

Factors Associated with Adherence to the Atrial Fibrillation Better Care (ABC) Pathway Among Rural Patients with Atrial Fibrillation: A Path Analysis Based on the Integrated Theory of Health Behavior Change (ITHBC)

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Background: The atrial fibrillation better care (ABC) pathway is an effective strategy for the integrated management of atrial fibrillation (AF). However, the adherence rate of ABC pathway in rural Chinese patients with AF is extremely low.

Aim: To explore the factors and mechanisms of adherence to the ABC pathway based on the integrated theory of health behavior change (ITHBC) among rural patients with AF.

Methods: In this cross-sectional study, we recruited 940 patients with AF from rural areas in China from July 2022 to September 2023. Patients completed a questionnaire covering AF-related demographic and clinical characteristics, AF knowledge, AF health beliefs, AF self-management ability, and social support. Adherence to ABC pathway was assessed based on AF-demographic and clinical characteristics. Path analysis was used to explore the relationship between variables.

Results: Adherence to ABC pathway among rural patients with AF was extremely low (5.7%). AF self-management ability ($\beta = 0.449$; $P < 0.001$) and social support ($\beta = 0.429$; $P < 0.001$) directly and positively affected adherence to ABC pathway. Additionally, AF knowledge ($\beta = 0.211$; $P < 0.001$), AF health beliefs ($\beta = 0.350$; $P < 0.001$) and social support ($\beta = 0.085$; $P < 0.001$) can also indirectly and positively affect adherence to ABC pathway through AF self-management ability. AF knowledge ($\beta = 0.121$; $P < 0.001$) can indirectly affect adherence to the ABC pathway through a series of mediations via AF health beliefs and AF self-management ability.

Conclusion: AF knowledge, AF health beliefs, and social support are important intervention components that should be closely integrated with AF self-management ability.

Keywords: atrial fibrillation, guideline adherence, rural population, knowledge, health belief, self-management, social support

Introduction

Atrial fibrillation (AF) is the most common arrhythmia.¹ In China, there are approximately 7.9 million patients with AF.² AF can lead to a range of complications, the most serious of which is stroke.¹ Patients with AF have a 4–5 times higher

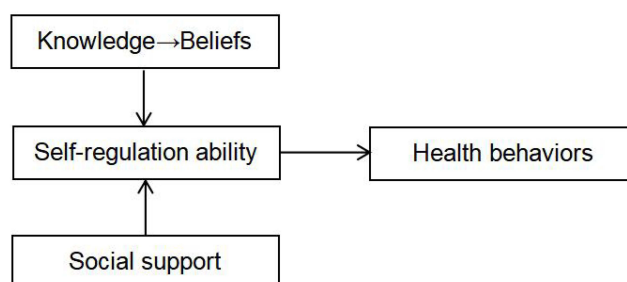


Figure 1 The integrated theory of Health Behaviour Change (ITHBC).

risk of stroke than those without AF, and AF-related ischemic strokes are almost twice as fatal as those without AF.^{1,3} The main symptoms of AF are palpitations, chest tightness, fatigue, and dyspnea, which impair the quality of life of more than 60% of patients.¹ Additionally, AF is often accompanied by cardiovascular diseases such as heart failure (HF), coronary artery disease (CAD), hypertension, diabetes, hyperlipidemia, and peripheral arterial disease (PAD).¹ In China, 73–90% of patients with AF have two or more cardiovascular diseases, and approximately 72% of deaths in patients with AF are attributed to cardiovascular disease.^{4–7}

Therefore, Lip⁸ proposed the atrial fibrillation better care (ABC) pathway in 2017 to guide the integrated management of AF. Moreover, the ABC pathway was also strongly recommended by the 2020 European Society of Cardiology (ESC) and 2021 Asia Pacific Heart Rhythm Society (APHRS) guidelines.^{1,9} The ABC pathway refers to “A, anticoagulation or stroke avoidance”, “B, better control of symptoms through heart rate or rhythm control”, and “C, optimal management of cardiovascular comorbidities and risk factors”.^{1,8,9} Adherence to the ABC pathway significantly reduces the risk of ischemic stroke, cardiovascular disease, and all-cause mortality (45%, 63%, and 58%, respectively).¹⁰ However, Since AF patients are primarily elderly and often have multiple comorbidities, this results in generally very low adherence to the ABC pathway. Improving adherence to the ABC pathway in AF patients is a challenging task worldwide. A study of 285,000 AF patients across developed countries showed that the adherence rate to the ABC pathway was 21%.¹⁰ In rural areas of China, where social economy and medical resources are relatively backward, only 5.75% of AF patients adhered to the ABC pathway.⁵ Improving adherence to the ABC pathway among rural patients with AF is an urgent need.

The integrated theory of health behavior change (ITHBC) has been widely used to guide health behavior change in patients with chronic diseases.¹¹ Based on multiple theories and a large body of empirical research, the ITHBC incorporates three constructs: knowledge and beliefs, self-regulation abilities, and social support.¹¹ (Figure 1). The ITHBC proposed that patients’ knowledge, beliefs, and social support can influence self-regulation ability and consequently change their health behavior.¹¹

Several studies have validated the relationship between some of the concepts in ITHBC and their effects on health behavior change in patients with AF. A study of patients with AF in high-altitude areas showed that patients’ knowledge and attitude could influence practice.¹² Ding et al’s¹³ study of patients with AF within 3 months after radiofrequency catheter ablation (RFCA) showed that patients’ knowledge of AF, self-management beliefs, and social support were associated with their self-management behavior of AF. A study by Li et al¹⁴ showed that knowledge of oral anticoagulants (OACs) in patients with AF was independently associated with attitude and practice. To date, no study has explored the variables of health behavior change that affect adherence to the ABC pathway among rural patients with AF.

Based on the ITHBC, this study aimed to explore the relationship between AF knowledge, AF health beliefs, AF self-management ability, and social support and adherence to the ABC pathway in rural patients with AF in China, to provide supportive evidence and identify intervention targets for improving adherence to the ABC pathway in rural patients with AF.

Methods

Design and Patients

This was a cross-sectional study involving a total of 940 rural patients with AF. The inclusion criteria were patients with an age ≥ 18 years, diagnosed with AF based on a 24-hour Holter, standard 12-lead ECG recording, or ≥ 30 second single-

lead ECG tracing. All patients had to be able to communicate, understand the content and purpose of the study, and agree to participate in the study. The exclusion criteria were transient AF due to reversible causes (eg, temporary AF induced by surgery, hyperthyroidism, or pulmonary embolism) and terminal stage of malignant cancer or serious mental disorder. The patient inclusion flowchart was presented in Figure 2.

Sample Size

Because the study explored factors affecting adherence to the ABC pathway based on ITHBC, which is a model with two independent variables and two mediating variables, the sample size requirements of a complex mediating model were referred to when determining the sample size.¹⁵ There are no reports on the effect size of this complex mediation model in patients with AF; therefore, we used the sample size of the partial mediation effect and the average effect size model to determine the sample size. The minimum required sample sizes for models with two independent variables and two mediating variables are 480 and 360, respectively.¹⁵ Considering a 20% non-response rate, a minimum of 600 patients with AF were required for this study.

Data Collection

Convenience sampling was used in this study. Since all ECG machines in Shangyou County, Ganzhou City, Jiangxi Province, China, were connected to a local general hospital, the medical record system of the general hospital had a list of all patients with a previous diagnosis of AF. After obtaining authorization from the local health management department, we retrieved the list of all patients with AF diagnosed from the general hospital from 2015 to 2022. Then, we selected those registered as permanent residents in local rural areas according to the official household registration system. After excluding patients who had died, were in the terminal stage of malignant tumors, or had disorder of consciousness, we sent a recruitment text message or placed a call to all surviving patients with AF. Patients were invited to attend a local general hospital to complete a data collection form. They were verified by specialist nurses in the chronic disease management center. Missing data were supplemented by interviewing patients on the spot or by reviewing the medical record system. For patients who could not be contacted or had mobility barriers, data were collected by village doctors at home.

Variables and Measurements

Demographic and Clinical Variables

Demographic characteristics included sex, age, education level, marital status, occupation, type of medical insurance, and monthly household income per capita. Clinical characteristics included the type of AF, the duration of AF, history of previous hospitalization for AF, history of previous hospitalization in a department of cardiology or neurology, the CHA₂DS₂-VASc stroke risk score, the HAS-BLED bleeding risk score, RFCA, left atrial appendage closure (LAAC), pacemaker implantation, the presence of chronic comorbidities, and the medications being used. Multimorbidity was defined

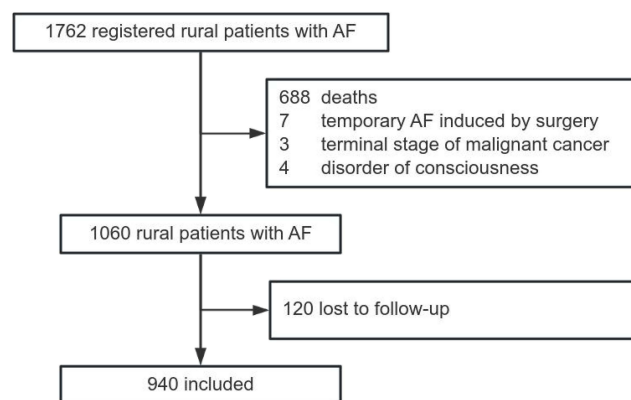


Figure 2 Flowchart of AF patients' selection.

as patients having ≥ 2 chronic conditions in addition to AF.¹⁶ Polypharmacy was defined as patients being administered ≥ 5 medications.¹⁷ The medication information was collected based on the patient's self-reported current medications being taken.

AF Knowledge

AF knowledge was measured using the AF knowledge scale developed by Xu et al.¹⁸ The questionnaire has five dimensions and 25 items: knowledge of AF, anticoagulation, healthy lifestyle, RFCA, and self-monitoring. A score of 1 was assigned to a correct answer, or "known," and 0 to an incorrect answer, or "unknown." The total scores range from 0 to 25. The content validity index of the scale was 0.946. The Cronbach's α value was 0.835 in this study.

AF Health Beliefs

According to the health belief model, health beliefs include six dimensions: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy.¹⁹ AF health beliefs were measured using the Atrial Fibrillation Health Belief Scale (AFHBS) developed by Xu et al.¹⁸ and the six-item Chinese version of the Chronic Disease Self-Efficacy Scale (CDSSES) developed by Lorig²⁰ and translated by Chow et al.²¹ Because AFHBS and CDSSES measured different dimensions of AF health beliefs, the scores of these two scales were summed to obtain the total score of AF health beliefs. The total scores range from 23 to 145.

The AFHBS has five dimensions and 17 items: perceived severity, perceived susceptibility, perceived benefits, perceived barriers, and motivation to maintain health. A 5-point Likert scale was used to score from strongly disagree to strongly agree. The total scores range from 17 to 85. The content validity index of the scale was 0.921. The Cronbach's α value was 0.840 in this study.

The 6-item CDSSES was used to measure self-efficacy. It reflects patients' confidence in overcoming fatigue, pain management, emotion management, symptom management, activity management, and medication management. Each item was scored from 1 to 10 points. A score of 1 indicated no confidence, and a score of 10 indicated high confidence. The Cronbach's α value was 0.791 in this study.

AF Self-Management Ability

AF self-management ability was measured using the Self-Management Ability Scale for patients with AF (SMAS-AF), developed by Wen.²² SMAS-AF has five dimensions and 22 items: compliance behavior management, bad habits management, emotional and social management, anticoagulant drug management, and disease prevention and monitoring management. A 5-point Likert scale was used, with each item ranging from "not done" (1 point) to "always done" (5 points). The total scores range from 22 to 110. The content validity index of the scale was 0.926. The Cronbach's α value was 0.891 in this study.

Social Support

Social support was measured using the Social Support Rating Scale (SSRS) developed by Xiao.²³ The SSRS has three dimensions and 10 items: objective support, subjective support, and utilization of social support. The total score of the scale was the sum of the scores of each item, with higher scores indicating better social support. The total scores range from 12 to 66. The Cronbach's α value was 0.784 in this study.

Adherence to the ABC Pathway

Adherence to the ABC pathway in patients with AF was assessed based on the 2020 ESC guideline criteria.¹ A - adherence was defined as patients at a high risk of stroke (CHA₂DS₂-VASc scores ≥ 2 in males or ≥ 3 in females) being administered an OAC or LAAC or not at high risk of stroke. Otherwise, patients were classified as A-non-adherence. B - adherence was defined as having European Heart Rhythm Association (EHRA) scores of I (asymptomatic) or II (mild symptoms not affecting daily activities). Otherwise, patients were classified as B-non-adherence. C - adherence was defined as cardiovascular risk or other comorbidities associated with AF that have been treated with appropriate medications or have achieved control standards as follows: (1) Effective control of hypertension defined as baseline blood pressure $\leq 140/90$ mmHg; (2) The treatment for HF included the use of Angiotensin Receptor-Neprilysin Inhibitors (ARNI)/angiotensin converting enzyme inhibitors (ACEI)/angiotensin receptor blockers (ARB) and β -blockers; (3)

Treatment for CAD involved the use of ACEI/ARB, β -blockers, and lipid-lowering drugs (LLD); (4) PAD treated with LLD; (5) Stroke/TIA treated with LLD; (6) Diabetes treated with insulin or oral hypoglycaemic drugs; (7) Hyperlipemia treated with LLDs; and (8) A body mass index (BMI) $<24.0 \text{ kg/m}^2$. Individuals were classified into the C-adherent group when all these diseases were properly medicated or well-controlled, or when individuals were not accompanied by any of these diseases. Otherwise, patients were classified as C-non-adherence. Adherence to the ABC pathway was defined as meeting all three components of the guideline criteria.

Data Analysis

Data analysis was performed using SPSS version 25.0 (SPSS Inc., Chicago, IL, USA) and Mplus version 8.0.²⁴ Categorical variables are reported as frequencies (percentages), while continuous variables are reported as means (standard deviations [SD]). Chi-square tests, *t*-test and analyses of variance were used to compare sociodemographic characteristics, clinical characteristics, and variables in the ITHBC between ABC-adherent and ABC-non-adherent patients with AF. A correlation analysis was used to analyze the correlation between variables. After controlling for sociodemographic and clinical characteristics that were significant in the univariate analysis, path analysis using bootstrapping with 5000 sample draws was used to explore the mediating hypothesis of the model. P-values < 0.05 (two-sided) were considered statistically significant.

Results

Sample Description

Among the 940 rural patients with AF, 50.7% were male, 79.3% were ≥ 65 years of age, 56.3% had a primary or lower level of education, 51.9% had a family per capita income of <1000 Renminbi Yuan (RMB), 77.2% were married, 44.5% were farmers, and 30.1% were unemployed. In terms of clinical characteristics, 78.2% had paroxysmal AF, 89.7% had a CHA₂DS₂-VASc score ≥ 2 in males or ≥ 3 in females, 93.1% had a HAS-BLED score ≤ 2 , and 47.8% had a disease duration of ≤ 1 year. Regarding multimorbidity and polypharmacy, 89.1% patients had ≥ 2 chronic diseases, and 37.8% were being administered ≥ 5 medications (Table 1).

Adherence to the ABC Pathway in Rural Patients with AF

In this study, only 5.7% of rural patients with AF adhered to the ABC pathway. Of the three components, component C (management of cardiovascular comorbidities and risk factors) had the lowest adherence rate (19.8%), followed by component A (anticoagulation or stroke avoidance, 32.2%). Approximately half (54.1%) of the patients adhered to component B (control of symptoms) (Table 2).

Table 1 Sociodemographic and Clinical Characteristics in Rural Patients with AF (N=940)

Variable	N (%)	Variable	N (%)
Sex		Type of AF	
Male	477 (50.7)	Paroxysmal AF	735 (78.2)
Female	463 (49.3)	Persistent AF	174 (18.5)
Age (years)		Long-standing persistent AF	31 (3.3)
<65	195 (20.7)	Disease course	
65-74	297 (31.6)	≤ 1 year	449 (47.8)
≥ 75	448 (47.7)	1-5 years	326 (34.7)
Educational level		≥ 5 years	165 (17.6)
Primary school or below	529 (56.3)	Previously hospitalized for AF	
Junior middle school	280 (29.8)	No	697 (74.1)
Senior middle school or above	131 (13.9)	Yes	243 (25.9)

(Continued)

Table 1 (Continued).

Variable	N (%)	Variable	N (%)
Monthly household income per capita (RMB)		Previously hospitalized in a department of cardiology or neurology	
<1000	488 (51.9)	No	234 (24.9)
1000–3000	291 (31.0)	Yes	706 (75.1)
>3000	161 (17.1)	CHA₂DS₂-VASc †	
Marital status		Score <2 (male) or <3 (female)	97 (10.3)
Married	726 (77.2)	Score ≥2 (male) or ≥3 (female)	843 (89.7)
Divorced /Widowed/Single	214 (22.8)	HAS-BLED ‡	
Occupation		Score ≤2	875 (93.1)
Farmer	418 (44.5)	Score ≥3	65 (6.9)
Worker/ Clerk/ freelance	132 (14.0)	RFCA	32 (3.4)
Retired	107 (11.4)	LAAC	7 (0.7)
Unemployed	283 (30.1)	Pacemaker implantation	22 (2.3)
Medical insurance		Polypharmacy	355 (37.8)
NRCMS	330 (35.1)	Oral anticoagulants	218 (23.1)
UEBMI /URBMI	601 (63.9)	β-blocker	321 (34.1)
No	9 (1.0)	Digoxin	133 (14.2)
Multimorbidity	838 (89.1)	ACEI	63 (6.7)
Hypertension	672 (71.5)	ARB	139 (14.8)
HF	512 (54.5)	CCB	174 (18.5)
CAD	447 (47.6)	Diuresis	305 (32.4)
Hyperlipemia	499 (53.1)	ARNI	60 (6.4)
Stroke/TIA	206 (21.9)	Antiplatelet drugs	153 (16.2)
PAD	185 (19.7)	LLD	257 (27.3)
Diabetes	140 (14.9)	Insulin/ Oral antidiabetic drugs	60 (6.4)
BMI (≥24 kg/m ²)	96 (10.2)		

Notes: †The CHA₂DS₂-VASc score was calculated to estimate the risk of stroke in AF patients. ‡The HAS-BLED score was calculated to predict the bleeding risk of AF patients on anticoagulants.

Abbreviations: ACEI, angiotensin-converting enzyme inhibitor; AF, Atrial fibrillation; ARB, Angiotensin Receptor Blocker; ARNI, Angiotensin Receptor-Nephrilysin Inhibitor; CCB, Calcium channel blocker; CAD, coronary artery disease; HF, heart failure; LAAC, left atrial appendage closure; LLD, Lipid-lowering drug; NRCMS, New Rural Cooperative Medical System; PAD, peripheral arterial disease; TIA, transient ischemic attack; LAAC, left atrial appendage closure; RFCA, radiofrequency catheter ablation; UEBMI, Urban Employee Basic Medical Insurance; URBMI, Urban Resident Basic Medical Insurance;

Table 2 Adherence to ABC Pathway in Rural Patients with AF. (N=940)

Variable	N(%)
ABC - adherence	54 (5.7)
A - adherence	303 (32.2)
B - adherence	509 (54.1)
C - adherence	186 (19.8)

Descriptions and Correlation Between Study Variables

The level of AF knowledge, AF health beliefs, AF self-management ability and social support of rural patients with AF were extremely low. The total scores were 4.15 ± 3.13 , 73.79 ± 14.56 , 53.05 ± 10.94 and 27.7 ± 4.80 respectively, which were less than or close to half of the total scores on the scale. There were moderately or highly significant positive correlations between these variables, with correlation coefficients ranging from 0.611 to 0.843. (Table 3).

Table 3 Descriptions and Correlation Between Study Variables. (N=940)

Total Score	M (SD)	AF Knowledge	AF Health Belief	AF Self-Management Ability	Social Support	VIF**
AF knowledge	4.15±3.13	1.000				3.641
AF health belief	73.79±14.56	0.768*	1.000			3.631
AF self-management ability	53.05±10.94	0.843*	0.830*	1.000		5.260
Social support	27.7±4.80	0.611*	0.690*	0.708*	1.000	2.152

Notes: *These correlation coefficients have $P < 0.001$. **Variance inflation factors (VIFs) were calculated to assess multicollinearity among these variables, with adherence to the ABC pathway as the dependent variable.

Univariate Analysis of Adherence to the ABC Pathway in Rural Patients with AF

Univariate analysis showed that patients with older age, lower education level, no employment or farming as their occupation, low income, persistent AF, and multimorbidity were more likely to be in the ABC-non-adherent group. Patients in the ABC-non-adherent group had lower levels of AF knowledge, AF health beliefs, AF self-management ability, and social support than those in the ABC-adherent group. (Table 4).

Test of the Hypothesized Path Models

ITHBC includes three constructs: knowledge and beliefs, self-regulation abilities, and social support. Therefore, path model tests were performed step by step for each construct and the overall construct of ITHBC, respectively (Figure 3).

Table 4 Univariate Analysis of Adherence to ABC Pathway in Rural Patients with AF. (N=940)

Variable	Non-adherence (n=886) N(%)	ABC – adherence (n=54) N(%)	χ^2/Z	P
Sex				
Male	449 (50.7)	28 (51.9)	0.028	0.867
Female	437 (49.3)	26 (48.1)		
Age (years)				
<65	158 (17.8)	37 (68.5)	−8.290	<0.001
65–74	283 (31.9)	14 (25.9)		
≥75	445 (50.2)	3 (5.6)		
Educational level				
Primary school or below	523 (59.0)	6 (11.1)	−8.876	<0.001
Junior middle school	266 (30.0)	14 (25.9)		
Senior middle school or above	97 (11.0)	34 (63.0)		
Marital status				
Married	682 (77.0)	44 (81.5)	0.588	0.443
Divorced /Widowed/Single	204 (23.0)	10 (18.5)		
Occupation				
Farmer	404 (45.6)	14 (25.9)	66.497	<0.001
Worker/Clerk/ freelance	101 (11.4)	31 (57.4)		
Retired	101 (11.4)	6 (11.1)		
Unemployed	280 (31.6)	3 (5.6)		
Medical insurance				
NRCMS	570 (64.3)	31 (57.4)	0.962	0.336
UEBMI/URBMI	307 (34.7)	23 (42.6)		
No	9 (1.0)	0 (0.0)		
Monthly household income per capita (RMB)				
<1000	482 (54.4)	6 (11.1)	−7.414	<0.001
1000–3000	272 (30.7)	19 (35.2)		
>3000	132 (14.9)	29 (53.7)		

(Continued)

Table 4 (Continued).

Variable	Non-adherence (n=886) N(%)	ABC – adherence (n=54) N(%)	$\chi^2/2$	P
Type of AF			–2.272	0.025
Paroxysmal AF	686 (77.4)	49 (90.7)		
Persistent AF	170 (19.2)	4 (7.4)		
Long-standing persistent AF	30 (3.4)	1 (1.9)		
Disease course			–1.450	0.152
≤1 year	427 (48.2)	22 (40.7)		
1–5 years	308 (34.8)	18 (33.3)		
≥5years	151 (17.0)	14 (25.9)		
Previously hospitalized for AF	230 (26.0)	13 (24.1)	0.094	0.759
No	661 (74.6)	45 (83.3)	2.074	0.150
HAS-BLED				
Score ≤2	823 (92.9)	52 (96.3)	0.465	0.495
Score ≥3	63 (7.1)	2 (3.7)		
RFCA	31 (3.5)	1 (1.9)	0.068	0.794
LAAC	6 (0.7)	1 (1.9)	0.025	0.873
Pacemaker implantation	22 (2.5)	0 (0.0)	—	0.632
Multimorbidity	806 (91.0)	32 (59.3)	52.910	<0.001
Polypharmacy	340 (38.4)	15 (27.8)	2.432	0.119
AF knowledge, M(SD)	3.81 ± 2.72	9.76 ± 4.10	–10.513	<0.001
AF health belief, M(SD)	71.94 ± 12.63	104.04 ± 10.15	–22.216	<0.001
AF self-management ability, M(SD)	51.46 ± 8.63	79.22 ± 11.77	–17.059	<0.001
Social Support, M(SD)	26.93 ± 3.57	40.41 ± 4.44	–26.501	<0.001

Abbreviations: LAAC, left atrial appendage closure; M, mean; NRCMS, New Rural Cooperative Medical System; RFCA, radiofrequency catheter ablation; SD, standard deviation; UEBMI, Urban Employee Basic Medical Insurance; URBMI, Urban Resident Basic Medical Insurance;

The fit measures for path Models 1 and 2 indicated a good fit (Model 1: $\chi^2/df = 58.603/14 = 4.186 < 5$, RMSEA = 0.058 < 0.08, CFI = 0.984 > 0.9, TLI = 0.970 > 0.9, SRMR = 0.027 < 0.05). Model 2: $\chi^2/df = 34.540/7 = 4.934 < 5$, RMSEA = 0.065 < 0.08, CFI = 0.979 > 0.9, TLI = 0.948 > 0.9, SRMR = 0.017 < 0.05). The fit measure for path Model 3 indicated an acceptable overall fit (Model 3: $\chi^2/df = 210.896/15 = 14.060 > 5$, RMSEA = 0.118 > 0.08, CFI = 0.937 > 0.9, TLI = 0.878 > 0.8, SRMR = 0.034 < 0.05). This may mainly be caused by the complexity of the model paths. The R^2 values for Models 1, 2 and 3 were 40.7%, 48.9% and 48.0% respectively.

Stepwise path model tests showed stable and consistent results. (Figure 3) Regarding the overall path structure of ITHBC (Model 3), AF self-management ability ($\beta = 0.449$, $P < 0.001$) and social support ($\beta = 0.429$, $P < 0.001$) directly and positively affected adherence to the ABC pathway. Social support also indirectly positively affected adherence to the ABC pathway through AF self-management ability ($\beta = 0.085$, $P < 0.001$, relative mediating effect = 16.5%). AF health beliefs had no direct effect on adherence to the ABC pathway, but they indirectly positively affected adherence to the ABC pathway through AF self-management ability. Possibly due to a masking effect, AF knowledge had a direct negative effect on adherence to the ABC pathway. However, it indirectly positively affected adherence to the ABC pathway through AF self-management ability ($\beta = 0.211$, $P < 0.001$, relative mediating effect = 41.5%). AF knowledge also indirectly positively affected adherence to the ABC pathway through a series of mediations via AF health beliefs and AF self-management ability ($\beta = 0.121$, $P < 0.001$, relative mediating effect = 23.8%). (Table 5).

Discussion

The study shows that the ITHBC-based pathway model can effectively predict adherence to the ABC pathway in rural patients with AF. Four findings were explored and validated in the study: (1) Adherence to the ABC pathway in rural patients with AF was extremely low (5.7%). (2) AF self-management ability and social support can directly and positively affect adherence to

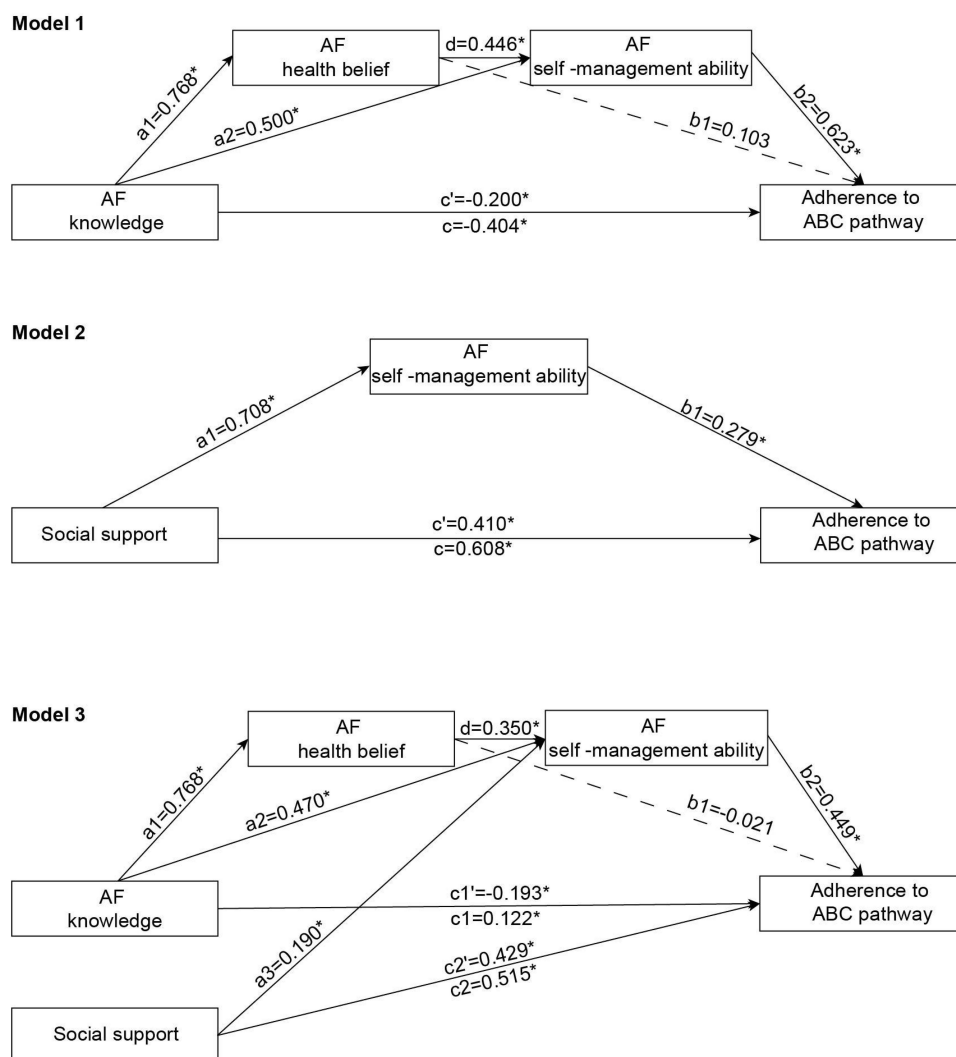


Figure 3 Test of the hypothesized model. *.The symbol indicates that the path coefficient has statistical significance ($P < 0.05$).

the ABC pathway. (3) AF knowledge, AF health beliefs, and social support can indirectly positively affect adherence to the ABC pathway through AF self-management ability. (4) Although AF health beliefs have no direct effect on adherence to the ABC pathway, the serial mediating effects of AF health beliefs and AF self-management ability also played an important role in the relationship between AF knowledge and adherence to the ABC pathway.

Table 5 Mediation Effects Between Study Variables. (N=940)

	<i>B</i> (95% CI)	SE	<i>t</i>	<i>P</i>
Model 1				
AF knowledge→AF health belief (<i>a1</i>)	0.768 (0.738–0.794)	0.014	53.865	<0.001*
AF knowledge→AF self-management ability (<i>a2</i>)	0.500 (0.439–0.558)	0.030	16.493	<0.001*
AF health belief→AF self-management ability (<i>d</i>)	0.446 (0.390–0.502)	0.028	15.680	<0.001*
AF health belief→Adherence to ABC pathway (<i>b1</i>)	0.103 (–0.015–0.240)	0.065	1.584	0.113
AF self-management ability→Adherence to ABC pathway (<i>b2</i>)	0.623 (0.462–0.765)	0.077	8.110	<0.001*
Direct effect AF knowledge→Adherence to ABC pathway (<i>c'</i>)	–0.200 (–0.332–0.060)	0.070	–2.867	0.004*

(Continued)

Table 5 (Continued).

	<i>B</i> (95% CI)	SE	<i>t</i>	<i>P</i>
Indirect effect (a1b1)	0.079 (−0.013–0.182)	0.050	1.590	0.112
Indirect effect (a2b2)	0.312 (0.232–0.392)	0.041	7.559	<0.001*
Indirect effect (a1d1b2)	0.213 (0.149–0.274)	0.032	6.704	<0.001*
Total effect (c)	0.404 (0.311–0.495)	0.047	8.592	<0.001*
Relative mediating effect 1=a1b1/c (%)	9.8%			0.186
Relative mediating effect 2=a2b2/c (%)	38.8%			<0.001*
Relative mediating effect 3=a1d1b2/c (%)	26.5%			<0.001*
R ²	40.7%			<0.001*
Model 2				
Social support→AF self-management ability (a1)	0.708 (0.657–0.751)	0.024	29.322	<0.001*
AF self-management ability→Adherence to ABC pathway (b1)	0.279 (0.160–0.398)	0.062	4.508	<0.001*
Direct effect Social support→Adherence to ABC pathway (c')	0.410 (0.295–0.520)	0.057	7.222	<0.001*
Indirect effect (a1b1)	0.198 (0.112–0.283)	0.044	4.490	<0.001*
Total effect (c)	0.608 (0.526–0.676)	0.608	16.127	<0.001*
Relative mediating effect 1=a1b1/c (%)	32.5%			<0.001*
R ²	48.9%			<0.001*
Model 3				
AF knowledge→AF health belief (a1)	0.768 (0.738–0.794)	0.014	53.865	<0.001*
AF knowledge→AF self-management ability (a2)	0.470 (0.406–0.530)	0.031	15.041	<0.001*
AF health belief→AF self-management ability (d)	0.350 (0.294–0.429)	0.029	11.904	<0.001*
AF health belief→Adherence to ABC pathway (b1)	−0.021 (−0.121–0.095)	0.055	−0.393	0.694
Social support→AF self-management ability (a3)	0.190 (0.131–0.249)	0.030	6.274	<0.001*
AF self-management ability→Adherence to ABC pathway (b2)	0.449 (0.281–0.600)	0.082	5.464	<0.001*
Direct effect AF knowledge→Adherence to ABC pathway (c1')	−0.193 (−0.318–0.063)	0.065	−2.975	0.003*
Direct effect Social support→Adherence to ABC pathway (c2')	0.429 (0.314–0.535)	0.055	7.752	<0.001*
Indirect effect (a1b1)	−0.016 (−0.093–0.073)	0.042	−0.393	0.695
Indirect effect (a2b2)	0.211 (0.135–0.289)	0.040	5.305	<0.001*
Indirect effect (a3b2)	0.085 (0.056–0.125)	0.019	4.578	<0.001*
Indirect effect (a1db2)	0.121 (0.070–0.176)	0.027	4.431	<0.001*
Total effect (c1)	0.122 (0.026–0.228)	0.052	2.358	0.018*
Total effect (c2)	0.515 (0.401–0.610)	0.053	9.775	<0.001*
Relative mediating effect 1=a1b1/c (%)	3.1%			0.466
Relative mediating effect 2=a2b2/c (%)	41.5%			<0.001*
Relative mediating effect 3=a3b2/c (%)	16.5%			<0.001*
Relative mediating effect 4=a1db2/c (%)	23.8%			<0.001*
R ²	48.0%			<0.001*

Note: Age, educational level, occupation, monthly household income per capita, type of AF and multimorbidity were controlled in the mediation model. **P*<0.05.

Abbreviation: CI, 95% confidence intervals.

It seems that education and economic status in rural areas are associated with few patients (5.7%) being treated according the ABC pathway in this study, which was much lower than that in developed countries (21%) and urban areas in China (22.8%).^{10,25,26} Furthermore, considering that 39.5% (688/1762) of the patients died and 11.3% (120/1060) of the patients were lost to follow-up in the medical registration system, the rate of adherence to the ABC pathway for rural patients with AF in the real world might be even lower. Similarly, rural patients also had relatively lower levels of AF knowledge, AF health beliefs, AF self-management ability, and social support. AF knowledge (4.15 ± 3.13 vs 11.79 ± 5.58), AF health beliefs (AFHBS: 59.63 ± 15.67 vs 71.23 ± 6.64; CDSes: 14.16 ± 5.67 vs 32.13 ± 1.50), AF self-management ability (53.05 ± 10.94 vs 76.73 ± 17.54) and social support [27.7 ± 4.80 (total score 66) vs 63.84 ± 10.01, (total score 85)] scores of rural patients with AF were much lower than those of urban patients in China.^{18,27–29} Furthermore, compared with urban areas, medical resources and quality in rural areas are relatively insufficient.³⁰ It

lead to a decrease in the utilization of health care resources in rural patients with AF.³¹ Therefore, clarify the prediction of adherence to the ABC pathway by AF knowledge, AF health beliefs, social support, and AF self-management ability and elucidating the mechanisms involved based on the ITHBC, and maximizing the accessibility and utilization of medical resources, is of crucial importance for the construction of a targeted and effective integrated management program for rural patients with AF.

In this study, AF self-management ability and social support had a direct positive effect on adherence to the ABC pathway. Although the path analysis showed a negative direct effect of AF knowledge on adherence to the ABC pathway, this may be due to a masking effect. The indirect effect of AF knowledge on adherence to the ABC pathway through AF health beliefs and AF self-management ability was positive. This result is consistent with theories on health behavior change, such as cognitive behavioral theory, the theory of reasoned action, and social cognitive theory. The effect of improving the level of AF knowledge, AF self-management ability, and social support on improving adherence to “A” (ie, anticoagulation) has been widely verified.^{32,33}

AF knowledge, AF health beliefs, and social support also had indirect positive effects on adherence to the ABC pathway through AF self-management ability in the study. The same result was shown in a study predicting lymphedema self-management behavior in patients with breast cancer that was based on the ITHBC.³⁴ AF self-management ability is an important mediating variable for improving adherence to the ABC pathway. Model 3 showed that AF self-management ability had the largest positive direct effect on adherence to the ABC pathway. The indirect positive effects of AF knowledge and social support on adherence to the ABC pathway through AF self-management ability accounted for 41.5% and 16.5% of the total effect, respectively. The serial mediating effect of AF health beliefs and AF self-management ability between AF knowledge and adherence to the ABC pathway accounted for 23.8% of the total effect. A study showed that the activation of self-management ability was positively associated with health outcomes in patients with AF.³⁵ It suggests that future intervention strategies should focus more on strengthening AF self-management ability and consider AF knowledge, AF health beliefs, and social support as important components of self-management interventions.

Notably, there was no direct effect of AF health beliefs on adherence to the ABC pathway in the current study. This is inconsistent with the findings in other studies, which showed that health beliefs directly influence health behaviors.¹⁴ In the current study, the effect of AF health beliefs on adherence to the ABC pathway was fully mediated by AF self-management ability. This may be mainly due to the poor AF self-management abilities of rural patients with AF. Consequently, patients do not have the corresponding skills and abilities for self-management, even if they are confident enough to actively change their health behaviors. However, this does not mean that AF health beliefs are not important for adherence to the ABC pathway in rural patients with AF. The serial mediation of AF health beliefs and AF self-management ability between AF knowledge and adherence to the ABC pathway was the second largest mediating effect. AF health belief is also a key component of intervention strategies for rural patients with AF, and it should be closely integrated with the components of AF knowledge and AF self-management ability.

Limitations

This study has some limitations. Firstly, this is a cross-sectional study. Although path analysis can explain complex relationships between variables, its application to inferring causal relationships is limited. In the future, prospective longitudinal studies or empirical studies are needed to further verify the effects and mechanism of the variable model based on ITHBC on adherence to the ABC pathway in rural patients with AF. Secondly, the risk factors assessed in the C component of this study were not comprehensive enough, and future research should further consider lifestyle-related factors. Thirdly, the integrated management of patients with AF requires the cooperation of patients and medical multidisciplinary teams. The study only explored patient-related factors. Further exploration of the influencing factors and perceptions of other stakeholders on patients' adherence to the ABC pathway is required. Fourth, although Models 1 and 2 have good fits, some of the fit indicators of Model 3 were only close to the fit criteria. Therefore, Model 3 was mainly used to test the path relationships and conclusion reliability based on the complete ITHBC model in the study, rather than as an accurate effect estimation model. Finally, the study was conducted among rural patients with AF from only one county in China. Therefore, the conclusions of the study need to be extrapolated with caution.

Conclusions

Adherence to the ABC pathway by rural patients with AF in China is extremely low. In the current study, the path analysis based on ITHBC elucidated the effects and mechanisms of AF knowledge, AF health beliefs, AF self-management ability, and social support on adherence to the ABC pathway among rural patients with AF. AF self-management ability has the greatest direct positive effect and an important mediating effect on adherence to the ABC pathway. AF knowledge, AF health beliefs, and social support have indirect positive effects on adherence to the ABC pathway through AF self-management ability. We suggest that effective interventions to strengthen AF self-management ability should be explored among rural patients with AF in the future, and that AF knowledge, AF health beliefs, and social support should be closely combined with AF self-management ability as important intervention components.

Data Sharing Statement

The data that support the findings of this study are available on request from the corresponding author, Xiaomin Zhang or Kun Li.

Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki and has been approved by the Medical Ethics Committee of the People's Hospital of Shangyou, China (approval number:SYRY-20220716-002). Confidentiality of patients personal information was ensured, and informed consent was obtained from all patients.

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Disclosure

The authors report no conflicts of interests in this work.

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