

# Influencing Factors of Self-Management Behavior in Patients with Glaucoma in West China: A Cross-Sectional Study

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**Background:** Glaucoma is the world's leading cause of irreversible blindness, and poor self-management behavior is a global public health problem. Effective self-management behavior is crucial for controlling the progression of the disease. Nevertheless, few studies have carried out large-sample research on the factors influencing self-management behavior in glaucoma patients. The aim of this study was to comprehend the influencing factors of self-management behavior in glaucoma patients in western China and to provide a scientific basis for further exploring the intervention measures to enhance self-management behavior.

**Methods:** This cross-sectional study was conducted at West China Hospital, Sichuan University. It enrolled 538 participants from 12 provinces, municipalities, and autonomous regions across western China via convenience sampling. Survey instruments included: 1) a self-developed general information questionnaire (covering demographic and disease-related data); 2) the Glaucoma Self-Management Questionnaire (GSMQ); 3) the Social Support Rating Scale (SSRS); and 4) the Brief Illness Perception Questionnaire (BIPQ).

**Results:** The mean total score of the glaucoma self-management questionnaire was  $50.64 \pm 6.06$ . The mean total score of the social support rating scale was  $31.04 \pm 7.65$ . The mean total score on the brief illness perception questionnaire was  $47.65 \pm 7.33$ . Patients with glaucoma identified various contributing factors to their condition, with emotion ranking highest at 29.4%, followed by stress at 22.5%, and genetics at 18.2%. Multivariate analysis showed that smoking, type of glaucoma, annual follow-up frequency, assignment of a follow-up doctor, social support, and illness perception significantly affected self-management behaviors ( $P < 0.05$ ).

**Conclusion:** Self-management behaviors, social support and disease perception of glaucoma patients are all at a moderate level. Smoking, less than two annual follow-ups, primary open-angle glaucoma and not having a designated follow-up doctor are all associated with poorer self-management behaviors. A higher level of social support is associated with improved self-management behavior. Patients who perceived greater harm to their physical wellbeing due to the disease tended to show poorer self-management behavior.

**Keywords:** glaucoma, self-management behavior, influencing factor

## Introduction

Glaucoma is a prevalent ophthalmic disease characterized by optic neuropathy and presenting as optic atrophy, visual field loss, and visual dysfunction.<sup>1</sup> Primary glaucoma is the most common form. The number of patients with glaucoma worldwide will increase to 111.8 million by 2040.<sup>2</sup> In China, the number of patients is predicted to be 25.16 million in 2050.<sup>3</sup> Glaucoma is the world's leading cause of irreversible blindness,<sup>4</sup> causing blindness of more than 8 million people worldwide.<sup>5</sup> In China, the number of patients with severe visual impairment is 5.2 million, accounting for about a fifth of the total number of patients with blindness caused by glaucoma in the world.<sup>6,7</sup> After the decline of visual function, many patients experience psychological problems,<sup>8</sup> such as anxiety,<sup>9</sup> depression,<sup>10</sup> and decreased activity and self-care.<sup>11</sup> Patients also experience falls,<sup>12</sup> car accidents,<sup>13</sup> and other accidents, which have a huge impact on patient safety and quality of life.

Glaucoma is a chronic disease that seriously threatens the visual health of patients.<sup>14</sup> Once diagnosed, lifelong monitoring, treatment, and long-term follow-up are required. Studies have shown that good self-management is important for controlling disease progression and improving prognosis.<sup>15–17</sup> Currently, research on self-management behavior at home and abroad has encompassed many health fields and is widely recognized as an important component in the treatment, prevention, and control of chronic diseases, particularly in the management of common chronic diseases. Numerous studies both domestically and internationally have confirmed that transitioning from passive management to active self-management plays a crucial role in disease control and maintaining good health.<sup>18–20</sup> There are various factors that influence patients' self-management behavior. In addition to general demographics and disease-related factors, illness perception and social support are also significant factors affecting patients' self-management behavior in other studies on chronic disease self-management behavior.<sup>21–23</sup> At present, studies on self-management behavior mainly focus on chronic diseases, such as hypertension,<sup>24</sup> diabetes,<sup>25</sup> and other chronic diseases.<sup>26,27</sup> There are few reports on self-management behavior of glaucoma and its influencing factors. However, improving self-management behavior of glaucoma patients is still an urgent problem for ophthalmologists to solve. Therefore, this study aims to understand the current situation of self-management behavior among glaucoma patients in western China and analyze various influencing factors. This will provide scientific reference information for clinical staff to further explore intervention measures aimed at improving self-management behavior.

## Subjects and Methods

### Subjects

In this prospective cross-sectional study, patients with glaucoma were enrolled at West China Hospital, Sichuan University from November 2022 to January 2024.

Our research complies with the Declaration of Helsinki and has been approved by the Ethics Committee of West China Hospital (Approval Number: 2022(1483)). All patients signed written informed consent forms prior to the investigation. The inclusion criteria are as follows: (1) Diagnosed with primary glaucoma according to the 2014 Expert Consensus on the Diagnosis and Treatment of Primary Glaucoma in China;<sup>28</sup>

(2) Having received intraocular pressure-lowering treatment for over one week and requiring long-term medication and follow-up; (3) Aged between 18 and 85 years;

(4) Capable of communicating effectively with researchers; (5) Having signed a written informed consent form and voluntarily participated in the study. Patients were excluded if they met any of the following criteria: (1) Suffered from other serious organic diseases; (2) Had other ophthalmic diseases; (3) Withdrew during the investigation;

(4) Had stable intraocular pressure after laser or surgical treatment and did not require medication.

### Study Instruments

#### The General Information Questionnaire

The general demographic data of patients included gender, age, place of residence, level of education, working status, marital status, family type, mode of payment and economic burden, smoking, and alcohol-drinking status. Disease-related data include type of glaucoma, vision, time of illness, family history of glaucoma, surgical treatment, type of eye drops, annual follow-up frequency, other chronic diseases, and the presence of an assigned follow-up doctor.

#### Glaucoma Self-Management Questionnaire(GSMQ)

The glaucoma self-management questionnaire was developed by Chinese scholar Wu Peixia.<sup>29</sup> The scale has a total of 17 items and three dimensions. The three dimensions are life adjustment, functional health care, and medical management. There are four answer options, which are: not doing it at all (scores 1), doing it occasionally (scores 2), doing it mostly (scores 3), and doing it completely (scores 4). The higher the total score of the 17 items, the better the patient's self-management behavior. The research shows<sup>29</sup> that the Cronbach's  $\alpha$  coefficient of this scale in the Chinese cultural background is between 0.712 and 0.891, which has good reliability and validity.

### Social Support Rating Scale(SSRS)

The social support rating scale was developed and revised by mental health workers Xiao Shuiyuan<sup>30</sup> and is widely used in other chronic diseases in China. This scale has three dimensions, totaling 10 items. The three dimensions include subjective support, objective support, and the utilization of social support. The score range of the scale is 12–66 points and the higher the score, the more social support they receive. A score less than 22 is considered a low social support level, a score of more than 45 is considered as a high social support level and the score between the two is considered moderate.<sup>31</sup> The Cronbach's  $\alpha$  coefficient of the scale is 0.780,<sup>32</sup> and the correlation coefficient between the sub-scale and the total scale of this questionnaire is 0.724–0.835.<sup>33</sup> The above research indicates that the scale has strong reliability and validity in the context of Chinese culture.

### Brief Illness Perception Questionnaire (BIPQ)

The brief illness perception questionnaire was created by Broadbent.<sup>34</sup> The questionnaire includes 8 dimensions: consequences, timeline, personal control, treatment control, identity, concerns, understanding, and emotional response. There are a total of nine items in this scale, using a 0–10 level scoring method. Among them, 1, 2, 5, 6, and 8 are scored positively, and 3, 4, and 7 are scored negatively. The ninth item is an open-ended question, which asks the top three reasons why patients believe they are sick. The total score of this scale is from 0 to 80, and the higher the score, the greater the degree of harm that patients perceive the disease to have. This scale can quickly and conveniently assess patients' disease cognition status.<sup>35</sup> The research shows<sup>36</sup> that the Cronbach's  $\alpha$  coefficient of this scale in the Chinese cultural background is 0.831, which has good reliability and validity.

## Statistical Analysis

Statistical analysis was conducted using SAS 9.2 software. Categorical data were described by frequency and proportion, while continuous data were described by mean and standard deviation. Categorical data were analyzed using chi-square test or Fisher's exact probability test, and continuous data were analyzed using independent sample *t*-test or Mann–Whitney *U*-test. In this study, the total score of the self-management behavior scale was taken as the dependent variable, and the variables with statistical significance in the univariate analysis as well as those potentially meaningful based on literature review and clinical experience of glaucoma experts were taken as independent variables to establish a multiple linear regression model, in order to explore the influencing factors of self-management behavior in glaucoma patients.

## Results

### Demographic Information on Patients with Glaucoma

As shown in Tables 1 and 2, a total of 538 patients diagnosed with primary glaucoma were included, with an average age of 60.83±14.18 years. The cohort consisted of 246 males (45.7%) and 292 females (54.3%), and 266 cases (49.4%) presented with PACG, while the remaining 272 cases (50.6%) had POAG.

### Status of Self-Management Behavior in Patients with Glaucoma

As shown in Table 3, the average total score on the glaucoma self-management behavior scale was 50.64±6.06, with the mean scores for the three dimensions as follows: life adjustment 7.82±1.50, functional health care 17.91±2.45, and medical management 24.91±3.55.

### Status of Social Support in Patients with Glaucoma

The mean total score of the social support scale was 31.04±7.65, with the mean scores for the three dimensions as follows: subjective support 17.36±4.75, objective support 7.20±2.15, and support availability 6.48±2.27.

### Status of Illness Perception in Patients with Glaucoma

The illness perception scale score for patients with glaucoma was 47.65±7.33. The ninth question was open and aimed to gather insights on the significant perceived causes of the disease. Patients with glaucoma believed that emotions, stress, genetics, eye habits, and excessive eye use were the main contributing factors to their condition. The top three rankings were emotions (29.4%), stress (22.5%), and genetics (18.2%). Disease concern, course of the disease, and emotional feedback were the highest-scoring items in the illness perception scale, as shown in Table 4.

**Table 1** General Demographic Characteristics of 538 Patients with Glaucoma

Characteristic		N	%
Age	< 60 years	216	40.1
	≥60 years	322	59.9
Gender	Male	246	45.7
	Female	292	54.3
Place of residence	City	173	32.2
	Town	246	45.7
	Country	119	22.1
Level of education	Primary and below	173	32.2
	Junior high school	133	24.7
	High school	188	34.9
	College degree or above	44	8.2
Working status	In work	122	22.7
	Unemployed or retired	295	54.8
	Farmer	121	22.5
Marital status	Married	441	82
	Unmarried or divorced	97	18
Family type	Solitary	40	7.4
	Live with family	498	92.6
Mode of payment	Medical insurance	315	58.6
	Self-paying	223	41.4
Economic burden	Light	161	30
	Medium	217	40.3
	Heavy	160	29.7
Smoking	Yes	54	10
	No	484	90
Drinking alcohol	Yes	73	13.6
	No	465	86.4

**Table 2** Disease Data of Patients with Glaucoma (n=538)

Disease Data	N	(%)
Types of glaucoma		
PACG	266	49.4
POAG	272	50.6
Vision		
<0.3	122	22.7
≥ 0.3	416	77.3

(Continued)

**Table 2** (Continued).

Disease Data	N	(%)
Time of illness		
Less than 1 year	215	40.0
1–5 years	240	44.6
>5 years	83	15.4
Family history of glaucoma		
Yes	57	10.6
No	481	89.4
Surgical treatment		
Yes	282	52.4
No	256	47.6
Type of eye drops		
1	93	17.3
2	242	45.0
3	148	27.5
4	55	10.2
Annual follow-up frequency		
≤ 2 times	215	40.0
>2 times	323	60.0
Other chronic diseases		
Yes	203	37.7
No	335	62.3
Doctor follow-up		
Variable follow-up	267	49.6
An assigned follow-up	271	50.4

**Table 3** Scores for the Glaucoma Self-Management Behavior Scale. (SD=standard Deviation)

Dimension Item	Mean ± SD
Life adjustment	7.82±1.50
Emotion control	2.28 ± 0.74
Sleep quality	2.57 ± 0.66
Habit of defecation	2.97 ± 0.58
Functional health care	17.91±2.45
Collar tightness	3.82 ± 0.44
Eye usage habits	2.58 ± 0.69
Mode of motion	2.67 ± 1.45
Entertainment methods	2.50 ± 0.77
Bad habits	3.35 ± 0.78
Massage on eyeball	2.99 ± 0.71
Medical management	24.91±3.55
Follow up on time	2.64 ± 0.75
Check according to medical advice	3.86 ± 0.39
Take the initiative to inform	3.31 ± 0.53
Seek medical attention in case of Abnormalities	2.66 ± 0.76
Medication by frequency	3.12 ± 0.61
Dosage based medication	3.18 ± 0.53
Medication according to time	3.13 ± 0.54
Long-term use of medication as required	3.03 ± 0.62
The average overall score for glaucoma self-management behavior	50.64±6.06

**Table 4** Score of Illness Perception Scale (SD=standard Deviation)

Item	Mean $\pm$ SD
Disease impact	6.87 $\pm$ 2.70
Course of disease	7.96 $\pm$ 2.43
Personal control	3.67 $\pm$ 2.02
Treatment control	3.22 $\pm$ 1.82
Recognition of symptoms	4.18 $\pm$ 2.56
Disease concern,	8.55 $\pm$ 1.65
Understanding of disease	5.78 $\pm$ 3.20
Emotional feedback	7.43 $\pm$ 2.46
The average overall score for illness perception scale	47.65 $\pm$ 7.33

### Single-Factorial Analysis of the Factors That Influence Self-Management Behavior

As shown in Table 5, there is a statistically significant difference in the total score of self-management behavior among glaucoma patients with different places of residence, the level of education, working status, mode of payment, economic burden, smoking, types of glaucoma, vision, annual follow-up frequency, and an assigned follow-up doctor.

**Table 5** Single-Factorial Analysis of the Influencing Factors of Self-Management Behavior in Patients with Glaucoma

	N	Total score	P
Age			
< 60岁	216	50.45 $\pm$ 6.22	0.555a
$\geq$ 60岁	322	50.76 $\pm$ 5.95	
Gender			
Male	246	50.14 $\pm$ 6.21	0.082a
Female	292	51.05 $\pm$ 5.90	
Place of residence			
City	173	51.74 $\pm$ 6.46	< 0.001b*
Town	246	50.74 $\pm$ 6.24	
Country	119	48.82 $\pm$ 4.49	
Level of education			
Primary and below	173	49.28 $\pm$ 5.21	0.001b*
Junior high school	133	51.12 $\pm$ 5.36	
High school	188	51.02 $\pm$ 6.74	
College degree or above	44	52.89 $\pm$ 7.06	
Working status			
In work	122	51.13 $\pm$ 6.84	< 0.001b*
Unemployed or retired	295	51.50 $\pm$ 6.00	
Farmer	121	48.04 $\pm$ 4.46	
Marital status			
Married	441	50.49 $\pm$ 5.77	0.289 <sup>a</sup>
Unmarried or divorced	97	51.32 $\pm$ 7.21	
Family type			
Solitary	40	49.03 $\pm$ 5.47	0.080 <sup>a</sup>
Live with family	498	50.77 $\pm$ 6.09	
Mode of payment			
Medical insurance	315	51.59 $\pm$ 5.88	< 0.001 <sup>3*</sup>
Self-paying	223	49.30 $\pm$ 6.06	

(Continued)

**Table 5** (Continued).

	<b>N</b>	<b>Total score</b>	<b>P</b>
Economic burden			
Light	161	51.58 ± 6.28	< 0.001 <sup>b*</sup>
Medium	217	51.26 ± 6.39	
Heavy	160	48.84 ± 4.91	
Smoking			
Yes	54	47.56 ± 5.59	< 0.001 <sup>a*</sup>
No	484	50.98 ± 6.01	
Drinking alcohol			
Yes	73	51.51 ± 6.85	0.239 <sup>a</sup>
No	465	50.50 ± 5.92	
Types of glaucoma			
PACG	266	52.57 ± 6.34	< 0.001 <sup>a*</sup>
POAG	272	48.75 ± 5.11	
Vision			
<0.3	112	48.16 ± 5.57	< 0.001 <sup>a*</sup>
≥0.3	416	51.36 ± 6.01	
Time of illness			
Less than 1 year	215	51.17 ± 5.51	0.037 <sup>b*</sup>
1–5 years	240	50.67 ± 6.02	
>5 years	83	49.17 ± 7.23	
Family history of glaucoma			
Yes	57	51.51 ± 7.35	0.338 <sup>a</sup>
No	481	50.53 ± 5.88	
Surgical treatment			
Yes	282	50.88 ± 6.00	0.331 <sup>a</sup>
No	256	50.37 ± 6.11	
Type of eye drops			
1	93	51.58 ± 5.28	0.145 <sup>b</sup>
2	242	50.66 ± 6.30	
3	148	49.82 ± 5.95	
4	55	51.16 ± 6.32	
Annual follow-up frequency			
≤ 2 times	215	49.34 ± 5.58	< 0.001 <sup>a*</sup>
>2 times	323	51.50 ± 6.21	
Other chronic diseases			
Yes	203	50.69 ± 5.36	0.859 <sup>a</sup>
No	335	50.60 ± 6.45	
Doctor follow-up			
Variable follow-up	267	49.40 ± 5.63	<0.001 <sup>a*</sup>
An assigned follow-up	271	51.86 ± 6.22	

**Notes:** <sup>a</sup>Independent sample t-test; <sup>b</sup>Analysis of variance; \*Indicating  $P < 0.05$ .

## Correlation Between Social Support and Self-Management

The total social support score and the scores of each dimension (subjective support, objective support, support availability) were positively correlated with the total score of glaucoma self-management ( $P < 0.05$ ). The correlation coefficient  $r$  ranged between 0.3 and 0.5, indicating a moderate level of correlation.

**Table 6** Multivariate Analysis of Factors Influencing Self-Management Behavior in Patients with Glaucoma

	Estimate	S.E	t	P	95 CI	95 CI
Intercept	45.463	2.909	15.628	<0.001	39.748	51.178
Age	0.256	0.431	0.594	0.553	-0.591	1.103
Place of residence	-0.080	0.356	-0.223	0.823	-0.779	0.620
Level of education	0.482	0.250	1.927	0.055	-0.009	0.974
Working status	-0.642	0.384	-1.671	0.095	-1.397	0.113
Mode of payment	0.268	0.540	0.497	0.620	-0.792	1.329
Economic burden	-0.005	0.327	-0.016	0.988	-0.648	0.638
Smoking	2.180	0.664	3.282	<0.001	0.875	3.485
Type of glaucoma	-2.635	0.437	-6.033	<0.001	-3.493	-1.777
Vision	0.168	0.489	0.344	0.731	-0.792	1.129
Time of illness	-0.196	0.278	-0.706	0.481	-0.743	0.350
Follow-up frequency	1.124	0.404	2.781	0.006	0.330	1.918
Doctor follow-up	2.043	0.393	5.198	<0.001	1.271	2.815
Total score of social Support	0.336	0.026	12.887	<0.001	0.285	0.387
Total score of illness perception	-0.223	0.027	-8.198	<0.001	-0.277	-0.170

## Correlation Analysis Between Illness Perception Score and Self-Management Total Score and Scores in Various Dimensions

The total illness perception score was negatively correlated with the total score of glaucoma self-management, as well as with the scores of each dimension (life adjustment, functional health care, medical management) ( $P < 0.05$ ). The correlation coefficient  $r$  ranged between  $-0.3$  and  $-0.5$ , indicating a moderate level of correlation.

## Multivariate Analysis of Factors Influencing Self-Management Behavior

Age, place of residence, level of education, and other factors were included as independent variables in the multivariate regression analysis. As shown in Table 6, smoking, type of glaucoma, annual follow-up frequency, an assigned follow-up doctor, social support levels, and illness perception scores had statistically significant effects ( $P < 0.05$ ) on the overall score of self-management behavior in patients with glaucoma. Smokers exhibited lower self-management behavior scores compared to non-smokers. Patients diagnosed with POAG had lower scores than those with PACG. Scores were lower for those with less than two annual follow-ups. Patients without a designated doctor for follow-up displayed lower scores compared to those who had one assigned. Higher levels of social support were associated with higher total self-management behavior scores, while increased illness perception was linked to decreased total self-management behavior scores.

## Discussion

### Analysis of Self-Management Behavior in Patients with Glaucoma

Our research results show that the level of glaucoma self-management behavior was moderate, possibly because 60% (323) of participants had been living with the disease for either 1–5 years or more than 5 years, which is in line with previous research.<sup>37,38</sup> This suggests that the disease has a relatively prolonged duration and that patients have a degree of familiarity with life adaptation, functional healthcare, and medical disease management. Among the three dimensions of self-management behavior, the score of life adjustment was the lowest, and the score of medical management was the highest. Of the 17 items of self-management behavior, the three items with the lowest scores were emotional control, appropriate entertainment and leisure activities, and eye habits. The emotional control score was the lowest. Many studies have shown that patients with glaucoma have a higher risk of developing emotional disorders, and present with common psychological problems such as anxiety and depression.<sup>39–41</sup> These emotional states have potential impacts on treatment compliance, disease progression, and overall quality of life. Better self-management behavior was associated with

stronger mental health regulation.<sup>42</sup> The aforementioned research aligns with the findings of this study; that individuals with glaucoma encounter challenges in managing their emotions and regulating their psychological wellbeing. This underscores the importance for healthcare professionals to prioritize and address emotional management among patients with glaucoma during clinical practice, and also provide effective psychological care. It is crucial to ensure that patients with glaucoma have an understanding of their condition and recognize the significance of emotional management in disease control. Greater attention should also be devoted to both the physical and mental health of these patients. Among the three dimensions of the glaucoma self-management scale, the score for medical management was the highest, mirroring the prevailing trend observed in self-management practices for numerous common chronic diseases in China.<sup>43,44</sup> These findings indicate that the level of compliance behaviors in managing various prevalent chronic diseases in China is generally high. Although the overall self-management of glaucoma patients in this study was at a moderate level, there remains significant room for improvement. It is advisable that medical staff continue to focus on the items with lower scores in self-management behaviors and take proactive intervention measures to enhance the patients' self-management behavior levels. This is of great significance for preventing further deterioration of visual function.

### **Analysis of the Status of Social Support in Patients with Glaucoma**

Our research findings indicate that the level of social support for glaucoma patients is moderate, which is consistent with the results of previous studies conducted in China.<sup>45,46</sup> Among the three dimensions assessed, subjective support received the highest score, while support utilization had the lowest score. The dimension of support utilization encompasses “ways to engage in effective communication, seek assistance, and foster constructive social interaction during times of distress”. Patients with primary glaucoma may experience varying degrees of challenges when dealing with medical, emotional, and social aspects.<sup>47</sup> It is recommended that healthcare professionals actively engage in communication with patients, encouraging them to fully utilize the social support system when facing difficulties. Patients should be encouraged to initiate conversations and seek assistance, actively participate in social group activities, and proactively seek additional social support. Meanwhile, we also appeal to families and society to pay greater attention to and offer more support to glaucoma patients. Provide them with emotional care and assistance to boost their confidence in combating the disease.

### **Analysis of Illness Perception of Patients with Glaucoma**

Our research findings suggest that the disease perception among glaucoma patients is at a moderate level. This is higher than the results of some other domestic studies,<sup>48,49</sup> indicating that the participants in this study may have a more pessimistic outlook regarding their condition. The three dimensions with the highest scores on the illness perception scale were disease attention, course of disease, and emotional feedback. Patients with glaucoma exhibited concern regarding their condition. This may be attributed to the fact that glaucoma is a chronic disease that requires lifelong monitoring and management. Additionally, the extended duration of the disease and its impact on emotional wellbeing may contribute to this perception. The ninth question was open-ended and asked the patient to summarize the three most important causes of their illness. The top three reasons ranked were emotion, stress, and genetics. Patients with glaucoma may be aware of difficulties in their emotional management and psychological regulation. Patients with a family history of glaucoma also recognize that glaucoma has a clear genetic link. Furthermore, societal progress has engendered an accelerated pace of life, leading to substantial pressure for many individuals. Clinicians should pay attention to the cognitive status of patients with glaucoma, encourage them to actively learn about the disease, adjust their mentality, maintain good emotions, and thus establish confidence in overcoming the disease.

### **Analysis of the Influencing Factors of Self-Management Behavior in Patients with Glaucoma**

Our findings indicate that patients who smoke had a lower level of self-management behavior compared to non-smoking patients, which aligns with the results reported in previous studies in China.<sup>37,50</sup> The underlying reasons for this may be attributed to relatively poor health behaviors, low health beliefs, and limited self-management awareness among smoking patients. Ophthalmic healthcare professionals must monitor the smoking status of patients with glaucoma. For patients who smoke, it is crucial to encourage smoking cessation and healthy lifestyle habits. For individuals unable to quit smoking, informing them about the detrimental effects of smoking on their overall health and disease prognosis is

essential. Collaboratively assisting these patients in cultivating positive living habits will ultimately contribute to promoting their overall wellbeing.

Our research results indicate that the self-management proficiency of patients with PACG was greater than that of patients with POAG. This is consistent with existing research in China.<sup>51</sup> This difference can be attributed to the relatively gradual onset and insidious symptoms associated with POAG. In its early stages, many patients remain asymptomatic and do not pay sufficient attention to changes. Consequently, by the time symptoms manifest, a significant number of patients have already progressed to the intermediate or advanced stages of the disease, resulting in varying degrees of visual field loss and damage. Compared with patients with primary open-angle glaucoma (POAG), those with acute angle-closure glaucoma in primary angle-closure glaucoma (PACG) during a major attack exhibit severe headache and eye pain. These symptoms are often accompanied by manifestations such as nausea, vomiting, and vision loss. These typical symptoms may heighten patients' perception of the "severity" and "susceptibility" of the disease, leading them to develop a sense of "imminent disease threat" and thus actively engage in management behaviors such as taking prescribed medications and attending regular follow-ups. This characteristic results in better self-management behaviors among PACG patients compared to POAG patients. The above research findings and their underlying reasons are also consistent with the theoretical framework of the Health Belief Model (HBM).<sup>52</sup>

In this model, symptom salience influences disease self-management by affecting patients' "perception of threat" and "perception of action benefits". It is recommended that ophthalmic healthcare professionals pay close attention to the self-management practices adopted by patients with POAG. Encouraging active participation in disease management and closely monitoring patient disease progress can contribute to preventing further deterioration of visual function. Our research results indicate that patients with glaucoma who attended more than 2 follow-up visits demonstrated superior self-management behavior compared to those with fewer than 2 follow-ups. Reason analysis: On the one hand, multiple follow-ups enhance patients' self-management ability through direct mechanisms such as knowledge reinforcement, behavior supervision, and personalized intervention; on the other hand, patients who actively participate in multiple follow-ups may have higher health motivation themselves. In addition, the accumulation of doctor-patient trust and the optimization of program adaptability may also play a role in dynamic interaction. Previous studies have not reported this association, which may be related to differences in follow-up design, disease type, or sample characteristics. Future research needs to further verify the association between follow-up frequency and self-management behavior level of glaucoma patients, and explore the optimal follow-up frequency and content combination to improve the self-management behavior level of glaucoma patients.

Our research results indicate that patients with glaucoma who received consistent follow-up visits from their healthcare providers demonstrated elevated levels of self-management behaviors. This may be because patients with glaucoma under consistent care by familiar designated doctors are more inclined to engage in effective communication, while these doctors also possess comprehensive knowledge about the patient's conditions. Consequently, this facilitates enhanced doctor-patient interaction and fosters a stronger therapeutic alliance, ultimately promoting the patients' self-management proficiency. Patients with glaucoma who do not have an assigned doctor may not have a high level of attention to their disease and the doctor's instructions. Due to their unfamiliarity with each other, both parties may spend more time understanding the condition and communicating. Patients often compare the advice of different doctors and hesitate in different doctor's decisions, which may reduce their trust in doctors, affect the establishment of doctor-patient relationships, and thus affect their self-management behavior level. It is advisable that medical staff establish long-term doctor-patient relationships with glaucoma patients and encourage them to follow up with designated doctors whenever possible. Through continuous guidance, supervision, and personalized management, patients' self-management capabilities can be enhanced, thus improving their health status. This study is the first to report the association between fixed-doctor follow-up and the level of self-management behaviors in glaucoma patients. Future research could employ controlled studies to further explore the causal relationship.

Our results show that the higher the social support of patients with glaucoma, the better their self-management behavior. This is consistent with similar research in China.<sup>53-55</sup> Patients with high social support may receive better emotional and material care. The support of family, friends, and society can help patients cope with the pressures brought about by the disease, increase confidence in overcoming the disease, and help patients to be more proactive in effectively managing the disease. Ophthalmic healthcare professionals should have a comprehensive understanding of the social support network available to patients during their treatment and care. Additionally, they should enhance their guidance on the social support

system for both patients and their families, emphasizing the significance of such support in promoting self-management of the disease. It is also crucial to encourage patients to actively utilize social support resources, engage in effective communication, and promptly express their needs to acquire increased social support, enhance their self-management, and increase their quality of life.

Our findings indicate that patients with glaucoma hold the belief that the greater the harm the disease inflicts on their physical condition, the poorer their self-management behavior. This is in line with some findings in China,<sup>48,49</sup> and contrary to others.<sup>43,56</sup> The reason for this belief may be related to the nature of glaucoma, which, as an irreversible and blinding lifelong eye disease, has a significant psychological impact on patients. In addition, patients with glaucoma have certain personality traits that are pessimistic and paranoid,<sup>41</sup> leading to a more pessimistic view of the disease. They may have insufficient confidence in self-management due to their concerns about continuous impairment of visual function, leading to poor self-management behavior. We suggest that ophthalmic healthcare workers should help patients with glaucoma understand the impact of the disease on visual function, correct cognitive biases, and monitor patient emotions. Encouragement should be prioritized and the severity of the disease should not be exaggerated so that the psychological burden on patients is minimized and their confidence in actively participating in disease self-management is enhanced.

This study was a single-center and cross-sectional study covering one time period. The representativeness of the sample is limited, and the results cannot be applied to all patients with glaucoma. We recommend that future studies further expand the sample size, sample sources, and range of influencing factors. Multicenter, longitudinal, and randomized controlled studies could be carried out to delve deeper into the controllable factors associated with self-management behaviors in glaucoma patients.

## Conclusions

This study is the first to uncover the association between the frequency of follow-up visits, regular follow-up with a fixed doctor, and the self-management behaviors of glaucoma patients. It fills the gap in this research area and provides new perspectives and a basis for subsequent investigations. It is advisable that healthcare professionals monitor the status of patients' self-management behavior and its influencing factors and implement practical intervention measures to improve self-management behavior in glaucoma patients. There is also an urgent need for society as a whole to raise awareness about this disease, particularly emphasizing the role of families in providing increased support, understanding, and care.

## Abbreviations

PACG, primary angle-closure glaucoma; POAG, primary open-angle glaucoma; GSMQ, Glaucoma self-management questionnaire; SSRS, Social support rating scale; BIPQ, Brief illness perception questionnaire.

## Data Sharing Statement

The datasets generated during the current study are available from the corresponding author on reasonable request.

## Ethics Approval and Consent to Participate

The study complied with the Declaration of Helsinki and was approved by the ethics committee of West China Hospital of Sichuan University. All patients provided written informed consent.

## Acknowledgments

The researchers would like to thank all participants in this study. In addition, thank you to all glaucoma patients who volunteered to participate in this study.

## Author Contributions

Xin Zhang is the first author. All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

## Funding

This work was supported by the Science & Technology Department of Sichuan Province (China) funding projects (2024JDKP0056).

## Disclosure

The authors declare that they have no competing interests.

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