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The Mediating Role of Emotion Regulation in Explaining the Causal Relationships Between Childhood Trauma and Pain in Women with Rheumatoid Arthritis

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A B S T R A C T

Purpose: The present study aimed to investigate the mediating role of emotion regulation in explaining the causal relationships between childhood trauma and pain in women with rheumatoid arthritis.

Methods and Materials: In a cross-sectional study based on structural equation modeling, during the period from December 2022 to June 2023, 286 participants diagnosed with rheumatoid arthritis, who had been referred to three hospitals (Loghman, Taleghani, and Shahid Tajrish) in Tehran, were selected using purposive sampling. After obtaining informed consent and meeting the inclusion criteria, they were enrolled in the study. Three indices—childhood trauma, pain, and emotion regulation—were assessed at one time point by the participants. Data were analyzed using SPSS and AMOS software version 25.

Findings: Data analysis showed that both emotion regulation strategies, reappraisal ($\beta = 0.068$, $p = 0.001$) and emotional suppression ($\beta = 0.140$, $p = 0.001$), positively and significantly mediated the relationship between childhood trauma and pain in women with rheumatoid arthritis.

Conclusion: The findings of this study, consistent with previous research, indicate an association between childhood trauma and pain mediated by emotion regulation. However, in patients with rheumatoid arthritis, pain and other psychological variables exhibit a complex relationship that requires further research.

Keywords: *Pain, Childhood Trauma, Emotion Regulation, Rheumatoid Arthritis.*

1. Introduction

Rheumatoid arthritis is a chronic systemic autoimmune disorder that primarily causes joint tenderness, swelling, destruction, and the resulting disability (Díaz-González & Hernández-Hernández, 2023). While its exact cause remains unknown, rheumatoid arthritis results from the interaction between hereditary genetic factors and environmental triggers during the preclinical stages of the disease, where tolerance is broken, and autoantibodies, including anti-citrullinated peptide antibodies, are produced long before the onset of joint symptoms (Favalli, 2020). Rheumatoid arthritis is characterized by dysregulated inflammatory and immune processes in the synovium of the joints, as well as bone loss, which makes it an excellent model for gaining insight into osteoimmunology (Auréal et al., 2020). Rheumatoid arthritis affects approximately 0.5% to 1% of the global population (Simon et al., 2021). Iran is one of the largest centers for rheumatoid arthritis in West Asia (Shadmanfar et al., 2020), with a reported prevalence of 0.33% (Jamshidi et al., 2014). Patients suffering from this condition exhibit various psychological symptoms, such as high levels of stress, negative mood, poor self-efficacy, and maladaptive coping mechanisms, which significantly impact their quality of life, pain perception, and even personality (Sturgeon et al., 2016). The psychological background of rheumatoid arthritis, including predisposing factors, pre-disease traits, and subsequent psychological disorders, has been the subject of long-term study (Keefe & Somers, 2010).

In terms of mental health disorders, approximately 20-40% of patients with rheumatoid arthritis meet the criteria for major depressive disorder, while 25-70% of patients present with an anxiety disorder. Moreover, most patients exhibit both symptoms. Research shows that these psychological factors have adverse consequences in terms of disease severity and activity (Matcham et al., 2018), and they are associated with increased pain, fatigue, and functional impairment (Majnik et al., 2022). As rheumatoid arthritis is undoubtedly a chronic pain condition, it has biological (inflammatory pain, fatigue), psychological (anxiety, depression), and social (reduced work capacity, less active lifestyle) dimensions (Nagy et al., 2023).

Pain is one of the main symptoms of rheumatoid arthritis and the strongest predictor of psychosocial health (Das & Choy, 2023). Consequently, patients typically describe pain as their most significant symptom (Choy et al., 2023). Although joint inflammation and damage are recognized causes of pain in rheumatoid arthritis (Boyden et al., 2016; Choy & Calabrese, 2018), the level of pain and pain-related disability reported by some patients exceeds expectations based on assessments of joint damage and inflammation (Druce et al., 2015). This is referred to as disproportionate joint pain, which is clinically relevant for patients with rheumatoid arthritis. Additionally, in some patients, despite treatment with anti-inflammatory disease-modifying antirheumatic drugs (DMARDs), pain remains persistent (Jo et al., 2023). It has been shown that patients with rheumatoid arthritis experience increased pain sensitivity to various stimuli (Finckh et al., 2022), and this sensitivity may increase with the duration of rheumatoid arthritis (Videm et al., 2022). Thus, the higher-than-expected pain levels in some rheumatoid arthritis patients may result from hyperalgesia.

On the other hand, studies have shown that rheumatoid arthritis is associated with various emotional stressors (Spitzer et al., 2013). Adverse childhood experiences are negative and stressful events occurring before age 18, which include childhood maltreatment and family dysfunction, such as divorce (Francis et al., 2023). Childhood maltreatment can be categorized as physical, emotional, and sexual abuse, as well as physical and emotional neglect (Lee et al., 2023). Childhood trauma represents one of the most severe forms of stress and has been shown to have long-term negative consequences for both mental and physical health well into adulthood (Suglia et al., 2018). Individuals who experience childhood maltreatment are at a higher risk of adverse physical (To et al., 2013) and mental health outcomes (Pierce et al., 2023) in adulthood. Childhood maltreatment may be associated with inflammatory diseases driven by the immune system (Herzog & Schmahl, 2018), such as multiple sclerosis (Shaw et al., 2017), inflammatory bowel disease (Fuller-Thomson et al., 2015), and rheumatoid arthritis (Bayram & Erol, 2014). Similarly, a study found that adults with two or more adverse childhood experiences were at increased risk of developing rheumatic diseases, including rheumatoid arthritis (Helo et al., 2017).

Another dimension worth considering in individuals with rheumatoid arthritis is emotion. The experience and regulation of emotions are fundamental human characteristics (Vater & Schröder-Abé, 2015). Therefore, it is crucial to address the pain symptoms and the emotions these patients experience. Emotion regulation involves efforts, through implicit or explicit goal execution, to alter the course of positive or negative emotional experiences. Researchers have cataloged several emotion regulation strategies, such as reappraisal, distraction, expressive

E-ISSN: 3041-8828

suppression, and distancing, through which individuals modulate their emotions. Extensive research generally explores how these processes are deployed in individuals (English et al., 2017; Ma & Fang, 2019; Vater & Schröder-Abé, 2015). Increasing the quantity and quality of emotion regulation skills and reducing emotional reactivity is a common goal of many psychotherapies, as enhancing emotional regulation abilities can reduce distress in various contexts of psychosocial functioning (Ma & Fang, 2019). Indeed, skillful emotion regulation is generally associated with improved communication functioning and social relationships (Vater & Schröder-Abé, 2015). Moreover, individuals with advanced emotion regulation are also better able to select strategies that best align with their goals within a given situation (English et al., 2017). Considering that inflammatory biology responds to increased negative emotions, such as anger or anxiety, it is plausible that improved emotion regulation may also influence inflammatory biology (Carroll et al., 2011).

In conclusion, based on the literature, it is hypothesized that childhood trauma is associated with pain and that this relationship may be moderated by emotion regulation. Despite the research background on the relationship between these variables, examining the multiple relationships among these variables within a structural equation modeling framework has not yet been considered. The present study aims to investigate the mediating role of emotion regulation in explaining the causal relationships between childhood trauma and pain in women with rheumatoid arthritis.

2. Methods and Materials

2.1. Study Design and Participants

This study was a cross-sectional research conducted using structural equation modeling (SEM). From December 2022 to June 2023, 286 participants diagnosed with rheumatoid arthritis who were referred to three hospitals (Loghman, Taleghani, and Shahid Tajrish) in Tehran were selected through purposive sampling. After obtaining informed consent and meeting the specified inclusion criteria, participants were enrolled in the study. The inclusion criteria were as follows: 1) age range of 18-45 years (based on the allostatic load theory regarding the impact of time on the embodiment of traumatic events, the sample was chosen within a limited age range); 2) diagnosis of rheumatoid arthritis by a specialist physician; 3) a score higher than 41 on the Childhood Trauma Scale; 4) no palliative care using opioid medications (prescribed analgesics were allowed, but the use of any illicit narcotic drugs was prohibited); 5) no psychological interventions in the past 6 months; and 6) the ability to read and write. The exclusion criterion was incomplete questionnaires. Three indices—pain, adverse childhood experiences, and quality of life—were completed by the participants at one point in time. Data were analyzed using SPSS and AMOS version 25.

2.2. Measures

2.2.1. Childhood Trauma

This self-report questionnaire was developed by Bernstein et al. in 1994. The second version, consisting of 53 items, was presented in 1995, and the final 34-item version was finalized in 1998. The short form consists of 28 items. Responses are given on a 5-point Likert scale ranging from “never” to “always,” and it assesses five subscales: physical abuse, emotional abuse, sexual abuse, physical neglect, and emotional neglect. In the study by Ebrahimi and Dezhkam (2012), Cronbach’s alpha for the total questionnaire and its subscales ranged between 0.813 and 0.977. Similarly, in the study by Norouzi and Zemestani (2020), Cronbach’s alpha for emotional abuse was 0.82, physical abuse 0.81, sexual abuse 0.86, emotional neglect 0.90, and physical neglect 0.71 (Arbab et al., 2020). In the present study, Cronbach’s alpha for emotional abuse was 0.84, physical abuse 0.75, sexual abuse 0.56, emotional neglect 0.80, and physical neglect 0.74.

2.2.2. Pain

The revised McGill Pain Questionnaire (2SF-MPQ) was developed in 2009 by Dworkin et al. to expand and enhance the original McGill Pain Questionnaire by adding indicators for both neuropathic and non-neuropathic pain. The questionnaire consists of 22 items, with a response range from 0 to 10 in relation to pain severity, based on data from 882 participants with various pain symptoms and 226 patients with diabetes and neuropathic pain who participated in a randomized clinical trial. The findings indicated acceptable reliability and validity for this questionnaire. Exploratory and confirmatory factor analyses revealed four subscales: continuous pain, intermittent pain, neuropathic pain, and affective pain. Cronbach’s alpha was reported as 0.87, 0.87, 0.83, and 0.86, respectively. Tanhaei et al. (2012) validated this tool for patients with irritable bowel syndrome, reporting three factors: sensory pain, affective pain, and neuropathic pain. In the Iranian version,

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Cronbach's alpha for sensory pain was 0.87, affective pain 0.87, neuropathic pain 0.78, and the total scale 0.92 (Ensandoost et al., 2021). In the present study, Cronbach's alpha for sensory pain was 0.82, affective pain 0.87, and neuropathic pain 0.74.

2.2.3. Emotion Regulation

This questionnaire was developed by Gross and John in 2003 and consists of 10 items. It includes two subscales: reappraisal with 6 items and suppression with 4 items. Respondents rate each item on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The total score for emotion regulation ranges from 10 to 50, with the reappraisal subscale ranging from 6 to 30 and the suppression subscale from 4 to 20. Cronbach's alpha for reappraisal was reported as 0.79, and for suppression, 0.73. The test-retest reliability after 3 months for the entire scale was 0.69. The internal consistency (Cronbach's alpha ranging from 0.60 to 0.81) and validity of the questionnaire were supported by principal component analysis using varimax rotation, with a correlation between the two subscales (r = 0.13) and satisfactory construct validity (Abbasian Hadadan, 2024; Babakhanlou, 2023; Roghani et al., 2022). In the present study, Cronbach's alpha for reappraisal was 0.79 and for suppression 0.64.

2.3. Data Analysis

The data were analyzed using SPSS version 21 software and repeated measures analysis of variance (ANOVA).

3. Findings and Results

In the present study, 286 participants were included with a mean age of 38.67 and a standard deviation of 5.86 years. Among the participants, 59 individuals (20.6%) were single, 178 individuals (62.2%) were married, and 49 individuals (17.1%) were divorced. Regarding education, 86 participants (30.1%) had less than a high school diploma, 83 participants (29%) had a high school diploma, 25 participants (8.7%) had an associate degree, 70 participants (24.5%) held a bachelor's degree, and 22 participants (7.7%) had a master's degree or higher. Additionally, 131 participants (45.8%) were housewives, 50 participants (17.5%) were employees, 81 participants (28.3%) were self-employed, and 24 participants (8.4%) were unemployed. Finally, the duration since the diagnosis of the disease for 145 participants (50.7%) was less than 2 years, for 84 participants (29.4%) between 2 to 5 years, and for 57 participants (19.9%) more than 5 years.

Table 1

Correlation Coefficients for Variables

Variables	1	2	3	4	5	6	7	8	9	10
1. Childhood Trauma - Emotional Abuse	-									
2. Childhood Trauma - Physical Abuse	0.61	-								
3. Childhood Trauma - Sexual Abuse	0.40	0.48	-							
4. Childhood Trauma - Emotional Neglect	0.47	0.43	0.59	-						
5. Childhood Trauma - Physical Neglect	0.66	0.52	0.61	0.55	-					
6. Emotion Regulation - Reappraisal	-0.26	-0.24	*-0.14*	-0.22	*-0.15*	-				
7. Emotion Regulation - Suppression	0.31	0.19	0.30	0.37	0.30	-0.43	-			
8. Pain - Sensory	0.42	0.40	0.26	0.39	0.27	-0.27	0.62	-		
9. Pain - Affective	0.37	0.42	0.25	0.28	0.19	-0.34	0.48	0.56	-	
10. Pain - Neuropathic	0.34	0.38	0.39	0.24	0.37	-0.27	0.32	0.49	0.53	-

P<0.01

E-ISSN: 3041-8828

Table 2

Means, Standard Deviations, Skewness, Kurtosis, Tolerance, and VIF for Variables

Variable	Mean	SD	Skewness	Kurtosis	Tolerance	VIF
1	16.93	4.24	-0.86	-0.78	0.43	2.32
2	14.01	3.87	-0.62	-0.95	0.39	2.56
3	10.16	3.35	1.25	0.39	0.44	2.29
4	10.40	3.94	-0.77	-0.09	0.40	2.47
5	11.97	3.85	-0.33	-0.42	0.67	1.50
6	16.13	4.80	0.14	-0.97	0.56	1.78
7	10.55	3.92	0.24	-0.76	0.62	1.61
8	28.02	6.60	0.11	-1.13	-	-
9	22.19	5.17	-0.23	-0.29	-	-
10	17.81	4.86	-0.35	-0.61	-	-

The results of correlation coefficients between the study variables indicate that the correlations are in the expected direction and aligned with the theoretical foundations of the research field. To evaluate the assumption of normality in the univariate distribution of the data, the skewness and kurtosis indices were examined. The skewness and kurtosis values for the variables did not exceed the range of -2 to +2, indicating that there were no significant deviations from univariate normality. The multicollinearity assumption was assessed using the variance inflation factor (VIF) and tolerance coefficient. The results also demonstrates that the multicollinearity assumption was satisfied, as the tolerance values for all predictor variables were greater than 0.1, and the VIF values were less than 10 for each predictor variable.

To assess the assumption of multivariate normality, the Mahalanobis distance values were analyzed, and a plot of the distribution was created. The skewness and kurtosis of the Mahalanobis distance scores were 2.14 and 7.05, respectively. Since these values exceeded the range of ±2, the assumption of multivariate normality was not satisfied. As a result, a box plot was generated, revealing that 5 participants' data represented multivariate outliers. After removing the data of these 5 participants, the skewness and kurtosis values decreased to 0.86 and 1.07, respectively, indicating that the multivariate normality assumption was then satisfied. Finally, the homogeneity of variance assumption was evaluated using a scatter plot of standardized residuals, and the results confirmed that this assumption was also satisfied in the present study.

In this study, childhood trauma and pain were latent variables that formed the measurement model. It was hypothesized that the latent variable of childhood trauma would be measured by indicators of emotional abuse, physical abuse, sexual abuse, emotional neglect, and physical neglect, and that the latent variable of pain would be measured by indicators of sensory pain, affective pain, and neuropathic pain. The fit of the measurement model with the collected data was evaluated using confirmatory factor analysis (CFA) with AMOS version 24 and the maximum likelihood (ML) estimation method. Table 3 shows the fit indices of the measurement model.

Table 3

Fit Indices for the Measurement Model

Fit Indices	Initial Measurement Model	Modified Measurement Model	Cut-off Point
Chi-square	111.79	42.94	-
Degrees of Freedom	19	18	-
χ^2/df	5.88	2.39	< 3
GFI	0.924	0.966	> 0.90
AGFI	0.856	0.932	> 0.85
CFI	0.921	0.979	> 0.90
RMSEA	0.132	0.070	< 0.08

Table 3 indicates that two fit indices, RMSEA and χ^2/df, did not support an acceptable fit of the initial measurement model with the data. Therefore, the measurement model was modified by adding covariance between the errors of the sexual abuse and emotional neglect indicators. As shown in Table 3, the fit indices obtained after the modification

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indicated an acceptable fit of the measurement model with the data. In the measurement model, the highest factor loading belonged to the physical abuse indicator (β = 0.942), and the lowest factor loading belonged to the sexual abuse indicator (β = 0.528). Since all factor loadings were above 0.32, it can be concluded that all indicators had sufficient capacity to measure the two latent variables.

To test the research hypotheses, a model was designed in which it was hypothesized that childhood trauma is related to pain in women with rheumatoid arthritis, mediated by emotion regulation. Structural equation modeling (SEM) was used to test this model. Table 4 shows the fit indices for the structural model.

Table 4

Fit Indices for the Structural Model

Fit Indices	Initial Structural Model	Modified Structural Model
Chi-square	108.34	80.27
Degrees of Freedom	31	30
χ^2/df	3.50	2.68
GFI	0.935	0.949
AGFI	0.885	0.907
CFI	0.938	0.959
RMSEA	0.094	0.077

Table 4 shows that, except for two fit indices (GFI and CFI), the other indices did not support an acceptable fit of the initial structural model with the data. Therefore, the structural model was modified by adding covariance between the errors of the emotional suppression and reappraisal indicators of emotion regulation. After this modification, the fit indices showed an acceptable fit of the structural model with the data. Table 5 presents the path coefficients between the variables in the structural model.

Table 5

Path Coefficients Between Variables in the Structural Model

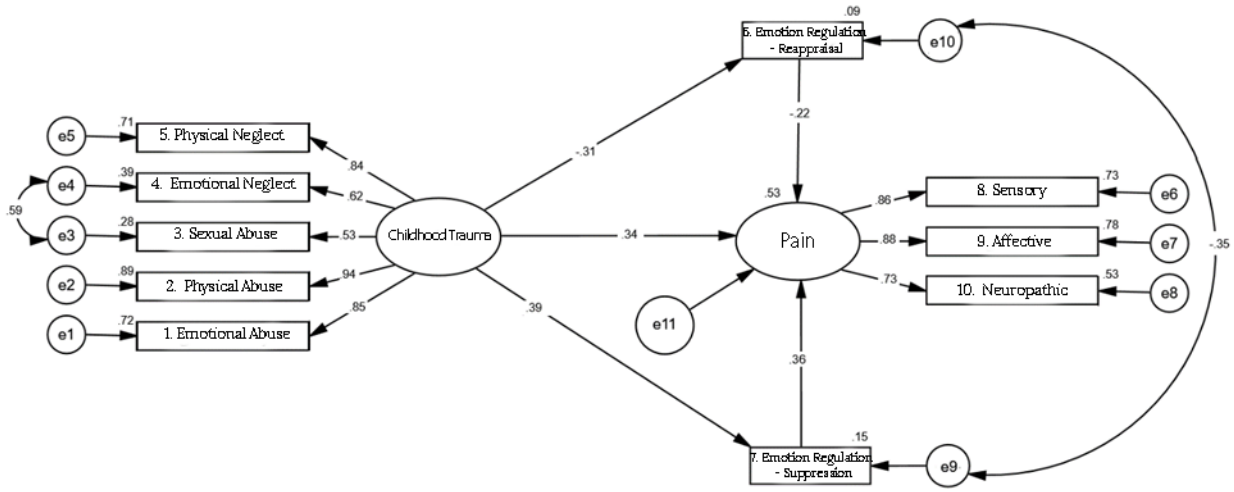
Latent Variables	B	S.E.	β	p
Childhood Trauma → Emotion Suppression	0.290	0.043	0.361	0.001
Childhood Trauma → Reappraisal	-0.339	0.074	-0.307	0.001
Emotion Suppression → Pain	1.213	0.218	0.386	0.001
Reappraisal → Pain	-0.460	0.104	-0.217	0.001
Direct Path: Childhood Trauma → Pain	0.799	0.145	0.342	0.001
Indirect Path: Childhood Trauma → Pain	0.508	0.092	0.208	0.001
Total Path: Childhood Trauma → Pain	1.307	0.166	0.559	0.001

Table 5 shows that the total path coefficient between childhood trauma and pain is positive and significant (β = 0.559, p = 0.001). The path coefficient between emotion regulation reappraisal and pain is negative (β = -0.217, p = 0.001), while the path coefficient between emotion suppression and pain is positive and significant (β = 0.386, p = 0.001). The indirect path coefficient between childhood trauma and pain is also positive and significant (β = 0.218, p = 0.001). This finding suggests that both emotion regulation strategies, reappraisal and emotion suppression, positively and significantly mediate the relationship between childhood trauma and pain in women with rheumatoid arthritis. To assess the significance of the mediating role of each emotion regulation strategy, Baron and Kenny's formula (1986, as cited in Mallinckrodt et al., 2006) was used. The results show that both reappraisal (β = 0.068, p = 0.001) and emotion suppression (β = 0.140, p = 0.001) significantly mediate the relationship between childhood trauma and pain in women with rheumatoid arthritis.

E-ISSN: 3041-8828

Figure 1

Structural Model of the Research Using Standardized Data



As shown above, the total R^2 for the variable pain is 0.53, indicating that childhood trauma and emotion regulation strategies together explain 53% of the variance in pain among women with rheumatoid arthritis.

4. Discussion and Conclusion

The present study aimed to examine the mediating role of emotion regulation in explaining the causal relationships between childhood trauma and pain in women with rheumatoid arthritis. The findings revealed a positive and significant relationship between childhood trauma and pain. The path coefficient between emotion regulation reappraisal and pain was negative, while the path coefficient between emotion regulation suppression and pain was positive and significant. Moreover, the indirect path coefficient between childhood trauma and pain was positive and significant. This finding suggests that both reappraisal and suppression, as emotion regulation strategies, positively and significantly mediate the relationship between childhood trauma and pain in women with rheumatoid arthritis.

In explaining this finding, it can be said that rheumatoid arthritis is associated with various emotional stressors. If rheumatoid arthritis is linked to childhood trauma, it is clear that the long-term negative consequences for physical health can extend into adulthood. In line with this, studies reported an association between childhood trauma and the development of rheumatoid arthritis, especially in women (Bayram & Erol, 2014; Hellou et al., 2017; Spitzer et al., 2013). This relationship may be mediated by disruptions in the neuroendocrine-immune network; however, larger prospective studies are needed to clarify the connection between early-life stress and the risk of rheumatoid arthritis in genetically predisposed individuals.

On the other hand, when individuals face adverse childhood experiences, observable effects on their cognitive functioning, including changes in emotions, can occur. The participants in the present study had unfavorable experiences with their primary caregivers during childhood, which may have contributed to mental and physical health problems later in life. However, as adults, they may have somewhat compensated for this emotional gap by adjusting their attitudes and relationships (Jerud et al., 2014; Jones et al., 2023; Peng et al., 2021; Zitzmann et al., 2024). In this study, participants reported that they often struggled to regulate their emotions in their interactions with others, given their physical and psychological conditions. Some participants indicated difficulty in expressing emotions such as anger, sadness, frustration, hopelessness, or discouragement, and they felt unable to communicate their condition effectively to others, preventing them from receiving empathy from those close to them. This, in turn, may have exacerbated their psychological distress.

Therefore, it seems that childhood trauma is associated with emotional hyper-reactivity and emotional dysregulation. Moreover, exposure to traumatic life events in childhood is linked to symptoms of mixed mood states, which are manifested through emotional overreaction. Importantly, among the various forms of childhood trauma, emotional abuse is particularly strongly associated with negative affect and difficulties in emotion regulation later in

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life. Individuals who are capable of regulating their emotions tend to have a better understanding of their own and others' emotions. As a result, they develop more advanced interpersonal and intrapersonal skills, leading to better relationships. In contrast, individuals who struggle with emotion regulation are less likely to regain emotional balance, have difficulty maintaining relationships, and feel trapped in negative interaction patterns with others. They often experience a sense of being out of control. Thus, it appears that childhood trauma and emotion regulation play a significant role in influencing pain symptoms in patients with rheumatoid arthritis.

Authors' Contributions

All authors significantly contributed to this study.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

The research protocol associated with this study was reviewed and approved by the Ethics Committee of Bushehr University of Medical Sciences under the ethics code IR.BPUMS.REC.1401.069. All participants provided informed consent, and the study was conducted in accordance with the ethical standards outlined by the Declaration of Helsinki, ensuring participant confidentiality and the right to withdraw from the study at any point.

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