six subscales including impulsive style, reflective style, problem solving confidence, avoidant style, monitoring, and planfulness (16). Responses to each item are scored ranged between 1 (strongly agree) and 6 (strongly disagree). The total score is ranges from 32 to 198. Lower scores indicate that a person perceives him/herself to be more confident in problem solving, and to have more personal control over the problem (16).

Statistical Analysis

The distribution of continuous variables was investigated for normality using the Shapiro-Wilk test. Descriptive variables were presented as mean ± standard deviation (SD), median (interquartile range [IQR]), and number, percentage (n, %). The difference between normally distributed and non-normally distributed continuous variables in two independent groups was compared using the Student's t-test and Mann-Whitney U test, respectively. Spearman correlation analysis was used to determine the correlation coefficients between the continuous descriptive variables, PCI active and passive coping subscales, and PSI scores. Multivariate linear regression analysis was used to identify the final predictive variables for the PCI subscales in medical students. Age, sex, school year, BMI, nighttime sleep duration, frequency of physical activity, VAS score, and PSI total score were included in the multiple linear regression analysis to determine the independent variables for both the PCI active coping and PCI pain coping subscales. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The median age of the participants was 22.0 years (IQR, 20.0-23.0). Of the participants, 11.4% were in the first school year, 15.5% were in the second year, 27.3% were in the third year, 15.5% were in the fourth year, 20.4% were in the fifth year, and 9.8% were in the sixth year. The CMSP prevalence was 80.8%. Of the participants, 51.4% reported having chronic neck pain, 48.6% reported chronic upper back, 32.2% reported chronic shoulder pain, 3.3% reported chronic elbow pain, 15.1% reported chronic wrist/hand pain, 40.8% reported chronic low back pain, 4.9% reported chronic hip pain, 17.1% reported chronic knee pain, and 11.4% reported chronic ankle/foot pain. 12.2% of the participants reported having a history of taking sick leave from school due to MSP, 40.4% reported having a history of medication due to MSP, 51.0% reported having a limitation in activities of daily living due to MSP, and %3.3 reported a history of musculoskeletal surgery. The median VAS score was 4.0 (IQR, 3.0-6.0).

Demographic variables, the CPI scores, and PSI scores in participants with and without CMSP were presented in Table 1.

The median active coping subgroup score of the PCI was 2.0 (IQR, 1.63-2.38). The mean passive coping subgroup score of the PCI was 2.10±0.49. The mean PSI score was 86.7±18.8. There was no statistically significant difference between participants with and without CMSP in terms of PCI active and passive coping subscales, and PSI scores (p>0.05) (Table 1). In addition, there was no statistically significant difference between female and male participants in terms of PCI active and passive coping subscales, and PSI scores (p>0.05).

The PSI scores were negatively correlated with the PCI active coping subscale score (r=-0.159, p=0.025) and positively correlated with the PCI passive coping subscale score (r=0.210, p=0.003) in individuals with CMSP. Subgroup analysis showed that, the PSI scores were negatively correlated with PCI Distraction subscale scores (r=-0.141, p=0.048), and positively correlated with the PCI Worry subscale scores (r=0.273, p<0.001), and the PCI Retreating subscale scores (r=0.197, p=0.005). There were no statistically significant correlations between the PSI scores and the PCI subscales of the Pain Transformation, Relaxing Thinking, and Resting scores (p>0.005). Correlations between demographic variables, PCI active and passive coping subscales, and PSI scores in participants with CMSP are presented in Table 2.

Multivariate regression analysis showed that PSI score was the only factor associated with the PCI active coping score in the participants with CMSP (B=-0.004, p=0.024) (R^2=0.026). The PSI score (B=0.006, p=0.001) and VAS score (B=0.045, p=0.016) were factors associated with the PCI passive coping score (R^2=0.079).

DISCUSSION

The findings of the current study indicated that the prevalence of CMSP was 80.8% in medical students. Higher levels of problem-solving confidence were associated with greater use of active pain coping strategies and lower use of with passive pain coping strategies.

Musculoskeletal pain results from differential sensory innervation of bones, joints, and muscles. Peripheral and sensory nervous systems and mediators play a role in its pathogenesis (17). Interactions between neurons and non-neuronal cells such as glial, mesenchymal, and immune cells can amplify or sensitize pain signals. This can lead to cortical remodeling (17).

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Table 1: Demographic variables, the CPI scores, and PSI scores in participants with and without CMSP

Variables	With CMSP n=198	Without CMSP n=47	p-value
Age (year) (median [IQR])	22.0 (IQR, 20.0-23.0)	22.0 (IQR, 20.0-23.0)	0.325
Sex, n (%)			
Female	120 (60.6)	20 (42.6)	**0.025**
Male	78 (39.4)	27 (57.4)	
BMI (kg/m^2) (median [IQR])	22.0 (IQR, 20.1-25.2)	23.7 (IQR, 21.1-24.9)	0.260
Cigarette use, n (%)			
Yes	45 (22.7)	7 (14.9)	0.121
No	145 (73.2)	35 (74.5)	
Ex-smoker	8 (4.0)	5 (10.6)	
Physical activity, n (%)			
Yes	88 (44.4)	25 (53.2)	0.280
No	110 (55.6)	22 (46.8)	
Frequency of physical activity (day/week) (median [IQR])	2.0 (IQR, 1.0-3.0)	3.0 (IQR, 1.0-4.0)	0.118
Sleep duration (hour/day) (median [IQR])	7.0 (IQR, 6.0-8.0)	7.0 (IQR, 6.0-7.0)	0.051
VAS (cm) (median [IQR])	5.0 (IQR, 3.0-6.0)	0.0 (IQR, 0.0-2.0)	**<0.001**
History of taking sick leave from school due to MSP, n (%)			
Yes	27 (13.6)	3 (6.4)	0.173
No	171 (86.4)	44 (93.6)	
History of medication due to MSP, n (%)			
Yes	87 (43.9)	12 (25.5)	0.021
No	111 (56.1)	35 (74.5)	
Limitation of activities in daily living due to MSP, n (%)			
Yes	109 (55.1)	16 (34.0)	0.010
No	89 (44.9)	31 (66.0)	
Pain coping inventory scores			
PCI distraction (median [IQR])	2.17 (IQR, 1.67-2.67)	2.33 (IQR, 1.67-2.67)	0.841
PCI pain transformation (median [IQR])	2.0 (IQR, 1.5-2.5)	1.5 (IQR, 1.0-2.0)	**0.012**
PCI relaxing thinking (median [IQR])	2.0 (IQR, 1.33-2.33)	2.0 (IQR, 1.33-2.33)	0.634
PCI worrying (median [IQR])	1.75 (IQR, 1.25-2.0)	1.75 (IQR, 1.25-2.0)	0.661
PCI resting (median [IQR])	2.5 (IQR, 2.0-2.83)	2.17 (IQR, 1.83-2.83)	0.092
PCI retreating (median [IQR])	2.0 (IQR, 1.5-2.5)	2.0 (IQR, 1.5-2.25)	0.243
PCI active subscale (median [IQR])	2.0 (IQR, 1.63-2.38)	2.0 (IQR, 1.63-2.38)	0.689
PCI passive subscale (ort±SS)	2.13±0.48	1.98±0.54	0.067
Problem solving inventory scores			
PSI avoident (median [IQR])	9.5 (IQR, 8.0-12.0)	9.0 (IQR, 6.0-14.0)	0.829
PSI problem solving (median [IQR])	14.0 (IQR, 12.0-18.0)	14.0 (IQR, 11.0-20.0)	0.747
PSI monitoring (median [IQR])	6.0 (IQR, 5.0-8.0)	6.0 (IQR, 5.0-9.0)	0.102
PSI planfulness (median [IQR])	9.0 (IQR, 7.0-11.0)	9.0 (IQR, 8.0-13.0)	0.160
PSI reflective (median [IQR])	10.0 (IQR, 8.0-13.0)	11.0 (IQR, 9.0-13.0)	0.077
PSI impulsive (mean±SD)	30.9±7.6	30.2±7.4	0.551
PSI total (mean±SD)	86.2±18.7	88.5±19.6	0.450

BMI: Body mass index, CMSP: Chronic musculoskeletal pain, MSP: Musculoskeletal pain, PCI: Pain coping inventory, PSI: Problem solving inventory, VAS: Visual analog scale

Table 2: Correlations between demographic variables, PCI active and passive coping subscales, and PSI scores in participants with CMSP

Variables	PCI active coping	PCI passive coping	PSI total	PSI avoidant	PSI problem solving	PSI monitoring	PSI planfulness	PSI reflective	PSI impulsive
Age	r=-0.056 p=0.434	r=0.010 p=0.890	r=-0.076 p=0.289	r=-0.032 p=0.650	r=-0.077 p=0.280	r=-0.048 p=0.504	r=-0.066 p=0.359	r=-0.046 p=0.518	r=-0.099 p=0.518
BMI	r=0.034 p=0.633	r=0.003 p=0.969	r=0.104 p=0.143	r=0.072 p=0.313	r=0.050 p=0.483	r=0.025 p=0.727	r=0.026 p=0.711	r=0.030 p=0.676	r=0.100 p=0.160
School year	p=0.054	r=-0.096 p=0.178	r=-0.098 p=0.171	r=-0.066 p=0.353	r=-0.074 p=0.301	r=-0.060 p=0.400	r=-0.033 p=0.647	r=-0.007 p=0.926	r=-0.115 p=0.107
Sleep duration	p=0.083	r=0.106 p=0.138	**r=0.243** **p=0.001**	**r=0.272** **p<0.001**	**r=0.189** **p=0.008**	**r=0.158** **p=0.027**	r=0.115 p=0.107	**r=0.162** **p=0.023**	r=0.129 p=0.072
Physical activity frequency	r=-0.019 p=0.794	r=-0.106 p=0.138	r=-0.111 p=0.118	r=-0.040 p=0.572	**r=-0.148** **p=0.037**	r=-0.088 p=0.217	r=-0.090 p=0.208	r=-0.053 p=0.459	r=0.003 p=0.965
VAS	r=-0.038 p=0.592	**r=0.146** **p=0.041**	r=0.010 p=0.886	r=0.128 p=0.073	r=-0.003 p=0.970	r=0.027 p=0.704	r=-0.084 p=0.241	r=-0.065 p=0.365	r=-0.018 p=0.805
PCI active coping		r=0.030 p=0.674	**r=-0.159** **p=0.025**	r=-0.078 p=0.276	**r=-0.158** **p=0.026**	**r=-0.184** **p=0.009**	**r=-0.140** **p=0.049**	r=-0.091 p=0.202	r=-0.038 p=0.599
PCI passive coping	p=0.674	-	**r=0.210** **p=0.003**	**r=0.170** **p=0.017**	**r=0.179** **p=0.012**	r=0.077 p=0.282	r=0.124 p=0.081	r=0.134 p=0.059	r=0.136 p=0.055
PSI total	**r=-0.159** **p=0.025**	**r=0.210** **p=0.003**	-	**r=0.637** **p<0.001**	**r=0.785** **p<0.001**	**r=0.290** **p<0.001**	**r=0.644** **p<0.001**	**r=0.689** **p<0.001**	**r=0.712** **p<0.001**

BMI: Body mass index, CMSP: Chronic musculoskeletal pain, PCI: Pain coping inventory, PSI: Problem solving inventory, VAS: Visual analog scale

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In addition, a number of other factors may influence the manifestations and perceptions of MSP, including age, sex, mood, genetic, epigenetic, social, and cultural factors, beliefs, thoughts, and behaviors (17,18). In addition to the pathogenesis of pain, patients' thoughts and behaviors which are defined as pain coping, are important factors that influence physical functioning, psychological functioning, and pain management (13,17). These pain coping strategies may be adaptive or maladaptive, and positive or negative, depending on the patient's cognitive, functional, and psychosocial state (13). Passive pain strategies have been found in the literature to be associated with poor outcomes, decreased physical function, and increased psychological distress (13). Therefore, identifying the factors associated with active and passive pain coping strategies may be useful in educating patients, managing their CMSP, and preventing the long-term negative consequences of CMSP. The current study showed that, although there was no statistically significant difference between individuals with and without the CMSP, Pain Transformation Subscale score of the PCI was higher in individuals with the CMSP than in those without. In addition, the VAS score was positively correlated with passive PCI subscale scores.

The present study demonstrated that greater use of active pain coping was associated with a greater perceived problem-solving ability. In addition, passive pain coping was found to be associated with lower perceived problem-solving ability. In addition, there was a negative correlation between the active pain coping subscale of the PCI and the problem solving, monitoring, and planfulness subscales of the PSI. To the best of our knowledge, there is a limited data on the literature about the relationship between musculoskeletal pain coping and problem solving. A few studies in the literature have investigated the relationship between worry and chronic pain coping strategies (8,9). Eccleston et al. reported that although worry may help to search for ways to solve problems in patients with pain, it may also result in a misdirected problem-solving process in individuals with chronic pain conditions (8). The results of our study demonstrated a positive correlation between the PSI scores and the Worry subscale of PCI scores, a finding that is consistent with the hypothesis presented above. Furthermore, a few studies in the literature have investigated problem-solving therapy in patients with chronic pain or MSP (19,20). Ribera et al. investigated the social problem solving in chronic pain and they reported that problem solving components were found associated with mental health (21). These findings may be related to the fact that increased problem solving skills may help identify the cause of pain, create solutions to relieve pain, and remain physically active in daily activities.

It is noteworthy that the duration of sleep was inversely correlated with problem-solving ability in the present study. This finding may be attributed to the quality of nighttime sleep. The assessment of sleep quality was limited to the duration of nighttime sleep, without consideration of the frequency of waking up, sleep latency, habitual sleep efficiency, sleep disturbances, daytime dysfunction, or dreaming. These factors may influence sleep quality and problem solving ability (22,23). Further studies investigating the relationship between sleep quality, problem solving, and CMSP coping are needed.

Strengths of this study include the inclusion of components of musculoskeletal pain coping strategies and problem-solving ability, the lack of occupational diversity among participants, and the inclusion of younger adults. Limitations of the study include the relatively small sample size and the lack of assessment of depression, anxiety and sleep quality.

In conclusion, problem-solving skills may influence the use of coping strategies for musculoskeletal pain. The development of problem-solving abilities, and even the teaching of such abilities from an early age, may prove beneficial in the management of CMSP, the reduction of the use of passive coping strategies, and the facilitation of more active engagement in activities of daily living.

*Conflict of Interest***:** The authors have no conflicts of interest to declare.

*Researchers' Contribution Rate Statement***:** Concept/Design: DBK, MFE, NNO, SK, SO, MUC, MTK; Analysis/Interpretation: DBK, MFE, NNO, SK, SO, MUC, MTK; Data Collection: DBK, MFE, NNO, SK, SO, MUC, MTK; Writer: DBK, MFE, NNO, SK, SO, MUC, MTK; Critical Review: DBK, MFE, NNO, SK, SO, MUC, MTK; Approver: DBK, MFE, NNO, SK, SO, MUC, MTK

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Ethics Committee Approval: The study protocol was approved by the Kırıkkale University Non-Interventional Research Ethics Committee (Date: 13/12/2023, number: 2023.12.11).

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