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The link between fear of disease progression and health promotion behaviors in patients with obstructive sleep apnea hypoventilation syndrome (OSAHS): the mediating role of social support

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Abstract

Objective This study aims to assess the levels of social support, fear of disease progression (FOP) and health promotion behaviors in patients with obstructive sleep apnea-hypopnea syndrome (OSAHS), and to examine the associations between FOP, social support, and health promotion behaviors in OSAHS patients, with a focus on exploring the mediating role of social support. The findings aim to provide insights for enhancing health promotion behaviors among OSAHS patients in China and to offer a theoretical foundation for healthcare professionals in devising intervention strategies to promote health behaviors in individuals with OSAHS.

Methods This cross-sectional study included 307 patients diagnosed with OSAHS in Jinzhou City, Liaoning province. The survey instruments utilized included the Demographic Characteristics Questionnaire, Social Support Rating Scale (SSRS), Fear of Disease Progression Scale (Fop-Q-SF), and Health-Promoting Lifestyle Scale (HPLP II). Pearson correlation analysis was employed to assess correlations, while multiple linear regression and structural equation modeling were utilized to explore potential mediation effects.

Results In the OSAHS patient population, FOP (r=-0.55, p<0.001) and social support (r=0.60, p<0.001) were found to be significantly correlated with health promotion behaviors. In the mediated effects model, social support was identified as a partial mediator in the association between FOP and health promotion behaviors among OSAHS patients, accounting for 59.00% of the total effect.

Conclusion FOP demonstrates a direct relationship with health promotion behaviors in patients with OSAHS, with social support playing a mediating role in this connection. Healthcare professionals are advised to underscore the significance of social support in promoting the health of OSAHS patients to mitigate FOP and consequently improve health promotion behaviors.

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Keywords Obstructive sleep apnea hypoventilation syndrome, Fear of disease progression, Social support, Health promotion behaviors, Mediating role

Introduction

Obstructive sleep apnea-hypoventilation syndrome (OSAHS) is a chronic condition characterized by the collapse and obstruction of the upper airway during sleep, resulting in apnea, hypoventilation, hypercapnia and hypoxaemia [1]. Global data suggests that nearly 1 billion individuals worldwide are affected by OSAHS, with an estimated 936 million adults aged 30–69 experiencing mild to severe OSAHS [2]. The escalating prevalence of OSAHS underscores its emergence as a significant public health issue. Several risk factors, including overweight, advanced age, male gender, and craniofacial structural anomalies, have been identified as contributors to the onset and progression of OSAHS [3, 4]. In addition, lifestyle factors such as anaerobic exercise, diet, smoking and alcohol consumption have been linked to the development and severity of OSAHS [5, 6]. Currently, the American Academy of Sleep Medicine guidelines have classified OSAHS as a chronic condition necessitating comprehensive, long-term multidisciplinary management. These guidelines advocate the implementation of health-promoting behaviors to enhance sleep health and overall well-being in patients with OSAHS [7]. In recent years, the recommendation of adopting health-promoting behaviors has become a standard clinical practice for managing OSAHS patients, supplementing traditional clinical interventions.

In 1987, American nursing scientist Pender developed a health promotion theory that outlined key factors significantly influencing individual health behavior [8]. This theory underscores the significant role of individual mental states and emotions in health behavior [9]. Multiple studies have indicated that fear of disease progression (FOP) has emerged as a prominent stressors prevalent among patients with chronic diseases [10–12]. This fear stems from the patient's apprehensions or worries regarding disease advancement and prognosis, potentially impeding the individual's motivation to embrace health promotion behaviors [13]. Studies have demonstrated that heightened apprehensions regarding medication side effects and physical limitations are contributory factors to suboptimal self-management practices among individuals with arthritis [14]. In addition, a longitudinal study focusing on health behaviors in diabetic patients revealed a robust correlation between inadequate health behaviors and fears of hypoglycemia [15]. FOP has the potential to diminish the overall quality of life across physical, psychological, and social domains, persisting even following the conclusion of active therapeutic interventions [16]. It is worth noting that OSAHS is a condition that cannot be completely cured; while advanced interventions such as surgery and Continuous Positive Airway Pressure (CPAP) can alleviate symptoms [17, 18], the enhanced survival rates often come with a treatment burden. This burden includes enduring frequent nocturnal apnea episodes, potential irreversible complications from invasive procedures, and the substantial cost associated with CPAP treatment, all of which contribute to maintaining OSAHS patients in a chronic state of long-term fear and anxiety. Despite the established link between FOP and healthy behaviors in different populations [19–21], the relationship between FOP—a relatively novel and underrecognized stressor among OSAHS patients—and health promotion behaviors remains insufficiently explored and warrants further investigation.

Social support is commonly described as the informational, emotional, and instrumental assistance provided by an individual's social connections, serving as a valuable tool and emotional resource in facilitating improved health outcomes. It plays a crucial role in fostering favorable psychological outcomes in chronic disease management [22]. Surveys conducted among diabetic cohorts have identified a positive correlation between elevated levels of social support and increased engagement in health promotion behaviors [23]. Furthermore, the research indicates that social support can mitigate psychological distress, potentially serving as a protective factor against the exacerbation of FOP [24]. In addition, the distinctive symptoms of snoring in OSAHS can elicit feelings of shame and diminish self-esteem among affected individuals [25], leading them to shoulder the burden of the condition in solitude. Nonetheless, it has been recognized that emotional support from family members plays a beneficial role in fostering both psychological and physical adaptation to the illness. This form of emotional support is naturally anticipated from immediate family members such as spouses and children. The implementation of positive coping strategies, whether internal or external, originating from social or familial networks, holds paramount importance in aiding patients to navigate and adjust to the evolving circumstances surrounding their condition [26]. Leung et al. showed that social support has the potential to enhance patients' mental well-being and enhance their adherence to treatment [27]. Therefore, the effect of social support on FOP in OSAHS patients warrants careful consideration.

To date, the association between social support and FOP in patients with OSAHS have not received widespread attention, and further exploration is needed regarding the link between patients' social support and

their engagement in health promotion behaviors. Social support serves as a crucial mediating factor in interpersonal dynamics, with its effectiveness contingent upon an individual's ability to articulate their needs [28]. Celik et al. has indicated that social support can mitigate patients' FOP, aiding them in navigating uncertainty and facilitating the adoption of positive coping strategies to enhance disease management and elevate their quality of life [29]. Kong's seminal work on factors influencing self-perceived burden in individuals with OSAHS further corroborated the significance of social support in mitigating patients' psychological distress [30]. The collective findings underscore the potential of social support in ameliorating the negative emotions experienced by OSAHS patients, consequently fostering the adoption of health promotion behaviors.

In summary, we hypothesized that:

H1a FOP is negatively correlated with health promotion behavior;

H1b FOP is negatively correlated with social support;

H1c Social support is positively correlated with health promotion behavior.

H2 Social support acts as a mediator in the relationship between FOP and health promotion behavior (the hypothetical model presented is illustrated in Fig. 1).

The aim of this study is to provide a corresponding reference for future clinical improvement of health promotion behaviors in Chinese OSAHS patients as well as a theoretical basis for the development of interventions.

Methods

Study design and setting

This was a cross-sectional questionnaire-based study in which patients who had polysomnography and were diagnosed with OSAHS at Jinzhou Medical University's First Affiliated Hospital between June 2023 and January 2024 were included. The inclusion criteria were (1) age ≥ 18 years; (2) those diagnosed with OSAHS by Polysomnography (More than 30 repeated apnea episodes and hypopnea during 7 h sleep every night, or AHI ≥ 5 times/h. Apnea events are mainly obstructive, accompanied by snoring, sleep apnea, daytime sleepiness, and other symptoms); (3) basic communication and understanding skills; (4) patients were informed about the diagnosis and consented to the study. Exclusion criteria: (1) missing or incomplete monitoring data; (2) severe dysfunction of organs such as the heart, brain, and kidneys in combination; (3) patients with severe mental illnesses who are unable to communicate and express themselves normally.

Self-reported measures

Demographics features

Based on relevant literature and expert correspondence, a self-designed questionnaire on socio-demographic factors such as age, gender, education, place of residence, BMI, OSAHS severity, smoking and drinking behavior (none/occasional/ frequent), physical activity (greater than or less than 2 times/month), and co-morbid chronic diseases (yes or no) was developed.

Social support rating scale (SSRS)

Developed by Chinese scholar Xiao Shui yuan [31], it is extensively used in China to assess the level of social support [32]. The scale consists of 10 items in 3 dimensions:3 items assessing objective support, 4 items assessing subjective support, and 3 items assessing support utilization. Items 1–4 and 8–10 were evaluated using a 4-point Likert scale. Item 5 included five alternatives (A to E), each with a score of 1 to 4, ranging from 'no' to 'full support'. Answers to questions 6 and 7 were graded on a scale of 1 to 4, with 'no source' responses receiving a score of 0. The overall score was positively connected with the degree of social support and was classified as low (≤ 22), medium (23–44) or high (≥ 45). The Cronbach's alpha in this research was 0.84, indicating high reliability.

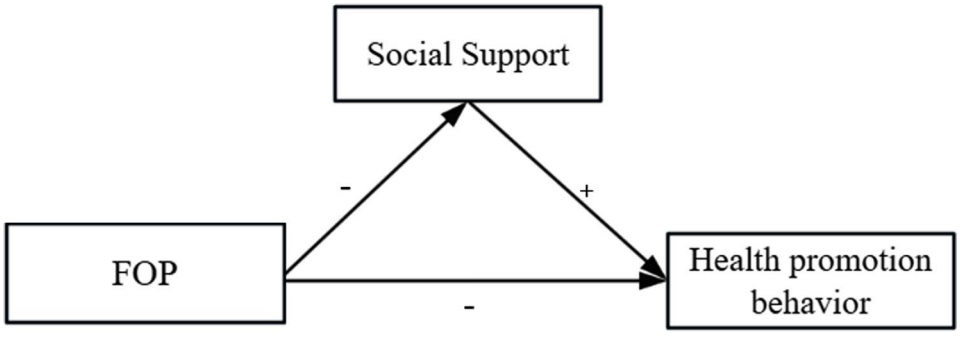

Fig. 1 Hypothetical model

Fear of progression questionnaire-short form (Fop-Q-SF)

The Fop-Q-SF is a scale used to assess patients' fear of disease progression developed by American scholars Mehnert et al. in 2006 [33], which has been shown to be valid for the Chinese population [34], and it consists of two dimensions with 12 entries: physical health (6 entries) and social family. The Likert scale ranges from 1 to 5. The scale total is the sum of each question's scores, which vary from 12 to 60. A total score of more than 34 indicates a patient's fear of illness Progression. The total Cronbach's alpha in this study was 0.89, indicating high reliability.

Health-promoting lifestyle profile II (HPLP II)

The HPLP II, developed by American scholar Walker in 1987 [8], was used to measure the degree of patients' health behaviors. Scholar Cao Wenjun introduced the Chinese version of the scale in 2016 [35]. The scale's 52 categories address six dimensions: health responsibility, nutrition, self-actualization, interpersonal connections, sports and exercise, and stress management. The Likert scale has four points, from 1 to 4 (less than always). Scale scores ranged from 52 to 208 points and were graded into four categories: excellent (172–208 points), good (132–171 points), fair (92–131 points), and bad (52–91 points), with higher scores suggesting more health promotion behaviors. The Cronbach's alpha in this research was 0.90, indicating high reliability.

Procedure

The research team consisted of three postgraduate students and one nurse, and the investigators explained in detail the purpose of the study and the study methodology to the patients in a separate room before collecting the study data in person with the patients' consent. All data were collected using paper questionnaires. The survey procedure strictly adhered to the basic principles of medical research and ensured confidentiality and privacy.

The study's questionnaire contained 21 variables. Based on Kendall's approximate sample size estimation method [36], the sample size should be 5–10 times the number of variables, ranging from 105 to 210 cases. The estimated sample size was adjusted to 132–264 cases, taking into account a 20% sample attrition rate and potential errors due to convenience sampling. A total of 330 questionnaires were distributed and 307 valid questionnaires were recovered, excluding 23 invalid questionnaires with incomplete answers and more than half of consecutive answers [37]. The recovery rate was 93.03%.

Ethics approval and consent to participate

All procedures were carried out in accordance with the 1964 Helsinki declaration, and the research proposal was approved by the Ethics Committee of Jinzhou Medical University (JZMULL2023149). All study participants received informed consent.

Statistical analysis

SPSS 26.0 and Amos 24.0 were utilized for statistical analysis. Descriptive statistics such as mean, standard deviation, frequency, and percentage were used to describe the basic characteristics of OSAHS patients. The t-test and one-way analysis of variance were used to examine intergroup differences in health promotion behavior. Pearson correlation analysis was used to analyze the correlation between FOP, social support and health promotion behavior. Through hierarchical multiple regression analysis, the mediating role of social support between FOP and health promotion behavior was explored. Finally, AMOS 24.0 software was adopted for structural equation modeling, the model is valid when the fit indices GFI, CFI, NFI and IFI > 0.9 and RMSEA < 0.8 [38]. The deviation-corrected non-parametric percentile Bootstrap method with 95% confidence interval was used to verify the mediating role of FOP between social support and health promotion behavior by repeated sampling 5000 times. An alpha level of 0.05 was used for the statistical tests.

Results

Participant characteristics

The research eventually comprised 307 OSAHS patients, consisting of 266 males (86.66%) and 41 females (13.33%). The minimum age of the sample was 18 years, and the maximum age was 72 years. Participants aged 41 to 59 years accounted for 63.51% of the total ($n=195$). The proportion of individuals diagnosed with moderate to severe OSAHS was 36.15% ($n=111$) and 56.67% ($n=174$), respectively. Obese and overweight patients accounted for 47.88% ($n=147$) and 36.15% ($n=111$), respectively. 67.75% ($n=208$) of patients smoked, 84.02%($n=258$) drank alcohol, and 76.22%($n=234$) exercised less than twice a month. Further comparing the differences in health promotion behavior scores of OSAHS patients, demographic characteristics showed significant differences in health promotion behaviors with respect to age, gender, BMI, smoking and drinking behaviors, and comorbidities with other chronic diseases. Patients over 60 years old exhibited significantly higher health promotion behaviors compared to younger age groups ($p<0.001$). Additionally, men demonstrated more proactive health promotion behaviors than women ($p<0.001$). A lower BMI was associated with higher levels of health promotion behavior ($p<0.001$). Patients with additional chronic diseases exhibited greater awareness of health behaviors ($p<0.001$). Furthermore, the bad habits of smoking also affected the scores of health promotion behaviors ($p<0.001$). Additional details are provided in Table 1.

Table 1 Univariate analysis of health promotion behavior in patients with different OSAHS characteristics ($n=307$)

Variables	Group	Total(N%)	Mean ± SD	df	*p*
Sex	Male	266(86.66)	139.69(23.41)	4.86	<0.001
	Female	41(13.33)	112.78(17.16)		
Age	≤ 40	62(20.19)	128.13(18.90)	8.37	<0.001
	41–59	195(63.51)	135.92(22.61)		
	≥ 60	50(18.56)	146.68(32.67)		
BMI	Malnutrition	4(1.30)	184.25(9.39)	6.58	<0.001
	Normal	45(14.65)	137.78(25.01)		
	Overweight	147(47.88)	137.15(25.27)		
	Obesity	111(36.15)	132.29(21.46)		
Educational level	College and below	265(86.31)	135.50(24.08)	2.14	0.285
	Bachelor or above	42(13.68)	139.86(26.60)		
Residence	Urban	181(58.95)	134.65(22.79)	2.06	0.216
	country	126(41.04)	138.15(26.56)		
Smoking behavior	Never	99(32.24)	136.17(25.62)	7.57	<0.001
	Sporadic	117(38.11)	141.76(21.63)		
	Often	91(29.64)	128.74(24.84)		
Drinking behavior	Never	49 (15.96)	142.9(23.32)	5.37	0.005
	Sporadic	143(46.57)	138.11(26.33)		
	Often	115(37.45)	130.68(21.36)		
Physical exercise	≤ 2 times/month	234(76.22)	129.88(22.00)	1.53	<0.001
	>2 times/month	73(23.77)	156.04(21.09)		
Combined with other chronic diseases	Yes	166(54.07)	121.03(17.59)	0.61	<0.001
	No	141(45.92)	153.83(18.85)		
OSAHS severity	Mild	22(7.16)	133.31(23.60)	0.82	0.440
	Moderate	111(36.15)	134.21(23.59)		
	Severe	174(56.67)	137.65(25.09)		

SD: standard deviation; df: degrees of freedom

Statistical description and Pearson correlation analysis of variables

The scores of each scale and its dimensions have been included in Table 2. Additional correlation analysis revealed that FOP was negatively correlated with health promotion behavior (r =-0.55, $p<0.001$), FOP was negatively correlated with social support (r =-0.51, $p<0.001$), and social support was positively correlated with health promotion behavior ($r=0.60$, $p<0.001$). Table 3 provide more details.

Analysis of multiple linear regression

With demographic characteristics as the control variable, FOP and social support as the main independent variables, and health promotion behavior as the dependent variable, three multiple linear regression analyses were conducted. The results show (Table 4) that, according to model 1, the general information explains 54.1% of the standardized variance ($F=52.47$, $p<0.001$); Multiple linear regression analysis of Model 2 demonstrated that the negative prediction of FOP for health promotion behavior, explaining 61.0% of the standardized variance ($F=60.94$, $p<0.001$); Model 3 showed that social support significantly positively predicted health promotion behavior, explaining 65.0% of the standardized variance ($F=63.57$, $p<0.001$).

Table 2 Fear of disease progression, social support, health promotion behaviors, all scales and dimension scores of OSAHS patients ($n=307$)

Variable	Min	Max	MD ± SD
FOP	12	55	35.10 ± 6.91
Physical health	6	28	17.83 ± 3.84
Social family	6	27	17.27 ± 3.45
SSRS	12	59	38.58 ± 9.11
Objective support	4	16	9.79 ± 2.91
Subjective support	5	35	16.31 ± 5.37
Support utilization	3	12	6.48 ± 2.56
HPB	74	198	136.10 ± 24.44
Health responsibility	10	40	25.68 ± 6.42
Nutrition	9	31	20.89 ± 5.00
Stress management	11	32	21.80 ± 4.33
Exercise	9	32	19.81 ± 4.80
Interpersonal connections	11	36	24.03 ± 4.96
Self-actualization	10	34	23.89 ± 4.88

FOP: fear of disease progression; SSRS: social support; HPB: health promotion behaviors; MD: mean difference; SD: standard deviation

Test of the mediating effect of social support on FOP and health promotion behavior

Based on the results of correlation and regression analyses, this study further constructed a structural model using AMOS 24.0 software (Fig. 2). The model used FOP as the independent variable, social support as the mediator variable, and health promotion behaviors as the dependent variable, and the large likelihood method was adopted to estimate and test the structural model. The model was modified according to modification indices (MI). The results showed a good model fit: CMIN/DF=2.882, RMSEA=0.078, GFI=0.943, CFI=0.961, NFI=0.941, IFI=0.961.

Table 5 includes path analysis of mediating effects, and the standardized path coefficient of FOP on health promotion behavior is -0.23($p<0.001$); The standardized path coefficient of FOP on social support is -0.63($p<0.001$). The standardized path coefficient of social support on health promotion behavior is 0.53($p<0.001$).

The mediating effect of social support between FOP and health promotion behaviors was verified by

Table 3 The correlation between FOP, SSRS, and HPB in patients with OSAHS ($n = 307$)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.FOP	1													
2.Physical	0.95	1												
3.Social	0.94	0.80	1											
4.SSRS	-0.51	-0.51	-0.46	1										
5.Objective	-0.47	-0.45	-0.44	0.81	1									
6.Subjective	-0.42	-0.43	-0.37	0.91	0.59	1								
7.Utilization	-0.40	-0.39	-0.36	0.72	0.50	0.48	1							
8.HPB	-0.55	-0.55	-0.49	0.60	0.49	0.52	0.48	1						
9.Responsibility	-0.47	-0.48	-0.40	0.49	0.40	0.45	0.35	0.83	1					
10.Nutrition	-0.47	-0.47	-0.42	0.47	0.39	0.40	0.40	0.81	0.52	1				
11.Stress	-0.50	-0.46	-0.48	0.51	0.40	0.45	0.40	0.75	0.52	0.50	1			
12.Exercise	-0.38	-0.37	-0.34	0.44	0.36	0.38	0.37	0.79	0.69	0.51	0.49	1		
13.Interpersonal	-0.41	-0.41	-0.37	0.48	0.40	0.41	0.37	0.84	0.66	0.74	0.57	0.54	1	
14.Actualization	-0.44	-0.45	-0.37	0.51	0.43	0.42	0.44	0.79	0.51	0.66	0.63	0.54	0.54	1

All correlations are significant at $p < 0.01$

replicating the sampling 5,000 times, using a deviation-corrected non-parametric percentile Bootstrap method with 95% confidence intervals. The results (Table 6) revealed that the direct effect accounted for 41.0% of the total effect, while the indirect effect accounted for 59.00%. The corresponding 95% confidence upper and lower intervals did not contain 0, which is required to demonstrate the validity of the mediating effect. Thus, social support partially explains the link between FOP and health promotion behaviors in OSAHS patients.

Discussion

Given the prevalent demographic trends of adult obesity and an aging population, the prevalence of obstructive sleep apnea is expected to rise [39]. Therefore, it holds great importance to enhance health promotion behaviors among individuals with OSAHS in order to alleviate disease symptoms and delay disease progression. This study revealed a robust negative correlation between FOP and health promotion behaviors in OSAHS patients, while also investigating the mediating influence of social support in this relationship. These findings suggest that addressing FOP and bolstering social support mechanisms could represent novel approaches to promote healthy behaviors in patients with OSAHS.

In this study, health promotion behaviors exhibited significant variations in relation to age, gender, BMI, smoking and alcohol consumption, regular exercise, and the presence of comorbid chronic conditions. Primarily, the decline in self-care capabilities among elderly patients, coupled with increased attention and assistance from family members, creates an enabling environment for better self-management of health among older individuals. Moreover, patients with concurrent chronic illnesses often benefit from enhanced access to healthcare services and possess a heightened awareness of their health, prompting them to adopt more health-promoting behaviors to enhance their overall well-being. Individuals with detrimental habits such as smoking and alcohol consumption demonstrated suboptimal health behaviors. Notably, the lack of disease awareness and insufficient consideration of the impact of unhealthy habits on disease progression may significantly contribute to the poor health behaviors observed, particularly given the high proportion of undiagnosed and untreated individuals within the at-risk population for OSAHS [40]. In addition, even though the evident advantages of healthy behaviors in attenuating the advancement of OSAHS, the healthcare resources currently accessible in China lack provisions for individuals with OSAHS, particularly those with obesity, to access personalized professional guidance for lifestyle modifications. Moreover, the apprehensions harbored by OSAHS patients and their unaddressed intrinsic requirements often go unnoticed by

Table 4 Multiple linear regression analysis results

Variables	Model 1				Model 2				Model 3			
	β	SE	t	95%CI	β	SE	t	95%CI	β	SE	t	95%CI
Age	0.11	1.64	2.69*	1.18,7.63	0.09	1.51	2.46*	0.74,66.69	0.09	1.44	2.56*	0.85,6.50
BMI	0.05	1.38	1.22	-1.03,4.41	0.07	1.27	1.72	-0.31,4.70	0.07	1.21	1.94	-0.03,4.74
Sex	-0.22	2.87	-5.50***	-21.45,-10.14	-0.18	2.68	-4.78***	-18.07,-7.54	-0.15	2.57	-4.11***	-15.64,-5.51
Smoking	-0.05	1.23	-1.26	-3.96,-5.65	-0.07	1.13	-1.85	-4.31,0.14	-0.05	1.08	-1.48	-3.72,0.53
Drinking	-0.08	1.38	-2.13*	-5.65,-0.23	-0.08	1.27	-2.63*	-5.85,-0.85	-0.10	1.21	-2.90*	-5.88,-1.12
Exercise	0.16	2.58	3.58***	4.15,14.30	0.16	2.38	3.80***	4.347,13.70	0.13	2.28	3.15*	2.70,11.68
Comorbidity	0.53	2.14	12.20***	21.93,30.37	0.43	2.11	9.84***	16.58,24.87	0.38	2.04	9.18***	14.66,22.67
Fear of disease progression					-0.30	0.14	-7.38***	-1.33,-0.77	-0.20	0.15	-4.93***	-1.01,-0.43
Social support									0.24	0.11	5.72***	0.43,0.87
F				52.47				60.94				63.57
R^2				0.55				0.62				0.66
Adjusted R^2				0.54				0.61				0.65

*: $p<0.05$; ***: $p<0.001$

caregivers and family members. These factors have the potential to impede the successful integration of health promotion behaviors.

Building upon this foundation, the current study delved into the interplay between FOP, social support, and health promotion behaviors in patients with OSAHS. Our findings revealed that patients exhibiting heightened levels of FOP tended to exhibit lower engagement in health-promoting behaviors, aligning with previous research outcomes [41]. This trend can be attributed to the dampening effect of fear and anxiety on individuals' motivation, with excessive fear potentially resulting in neglect or maladaptive coping strategies towards their physical well-being [42], thereby hindering the adoption of healthy behaviors. Some psychologists have postulated that excessive fear may induce avoidance behaviors [43]. A qualitative study on OSAHS patients has identified resistance towards CPAP therapy and apprehensions regarding prognosis as prominent factors impeding timely treatment initiation among OSAHS patients [44]. This avoidance mindset not only delays early diagnosis and intervention but also contributes to disease progression. Furthermore, the study corroborates Heathcote's research, indicating that FOP is associated with compromised emotional and social well-being in affected individuals [45]. Various sociodemographic, psychosocial, and clinical characteristics such as age, social support, and overall health status play pivotal roles in shaping FOP among individuals. Aligned with the observations of Chen regarding hemodialysis patients, individuals who are socially isolated and have lower levels of education exhibit a higher propensity for experiencing moderate to severe FOP [46]. This underscores the imperative to prioritize the assessment and management of FOP in patients with OSAHS. Therefore, we advocate for healthcare providers to emphasize the importance of disease understanding and fear evaluation, offering timely support to individuals with heightened negative disease perceptions. By addressing these concerns proactively, patients can mitigate their fear of disease and potential complications, enabling them to confront their illness and treatment regimen effectively.

As anticipated, social support serves as a mediator in the association between FOP and health promotion behaviors among individuals with OSAHS, whereby social support functions to enhance health promotion behaviors by alleviating FOP. This outcome can be elucidated more comprehensively through the lens of the stress-assessment-coping theory [47]. In this study, FOP emerged as the primary stressor for patients, while social support received during the illness trajectory served as a mediating factor influencing patient outcomes. Health behaviors in OSAHS were perceived as responses to stress. Elevated levels of social support were found to

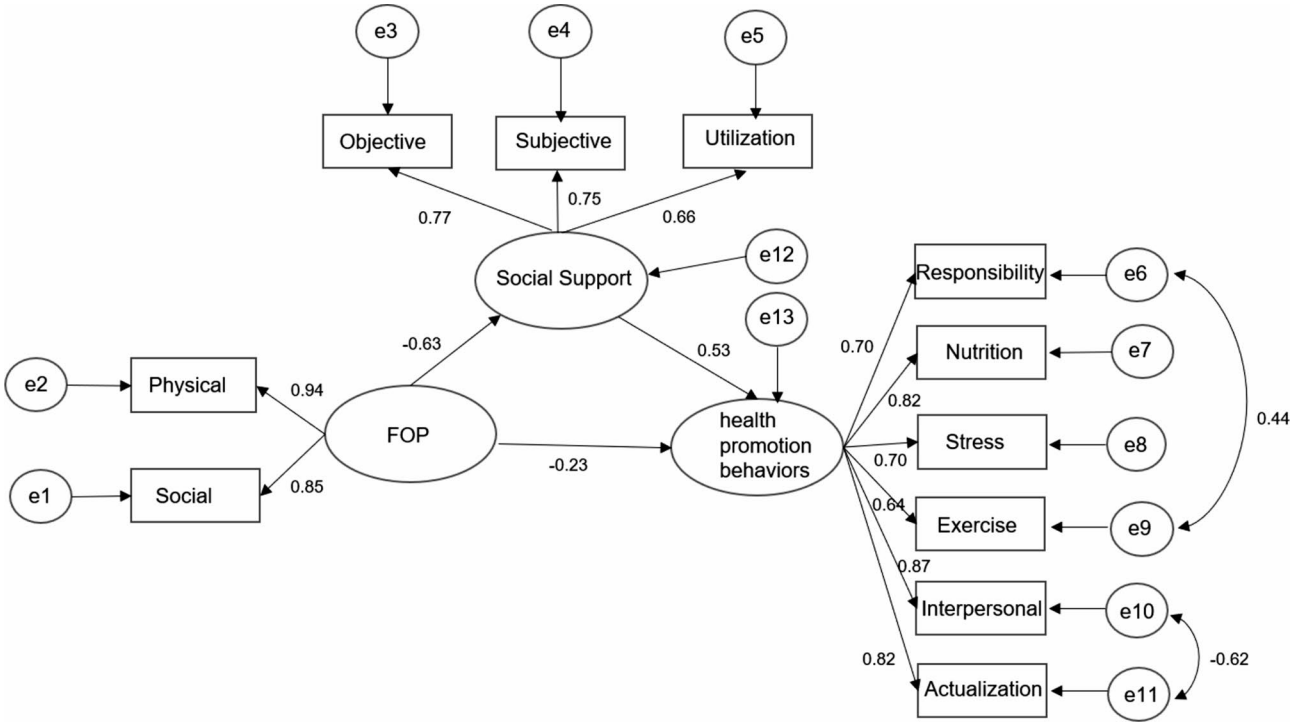

Fig. 2 Diagram of the mediating model of social support between FOP and health promoting behavior

Table 5 Path analysis ($n = 307$)

Path			Estimate	S.E	*p*
HPB	<---	FOP	-0.23	0.11	<0.001
SSRS	<---	FOP	-0.63	0.05	<0.001
HPB	<---	SSRS	0.53	0.17	<0.001

FOP: fear of disease progression; SSRS: social support; HPB: health promotion behaviors; Estimate: standardized path coefficient; S.E: standard error

Table 6 Mediation effect test for social support ($n = 307$)

	Effect value	LLCI	ULCI	Effect ratio (%)
Total Effect	-0.866	-1.070	-0.665	100%
Direct Effect	-0.355	-0.595	-0.107	41.00%
Indirect Effect	-0.511	-0.595	-0.107	59.00%

LLCI: lower limit of the confidence interval; ULCI: upper limit of the confidence interval

potentially mitigate FOP, thereby facilitating improved health promotion behaviors. Patients who perceived greater social support demonstrated enhanced capacity to confront the physical manifestations of the disease without succumbing to emotional distress, effectively managing negative emotions to adopt positive coping strategies. Moreover, bolstered by robust social support and a comprehensive understanding of the condition, individuals exhibited increased confidence and competence in managing their health concerns and engaging in health promotion behaviors. Furthermore, given the intimate link between detrimental lifestyle habits and OSAHS, the pivotal roles of social support and family dynamics in the daily management of patients cannot be overstated. These support systems are instrumental in facilitating the establishment and oversight of sustained healthy behaviors over the long term [48]. In individuals experiencing heightened levels of fear, tendencies towards social withdrawal can isolate them, hindering the expression of emotions and impeding their capacity to embrace healthy behaviors and seek necessary support proactively. Consequently, forthcoming research endeavors should prioritize social support as a focal point for interventions, motivating patients to actively pursue beneficial social networks. Encouraging families to provide comforting companionship, fostering trust, understanding, and respect within patient-caregiver relationships, can serve as vital components in enhancing patient outcomes.

The findings of this study suggest that enhancements in the health behaviors of individuals with OSAHS can be achieved through augmenting social support levels and mitigating FOP. It is essential to recognize that the type of social support needed varies based on the patient's individual characteristics and living circumstances. For instance, Korotkin's research indicates that individuals grappling with fear benefit from companionship support, whereas younger individuals may require familial support [49]. Hence, tailored interventions encompassing diverse forms of social support tailored to distinct patient cohorts should be implemented to optimize the availability and efficacy of social support resources in alleviating fear. Furthermore, hospitals should be

reinforced as primary hubs for social support, playing a pivotal role in disseminating health-related information. Leveraging digital resources effectively, hospitals can provide patients with an online platform to access professional guidance and facilitate the adoption of effective health behaviors. Furthermore, the assessment of OSAHS patients in this study revealed lower scores in the domains of exercise and nutrition. Considering the adverse impact of physical inactivity and a sedentary lifestyle on the disease prognosis of OSAHS patients, it is imperative to emphasize the importance of healthy behaviors, including dietary control and regular physical activity, in enhancing the overall well-being of OSAHS patients [50]. These aspects warrant particular attention and intervention to optimize patient outcomes.

Limitations

Firstly, it is essential to acknowledge that the current study employed a cross-sectional design, precluding the establishment of causal relationship between FOP, social support, and health promotion behaviors. Secondly, data collection in this study relied on convenience sampling and self-report measures, potentially introducing biases such as selection and reporting bias. Therefore, caution is warranted when interpreting the study outcomes. Future research endeavors are advised to incorporate a blend of self-assessment and external evaluation methods for data collection, while considering alternative sampling strategies to validate the study findings. Lastly, it is noteworthy that our investigation exclusively focused on examining the interplay between FOP, social support, and health promotion behaviors in OSAHS patients. Further exploration of additional psychosocial and emotional predictors influencing health promotion behaviors among individuals with OSAHS is warranted.

Conclusion

The findings of this study underscore the pressing need for individuals with OSAHS to enhance their health promotion behaviors. Furthermore, this investigation elucidates the correlation between fear of disease progression and health promotion behaviors in OSAHS patients. Social support, identified as a pivotal psychological determinant, not only offers emotional solace but also mitigates patients' apprehensions concerning disease advancement. This support fosters a more proactive involvement of patients in health promotion behaviors, thereby enhancing their overall quality of life.

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Author contributions
F Z: Data curation, Investigation, Writing – original draft, Writing – review & editing. C L: Writing – review & editing. C Z: Investigation. Q C: Investigation. H X: Investigation. K X: Data curation. Huiying Zhang: Supervision, Data curation.

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Data availability
Availability of data and materials The datasets generated and/or analyzed during the current study are not publicly available due Chinese people are relatively secretive about their lives and thoughts, although informed consent was obtained from study subjects prior to the survey and the findings were largely reported but are available from the corresponding author on reasonable request. All participants (or their proxies/legal guardians) provided informed consent to participate in the study. In addition, All the patients included in this study signed the informed consent form.

Declarations

Ethics approval and consent to participate
All procedures were carried out in accordance with the 1964 Helsinki declaration, and the research proposal was approved by the Ethics Committee of Jinzhou Medical University (JZMULL2023149). All participants (or their proxies/legal guardians) provided informed consent to participate in the study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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