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Developing a Structural Model of Treatment Adherence Based on Resilience with the Mediation of Perceived Stress in Patients with Rheumatoid Arthritis

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A B S T R A C T

Objective: The present study aimed to develop a structural model of treatment adherence based on resilience with the mediation of perceived stress in patients with rheumatoid arthritis.

Methods and Materials: Methodologically, this research was descriptive-survey and used structural equation modeling. The statistical population included patients with rheumatoid arthritis in the city of Isfahan. Participants were individuals with rheumatoid arthritis who had been referred to healthcare centers in Isfahan and had experienced the disease for at least one year. Data were collected using the Treatment Adherence Questionnaire by Ziaei (2010), the Connor-Davidson Resilience Scale (CD-RISC), Antonovsky's Sense of Coherence Scale (1993), Cohen, Kamarck, and Mermelstein's Perceived Stress Scale (1983), and the Difficulties in Emotion Regulation Scale (DERS) by Gratz and Roemer (2004). The data were analyzed using structural equation modeling and Amos 26 software.

Findings: The results confirmed the indirect effect of resilience on treatment adherence through the mediation of perceived stress ($p < .01$).

Conclusion: The findings demonstrated that the structural model of treatment adherence based on resilience with the mediation of perceived stress in patients with rheumatoid arthritis had a good fit.

Keywords: *Treatment Adherence, Resilience, Perceived Stress, Rheumatoid Arthritis*

1. Introduction

Musculoskeletal disorders are among the most prevalent and costly diseases across all age groups and societies, leading to disability, incapacity, early retirement, and job loss (Mats et al., 2021). Rheumatoid arthritis is one of the most common chronic, unexplained diseases and a major cause of disability, particularly in adulthood. This inflammatory, chronic, systemic disease affects humans exclusively, has an unknown cause, and is associated with joint involvement (Nasir et al., 2021). In recent years, the prevalence of this disease has significantly increased, with reports of its rising trend across various societies. The chronic inflammatory immune nature of this

condition results in symptoms such as pain, hyperallergy, and edema, along with psychological challenges for affected individuals. Thus, attention has increasingly been directed toward this disease due to its treatment costs and its significant impact on individuals' quality of life (Suh et al., 2022).

The concept of treatment adherence is considered a non-judgmental observation of reality rather than a means to blame the patient. At times, non-adherence can be rational to prevent harm or damage, ultimately allowing patients the autonomy to refuse treatment. The World Health Organization (WHO) recommends the term "adherence" for chronic diseases. Adherence is defined by WHO as the extent to which a person's behavior, such as taking medication, following a diet, or implementing lifestyle changes, aligns with recommendations from healthcare professionals (Banisafar et al., 2023; Sakkaki et al., 2023). Treatment adherence is a complex behavioral process influenced by various factors, including individual patient characteristics, doctor-patient relationships, and healthcare system support (Smaje et al., 2018). Adherence involves not only proper medication intake but also regular outpatient visits, adherence to prescribed dietary and exercise programs, and promptly reporting potential medical complications to healthcare providers. According to WHO, poor adherence to long-term therapeutic regimens is surprisingly common. Research suggests that emotional regulation may influence treatment adherence, quality of life, and symptoms of anxiety (Ridho et al., 2022; Schwarz et al., 2022).

Stress is the body's nonspecific response to any demand placed upon it. Individual perceptions of stress influence their reactions to it. Stress poses a significant threat that can lead to mental or physical illnesses or negatively affect individual performance. The construct of perceived stress originates from Lazarus and Folkman's conceptualization of stress as an individual's cognitive appraisal of negative life events. Perceived stress is defined as the extent to which situations in one's life are appraised as stressful (Acoba, 2024; Nakamura & Tsong, 2019; Omidi et al., 2024; Soria-Reyes et al., 2023). It reflects an individual's inability to adapt to stressful conditions, which can disrupt the vital psychological and physical balance of the body (Davis et al., 2018). While some stress can motivate individuals to overcome challenging situations, persistent stress-related symptoms may impair mental and physical health and reduce productivity in work and learning environments (De Cock et al., 2022). Researchers today are increasingly focusing on positive psychology constructs, particularly given the severe complications of this disease. Positive psychological variables, such as a sense of coherence, are especially noteworthy in managing this illness (Deshields et al., 2022; Mousavi Asl & Parouei, 2021; Nakamura & Tsong, 2019; Shan et al., 2022; Wood, 2019).

Resilience is not merely enduring adversity or threatening conditions. It is an active, constructive engagement with one’s environment. Resilience is the individual's ability to maintain psychological and biological balance under challenging conditions. It acts as a protective barrier in stress-inducing situations, preventing anxiety through key components such as self-confidence, personal competence, trust in instincts, positive acceptance of change, control, and spiritual influences (Wood, 2019). Resilience refers to an individual's ability and skill to adapt positively to stress or challenging conditions, such as living with a chronic disease. Successful adaptation to life’s challenges is a hallmark of resilience. Block posits that resilience entails adaptive flexibility in controlling one’s response according to environmental conditions. Consequently, individuals with higher resilience are more likely to experience positive emotions, possess higher self-confidence, and demonstrate better psychological adjustment compared to those with lower resilience (Nakamura & Tsong, 2019). Masten (2001) argued that resilience emerges once primary human needs are met following a disaster. Through resilience, adverse effects are mitigated, adjusted, or even eradicated, ensuring mental health preservation. Individuals with chronic illnesses need to learn adaptive skills and apply them to tackle daily challenges (Shan et al., 2022; Wood, 2019). Resilient individuals exhibit positive emotional and cognitive outcomes, self-esteem, social functioning, and resistance to the negative consequences of life’s adversities. Studies suggested that resilience enables individuals to return to their initial state of balance or achieve a higher level of equilibrium under threatening conditions, fostering successful life adaptation (Shan et al., 2022).

Chronic diseases are of such significance that they have garnered substantial attention worldwide due to their multifaceted personal, social, biological, genetic, and cultural causes. Rheumatoid arthritis, owing to its chronic nature, impacts the psychosocial and economic aspects of patients' lives, causing harm across these dimensions. Studies have shown that approximately 1% of the global population is affected by rheumatoid arthritis. Depression and anxiety are highly prevalent in such patients and are associated with worse outcomes of rheumatoid arthritis.

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Notably, depression rates among these patients are significantly elevated (Morf et al., 2021).

A review of the research literature reveals that most psychological studies on these patients have explored variables such as general health, sleep quality, depression, anxiety, quality of life, pain acceptance, and coping strategies. However, no research aimed at developing a model to improve the psychological challenges of these patients was found in the literature. The absence of studies with this objective and the conflicting results of existing studies highlight the need for this research. Given the importance of quality of life and treatment adherence for patients with chronic rheumatoid arthritis, identifying and strengthening related factors is a primary concern for health officials. Additionally, treatment adherence is a critical factor in managing chronic diseases. Based on these considerations, the central question of this research is whether resilience predicts treatment adherence in patients with rheumatoid arthritis and whether perceived stress mediates this relationship.

2. Methods and Materials

2.1. Study Design and Participants

This study is a descriptive-survey research using structural equation modeling (SEM). The statistical population consisted of patients with rheumatoid arthritis residing in Isfahan. Participants were required to have been diagnosed with rheumatoid arthritis for at least one year and to be seeking treatment at medical centers in Isfahan. Respondents were required to have a minimum education level above high school to ensure their comprehension of the reflective and content-based questions. Additionally, participants were excluded if they had mental health conditions that could affect their responses.

After obtaining the necessary approvals and an ethics committee letter from the university, the researcher approached the research setting. The researcher visited the research and educational supervisors of selected hospitals to obtain a referral for outpatient clinics. Subsequently, the researcher attended clinics affiliated with Isfahan and Iran universities of medical sciences during morning shifts on all weekdays except holidays. Eligible participants were identified, and the researcher introduced the study, explained its objectives, and obtained written consent. Participants were assured of confidentiality and were provided with the questionnaires for completion.

2.2. Measures

2.2.1. Treatment Adherence

This questionnaire assesses treatment adherence across three dimensions: dietary adherence (13 items), medication adherence (6 items), and activity patterns (7 items). The content validity of the questionnaire was confirmed by Ziaei and colleagues through expert review. The tool was refined based on feedback from 10 university professors specializing in nursing and midwifery at Mashhad University, ensuring its final approval. The reliability of the questionnaire was measured through inter-rater agreement, yielding correlation coefficients of 0.86, 0.91, and 0.95 for the dimensions of dietary adherence, medication adherence, and activity patterns, respectively. The internal consistency reliability of the instrument was further confirmed by Azizi et al. (2020) with a Cronbach's alpha of 0.86 (Banisafar et al., 2023).

2.2.2. Resilience

This scale, developed by Connor and Davidson (2003), consists of 25 items and measures resilience on a five-point Likert scale ranging from 0 (not true at all) to 4 (almost always true), with a total score range of 0–100. The scale evaluates five factors: personal competence, trust in one’s instincts, tolerance of negative affect, positive acceptance of change and secure relationships, and control and spiritual influences. Connor and Davidson reported a Cronbach's alpha of 0.89 for this scale, with test-retest reliability of 0.87 over four weeks. Significant positive correlations with Kobasa’s hardiness scale and negative correlations with the Perceived Stress Scale and Sheehan's Stress Vulnerability Scale confirmed the scale’s concurrent validity. The scale demonstrated no significant correlation with the Arizona Sexual Experience Scale, ensuring its discriminant validity. Mohammadi (2005) validated the scale in Iran, reporting a Cronbach's alpha of 0.89 and confirming its factor structure. Subsequent studies further supported its reliability and applicability in Iran (Bakhtiari & Pourdel, 2024; Karimi Dastaki & Mahmudi, 2024; Ramezani & Zangeneh Motlagh, 2023).

2.2.3. Perceived Stress

This 14-item scale assesses perceived stress using a five-point Likert scale (ranging from 0 = never to 4 = very often). It includes two subscales: negative perception of stress (items 1, 2, 3, 4, 11, 12, and 14) and positive perception of

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stress (items 5, 6, 7, 8, 9, 10, and 13), with reverse scoring for the latter. Internal consistency reliability, measured using Cronbach's alpha, ranged from 0.84 to 0.86 across various studies. Mimura and Griffiths reported Cronbach's alpha coefficients of 0.88 and 0.81 for the original and Japanese revised versions, respectively. Factor analysis revealed two factors explaining 53.2% of the variance in the original version and 49.9% in the Japanese version. Ahmadian (2012) reported Cronbach's alpha coefficients of 0.71 for positive perception and 0.75 for negative perception, with an overall reliability of 0.84 for the scale (Omidi et al., 2024).

2.3. Data analysis

The data analysis process involved multiple steps, including summarization, coding, classification, and processing of the collected data to facilitate hypothesis testing and analysis. Both conceptual and empirical data refinement was conducted, with various statistical techniques applied to support conclusions and generalizations. Descriptive statistics were used to categorize and describe the characteristics of the study population, including frequencies, percentages, charts, means, and standard deviations. SPSS 26 software was used for this purpose. Inferential statistics were employed to address research questions and test hypotheses. Structural equation modeling (SEM), a statistical method for examining relationships among multiple variables within a model, was utilized. If the data met normality assumptions, Amos 26 software was used; otherwise, Smart PLS 3 software, which does not require data normality, was applied.

3. Findings and Results

Among the participants, 68 individuals (11.4%) were aged 20–30 years, 129 individuals (21.6%) were aged 31–40 years, 156 individuals (26.1%) were aged 41–50 years, 193 individuals (32.3%) were aged 51–60 years, and 53 individuals (8.8%) were aged 61 years and above. Additionally, 382 participants (64.0%) were male, and 214 participants (36.0%) were female. Regarding economic status, 182 participants (30.5%) reported a poor economic status, 306 participants (51.3%) reported a moderate economic status, and 108 participants (18.1%) reported a good economic status. In terms of education, the majority had a bachelor's degree, with 213 participants (35.7%) reporting this level of education.

The statistical sample in this research comprised 240 individuals with social anxiety attending counseling centers in Tehran, with a mean age of 34.65 (SD = 1.65). The means and standard deviations of the research variables are presented in Table 1.

Table 1

Descriptive statistics for research variables (n=596)

Variable	Mean	SD	Range	Skewness	Kurtosis
Resilience	49.71	15.08	1–100	0.004	0.224
Perceived Stress	30.19	8.45	12–56	0.254	-0.340
Treatment Adherence	70.62	16.74	26–130	-0.052	-0.208

As indicated in Table 1, skewness and kurtosis values for all research variables fall within the range of -2 to 2, suggesting a normal distribution of data. Consequently, parametric tests such as Pearson correlation and the AMOS software were used for inferential data analysis.

Table 2

Correlation matrix between predictor, mediator, and outcome variables

Variable	Resilience	Perceived Stress	Treatment Adherence
Resilience	1		
Perceived Stress	-0.475**	1	
Treatment Adherence	0.376**	-0.253**	1

**p<0.01

As shown in Table 2, significant direct relationships were observed between resilience, perceived stress, and treatment

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adherence ($p < 0.01$). Resilience and treatment adherence exhibited a negative and significant relationship with perceived stress ($p < 0.01$).

Model fit indices for the proposed model were evaluated, as shown in Table 3, using metrics such as chi-square, relative chi-square (CMIN/DF), the Parsimonious Normed Fit Index (PNFI), Comparative Fit Index (CFI), Parsimonious Comparative Fit Index (PCFI), Incremental Fit Index (IFI), Goodness of Fit Index (GFI), and the Root Mean Square Error of Approximation (RMSEA).

Table 3

Fit indices for the proposed structural model

Fit Index	CMIN/DF	RMSEA (CI 90%)	PNFI	CFI	PCFI	IFI	GFI
Proposed Model	2.83	0.078	0.632	0.928	0.590	0.944	0.942

Acceptable Thresholds: PNFI, PCFI > 0.5; CFI, IFI, GFI > 0.9; RMSEA < 0.08; CMIN/DF: < 3 (good), < 5 (acceptable)

As shown in Table 3, indices such as PCFI = 0.590, PNFI = 0.632, CMIN/DF = 2.83, RMSEA = 0.078, IFI = 0.944, CFI = 0.928, and GFI = 0.942 indicate good model fit.

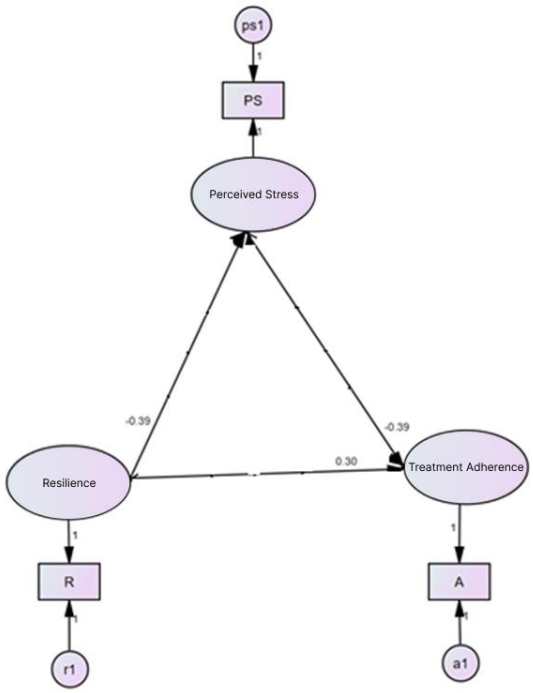
Table 4

Standardized direct, indirect, and total effects of model variables

From	To	Mediator	Direct Effect	Indirect Effect	Total Effect	Significance
Resilience	Treatment Adherence	-	0.30	-	0.30	$p < 0.01$
	Perceived Stress	-	0.30	0.15	0.45	$p < 0.01$
Perceived Stress	-	-	-0.39	-	-0.39	$p < 0.01$
Perceived Stress	Treatment Adherence	-	-0.39	-	-0.39	$p < 0.01$

Figure 1

Standardized coefficients of direct effects in the fitted model



Indirect effects were calculated by multiplying the direct effects of predictor variables on mediators with the effects of mediators on dependent variables. Total effects were derived by summing the direct and indirect effects.

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According to Table 4, resilience had a significant and positive direct effect on treatment adherence ($\beta = 0.30$, $p < 0.01$). Resilience also had a significant indirect effect on treatment adherence through perceived stress ($\beta = 0.15$, $p < 0.01$). The total effect of resilience on treatment adherence through perceived stress was $\beta = 0.45$ ($p < 0.01$).

4. Discussion and Conclusion

The results indicated that the structural model of treatment adherence based on resilience, mediated by perceived stress, had a good fit among patients with rheumatoid arthritis. These findings are consistent with prior studies (Haridoss et al., 2021; Morf et al., 2021; Mousavi Asl & Parouei, 2021; Nasir et al., 2021; Wang et al., 2021).

To interpret these findings, it can be suggested that rheumatoid arthritis leads to high levels of perceived stress in patients, perpetuating negative moods and stress through a maladaptive cognitive cycle. Psychological stress activates the sympathetic nervous system. Some patients hold negative beliefs about their emotions, such as considering their emotions meaningless, perpetual, debilitating, shameful, unique to themselves, unexpressable, and invalidatable. These individuals are more likely to employ maladaptive coping strategies, such as stress and negative emotional strategies (Soria-Reyes et al., 2023). Conversely, individuals with more positive or adaptive views of emotions are better at validating them, viewing emotions as meaningful, acceptable, not shameful or unique, and transient rather than permanent. Such individuals are less likely to use maladaptive coping strategies (Luo et al., 2022). This highlights the potential interdependence of emotional processing methods and the critical role of stress in altering brain-gut functions through mechanisms of emotional regulation. Overall, a complex pattern exists that researchers have yet to fully understand or explain.

Regarding resilience, it can be stated that resilience enables individuals to think and act more adaptively when facing stressful situations. Since patients with rheumatoid arthritis frequently contend with a series of distressing thoughts (Deshields et al., 2022), resilience influences thought processes by fostering a fundamental sense of personal control. This allows individuals to develop and access a repertoire of resilient strategies (Wang et al., 2021). Resilience plays a significant role in coping with stressful life events and serves as a source of resistance and a protective shield. In other words, enhancing resilience helps individuals confront and overcome stressors, thereby moderating stress and improving quality of life.

Poor treatment adherence, on the other hand, reduces the effectiveness of managing chronic diseases. Medication adherence is especially critical for chronic diseases, as proper adherence is necessary to control the disease and prevent its progression (Schwarz et al., 2022). Chronic diseases are progressive, and poor adherence leads to disease advancement, reduced quality of life, and ultimately, treatment failure. Since individuals with chronic illnesses, such as rheumatoid arthritis, often experience psychological challenges due to the difficulties of the disease and loss of hope, these disorders further contribute to non-adherence (Ridho et al., 2022). Consequently, treatment adherence is vital for improving quality of life, reducing symptoms, increasing physical functioning, and enhancing knowledge about medications in patients with chronic illnesses.

5. Limitations & Suggestions

The findings of this study are limited to patients with rheumatoid arthritis in Isfahan and may not be generalizable to patients in other regions. The complexity and numerous dimensions of the variables studied, as well as the extensive number of questionnaire items, led to fatigue and frustration among some participants. Another limitation is the self-reported nature of the tools used. The lack of sufficient research in this field in Iran posed challenges for this study. Additionally, the cross-sectional and non-experimental design of the research restricts causal conclusions.

It is recommended that this study be replicated in other cities to compare findings across different regions. Future research could also involve other patient populations and compare their results with this study. The role of negative life stressors should be considered in subsequent studies to understand the pathways leading to quality of life within the stress-vulnerability framework. Qualitative research on this topic is also recommended.

Given that health literacy results from education, experience, and learning, health education through media and the internet is suggested. Media, as a widely accessed communication tool, can play a significant role in promoting healthy lifestyles and encouraging self-care and treatment adherence through educational programs.

Based on the findings of this study, understanding health concepts to improve self-care, treatment adherence, and emotional regulation in patients with rheumatoid arthritis is of high importance. It is recommended that health

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organizations provide clear, accessible, and relevant educational materials on health topics and healthy lifestyles to the public. Using this health information, individuals, particularly patients with rheumatoid arthritis, can better manage their health and strengthen their capacity for healthcare decision-making. Similarly, educational institutions and organizations should create programs to enhance self-care, treatment adherence, and emotional regulation in patients with rheumatoid arthritis. This requires proper planning and financial support to raise public awareness of health literacy, provide accessible health information, and empower individuals to make informed health decisions and maintain well-being.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contributed in this article.

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