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ORIGINAL RESEARCH

An Exploratory Study of Factors Associated with Medication Adherence in Chinese Rheumatoid Arthritis Patients

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Purpose: This study aims to estimate the prevalence of medication adherence in Chinese patients with RA and to identify factors influencing it.

Patients and Methods: A cross - sectional study was conducted, involving 1137 RA patients who were treated at a university hospital in Guizhou, China. Sociodemographic data, medication adherence, patient satisfaction, and quality of life (QoL) were collected through face-to-face interviews, while disease course and comorbidities (including pneumonia and gastrointestinal conditions) were extracted from hospital information systems (HIS). Multifactorial logistic regression analysis was applied to assess the factors influencing patients' adherence. Subsequently, mediation analysis was employed to delve deeper into the interrelationships among the variables.

Results: The proportion of patients with good adherence was 61.57%. Multivariable logistic regression analysis revealed that patient satisfaction (OR=2.079), treatment regimen (OR=0.280), and pulmonary infection (OR=1.695) were independently associated with medication adherence. The QoL scores for the groups demonstrating good adherence and satisfaction were markedly higher compared to those exhibiting non-adherence and dissatisfaction (P<0.001). Medication adherence mediated the positive relationship between patient satisfaction and mental health (MH) in QoL (β= 0.140).

Conclusion: Our study demonstrates a significant positive correlation between patient satisfaction and medication adherence. Improving patients' satisfaction with treatment is feasible approaches to enhancing medication adherence. However, Single-center studies limit the generalizability of results, and potential confounding by unmeasured variables should be considered.

Keywords: rheumatoid arthritis, adherence, patient satisfaction, regression analysis, mediation analysis

Introduction

Rheumatoid arthritis (RA) is a prevalent chronic systemic autoimmune disorder characterized by inflammation in the joints and surrounding soft tissues, with recurrent and symmetrical polyarthralgia,[1–3] leading to progressive joint damage, disability, and a significant decline in quality of life (QoL). Over the past quarter-century, the treatment regimens for RA have been incrementally enhanced, yielding moderate efficacy; nonetheless, there is considerable scope for further enhancement. A key obstacle to effectively managing inflammation in RA is the patients' inconsistent adherence to their prescribed medications.[4] Studies have shown that nonadherence with disease-modifying antirheumatic drugs (DMARDs) in RA, leading to increased disease activity, reduced functionality, and a further deterioration in QoL.[5]

Medication adherence is the measure of a patient's compliance with medical directives and their alignment with prescribed treatment regimens.[6] It is well-established that non-adherence to medication regimens can result in detrimental

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health consequences and exacerbate the strain on the healthcare system. However, Medication adherence has long been a persistent issue in the management of chronic diseases globally.

To bolster patient adherence and refine intervention strategies for RA, it is crucial to delve into the determinants that sway patient adherence. Research has identified five key dimensions that affect medication adherence: socioeconomic factors, health system-related factors, treatment-related factors, illness-related factors, and patient-related factors.[7] The majority of existing studies on RA adherence have concentrated on patient and disease-related determinants. However, the influence of the doctor-patient relationship and other health system-related factors, such as patient satisfaction, on adherence has been less explored. Patient satisfaction has a profound impact on patient attitudes. We hypothesize that higher levels of patient satisfaction are associated with better medication adherence among patients with rheumatoid arthritis. According to available data, China is home to approximately 5 million RA patients. Moreover, to our knowledge, adherence data for this substantial patient population are often inadequately reported.

The objectives of this research are encapsulated in the following three goals: (1) to determine the prevalence of medication adherence among Chinese RA patients; (2) to identify factors correlated with patient medication adherence; and (3) to conduct an in-depth examination of the correlation between medication adherence and QoL. The ultimate aim is to offer actionable recommendations for enhancing the management of the RA patient population.

Methods

Ethical Considerations

The study was conducted in accordance with the principles of the Helsinki Declaration. Informed consent was obtained from all participants involved. The Research Ethics Committee of the Affiliated Hospital of Zunyi Medical University provided ethical approval for this study (KLL-2023-545).

Study Design

This study is a cross-sectional analysis, and the research subjects are patients with rheumatoid arthritis who received treatment at a tertiary hospital in Guizhou, China. The patient cohort was randomly selected, and the time range is from March 1, 2023, to January 1, 2024.

Participants

The study's subjects comprised individuals diagnosed with rheumatoid arthritis who were undergoing pharmacological treatment. These participants, hailing from Guizhou, China, had been under the continuous care of the Affiliated Hospital of Zunyi Medical University.

Eligible criteria: 1) Aged 18 years or older; 2) Classified according to the American College of Rheumatology/European Alliance of Associations for Rheumatology (ACR/EULAR) criteria;[8] 3) With a documented disease duration of at least one year; 4) Possessing the ability to communicate effectively; 5) Socially capable individuals who voluntarily enroll in the study, are able to provide informed consent, and have signed the consent form.

Exclusion criteria:1) Patients diagnosed with a mental disorder, having a history of psychiatric conditions, or exhibiting current psychological symptoms; 2) Participants with severe hearing impairment or cognitive deficits; 3) Any other conditions that may incapacitate socially and hinder cooperation with the study procedures.

A total of 1150 participants were recruited in this study. Among them, 13 participants were excluded after evaluation because they did not meet the criteria, and a total of 1137 participants were enrolled in the study (Figure 1).

Collecting Information and Participants' Assessments

Patient assessment and sociodemographic data were conducted via face-to-face interviews, with some information such as RA-related information obtained directly from the hospital information system (HIS). The assessments yielded the following results: medication adherence among RA patients was gauged using a custom-designed questionnaire; patient satisfaction was measured through self-assessment ratings; and QoL was evaluated with the Short Form-36 (SF-36)

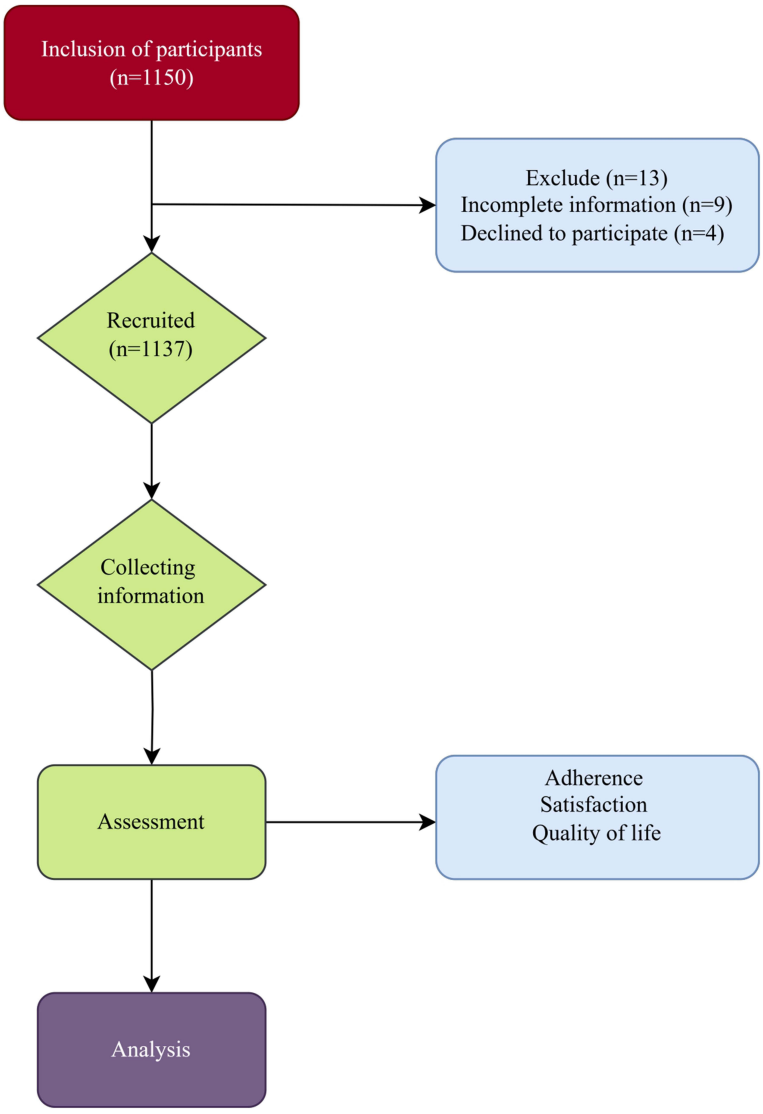

Figure 1 Study flowchart.

questionnaire. Among these factors, both medication adherence and patient satisfaction were evaluated over the past year. All patient-reported outcomes were collected using instruments in Chinese.

Description of the Questionnaires and Scales

The SF-36

The SF-36 was administered using the officially validated Chinese version. It comprises 36 items across 8 subscales: Physical Functioning (PF), Role Limitations due to Physical Health problems (RP), Bodily Pain (BP), General Health Perceptions (GH), Vitality (VT), Social Functioning (SF), Role Limitations due to Emotional Problems (RE), and Mental Health (MH). This structure facilitates a comprehensive evaluation of the respondents' QoL. These 8 dimensions are further synthesized into two higher-order summary scores: the Physical Component Summary (PCS) and the Mental Component Summary (MCS).[9] Each of the 8 subscales, as well as the summary scores, is scored from 0 to 100, with higher scores signifying a better health status.

Patient Satisfaction

To capture patients' subjective experiences and personal assessments of healthcare services, we utilized a self-rating method to measure satisfaction. Patients appraised their experiences by assigning themselves a score based on their level

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of satisfaction with the healthcare services provided, using a five-point Likert scale with the following criteria: very dissatisfied (0 points), dissatisfied (1 point), neutral (2 points), satisfied (3 points), and very satisfied (4 points). A score of 3 or above indicates satisfaction, whereas a score below 3 indicates unsatisfaction, with higher scores reflecting greater patient satisfaction.

The Definitions of Medication Adherence

Patients were deemed treatment-compliant if they followed the prescribed doses, dose intervals, and dosing regimens at least 80% of the time throughout the observation period.[10] Taking into account the unique characteristics and challenges faced by patients, and to ensure a more accurate understanding of the assessments, we tailored the Compliance Questionnaire in Rheumatology (CQR) and developed a We tailored the Compliance Questionnaire in Rheumatology (CQR) and developed a characteristic questionnaire specifically for this study as a pragmatic tool to capture key aspects of medication-taking behavior, and the items were carefully formulated through expert consultation and pilot testing. The detailed medication adherence questionnaire is included in Supplementary Figure S1. To minimize the impact of subjective responses and memory bias on our results, we used the actual number of patient visits as a metric for adherence. The adherence score was calculated using the following formula: Adherence score = (Number of visits × 0.3) + (Self-reported medication adherence score × 0.7). After careful consideration and thorough analysis, a score of 2.5 or higher was established to indicate adherence, while a score below this threshold was deemed to indicate non-adherence. When patients responded to the self-designed questions, we provided them with clear and detailed instructions. The instructions emphasized the importance of honesty and confidentiality, which we hoped would encourage patients to provide more accurate answers.

Sample Size Calculation

In this research, logistic regression was employed to comprehensively analyze the factors that exert an influence on treatment adherence among patients suffering from rheumatoid arthritis. Taking into account Cohen's medium effect size ($f^2 = 0.15$), the significance level set at ($\alpha = 0.05$), the statistical power of ($1 - \beta = 0.8$), and a total of 18 predictor variables, the minimum sample size was precisely calculated using the sample size formula.[11] The result indicated that the minimum sample size required was 993 cases. However, in light of potential data quality concerns such as invalid questionnaires or missing data, we further adjusted the sample size by increasing it by 10%. Consequently, we ultimately determined that a minimum of 1092 subjects were essential for this study. The final effective sample size included in this study was 1137, which fulfills the sample size requirements.

Statistical Analysis

We performed descriptive statistical analysis, presenting continuous variables using measures such as mean, median, standard deviation (SD), and interquartile range (IQR), and categorical variables using counts and percentages. Given that none of the continuous variables in this study followed a normal distribution, non-parametric tests (Mann–Whitney *U*-test, chi-square) were employed to assess group differences. The chi-square test was used to compare proportions. The prevalence of medication adherence and patient satisfaction were estimated with 95% confidence intervals (CIs) using the Bootstrapping method.

The associations between relevant independent variables and adherence were initially screened using the chi-square test, non-parametric tests, and univariate logistic regression analysis. Variables included in the model were selected based on their statistical significance ($P \leq 0.1$) in the univariate analyses. To address potential confounding, we identified key covariates—age, gender, and disease duration—based on prior literature and clinical relevance. These variables were forced into the models due to their established associations with the disease. To assess the model's robustness, repeated multivariable logistic regression analyses were conducted as a sensitivity analysis using the full model approach. Additionally, after adjusting for relevant factors, mediation analyses were performed to explore the relationships among the variables further.

A two-tailed test was conducted, defining statistical significance at $P<0.05$. Data analysis was performed using SPSS 29.0. We conducted mediation analyses with the PROCESS macro for SPSS to calculate effect sizes and used

bootstrapping with 5000 iterations to determine 95% confidence intervals.[12,13] In this analyses, an effect was considered significant if the 95% confidence interval did not include zero. Our estimates excluded any cases with missing data.

Results

Population Characteristics of the Study Sample

An overview of the sample demographics and stratified characteristics is presented in Table 1. The cohort was predominantly female (80.39%), with a median age of 53 years. Among them, 261 patients were elderly, at 60 years or older, comprising 22.96% of the total population. The median duration since disease onset was 5 years, with 347 patients having a disease history of over a decade. Many patients were on second-line DMARDs, with fewer receiving first-line DMARDs. Additionally, 208 patients experienced pulmonary infection during the course of treatment, and a majority reported gastrointestinal symptoms.

Patient Satisfaction

In this study, the overall patient satisfaction scores were relatively low, with a median score of 2 (interquartile range, 2–3), translating to a satisfaction rate of only 44.59% (95% CI, 41.6–47.8%).

Current Situation Analysis of Medication Adherence in RA Patients

Based on our established definition of adherence, 437 participants were classified as non-adherent, while 700 were able to consistently follow their physician's treatment recommendations. The median medication adherence score for RA patients was 2.9 (range, 2–3.9). Consequently, the overall adherence rate was 61.57% (95% CI, 58.84% to 64.38%).

Differences Among RA Patients by Adherence Level

Patients were categorized into adherence and non-adherence groups. The comparative analysis of these two patient cohorts is detailed in Table 1. In summary, significant differences between the groups were observed with respect to gender, treatment regimen, incidence of pulmonary infection, satisfaction levels, and SF-36 health survey scores (Table 1).

Univariate Analysis and Model Building

Variables for inclusion in the test model were selected based on their statistical significance ($P \leq 0.1$) in initial univariate screenings, which encompassed chi-square tests, nonparametric tests, and univariate logistic regression analysis (Table 1 and Supplementary Materials Table S1). Additionally, certain variables were forcibly entered into the model, such as age, gender, and disease duration. All candidate variables were screened for collinearity, with a variance inflation factor (VIF) of less than 2 for all, suggesting no significant collinearity issues. The final set of variables incorporated into the regression model included: gender, age, disease duration, drug type, treatment regimen (first-line or second-line DMARDs), elderly status, disease duration exceeding 10 years, patient satisfaction, gastrointestinal reaction, pulmonary infection, and the 8 subscale scores of the SF-36.

Multivariable Logistic Regression Analysis

The findings from the multivariable logistic regression analysis are presented in Table 2. Patient satisfaction (OR = 2.079, 95% CI 1.603 to 2.696; $p<0.001$), treatment regimen involving first-line or second-line DMARDs (OR = 0.280, 95% CI 0.215 to 0.364; $p<0.001$), and the occurrence of pulmonary infection (OR = 1.695, 95% CI 1.196 to 2.402; $p = 0.003$) were identified as independent predictors of medication adherence among patients. Take patient satisfaction for example, after adjusting for confounding variables, patients who were satisfied had 2.079 times higher odds of medication adherence compared to those who were dissatisfied (95% CI: 1.603–2.696).

Sensitivity Analysis

To assess the robustness of our model, we conducted a sensitivity analysis. Specifically, we performed multivariable logistic regression using the full model approach, which involved adjusting for all pre-specified covariates (age, sex,

Table 1 Factors and Their Comparison, Total and by Adherence Group

Factors	Non-Adherence, N =437	Adherence, N =700	M/χ^2	*P*
Socio-demographic				
Female sex[a]	340 (77.8)	574 (82)	3.01[b]	0.083
Age (years)	53 (47–59)	52 (46–59)	149,641.50[c]	0.539
Age≥60	101 (23.11)	160 (22.86)	0.01[b]	0.921
Age<60	336 (76.89)	540 (77.14)		
RA-related				
Disease duration (years)	5 (2–10)	5 (2–10)	167,121.50[c]	0.008**
Disease duration≥10 years[a]	124 (28.38)	223 (31.86)	1.54[b]	0.215
Disease duration<10 years[a]	313 (71.62)	477 (68.14)		
Patient-reported outcomes(SF-36)				
PF	75 (55–90)	75 (55–90)	153,101.50[c]	0.945
RP	25 (0–100)	50 (0–100)	165089[c]	0.019*
BP	62 (51–74)	62 (62–74)	170722[c]	<0.001***
GH	52 (30–65)	55 (35–65)	164440[c]	0.032*
PCS	52.50 (41.50–71.75)	57.63 (44.06–72.25)	157,099.50[c]	0.019*
VT	75 (65–80)	75 (65–80)	164,865.50[c]	0.022*
SF	87.5 (75–87.50)	87.5 (75–87.50)	163,742.50[c]	0.031*
RE	66.70 (66.70–100)	66.70 (66.70–100)	156,964.50[c]	0.421
MH	80 (68–80)	80 (72–80)	167,503.50[c]	0.004**
MCS	76.88 (64.42–85.63)	78.55 (68.37–86.88)	164,789.50[c]	0.028*
Treatment[a]				
Injectable	20 (4.58)	101 (14.43)	27.46[b]	<0.001***
Non-injectable	417 (95.42)	599 (85.57)		
First-line DMARDs	121 (27.69)	404 (57.71)	97.59[b]	<0.001***
Second-line DMARDs	316 (72.31)	296 (42.29)		
Adverse reaction[a]				
Gastrointestinal symptoms	269 (61.56)	450 (64.29)	0.86[b]	0.353
Pulmonary infection	58 (13.27)	150 (21.43)	11.97[b]	<0.001***
Patient satisfaction[a]				
Satisfied	149 (34.1)	358 (51.14)	31.64[b]	<0.001***
Dissatisfied	288 (65.9)	342 (48.86)		

Notes: Data are presented as the median (IQR) unless otherwise indicated, M=Mann–Whitney *U*-test, [a]Number (%) of patients, [b]χ^2 value, [C]U value, **P*<0.05, ***P*<0.01, ****P*<0.001.

Abbreviations: SF-36, short form-36 questionnaire; PF, physical functioning; RP, role limitations due to physical health problems; BP, body pain; GH, general health perceptions; PCS, Physical Component Summary; VT, vitality; SF, social functioning; RE, role limitations due to emotional problems; MH, mental health; MCS, Mental Component Summary; DMARDs, disease-modifying antirheumatic drugs.

disease duration, comorbidity status, and treatment type) simultaneously within a single model. The results of this analysis were consistent with our primary findings. The full model approach was chosen to minimize residual confounding and provide a more conservative estimate of the associations under investigation. (Supplementary Materials Table S2).

Stratified Analysis

To identify subgroups of rheumatoid arthritis patients that significantly impact patient satisfaction, we stratified the study population based on gender (female vs male), age (below 60 years vs 60 years or above), and disease duration (less than

Table 2 Predictors of Medication Adherence: Multivariable Logistic Regression Analysis

Factors	OR	95% CI		*P*
		Lower	Upper	
Patient satisfaction				
Dissatisfied	1			
Satisfied	2.079	1.603	2.696	<0.001
Treatment				
Second-line DMARDs	1			
First-line DMARDs	0.280	0.215	0.364	<0.001
Pulmonary infection				
No	1			
Yes	1.695	1.196	2.402	0.003

Notes: Model were adjusted for gender, age, duration of disease, type of drug (injectable or not), treatment regimen (first or second line DMARDs), whether the elderly, duration of disease more than 10 years (yes or no), patient satisfaction, whether gastrointestinal reaction (yes or no), presence of pulmonary infection (yes or no) and 8 subscales score of SF-36.
Abbreviations: OR, odds ratio; CI, confidence interval.

10 years vs 10 years or more). Further stratifications were performed according to the use of antirheumatic drugs (second-line DMARDs vs first-line DMARDs) and the occurrence of pulmonary infection during the treatment period within the past year. After adjusting for the variables in our model, we conducted a stratified analysis. However, the interaction between patient satisfaction and adherence did not reach statistical significance across all stratified analyses. In essence, this indicates that the impact of patient satisfaction on adherence is consistent across the various subgroups, with no discernible differences observed (Figure 2). Furthermore, we performed a similar stratified analysis to explore whether there were any differences in their effects on adherence across treatment regimens and pulmonary infection in each subgroup. None of these stratified interactions reached statistical significance (Supplementary Materials Tables S3 and S4).

QoL Comparison

Patients were categorized based on adherence and satisfaction criteria. We monitored the QoL for each group and analyzed the corresponding SF-36 scores to identify any disparities. In brief, the SF-36 scores were markedly higher for the adherence group compared to the non-adherence group (Table 1). Additionally, the SF-36 scores for the satisfied group were significantly higher than those of the dissatisfied group (Table 3 and Figure 3).

Mediation Analysis

Logistic regression analysis affirms the positive correlation between patient satisfaction and medication adherence. Noting the pronounced differences in QoL scores between the satisfied and non-satisfied groups, as well as between the adherent and non-adherent groups, we hypothesize that patient satisfaction may enhance QoL via medication adherence, informed by practical clinical insights. We utilized regression analysis to investigate the mediating effect of medication adherence on the relationship between patient satisfaction and QoL.

We introduced medication adherence as a mediating variable in our structural equation modeling. After performing the model and confirming the absence of multicollinearity issues, we applied the PROCESS macro, developed by

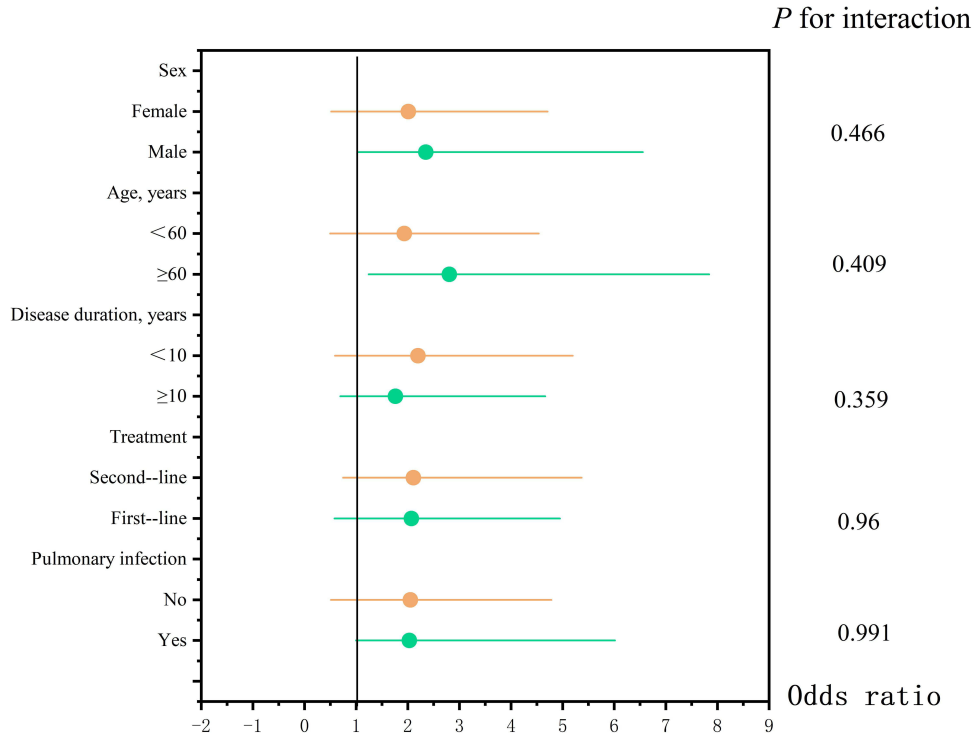

Figure 2 Stratified analyses of the associations between patient satisfaction and adherence to RA.
Notes: Definition of the subgroup: gender (female vs male), age (below 60 years vs 60 years or above), disease duration (less than 10 years vs 10 years or more), treatment (second-line DMARDs vs first-line DMARDs), and presence of pulmonary infection (yes or no).

Andrew F. Hayes, in SPSS to estimate the mediating effect according to Model 4. This PROCESS macro automatically performs the requisite regression analyses to determine the total, direct, and indirect effects. The mediating role of medication adherence between patient satisfaction and the SF-36 scores—encompassing eight components (PF, RP, BP, GH, VT, SF, RE, MH) and two higher-order summary scores (PCS, MCS)—was confirmed and analyzed using the bootstrap method as outlined by Hayes. The findings indicate that medication adherence serves as a mediator for the relationship between patient satisfaction and mental health (MH) (β = 0.140, 95% CI 0.008 to 0.337) (Table 4).

Table 3 SF-36 Scores Comparison of Satisfied and Dissatisfied Group

Items of SF-36	Dissatisfied Group, N =630	Satisfied Group, N =507	M (a)	*P*
PF	70 (50–85)	80 (62.50–95)	201,022	<0.001***
RP	25 (0–75)	50 (0–100)	197,693.50	<0.001***
BP	62 (51–74)	74 (62–74)	209,136	<0.001***
GH	45 (30–60)	60 (42–65)	209,005.50	<0.001***
PCS	50.75 (39.13–67.88)	64.25 (48.25–77.75)	207,851	<0.001***
VT	75 (65–80)	80 (70–80)	187,912.50	<0.001***
SF	87.50 (62.50–87.50)	87.5 (75–87.5)	192,778	<0.001***
RE	66.70 (33.30–100)	100 (66.70–100)	184,812.50	<0.001***
MH	76 (68–80)	80 (72–80)	188,312.50	<0.001***
MCS	75 (50–75)	75 (75–100)	197,231	<0.001***

Notes: Data are presented as the median (IQR) unless otherwise indicated, M=Mann–Whitney *U*-test, a=U value, ***P<0.001.
Abbreviations: SF-36, short form-36 questionnaire; PF, physical functioning; RP, role limitations due to physical health problems; BP, body pain; GH, general health perceptions; PCS, Physical Component Summary; VT, vitality; SF, social functioning; RE, role limitations due to emotional problems; MH, mental health; MCS, Mental Component Summary.

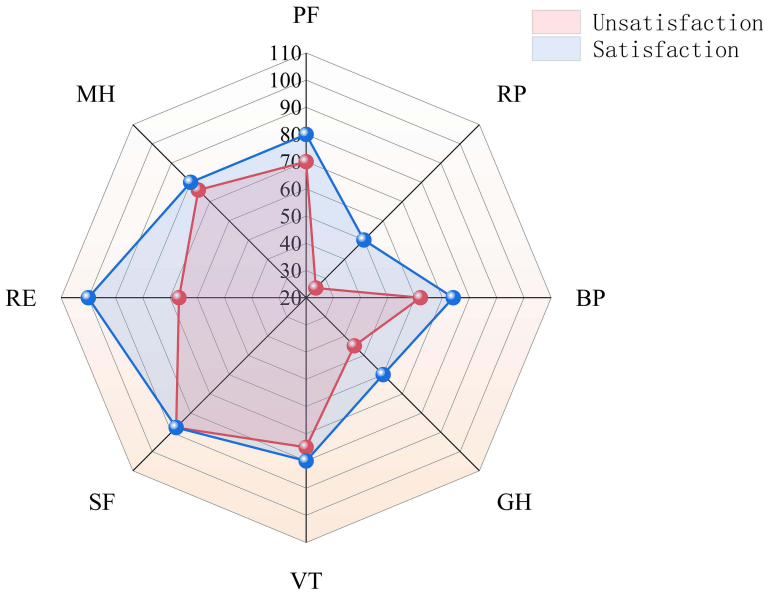

Figure 3 SF-36 scores Comparison of satisfied and dissatisfied group.
Abbreviations: PF, physical functioning; RP, role limitations due to physical health problems; BP, body pain; GH, general health perceptions; VT, vitality; SF, social functioning; RE, role limitations due to emotional problems; MH, mental health.

Medication adherence was not found to mediate the relationship between patient satisfaction and other SF-36 dimensions beyond MH (Supplementary Materials Table S5).

The bootstrap method implemented in the PROCESS macro reveals that the upper and lower bounds of the 95% confidence intervals for the effect estimates among patient satisfaction, MH, and medication adherence exclude 0. This suggests that patient satisfaction has a direct impact on MH and also indirectly influences MH through medication adherence. As detailed in Table 4, the direct effect is quantified at 1.606 and the mediated effect at 0.140, which respectively account for 91.98% and 8.02% of the total effect size of 1.746. Figure 4 illustrates the mediation analysis outcomes, showcasing the mediating role of medication adherence between patient satisfaction and MH after adjusting for the influence of covariates.

Discussion

It is crucial for patients to remain consistent in following their treatment plans. However, the adherence rate among RA patients is less than ideal, with non-adherence potentially leading to treatment failure, delayed recovery, and disease progression.[14] In this study, demographic characteristics such as age and gender, as well as disease-related factors like disease duration and drug dosage form, were not associated with adherence in our study. Instead, critical factors influencing medication adherence included the treatment regimen, pulmonary infection during treatment, and patient satisfaction.

Table 4 The Mediating Role of Medication Adherence Between Patient Satisfaction and Mental Health

	β	SE	95% CI		Effect Quantity
			Lower	Upper	
Total effect	1.746	0.783	0.209	3.283	100%
Direct effect	1.606	0.793	0.050	3.162	91.98%
Mediating effect	0.140	0.086	0.008	0.337	8.02%

Notes: Gender, age, disease duration, treatment modality, and history of pulmonary infections were included as covariates in the model.
Abbreviations: SE, standard error; CI, confidence interval.

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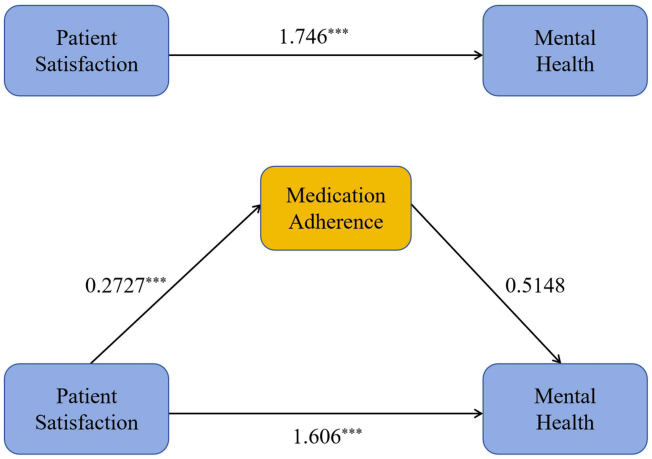

Figure 4 Relationship between patient satisfaction, medication adherence, and mental health.
Note: ***$P < 0.01$.

In rheumatology research, the reported rates of medication adherence exhibit a wide range of variability, primarily due to the inconsistent definitions of adherence and the diverse methodologies used for its assessment. Consequently, data from previous studies indicate a broad spectrum of adherence prevalence, ranging from 9% to 94%.[15,16] This variability in adherence definitions and measurements poses a significant challenge in the field. Given the absence of a standardized method for measuring adherence, it is generally recommended to employ multiple assessment methods in tandem. A specific questionnaire, the CQR, is designed to evaluate adherence to treatments for rheumatic diseases.[17] For this study, we utilized a questionnaire that has been thoughtfully contextualized and adapted from the CQR. Additionally, to mitigate the inherent subjectivity and potential memory bias associated with patient self-reporting, we supplemented the adherence questionnaire with a review of patients' actual medical records from the past year, accessed via the HIS. This dual approach allowed for a more nuanced and objective assessment of patient adherence.

Previous research has predominantly concentrated on patient- and treatment-related determinants, frequently overlooking other influential factors such as the attitudes of healthcare professionals, trust, and the cumulative effect of these variables on adherence.[18–20] Some perspectives suggest that, compared to sociodemographic or clinical factors, psychological factors have a more pronounced impact on treatment adherence in RA.[16] Additionally, health system-related factors, including doctor-patient communication, the quality of healthcare services, patient satisfaction, and the quality of the doctor-patient relationship, also play a role in adherence.[21–23] Against this backdrop, our study honed in on patient satisfaction to explore its correlation with adherence.

Socio-demographic factors and Patient-related factors, such as gender, age, and disease duration have an impact on adherence in past studies.[20,24–26] However, our study yielded different findings; no significant association was observed between adherence and these variables. This could be attributed to several factors. As the standard of living for citizens increases, they acquire more health knowledge, modify their lifestyles, gain better healthcare access and enjoy more social support. In turn, these changes can alter patient adherence and reduce disparities among these factors.[27] In summary, while the direct and significant impact of gender, age, and disease duration on adherence in patients with rheumatoid arthritis may be insignificant, they could still exert influence indirectly by shaping factors such as the patient's perception of the disease, and acceptance of treatment. While this study provides novel insights of adherence, we acknowledge the potential influence of unmeasured sociodemographic factors. Educational attainment and socioeconomic status may modulate health literacy and access to care, while insurance type could affect medication affordability. Future studies should integrate comprehensive sociodemographic profiling with real-world adherence monitoring to better understand these complex interactions.

Therapeutic-related factors can influence adherence to varying extents. Patients often favor oral medications due to their convenience, non-invasiveness, and lower cost, potentially leading to higher medication adherence.[28,29] However, this preference does not invariably result in discernible adherence differences. As indicated by the COPARA Study and

Kaleb Michaud's research,[30,31] our study found no significant correlation between different dosage forms—namely oral and injectable—and the adherence of RA patients. Furthermore, our findings corroborate the notion that second-line DMARDs therapy may enhance patient adherence more than first-line DMARDs users.[16,32] Over time, second - line medications may more effectively control patients' conditions. This can enhance patients' confidence in the treatment, thereby improving their treatment adherence. Besides, whether this is due to better symptom control or patient preferences still remains to be further explored. The side effects of medications and complications that arise during treatment are significant factors affecting adherence.[33] While therapeutic drugs for RA can cause gastrointestinal symptoms, our study's results indicate that these symptoms do not significantly impact patient adherence. Interestingly, we found a positive correlation between pulmonary infection and adherence. Although pulmonary infection itself does not directly improve patient adherence, it may serve as a reminder for patients to prioritize their health, leading them to follow their doctor's advice more closely. The occurrence of a pulmonary infection might result in more frequent interactions between patient and the healthcare system, which could reinforce the importance of adhering to the medication regimen. Consequently, patients who believe that the medication is effective and that side effects are manageable are more likely to adhere to their treatment regimen.

In our investigation of health system-related factors, we concentrated on the profound influence of patient satisfaction on medication adherence. Patient satisfaction within China's healthcare system is recognized as a multi-dimensional and multi-level concept, affecting and being affected by all elements of medical services.[34] It is inextricably linked to the quality and accessibility of healthcare, the rapport between providers and patients, the healthcare environment, service processes, and numerous other factors. A wealth of evidence has illustrated a strong association between patient satisfaction and adherence, with satisfaction being a crucial indicator of the doctor-patient relationship.[26,35–37] The patient satisfaction rate was found to be 44.59% in our study, which is lower than the 60.08% of the general population in China reported by during 2013–2015,[38] suggesting a marginal decline. Importantly, our results confirm the significant influence of patient satisfaction on adherence.

Enhancing patient QoL is a paramount objective of therapeutic interventions. We identified through mediation analysis that medication adherence plays a positive mediating role between patient satisfaction and MH components within the SF-36. The distinct mediation effects across various QoL dimensions are likely to mirror the exclusive psychological trajectories connecting patient satisfaction with medication adherence. To be more specific, the MH aspect within QoL encompasses emotional wellness and psychological resilience. These elements are profoundly shaped by the relationships between patients and providers, as well as the patients' treatment encounters. In return, these factors can directly exert an impact on medication - taking behaviors via mechanisms like motivation, self - efficacy, and the perceived value of treatment. Conversely, the physical health and social functioning components of QoL are probably more significantly swayed by disease severity and external factors, such as social support and environmental obstacles. These external determinants are relatively less amenable to change merely through enhancing patient satisfaction. This also provides significant insight that enhancing patient satisfaction is a viable intervention for improving medication adherence and also contributes to enhancing the QoL. In China, a study has revealed that communication with physicians and treatment costs are independent factors associated with patients' satisfaction regarding treatment. Therefore, strengthening effective communication with patients and optimizing cost - control measures represent potent approaches to enhance patient satisfaction.[39] These measures also help to enhance patients' trust in doctors and their medication adherence.

Despite its contributions, this study has certain limitations. Firstly, the study lacks specific socio-demographic information, such as educational level, socioeconomic status, occupation, place of residence, and type of health insurance, which are known to influence clinical outcomes like disease activity, disability, and QoL.[40] The original study design primarily focused on evaluating health system-related factors and treatment-related factors as potential predictors of adherence. Consequently, these socio-demographic factors were not included in the analysis. Whether these unmeasured socio-demographic factors interact in complex ways with the variables currently under investigation remains to be elucidated in future studies. Secondly, there is a potential bias in self - reported data in this study. Due to the possible influence of memory bias and social desirability, patients may inaccurately report their own behaviors. We have adopted measures such as evaluating compliance based on actual visit frequencies to minimize this bias. However, these

methods may not completely eliminate the bias. Thirdly, the assessment did not include indicators of disease activity, which, when combined with QoL scores, could provide a more holistic evaluation of patients' overall status. Fourthly, the study participants were all recruited from a single medical institution, which inevitably limits the generalizability of the findings. In future research, multicenter, longitudinal studies should be prioritized to firmly establish the causal relationships between patient satisfaction and treatment adherence. Moreover, the influence of socioeconomic factors, healthcare accessibility, and digital health interventions on treatment adherence requires more in - depth and comprehensive investigation. This approach is expected to yield adherence assessment results with greater generalizability.

Conclusion

In summary, our study identified patient satisfaction, treatment regimen, and pulmonary infection during treatment as key predictors of medication adherence in Chinese RA patients. These findings highlight the need for patient-centered care approaches to improve adherence outcomes. Therefore, healthcare providers should prioritize patients' feelings and offer a positive healthcare experience. Routine care should include regular assessment of treatment satisfaction. Healthcare policymakers need to establish specialized adherence support programs. These measures are conducive to enhancing patient satisfaction and medication adherence.

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Disclosure

The authors report no competing interests.

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