Patient Preference and Adherence

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ORIGINAL RESEARCH

Exploring the Factors Related to Medication Adherence in Patients with Rheumatoid Arthritis Based on Social Cognitive Theory: A Path Analysis

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Background: Studies have shown that poor medication adherence is common in patients with rheumatoid arthritis (RA). However, the related factors and underlying mechanisms remain unclear. Through theory-based research, the mechanism of medication adherence in RA patients can be better explored and clarified, providing reference for clinical intervention.

Aim: To explore the mediating role of medication self-efficacy between perceived barriers, pharmacologic treatment expectations, social support and medication adherence in patients with RA based on the social cognitive theory.

Methods: A total of 232 participants diagnosed with RA were recruited from three general hospitals in Guangzhou, China. Participants' sociodemographic, disease-, and medication-related information as well as data on their perceived barriers, pharmacologic treatment expectations, social support, medication self-efficacy, and adherence were collected. SPSS 25.0 software was used for univariate analysis of medication adherence and to explore the correlation between variables. Mplus 8.0 was used to build a parallel mediation model and perform path analysis.

Results: In addition to pharmacologic treatment expectations, perceived barriers, family support, and medication self-efficacy were associated with medication adherence. A mediating model with three independent variables showed that medication self-efficacy fully mediated the negative impact of perceived barriers on medication adherence. Family support had a positive effect on both medication adherence and self-efficacy, but it did not affect medication adherence through medication self-efficacy.

Conclusion: Medication self-efficacy, as a mediating factor, plays a key role in improving medication adherence of RA patients. In nursing practice, timely assessment of the actual or potential barriers on medication adherence of patients and implementation of targeted intervention measures such as health education, as well as giving full play to the positive role of the family support system to improve patients' medication self-efficacy, will effectively enhance the medication adherence of patients with RA.

Keywords: rheumatoid arthritis, medication self-efficacy, perceived barriers, pharmacologic treatment expectations, social support, medication adherence

Introduction

Rheumatoid arthritis (RA), a chronic immune disease characterized by joint pain, swelling, deformity, and progressive joint structural damage, involves multiple organs and systems throughout the body. To date, no cure for RA has been developed and pharmacologic treatment is the main therapeutic approach. However, studies have shown that poor medication adherence is common in patients with RA.[1,2] Patients with poor medication adherence often rarely achieve

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effective therapeutic outcomes, resulting in deterioration of symptoms or patient condition such as higher disease activity, poorer physical function, and lower health-related quality of life.[2,3]

Studies have found that patients with RA's medication adherence are affected by a variety of factors such as functional disability, depression, self-efficacy, and social support.[1,4] However, the underlying mechanisms remain unclear. Investigation of the influencing mechanisms and theoretical analysis can better elucidate the determinants of medication adherence in RA, and the findings should enable the provision of effective and targeted interventions.[1]

Bandura's Social Cognitive Theory believes that individual behavior is influenced by external environment and personal factors.[5,6] Among these, social support is an important external factor, while perceived barriers, outcome expectations, and self-efficacy are personal factors. Studies have shown that patients with RA who receive higher social support have better adherence to medication.[4] The social support received by patients (such as reminders to take medication, preparation of pill boxes, and other instrumental support) can directly improve adherence.[7] Researchers are now devoting more attention to perceived barriers to medication adherence in patients with RA, namely their subjective perceptions and concerns about medication-related difficulties or negative factors during long-term treatment. These barriers may reduce patients' medication adherence, thereby affecting the therapeutic effect of the disease. Related qualitative studies in patients with RA have shown that perceived barriers may affect medication adherence,[8,9] but there is still a lack of empirical evidence to clarify the relationship between these two variables in patients with RA. In addition, the treatment adherence of patients with RA may be guided by their treatment outcome expectations. Brandstetter et al's[7] study showed that the patients' intention to achieve the expected treatment effects promotes their medication adherence. However, the findings of Brus et al[10] and Kiltz et al[11] did not agree with these results. It requires further investigation to confirm.

Medication self-efficacy refers to an individual's confidence in their ability to correctly follow a medication regimen or other recommendations.[12] High medication self-efficacy plays an important role in the ability of patients with RA to manage and adjust medication-taking.[10,13] In addition, previous study has found that self-efficacy also mediates the effect of social support on medication adherence.[1] Perceived social support is a psychological resource that can regulate the individual's thinking process and improve self-efficacy to promote adherence behavior.[14,15]

Bandura's social cognitive theory points out that the barriers, difficulties, and outcome expectations encountered by individuals in the process of performing behaviors affect their self-efficacy, which in turn affects their positive or negative coping strategies, choices, and persistence with action plans.[6] In the study of Yu et al[16] perceived barriers in patients with HIV negatively affected medication adherence indirectly, through self-efficacy. In addition, in studies among adolescents with asthma, better medication adherence was associated with higher medication self-efficacy and higher outcome expectations, and outcome expectation was positively associated with medication self-efficacy.[17,18] Based on these studies, we speculate that a similar relationship may exist in patients with RA. However, current studies in patients with RA are limited.

In the context of the above theories and research evidence, this study hypothesized that patients with RA's perceived barriers, pharmacologic treatment expectations, and social support influence medication adherence through medication self-efficacy. The purpose of this study was to establish a cognitive theory-based mediation model to examine whether medication self-efficacy mediates the relationships between perceived barriers, pharmacologic treatment expectations, and social support with medication adherence. The findings of this study provide a valuable reference for formulating effective interventions and measures to improve medication adherence among patients with RA.

Methods

Design

This is a cross-sectional study. Convenience sampling was used to select patients with RA receiving treatment at three tertiary grade-A hospitals in Guangzhou, China, from November 2022 to June 2023.

Sample Size

Sample size estimation was conducted using G*Power 3.1.9.2 software. When using G-power to calculate the sample size corresponding to the mediation model, the effect size f2 values are 0.02, 0.15, and 0.35 corresponding to small,

medium, and large effect sizes.[19] At the same time, the maximum number of predictors needs to be considered to determine the minimum sample size.[19] Due to the lack of direct data on mediation effect sizes in RA populations, we referred to similar studies in chronic disease populations (hemodialysis and diabetes), which reported medium effect sizes.[20,21] Reviewing previous studies, we consider a total of 21 predictors of medication adherence, including socio-demographic characteristics, disease characteristics, and core variables of social cognitive theory. Based on this, we selected a medium effect size (f^2= 0.15) for sample size calculation to ensure sufficient statistical power, with α = 0.05, power = 0.90, the predictors were 21, and the calculated sample size was 195. Considering that 10% of the questionnaires might not be included in the analysis for some reasons (for example, excessive missing data or inconsistency), we estimated a sample size of 217.

Participants

The inclusion criteria for participants were as follows: (1) meeting the RA classification criteria established by ACR/EULAR in 2010;[22] (2) having a disease duration of at least 3 months and currently receiving oral medication for RA; (3) aged ≥18 years, capable of normal communication, and willing to participate in the study. Exclusion criteria were as follows: (1) presence of mental disorders or severe cognitive impairment, rendering the individual unable to cooperate; (2) concurrent significant failure of organs such as heart, liver, and kidney; malignant tumors; or severe infections; (3) concurrent non-RA diseases (such as trauma, stroke) causing functional limitations or physical disabilities; (4) pregnancy or lactation.

Variables and Instruments

Sociodemographic and Clinical Characteristics Questionnaire

The sociodemographic characteristics included gender, age, education level, marital status, occupation, family monthly income, and medical insurance type. Clinical characteristics included disease course, number of hospitalizations since diagnosis, morning stiffness, degree of pain, tender joint count (TJC) and swollen joint count (SJC), joint deformity, comorbidities, and complications. Comorbidities mainly included osteoporosis, hypertension, diabetes and coronary heart disease. Complications mainly included dry eye, xerosis, hematological diseases, and pulmonary fibrosis. In addition, researchers collected information on the types of medications and the number of days participants took them.

The modified health assessment questionnaire (MHAQ) was used to assess functional limitation.[23] The MHAQ included eight items: getting dressed, rising, eating, walking, hygiene, reach, grip, and usual activities. The eight items were scored on a four-point Likert scale, where 0 = no difficulty at all, 1 = with some difficulty, 2 = with much difficulty, and 3 = unable to do. The MHAQ score was calculated as the sum of all item scores divided by the number of items. Higher scores indicate poorer functioning and greater disability. An MHAQ score of 0.3 was considered to indicate normal function. The MHAQ scores were divided into the following categories: mild (MHAQ < 1.3), moderate (1.3 ≤ MHAQ ≤ 1.8), and severe (MHAQ > 1.8) loss of function.

The disease activity score 28 (DAS28) instrument was used to assess the swelling and tenderness of 28 joints, including the bilateral shoulder joints, bilateral elbow joints, bilateral wrist joints, bilateral metacarpophalangeal joints, bilateral proximal interphalangeal joints, and bilateral knee joints.[24] DAS28 scores were calculated as follows: DAS28 = $0.56*\sqrt{(TJC)} + 0.28*\sqrt{(SJC)} + 0.7*\ln$ (erythrocyte sedimentation rate (ESR)) + 0.014 * (global health (GH)). The GH parameters represent patients' self-assessment of disease activity on a scale of 0 to 100, with 100 indicating maximum disease activity. A DAS28 < 2.6 indicates disease remission; 2.6 ≤ DAS28 ≤ 3.2 indicates mild disease activity; 3.2 ≤ DAS28 ≤ 5.1 indicates moderate disease activity; and DAS28 > 5.1 indicates high disease activity.

Medication Self-Efficacy

The Chinese version of Self-efficacy for Appropriate Medication Use Scale (SEAMS) was used to evaluate the level of self-efficacy for medication use of participants.[25] The scale was scored using Likert three-level scoring method. There were 13 items in total, and the total scores ranged from 13 to 39. Higher scores indicated higher levels of medication self-efficacy. The Cronbach's α coefficient of the scale in this study was 0.934.

Perceived Medication Barriers

The 15 items of perceived barriers in the Adherence Starts with Knowledge Questionnaire (ASK-20) were used to investigate the perceived barriers to medication adherence of participants, including drug-related lifestyle, attitudes and beliefs, communication with the healthcare team, help from others, and taking medication dimensionalities.[26] The questionnaire was scored using a Likert five-point scale, ranging from "strongly agree" to "strongly disagree" corresponding to scores of 5 to 1. Items 7 to 12 were scored in reverse. Total scores ranged from 15 to 75, with higher scores indicating greater perceived barriers to medication adherence. The questionnaire was authorized and approved by the original author and the license for use was applied for through ePROVIVE ("Official ASK-20 | Adherence Starts with Knowledge 20 Distributed by Mapi Research Trust | ePROVIDE" 2023). The questionnaire was translated into Chinese in accordance with the guidelines of the International Society for Pharmacoeconomics and Outcomes Research (ISPOR).[27] The Cronbach's α coefficient of the questionnaire in this study was 0.615.

Pharmacologic Treatment Expectations

The expectations from pharmacologic treatment questionnairecontained 11 items, including the expectation of relief from RA disease-related symptoms and improvement of physical function, self-care, and workability.[28] The questionnaire utilizes a 7-point Likert scale, with a score of "1" indicating "no improvement needed" and a score of "7" indicating "most improvement needed." The total scores range from 1 to 7, with higher scores indicating greater expectations of the participants from pharmacologic treatment.

Social Support

The Perceived Social Support Scale (PSSS) was used to investigate the social support received by participants.[29] The scale included the three dimensions of support from family, friends and others' support, a total of 12 items. The item score ranged from 1 to 7, and the total score ranged from 12 to 84. The higher the score, the better the social support status. The Cronbach's α coefficient of the scale in this study was 0.874.

Medication Adherence

The study used the item "In the past 28 days, did you miss your medication?" to investigate the medication adherence of participants. No missed doses indicated adherence, and the presence of missed doses indicated non-adherence. All statistical analyses on medication adherence were conducted using binary categorical variables (adherence was coded as 1 and non-adherence as 0).

Data Collection

Study objectives and right to anonymity or to withdraw at any time were explained to participants before the survey. After informed consent was obtained, the requirements for completion were explained to patients, and electronic or paper questionnaires were distributed. For those who had difficulties filling out the questionnaires because of hand pain or reading difficulties, the researchers filled out the questionnaires truthfully according to their answers. The questionnaire was checked promptly after completion, and if there was missing information, the participants were immediately contacted and the relevant missing information was sought. Questionnaires were collected from participants in outpatient and inpatient wards. Hospitalized patients were asked to recall their status at admission. The personal information of the participants was kept confidential.

Statistical Analysis

SPSS25.0 software was used for data analysis. Multiple interpolation method is used to interpolate the missing data. Continuous data were described by the mean and standard deviation, and categorical variables were described by the frequency or percentage. Chi-square test and *T*-test were used to analyze differences in sociodemographic and clinical characteristics between the medication adherence group and medication non-adherence group. The Bonferroni method was used to correct the test level for multiple categorical variables. T tests were used to analyze differences in medication self-efficacy, perceived barriers to medication adherence, pharmacologic treatment expectations, and social support between the adherence and non-adherence groups. All continuous variables conformed to normal distribution; therefore,

the correlation between variables was analyzed by Pearson correlation analysis. Mplus 8.0 was used to construct parallel mediation models for the three independent variables simultaneously after controlling for covariates that may affect medication adherence, including variables with $P<0.1$ in the chi-square test. All tests were two-sided.

Results

Participants' Characteristics

A total of 232 participants were enrolled in this study (Table 1). The mean age of the participants was (51.40 ± 14.62) years and most of them were female (79.3%); 52.2% had a disease duration of less than 5 years; and 84.1% were treated with 1–2 kinds of disease-modifying antirheumatic drugs (DMARDs). In addition, 37.1% (n = 86) of the participants were assigned to the non-adherence group. Participants who were younger, had a shorter disease duration, and had no comorbidities or deformities were more likely to be non-adherent ($P < 0.05$).

The data analysis results shown that the medication self-efficacy scores of 232 patients with RA were at a medium level (30.89±6.74), perceived barriers to medication adherence were at a medium level (33.75±7.71), pharmacologic treatment expectations were at a medium level (5.57±1.31), and social support is at a high level (62.60±11.12). Participants in the adherence group had higher levels of medication self-efficacy, perceived barriers, and family support compared with participants in the non-adherence group.

Table 1 Sociodemographic and Clinical Characteristics of Patients with RA (N=232)

Variable	Overall (N=232)	Adherence (N=146)	Nonadherence (N=86)	X^2/t	P
Demographic characteristics					
Gender, n (%)				1.158	0.282
Male	48(20.7)	27(18.5)	21(24.4)		
Female	184(79.3)	119(81.5)	65(75.6)		
Age (years)[b], n (%)				8.735[a]	**0.013**
19–44[1]	63(27.2)	30(20.5)	33(38.4)		1>2
45–59[2]	100(43.1)	68(46.6)	32(37.2)		1>3
60–82[3]	69(29.7)	48(32.9)	21(24.4)		
Educational level, n (%)				5.760	0.124
Primary school or below	55(23.7)	40(27.4)	15(17.4)		
Junior middle school	73(31.5)	49(33.6)	24(27.9)		
Senior middle school	38(16.4)	21(14.4)	17(19.8)		
College or above	66(28.4)	36(24.7)	30(34.9)		
Marital status, n (%)				1.160	0.282
Married	199(85.8)	128(87.7)	71(82.6)		
Widowed/Single	33(14.2)	18(12.3)	15(17.4)		
Occupation, n (%)				2.638	0.104
Unemployed	158(68.1)	105(71.9)	53(61.6)		
Employed	74(31.9)	41(28.1)	33(38.4)		
Monthly household income percapita (CNY), n (%)				1.859	0.602
<3000	65(28.0)	43(29.5)	22(25.6)		
3000–4999	85(36.6)	56(38.4)	29(33.7)		
5000–9999	58(25.0)	34(23.3)	24(27.9)		
>10,000	24(10.3)	13(8.9)	11(12.8)		
Medical insurance, n (%)				4.405	0.221
UEBMI	108(46.6)	67(45.9)	41(47.7)		
URBMI	48(20.7)	36(24.7)	12(14.0)		
NRCMS	38(16.4)	21(14.4)	17(19.8)		
Self-paying/Free medicare	38(16.4)	22(15.1)	16(18.6)		

(*Continued*)

Table 1 (Continued).

Variable	Overall (N=232)	Adherence (N=146)	Nonadherence (N=86)	X^2/t	*P*
Clincal characteristics					
Disease course (years) (M, SD)	8.22(8.16)	9.38(9.03)	6.26(5.98)	2.850	**0.005**
Number of hospitalizations after diagnosis (M, SD)	2.29(2.71)	2.55(2.86)	1.84(2.37)	1.963	0.051
Comorbidity, n (%)				4.218	**0.040**
No	142(61.2)	82(56.2)	60(69.8)		
Yes	90(38.8)	64(43.8)	26(30.2)		
Complication, n (%)				0.986	0.321
No	204(87.9)	126(86.3)	78(90.7)		
Yes	28(12.1)	20(13.7)	8(9.3)		
TJC	4.73(5.08)	4.79 (4.99)	4.63 (5.25)	0.231	0.817
SJC	2.02(2.56)	2.03 (2.72)	2.00 (2.27)	0.098	0.922
Morning stiffness, n (%)				1.441	0.230
No	83(35.8)	48(32.9)	35(40.7)		
Yes	149(64.2)	98(67.1)	51(59.3)		
Pain degree, n (%)				1.167	0.761
No	41(17.7)	25(17.1)	16(18.6)		
Mild	100(43.1)	66(45.2)	34(39.5)		
Moderate	70(30.2)	41(28.1)	29(33.7)		
Severe	21(9.1)	14(9.6)	7(8.1)		
Disease activity, n (%)				4.864	0.182
Remission	47(20.3)	27(18.5)	20(23.2)		
Mild	18(7.8)	9(6.2)	9(10.5)		
Moderate	116(50.0)	72(49.3)	44(51.2)		
High	51(22.0)	38(26.0)	13(15.1)		
Joint deformity, n (%)				7.391	**0.007**
No	116(50.0)	63(43.2)	53(61.6)		
Yes	116(50.0)	83(56.8)	33(38.4)		
Functional limitation, n (%)				3.480	0.062
No	103(44.4)	58(39.7)	45(52.3)		
Mild/Moderate/Severe	129(55.6)	88(60.3)	41(47.7)		
Number of medication (M, SD)		5.26(2.43)	4.69(2.03)	1.844	0.066
DMARDs, n (%)				0.155	0.694
No	14 (6.0)	10 (6.8)	4 (4.7)		
Yes	218 (96.0)	136 (93.2)	82 (95.3)		
NSAID, n (%)				0.133	0.716
No	107(46.1)	66(45.2)	41(47.7)		
Yes	125(53.9)	80(54.8)	45(52.3)		
Glucocorticoid, n (%)				0.077	0.782
No	143(61.6)	89(61.0)	54(62.8)		
Yes	89(38.4)	57(39.0)	32(37.2)		
Biologicals, n (%)				0.000	0.996
No	178(76.7)	112(76.7)	66(76.7)		
Yes	54(23.7)	34(23.3)	20(23.3)		

Notes: [a]Bonferroni method was used for post hoc comparisons;[b] The mean score was 51.40 years, with an SD of 14.62.The bolded values indicate statistical significance ($P < 0.05$).

Abbreviations: RA, rheumatoid arthritis; CNY, Chinese Yuan; DMARDs, disease-modifying anti-rheumatic drugs; M, mean; NRCMS, New Rural Cooperative Medical System; NSAID, nonsteroidal anti-inflammatory drug; SD, standard deviation; SJC, swollen joint count; TJC, tender joint count; UEBMI, Urban Employee Basic Medical Insurance; URBMI, Urban Resident Basic Medical Insurance;

Table 2 Correlation Between Medication Self-Efficacy, Perceived Barriers, Pharmacologic Treatment Expectations, Social Support and Medication Adherence in Patients with RA (N=232)

Variable	Medication Adherence *t*	Medication Self-Efficacy *r*	Perceived Barriers *r*	Pharmacologic Treatment Expectations *r*	Social Support *r*	Family Support *r*	Friends Support *r*	Others Support *r*
Medication adherence	1							
Medication self-efficacy	5.088***	1						
Perceived barriers	−4.710***	−0.525***	1					
Pharmacologic treatment expectations	0.064	−0.188**	0.152*	1				
Social support	1.888	0.049	−0.081	−0.027	1			
Family support	4.437***	0.257***	−0.308***	0.008	0.484***	1		
Friends support	0.181	−0.077	0.068	−0.053	0.847***	0.057	1	
Others support	1.158	0.042	−0.070	0.006	0.853***	0.359***	0.568***	1

Notes: *P<0.05, **P<0.01, ***P≤0.001.

Correlation Analysis

Table 2 shown that medication adherence is positively correlated with medication self-efficacy ($t = 5.088$, $P < 0.001$) and family support ($t = 4.437$, $P < 0.001$), but negatively correlated with perceived barriers to medication adherence ($t = -4.710$, $P < 0.01$). Medication self-efficacy negatively correlated with perceived barriers to medication adherence ($r = -0.525$, $P < 0.001$) and pharmacologic treatment expectations ($r = -0.188$, $P < 0.01$), but positively correlated with family support ($r = 0.257$, $P < 0.001$). Perceived barriers to medication adherence were positively correlated with pharmacologic treatment expectations ($r = 0.152$, $P < 0.05$), but negatively correlated with family support ($r = -0.308$, $P < 0.001$).

Intermediate Path Analysis

Table 2 shows that the correlation between pharmacologic treatment expectations and adherence is not statistically significant. However, the significant variable correlation should not be used as a prerequisite for studying the mediating effect.[30] In combination with self-efficacy theory, there is theoretical support for the mediating role of medication self-efficacy in the relationship between pharmacologic treatment outcome expectations and medication adherence. Therefore, this path was included in the construction of the model for parallel mediation analysis of the three independent variables. To ensure accuracy of the mediating effect, confounding factors that may affect medication adherence were controlled, including age, disease course, number of hospitalizations after diagnosis, joint deformity, number of medications taken, functional limitations, and comorbidities. The results of model fitting showed that the X^2/df (14.081/7) value was less than 3, CFI = 0.943, TLI = 0.828, RMSEA = 0.066, and SRMR = 0.05; $P < 0.001$. Therefore, the model showed a good fit.

Figure 1 shows the path diagram of the parallel mediation model after controlling for covariates that may affect medication adherence. Table 3 shows the standardized coefficients of each path of the parallel mediation model. Perceived barriers had an

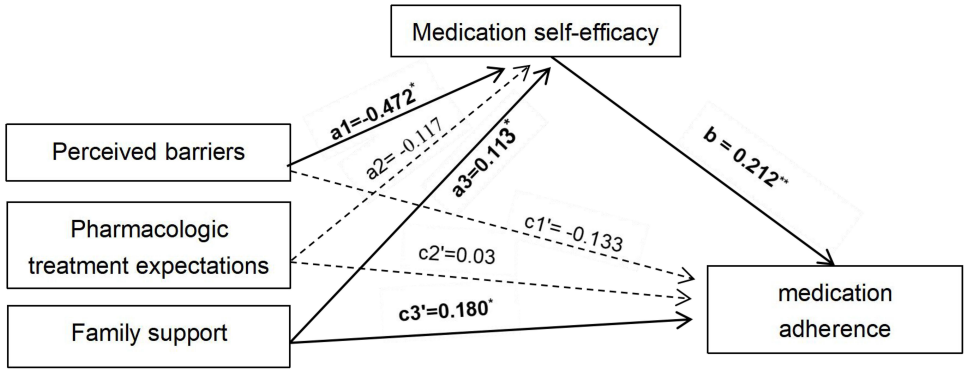

Figure 1 Mediating model path of medication self-efficacy between perceived barriers to medication adherence, pharmacologic treatment expectations, family support, and medication adherence.

Notes: All path coefficients are standardized values. The dashed line indicates that the path coefficient is not statistically significant (P>0.05). a1b = −0.100, $P < 0.01$; a2b = −0.025, $P > 0.05$; a3b= 0.024, $P > 0.05$.* $P < 0.05$, ** $P < 0.01$.

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Table 3 Bootstrap Results of the Parallel Mediation Model (N=232)

Path	*β*	t	*P*	95% CI	
				Lower	Upper
1. Perceived barriers → Medication self-efficacy → medication adherence;					
Direct effect (c1')	−0.133	−1.743	0.081	−0.288	0.013
Indirect effect (a1b)	−0.100	−2.621	**0.009**	−0.182	−0.032
Total (c1)	−0.233	−3.365	**0.001**	−0.375	−0.101
2. Pharmacologic treatment expectations → Medication self-efficacy → medication adherence					
Direct effect (c2')	0.036	0.575	0.565	−0.083	0.160
Indirect effect (a2b)	−0.025	−1.518	0.129	−0.068	−0.001
Total (c2)	0.012	0.175	0.861	−0.113	0.145
3. Family support → Medication self-efficacy → medication adherence					
Direct effect (c3')	0.180	2.683	**0.007**	0.038	0.302
Indirect effect (a3b)	0.024	1.654	0.098	0.003	0.063
Total (c3)	0.204	2.947	**0.003**	0.057	0.329

Notes: Age, disease course, number of hospitalizations after diagnosis, joint deformity, number of medications, functional limitations, and comorbidities were controlled in the mediation model. The bolded values indicate statistical significance ($P < 0.05$).
Abbreviation: CI, Confidence interval.

indirect effect on medication adherence through medication self-efficacy ($\beta = -0.100$, $P = 0.009$, 95% CI: [−0.182, −0.032]), although the direct effect on medication adherence was not statistically significant ($\beta = -0.133$, $P = 0.081$). In addition, pharmacologic treatment expectations did not affect medication adherence through medication self-efficacy ($\beta = -0.025$, $P = 0.129$), although there may be a masking effect between the indirect effect (a2b) and the direct effect (c2') of pharmacologic treatment expectations on medication adherence. It is worth noting that although family support affected medication self-efficacy ($\beta = 0.113$, $P = 0.036$), it did not affect medication adherence through medication self-efficacy ($\beta = 0.024$, $P = 0.098$), and only directly affected medication adherence ($\beta = 0.180$, $P = 0.007$).

Discussion

This study explored the mediating effect of medication self-efficacy on the relationships between perceived barriers, pharmacologic treatment expectations, and family support, and medication adherence in patients with RA. The findings provide a basis for understanding the mechanisms that influence medication adherence. Medication adherence was found to be positively correlated with medication self-efficacy and the family support dimension of social support, negatively correlated with perceived barriers, and uncorrelated with pharmacologic treatment expectations. Medication self-efficacy mediated the relationship between perceived barriers and medication adherence but did not mediate the effect of family support on medication adherence.

This study found that perceived barriers to medication-taking are an important factor that negatively affects medication adherence only through the mediating effect of medication self-efficacy; these results are consistent with the findings of Yu et al[16] in the HIV population. When patients perceive large medication barriers, they expect that greater effort and stronger persistence would be required to maintain medication-taking; this leads to a lack of confidence and lower medication self-efficacy, which ultimately negatively affects medication adherence. Asgari et al[31] implemented a medication adherence intervention for patients with RA by developing medication treatment and coping plans to overcome potential barriers and explored the intervention mechanism and mediating effects. The results showed that although medication adherence improved significantly at 6 months after the intervention, medication self-efficacy at 3 months did not mediate the effect of the intervention on medication adherence.[31] This finding may be attributed to the confounding effects of intervention programs (medication treatment plan) other than the coping plans aimed at overcoming barriers.[31] Although, in this research, medication self-efficacy mediated the relationship between perceived medication barriers and adherence, further empirical studies are needed to support this finding. Interventions related to improving medication self-efficacy and overcoming perceived barriers to improve patients' medication adherence are a worthy approach in clinical practice.

In this study, pharmacologic treatment expectations did not affect medication adherence, consistent with findings of Brus et al[10] and Kiltz et al.[11] In addition, medication self-efficacy did not play a mediating role in the relationship between them, which may be because of the following reasons. According to the mediation model constructed in this study, pharmacologic treatment expectations exert an indirect influence on medication self-efficacy via a negative pathway (a2 = −0.117), which subsequently affects medication adherence. Additionally, the indirect effect (a2b = −0.025) and the direct effect (c'2 = 0.036) operate in opposite directions and offset each other, leading to an insignificant overall effect. This phenomenon is termed the "masking effect. It is important to note that this study only assessed positive outcome expectations; therefore, the impact of negative outcome expectations on disease treatment adherence may have been neglected.[32] It is important to consider the influence of negative outcome expectations, such as the potential side effects of medication on adherence.[33] However, these factors have not been given sufficient attention by researchers.[7] Future studies could be conducted to comprehensively evaluate outcome expectations and explore their relationship with medication adherence.

Additionally, our study found a negative correlation between pharmacologic treatment expectations and medication self-efficacy. RA is a disease that often involves recurring attacks, joint pain, joint structural damage, physical dysfunction, and other symptoms, which affect patients' physical function and personal lives. In this study, patients with RA had higher outcome expectations and longer treatment courses. Experiencing multiple attacks may make treatment more challenging and result in poor therapeutic outcomes that fall short of patients' high outcome expectations; this would negatively affect confidence in taking medication.

This study found that the family support dimension of social support directly affected medication adherence. But support from friends or other sources did not affect medication adherence. Research shows that family members play a crucial role in providing help and care for patients in their day-to-day lives.[34] Patients with RA rely heavily on family support to perform simple daily activities such as washing and dressing.[30] The decline in physical function due to RA makes it challenging for patients to maintain previous levels of social interaction and activity and has an impact on working lives and relationships.[34] Nearly 70% of patients in this study were not in employment, which resulted in altered social relationships and reduced communication with friends and others (such as et al); as a result, family became their focus of social communication. This may explain why only the family support dimension affects medication adherence in the studied population.

Gong et al[1] found that social support (including support from family, friends, and others) can directly and indirectly influence medication adherence through self-efficacy. The findings are not entirely consistent with our research. One possible reason for this discrepancy could be that the average age of participants in their study was younger, while the proportion of patients who were employed was higher than in our study. As a result, their participants may have perceived the support from friends and et al to be higher.

In this study, although medication self-efficacy did not play a mediating role between social support and medication adherence, family support helps improve medication self-efficacy in patients with RA. Family support may be considered a factor in regulating the negative effects of barriers on medication self-efficacy and adherence. Better adherence can be achieved by actively engaging family members to assist in providing medication reminders, attending medical appointments, or overcoming barriers to medication-taking.

Limitations

This study has the following limitations. Medication adherence was measured based on the patient's recall of medication-taking over the past 28 days, which may result in recall bias. Therefore, in future research, use of the RA-specific medication adherence scale is recommended. In addition, this study is a cross-sectional survey, and only a limited interpretation could be made of the mediating effect of medication self-efficacy and the causal relationship between medication adherence and influencing factors. Hence, it is recommended that future interventional studies be conducted to provide more relevant evidence.

Conclusion

This study reveals that medication self-efficacy serves as a crucial mediator in the relationship between perceived barriers, family support and medication adherence, providing valuable theoretical insights for developing targeted

interventions. Based on these findings, in clinical practice, intervention methods centered on enhancing medication self-efficacy should be developed through evidence-based approaches. The medical team can incorporate the patient's perceived barriers, medication self-efficacy level, and family support system into the routine clinical assessment. Reduce patients' perceived barriers and enhance their beliefs through measures such as health education and psychological intervention. At the same time, actively mobilize the patient's family support network to promote the establishment of a social support system. Future research directions should build upon these findings to investigate additional influencing factors and pathways.

Data Sharing Statement

The data underlying this article will be shared on reasonable request to the corresponding author.

Ethics Statement

The study complied with the principles of the Declaration of Helsinki and was approved by the Ethics Committee of the School of Nursing, Sun Yat-sen University (approval No. L2022SYSU-HL-069). Written informed consent was obtained from all participants.

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Disclosure

The authors declare no conflicts of interest in this work.

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