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Knowledge, Attitude, and Practice of Rosacea Patients Towards Rosacea

Running title: KAP toward Rosacea

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Abstract

Background: This study aimed to investigate the knowledge, attitude, and practice (KAP) of rosacea patients towards rosacea.

Objective: The objective was to assess the KAP levels among rosacea patients to inform potential educational interventions.

Design: A web-based cross-sectional study was conducted.

Participants/Setting: The study was conducted from November 2022 to October 2023 among rosacea patients attending the Dermatology Department of Southwest Hospital, Chongqing, using a self-administered questionnaire.

Intervention: No specific intervention was applied; the focus was on understanding existing knowledge, attitudes, and practices.

Main Outcome Measures: The primary outcome measures included KAP scores regarding rosacea.

Statistical Analyses Performed: Multivariate logistic regression analysis and structural equation modeling were employed to analyze the associations between KAP scores and demographic factors.

Results: A total of 514 valid questionnaires were collected, with 458 (89.11%) respondents being females. The mean KAP scores were 7.14 ± 2.98 (possible range: 0 - 12) for knowledge, 52.57 ± 7.07 (possible range: 13 - 65) for attitude, and 62.77 ± 13.24 (possible range: 18 - 90) for practice. Multivariate analysis indicated that knowledge, attitude, being male, aged 25-30 years, and having health insurance were independently associated with proactive practice. Additionally, structural equation modeling revealed that knowledge directly influenced both attitude and practice, while attitude also directly impacted practice (all $P < 0.001$).

Conclusions: The study found that rosacea patients had inadequate knowledge, a positive attitude, and suboptimal practices regarding their condition. It is recommended that comprehensive patient education and support programs be developed to enhance knowledge, foster positive attitudes, and improve practice behaviors among rosacea patients.

Keywords: knowledge; attitude; practice; rosacea; cross-sectional study

Strengths and limitations of this study

- The study effectively gathered a substantial sample size of 514 valid responses, allowing for robust statistical analysis of knowledge, attitude, and practice among rosacea patients.
- Multivariate logistic regression and structural equation modeling provided insightful relationships between knowledge, attitude, and practice, highlighting key factors influencing proactive care among rosacea patients.
- The study's reliance on self-administered questionnaires may introduce response bias, as participants might overreport positive attitudes or practices related to rosacea management.
- The cross-sectional design limits causal inferences about the relationships between knowledge, attitude, and practice, making it challenging to determine long-term trends or effects.

Introduction

Rosacea, often referred to as acne rosacea, is a prevalent inflammatory skin condition that predominantly afflicts the central face (1, 2). It is characterized by chronic inflammatory facial dermatosis, featuring symptoms such as transient or persistent erythema, flushing, dryness, and skin burning, along with telangiectasia, vascular inflammation, inflammatory papules, pustules, and red or watery eyes (3). Notably, it is more frequently observed in women than in men (4). Recent international studies have reported a rosacea prevalence of approximately 5.5%, with the condition affecting up to 3.48% of the Chinese population (5, 6). Moreover, the accompanying subjective symptoms of rosacea, including sensations of burning, stinging, and pruritus, can further diminish patients' quality of life and disrupt their sleep patterns (7, 8). Hence, understanding patients' knowledge, attitudes, and practices regarding rosacea is crucial for improving treatment outcomes and enhancing their quality of life.

The Knowledge, Attitude, and Practice (KAP) survey functions as a research tool, illuminating a group's comprehension, beliefs, and actions on a specific subject, particularly within the realm of health literacy, where it is based on the premise that knowledge positively influences attitudes, which in turn mold behaviors (9-11). Considering that patients' self-management is crucial for the management and control of diseases, when patients actively engage and take appropriate measures to manage their conditions, it often leads to symptom alleviation, improved quality of life, and reduced healthcare resource utilization. It is noteworthy that there is currently lacking of KAP studies in this direction. Therefore, this study aimed to investigate the KAP of rosacea patients towards their condition.

Methods

Patient and public involvement

No patient involved

Study design and participants

This cross-sectional study was conducted between November 2022 and October 2023 among rosacea patients, at the Dermatology Department of Southwest Hospital, Chongqing. The inclusion criteria were: (1) A diagnosis conforming to the 2021 Chinese Rosacea Diagnosis and Treatment Expert Consensus, which delineates persistent erythema and hypertrophic alterations in the central facial area as core diagnostic criteria. A rosacea diagnosis could be established with the presence of one or more of these defining features. Key characteristics of rosacea included intermittent flushing, papules and/or pustules, telangiectasia, and specific ocular manifestations (such as eyelid telangiectasia, eyelid inflammation, keratitis, conjunctivitis, and keratoconjunctivitis), with the presence of two or more of these primary features warranting a rosacea diagnosis. (2) Individuals aged 18 or older, who possessed the capacity for independent thinking and responding to survey questions. Exclusion criteria encompassed: (1) Patients concurrently afflicted with facial allergic or inflammatory conditions, such as allergic dermatitis, steroid-dependent dermatitis, or common acne, as determined by the consensus of two or more experienced dermatologists in distinguishing these from similar facial dermatitis. (2) Patients contending with severe comorbidities, including cardiovascular diseases, lupus erythematosus, endocrine system disorders, hematological disorders, or confirmed tumors. (3) Nursing or pregnant women. (4) Individuals who declined to provide informed consent. This study has received ethical approval from ethics committee of Southwest Hospital, Chongqing (Approval No. KY2023027) and obtained informed consent from the research participants.

Questionnaire Introduction

A questionnaire with four dimensions was developed based on the guidelines for rosacea management and the Chinese Rosacea Diagnosis and Treatment Guidelines (2021 edition)

and previous literatures (12, 13). A rigorous refinement process was executed, involving input from three dermatology experts, resulting in the elimination of redundant or overlapping questions and the clarification of items with unclear wording. Prior to the official survey, a preliminary pilot test was conducted involving 32 participants. A pilot study involving 30 valid questionnaires revealed an overall Cronbach's α coefficient of 0.904. The Cronbach's α coefficient for the knowledge dimension was 0.823, for the attitude dimension it was 0.833, and for the practice dimension it was 0.825.

The final questionnaire, written in Chinese, comprised four distinct sections: (1) Demographic Information, collecting participant details such as age, gender, residence, education, employment, and income. (2) The knowledge dimension included 12 questions related to rosacea and oral anticoagulants, where participants received one point for each correct answer and none for incorrect or uncertain responses. (3) The attitude dimension comprised 13 questions rated on a five-point Likert scale, gauging participants' attitudes toward rosacea. (4) The practice dimension contained 18 questions also rated on a five-point Likert scale, evaluating participants' rosacea management practices. Scores exceeding 70% of the maximum in each section indicates adequate knowledge, positive attitude, and proactive practice (14).

Questionnaire Distribution and Quality Control

The questionnaire was administered in a paper-based format. Following the confirmation of a diagnosis in the outpatient department, based on meeting diagnostic criteria, validated by multiple doctors, and supported from image analysis. Patients were encouraged to contemplate their responses independently, with any uncertainties addressed through conversational clarification rather than inducing specific answers. The patients themselves completed the questionnaire, and ensured the quality and comprehensiveness of responses, all questionnaire items were made mandatory. A research team, consisting of three doctors

trained as research assistants responsible for questionnaire promotion and distribution, diligently assessed all submissions for completeness, internal consistency, and logical coherence. Submissions exhibiting logical errors, incomplete answers, or uniform responses across all items were categorized as invalid.

Statistical analysis

The sample size was 5-10 times the number of questionnaire items (15). The number of independent variables in this questionnaire was 43. Therefore, the required sample size was at least 215. Considering an estimated rate of invalid questionnaires of 20%, at least 269 participants were required.

Data analysis was conducted using Stata 17.0 (Stata Corporation, College Station, TX, USA). Continuous variables were described as mean ± standard deviation (SD), and between-group comparisons were performed using t-tests or analysis of variance (ANOVA). Categorical variables were presented as n (%). Pearson correlation analysis was employed to assess the correlations between KAP scores. In multivariate analysis, 70% score distribution of the total score was used as the cut-off value. Univariate variables with $P<0.05$ were enrolled in multivariate regression. Structural equation modeling (SEM) was employed to test the following hypotheses: 1) knowledge had impacts on attitude; 2) knowledge had impacts on practice; 3) attitude had impacts on practice. Two-sided P-values <0.05 were regarded as statistically significant.

Results

Initially, a total of 518 questionnaires were collected, excluding 1 questionnaire with residence selected “D”, 1 questionnaire with outliers in education, and 2 questionnaires with outliers in the knowledge section. The remaining valid questionnaires were 514, with a validity rate of 99.23%. Among them, 458 (89.11%) were females, 146 (28.40%) were in the

age group of 31-40 years, 399 (77.63%) were residing in urban areas, 333 (64.79%) were educated with college/bachelor's degree and above, 275 (53.50%) were employed, and with mean duration of rosacea diagnosis of 27.07±32.28 months.

The mean KAP scores were 7.14 ± 2.98 (possible range: 0 - 12), 52.57 ± 7.07 (possible range: 13 - 65), and 62.77 ± 13.24 (possible range: 18 - 90), respectively. The KAP scores varied from patients with different gender, age, residence, education, employment status, monthly Per capita Income, marital status (all of $P < 0.01$). Additionally, the availability of health insurance is more likely to affect patients practice ($P < 0.001$) (**Table 1**).

Table 1. Baseline characteristics and KAP scores.

Variables	n (%)	Knowledge		Attitude		Practice	
		Mean±SD	P	Mean±SD	P	Mean±SD	P
Total	514	7.14±2.98		52.57±7.07		62.77±13.24	
Gender			0.001		<0.001		<0.001
Male	56(10.89)	5.89±3.46		47.50±8.37		53.11±14.97	
Female	458(89.11)	7.30±2.88		53.19±6.64		63.95±12.53	
Age			<0.001		<0.001		<0.001
<25 years	122(23.74)	8.56±2.42		54.39±6.38		66.84±12.41	
25-30 years	111(21.60)	8.11±2.34		55.38±5.76		64.80±10.51	
31-40 years	146(28.40)	6.92±2.71		52.14±7.00		62.77±12.41	
41 years and above	135(26.26)	5.32±3.18		49.09±7.24		57.42±15.08	
Residence			<0.001		<0.001		<0.001
Rural	70(13.62)	5.76±3.69		49.96±8.78		55.20±16.84	
Urban	399(77.63)	7.44±2.84		53.37±6.56		64.16±12.37	
Suburban	45(8.75)	6.71±2.53		49.60±6.89		62.22±10.32	
Education			<0.001		<0.001		<0.001
Junior high school or below	80(15.56)	5.01±3.44		46.82±8.20		52.99±17.04	
High school / Technical school	101(19.65)	6.00±3.01		51.77±6.47		61.22±10.55	
College/Bachelor's and above	333(64.79)	8.00±2.43		54.20±6.15		65.59±11.68	
Employment Status			<0.001		<0.001		0.006
Employed	275(53.50)	7.66±2.48		53.71±6.37		64.25±11.82	
Other	239(46.50)	6.55±3.37		51.27±7.61		61.06±14.54	
Monthly Per Capita Income (CNY)			<0.001		<0.001		<0.001
<5000	189(36.77)	6.52±3.20		49.75±7.65		59.47±15.34	
5000-10000	164(31.91)	7.15±2.56		52.66±6.34		62.84±12.74	
>10000	161(31.32)	7.87±2.95		55.80±5.53		66.58±9.62	

Marital Status			<0.001	<0.001		<0.001
Married	262(50.97)	6.55±3.11		51.24±7.88	60.19±14.77	
Unmarried	195(37.94)	8.53±2.19		54.68±5.93	66.41±11.14	
Other	57(11.09)	5.12±2.61		51.51±4.67	62.19±9.04	
Health Insurance Type			0.977	0.718		<0.001
With insurance	483(93.97)	7.14±2.99		52.60±6.98	62.24±13.00	
Without insurance	31(6.03)	7.13±2.83		52.13±8.48	70.97±14.41	
Duration of disease (months)	27.07±32.28					

The distribution of knowledge dimensions revealed that the three knowledge items with the highest correctness rates were as follows: "*Fluctuations in temperature, sun exposure, emotional changes, or the consumption of spicy foods can swiftly trigger facial flushing in rosacea patients.*" (K5) with 93.58%, "*The primary clinical manifestations of rosacea include intermittent facial flushing, persistent erythema or papules, pustules, and dilated capillaries.*" (K1) with 87.16%, and "*The severity of rosacea is closely linked to post-diagnosis skincare practices, with excessive cleaning and improper skincare routines potentially exacerbating the condition.*" (K7) with 79.38%. The three items with the lowest correctness rates were "*Rosacea is a chronic, recurring inflammatory skin condition and does not typically involve eye symptoms.*" (K8) with 27.24%, "*Rosacea predominantly affects females aged 20-50, with children and the elderly being less susceptible to the condition.*" (K4) with 28.40%, and "*Rosacea is more commonly observed in individuals with darker skin tones compared to those with lighter skin tones.*" (K3) with 33.27%. (**Supplementary Table 1**).

When it comes to patients' attitudes towards rosacea, 79.57% consider the condition a major problem to varying degrees (A1). The vast majority (91.64%) reported that they would actively seek help from a doctor if the disease made them feel anxious (A2). 71.6% felt very low self-esteem or low self-esteem about their appearance caused by the disease (A3). The most strongly agreed risk factors to avoid were UV exposure (A4.1), inappropriate use of

skincare products (A4.10), and extreme temperature fluctuations (A4.5), with 56.03%, 49.81%, and 45.72%, respectively (**Supplementary Table 1**).

Specific sunscreen practices showed that participants always protected themselves from the sun by using sunshade umbrella. (P1.1, 22.57%) and sun-protective mask (P1.4, 17.12%). Regarding facial cleansing habits, 30.74%, 37.35%, 36.58%, and 35.80% avoided excessively hot or cold water (P2.1), the use of facecloths (P2.2), facial friction motions (P2.3), and excessive cleaning (P2.4), respectively. 52.14% always chose skincare products that were less irritating and suitable for them (P3.3). 45.72% reported that they were firm in their choice of formal medical treatment when necessary (4.1). It is worth noting that the largest proportion of people were not firm in reducing staying up late (P4.3), reducing the intake of spicy, surgery and oily food (P4.4), and exercising properly (P4.5), sometimes doing it but sometimes not, with 31.71%, 34.63%, and 33.27%, respectively (**Supplementary Table 1**).

Correlation analysis showed that significant positive correlations were found between knowledge and attitude ($r = 0.533$, $P<0.001$), as well as practice ($r = 0.536$, $P<0.001$). Meanwhile, there was also correlation between attitude and practice ($r = 0.592$, $P<0.001$) (**Supplementary Table 2**).

Multivariate logistic regression analysis shown that being male (OR = 0.311, 95% CI: 0.113-0.858, P = 0.024), aged 31-40 years (OR = 0.342, 95% CI: 0.144-0.810, P = 0.015), aged 41 years and above (OR = 0.295, 95% CI: 0.097-0.899, P = 0.032), lived in rural (OR = 2.354, 95% CI: 1.032-5.369, P = 0.042), graduated from high school or technical school (OR = 6.860, 95% CI: 1.357-34.688, P = 0.020), educated to college/bachelor's degree and above (OR = 7.043, 95% CI: 1.641-5.761, P = 0.017), and with monthly per capita income greater than 10,000 yuan (OR = 3.074, 95% CI: 1.641-5.761, P < 0.001) were independently associated with good knowledge (**Table 2**). Meanwhile, knowledge score (OR = 1.384, 95% CI: 1.253-1.529, P < 0.001), being male (OR = 0.258, 95% CI: 0.122-0.545, P < 0.001), and

with monthly per capita income greater than 10,000 yuan (OR = 4.264, 95% CI: 1.925-9.443, P < 0.001) were independently associated with positive attitude (**Table 3**). Furthermore, knowledge score (OR = 1.360, 95% CI: 1.209-1.529, P < 0.001), attitude score (OR = 1.132, 95% CI: 1.082-1.184, P < 0.001), being male (OR = 0.357, 95% CI: 0.136-0.943, P = 0.038), aged 25-30 years (OR = 0.482, 95% CI: 0.243-0.958, P = 0.037), and having health insurance (OR = 0.239, 95% CI: 0.094-0.608, P = 0.003) were independently associated with proactive practice (**Table 4**).

Table 2. Univariate and multivariate logistic regression analysis of good knowledge.

Variables	Univariate		Multivariate	
	OR (95%CI)	**P**	**OR (95%CI)**	**P**
Gender				
Male	0.365(0.142 0.939)	0.037	0.311(0.113, 0.858)	0.024
Female	ref		ref	
Age				
Below 25 years	ref		ref	
25-30 years	0.520(0.297 0.912)	0.023	0.537(0.274, 1.050)	0.069
31-40 years	0.217(0.117 0.400)	<0.001	0.342(0.144, 0.810)	0.015
41 years and above	0.097(0.044 0.216)	<0.001	0.295(0.097, 0.899)	0.032
Residence				
Rural	1.359(0.754 2.449)	0.307	2.354(1.032, 5.369)	0.042
Urban	ref		ref	
Suburban	0.280(0.085 0.928)	0.037	0.591(0.159, 2.204)	0.434
Education				
Junior high school or below	ref		ref	
High school / Technical school	9.630(2.178 42.575)	0.003	6.860(1.357, 34.688)	0.020

College/Bachelor's and above	12.332(2.963 51.321)	0.001	7.043(1.641, 5.761)	0.017
Employment Status				
Employed	ref			
Other	0.844(0.545 1.307)	0.447		
Monthly Per Capita Income (in CNY):				
<5000	ref		ref	
5000-10000	0.694(0.375 1.287)	0.247	0.724(0.363, 1.446)	0.361
>10000	2.601(1.562 4.332)	<0.001	3.074(1.641, 5.761)	<0.001
Marital Status				
Married	ref		ref	
Unmarried	2.666(1.692 4.199)	<0.001	1.535(0.737, 3.198)	0.253
Other	0.102(0.014 0.759)	0.026	0.091(0.011, 0.763)	0.027
Health Insurance Type				
With insurance	0.839(0.351 2.006)	0.694		
Without insurance	ref			
Time Since Diagnosis (months)	0.998(0.992 1.005)	0.669		

Table 3. Univariate and multivariate logistic regression analysis of positive attitude.

Variables	Univariate		Multivariate	
	OR (95%CI)	**P**	**OR (95%CI)**	**P**
Knowledge score	1.418(1.311 1.533)	<0.001	1.384(1.253, 1.529)	<0.001
Gender				
Male	0.252(0.142 0.447)	<0.001	0.258(0.122, 0.545)	<0.001
Female	ref			
Age				
Below 25 years	ref		ref	
25-30 years	2.000(0.920 4.341)	0.080	2.279(0.865, 6.009)	0.096
31-40 years	0.753(0.412 1.377)	0.357	1.180(0.448, 3.109)	0.737
41 years and above	0.399(0.223 0.713)	0.002	0.881(0.311, 2.500)	0.812
Residence				
Rural	0.330(0.192 0.568)	<0.001	0.719(0.336, 1.539)	0.395
Urban	ref		ref	
Suburban	0.488(0.247 0.963)	0.039	0.550(0.231, 1.314)	0.179
Education Level				
Junior high school or below	ref			
High school / Technical school	2.242(1.203 1.181)	0.011	0.439(0.176, 1.095)	0.078
College/Bachelor's and above	4.524(2.658 7.701)	<0.001	0.817(0.336, 1.986)	0.656
Employment Status				
Employed	ref		ref	
Other	0.608(0.399 0.924)	0.020	1.061 (0.582,1.932)	0.847
Monthly Per Capita Income (CNY)				

<5000	ref			
5000-10000	2.231(1.375 3.619)	0.001	1.810(0.979, 3.345)	0.058
>10000	6.398(3.373 12.134)	<0.001	4.264(1.925, 9.443)	<0.001
Marital Status				
Married	ref		ref	
Unmarried	2.785(1.717 4.516)	<0.001	1.618(0.696, 3.759)	0.263
Other	3.804(1.569 9.222)	0.003	6.391(2.150, 19.000)	0.001
Health Insurance Type				
With insurance	1.473(0.658 3.294)	0.346		
Without insurance	ref			
Time Since Diagnosis (months):	1.007(0.999 1.015)	0.075		

Table 4. Univariate and multivariate logistic regression analysis of proactive practice.

Variables	Univariate		Multivariate	
	OR (95%CI)	**P**	**OR (95%CI)**	**P**
Knowledge score	1.568(1.420 1.732)	<0.001	1.360(1.209, 1.529)	<0.001
Attitude score	1.205(1.159 1.253)	<0.001	1.132(1.082, 1.184)	<0.001
Gender				
Male	0.217(0.096 0.489)	<0.001	0.357(0.136, 0.943)	0.038
Female	ref			
Age				
Below 25 years	ref			
25-30 years	0.623(0.371 1.046)	0.074	0.482(0.243, 0.958)	0.037
31-40 years	0.403(0.245 0.662)	<0.001	0.618(0.268, 1.429)	0.261
41 years and above	0.232(0.135 0.400)	<0.001	0.855(0.324, 2.255)	0.751
Residence				
Rural	0.762(0.445 1.305)	0.322	1.340(0.585, 3.070)	0.489
Urban	ref		ref	
Suburban	0.445(0.214 0.924)	0.030	1.276 (0.524, 3.103)	0.591
Education Level				
Junior high school or below	ref		ref	
High school / Technical school	2.876(1.373 6.024)	0.005	2.153(0.771, 6.009)	0.143
College/Bachelor's and above	4.265(2.224 8.177)	<0.001	1.695(0.637, 4.505)	0.290
Employment Status				
Employed	ref		ref	
Other	0.668(0.465 0.961)	0.030	0.771(0.460, 1.290)	0.322
Monthly Per Capita				

Income (CNY):				
<5000	ref		ref	
5000-10000	1.069(0.676 1.688)	0.776	1.051(0.579, 1.908)	0.869
>10000	2.658(1.711 4.129)	<0.001	1.761(0.941, 3.294)	0.077
Marital Status				
Married	ref		ref	
Unmarried	1.736(1.187 2.539)	0.004	0.790(0.393, 1.591)	0.510
Other	0.317(0.144 0.699)	0.004	0.317(0.119, 0.848)	0.022
Health Insurance Type				
With insurance	0.396(0.189 0.827)	0.014	0.239(0.094, 0.608)	0.003
Without insurance	ref		ref	
Time Since Diagnosis (months):	0.997(0.991 1.002)	0.256		

The SEM demonstrate a highly favorable model fit indices, suggesting a well-fitting model (**Supplementary Table 3**), and showed that knowledge had direct effects on attitude (β = 0.667, p <0.001) and practice (β = 1.840, p <0.001). Moreover, attitude also have a direct impact on practice (β = 1.689, p <0.001) (**Figure 1**).

Discussion

Patients had inadequate knowledge, positive attitude and suboptimal practice towards rosacea. Multivariate logistic regression analysis showed that knowledge score, attitude score, being male, aged 25-30 years, and having health insurance were associated with proactive practice. SEM showed that knowledge had direct effects on attitude and practice, attitude also have a direct impact on practice. This study may contribute to reveal the extent of patients' understanding of their respective medical conditions, as well as their attitudes and practices regarding treatment and self-management.

This study underscores the need for targeted interventions to enhance clinical practice for rosacea patients. It is evident from the results that patients generally possess inadequate knowledge, exhibit a positive attitude, and engage in suboptimal practices regarding their condition. The mean scores for KAP, with a wide range of possible values, reveal significant room for improvement across all three domains. These findings align with previous studies that have highlighted knowledge deficits among rosacea patients (16). Notably, the study identifies various demographic and socioeconomic factors that influence patients' KAP scores. For instance, gender, age, residence, education level, employment status, and monthly per capita income all play a role in shaping patient KAP. This mirrors the findings of similar research, which underscores the importance of tailoring interventions to specific patient profiles. Furthermore, the availability of health insurance emerged as a crucial factor influencing patient practice, emphasizing the need for policy-level improvements to ensure affordable access to treatment and care. Multivariate logistic regression analysis reveals that male patients, those aged 31-40 and 41 years and above, residents of rural areas, individuals with higher education levels, and those with higher incomes demonstrate a greater likelihood of possessing good knowledge about rosacea. Similarly, a positive attitude is more prevalent among those with higher knowledge scores, males, and individuals with higher incomes. Importantly, both knowledge and attitude have a significant influence on proactive practice, suggesting that interventions aimed at enhancing knowledge and cultivating a positive attitude can lead to improved practice behaviors (9, 17). In conclusion, this study's findings provide valuable insights for tailoring interventions to address the specific needs and disparities within the rosacea patient population (18, 19).

The study's assessment of rosacea patients' knowledge highlights several areas of deficiency and misconceptions. While a substantial proportion of patients correctly identified the primary clinical manifestations of rosacea, including intermittent facial flushing, and dilated

capillaries. Additionally, misconceptions about the prevalence of rosacea in individuals with darker skin tones and the affected demographic, including children and the elderly, were evident. Patients also displayed limited awareness of the triggers for facial flushing and the possibility of effectively managing rosacea symptoms and recurrence. Furthermore, misconceptions were apparent regarding the involvement of eye symptoms. The study also identified a knowledge gap regarding the role of skin barrier function and the benefits of skin barrier repair in rosacea management. Moreover, there was limited awareness of the appropriateness of specific medications for mild and persistent erythema. Patients demonstrated partial knowledge about skincare products containing skin barrier repair ingredients and the potential benefits of complementary physical therapies. To address these deficiencies, clinical practice can benefit from tailored educational initiatives, effective trigger management, and the range of treatment options, both pharmaceutical and physical therapies (20-22).

The assessment of rosacea patients' attitudes reveals significant variations in their perceptions and behaviors. While the majority of participants reported not considering rosacea a significant issue. Furthermore, a notable number of respondents expressed a lack of proactive help-seeking behavior when experiencing anxiety due to their condition. These findings highlight the need for interventions aimed at fostering a better understanding of the psychosocial aspects of rosacea. A substantial proportion of participants acknowledged feeling self-conscious about their appearance due to rosacea, which is consistent with a previous study emphasizing the psychosocial impact of the condition (23). Additionally, the study identified factors that patients consider important to avoid, such as exposure to ultraviolet (UV) radiation, emotional stress, and inappropriate use of skincare products. These perceptions align with existing recommendations for rosacea management (12, 13). To improve clinical practice, healthcare professionals should emphasize the psychosocial impact

of rosacea and provide support for patients in coping with self-consciousness. Furthermore, patient education should emphasize the importance of avoiding trigger factors, aligning patient attitudes with established guidelines for rosacea management (24, 25).

The assessment of rosacea patients' practice behaviors reveals a range of practices. While a considerable number of patients regularly employ sun-protective measures, such as using sunshade umbrellas, wearing sunglasses and applying sunscreen, there is room for improvement in promoting these practices more consistently, especially in patients who never use them. In terms of facial cleansing habits, patients exhibit a variety of behaviors, with opportunities for improvement in avoiding the use of excessively hot or cold water and minimizing localized facial massages and friction, which are essential in rosacea management. Encouraging the avoidance of "three-no" skincare products can be further emphasized to enhance patient practices (26). For daily lifestyle and treatment practices, promoting formal medical treatment when necessary, emotion management, regular daily routines, a balanced diet, and appropriate physical exercise can be areas of focus for enhancing clinical practice (27, 28). The selection of suitable skincare and cosmetic products, and the importance of daily lifestyle choices and treatment adherence (29, 30).

The results of this study indicate a significant positive correlation between KAP among rosacea patients, affirming the interconnectedness of these aspects in managing the condition. The SEM further underscores the interdependence of these factors, demonstrating that knowledge has a direct and substantial impact on attitude and practice, while attitude itself directly influences practice behaviors. These findings suggest that interventions aiming to enhance patient knowledge can lead to more positive attitudes and, subsequently, improved practice behaviors. To improve clinical practice for rosacea patients, healthcare providers should focus on comprehensive educational programs that address these three interrelated components, thereby promoting a holistic approach to rosacea management (31).

A limitation of this study is its reliance on self-administered questionnaires, which may introduce response bias or social desirability bias, affecting the accuracy of the reported KAP scores. The study's cross-sectional design only provides a snapshot of the KAP at a specific point in time, limiting the ability to establish causality or assess changes over time. Additionally, the study was conducted in a single dermatology department in Chongqing, which may limit the generalizability of the findings to a broader population or different geographic regions.

Conclusion

In conclusion, patients had inadequate knowledge, positive attitude and suboptimal practice towards rosacea. Comprehensive patient education and support programs should be considered to improve the management of rosacea, with a focus on increasing knowledge, fostering positive attitudes, and enhancing practice behaviors among rosacea patients.

List of abbreviations

Knowledge, attitude, and practice KAP

Structural equation modeling SEM

Declarations

Ethics approval and consent to participate

All procedures were performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. This study has approved by the ethics committee of Southwest Hospital, Chongqing (Approval No. KY2023027) and obtained informed consent from the research participants. The study was carried out in accordance with the applicable guidelines and regulations.

Consent for publication

Not Applicable

Availability of data and materials

All data generated or analysed during this study are included in this published article [and its supplementary information files].

Competing interests

None

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Authors' contributions

L YY and G L carried out the studies, participated in collecting data, and drafted the manuscript. H TX performed the statistical analysis and participated in its design. H TX and G L participated in acquisition, analysis, or interpretation of data and draft the manuscript. All authors read and approved the final manuscript.

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Figure Legends

Figure 1. SEM for KAP.

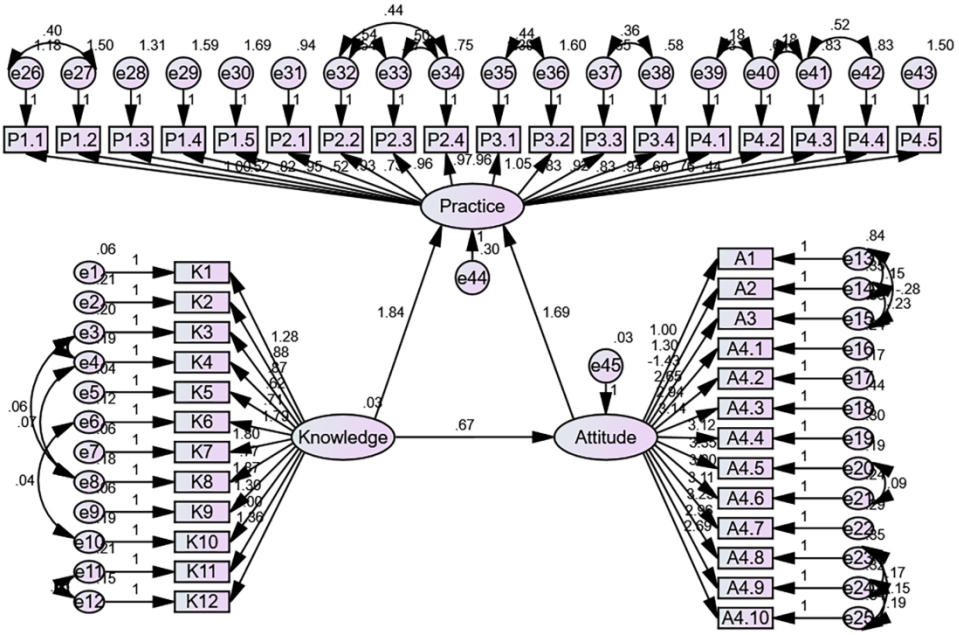

Figure 1. SEM for KAP.

170x115mm (300 x 300 DPI)

Supplementary Table 1. Knowledge, Attitude and Practice.

Item, n (%)	Correct Rate
1. The primary clinical manifestations of rosacea include intermittent facial flushing, persistent erythema or papules, pustules, and dilated capillaries.	348(87.16)
2. Rosacea is associated with genetic factors, and individuals may experience a tendency for facial flushing from an early age, often with family members exhibiting similar symptoms.	332(37.35)
3. Rosacea is more commonly observed in individuals with darker skin tones compared to those with lighter skin tones.	111(33.27)
4. Rosacea predominantly affects females aged 20-50, with children and the elderly being less susceptible to the condition.	146(28.40)
5. Fluctuations in temperature, sun exposure, emotional changes, or the consumption of spicy foods can swiftly trigger facial flushing in rosacea patients.	421(93.58)
6. While rosacea is challenging to cure and lacks a definitive treatment, it is possible to effectively manage symptoms and reduce the risk of recurrence.	333(64.79)

7. The severity of rosacea is closely linked to post-diagnosis skincare practices, with excessive cleaning and improper skincare routines potentially exacerbating the condition.						488(79.38)
8. Rosacea is a chronic, recurring inflammatory skin condition and does not typically involve eye symptoms.						170(27.24)
9. Impaired skin barrier function can trigger rosacea and skin sensitivity symptoms, making skin barrier repair a fundamental aspect of rosacea treatment.						411(78.02)
10. Mild and persistent erythema does not require specific medication; instead, repairing the skin barrier, practicing sun protection, and maintaining emotional stability are often sufficient.						256(53.70)
11. Skincare products containing ingredients like ceramides and hyaluronic acid, known for their skin barrier repair properties, can help alleviate symptoms.						314(61.09)
12. In addition to pharmaceutical treatments, physical therapies such as laser, radiofrequency, and beauty treatments can serve as effective complementary approaches to manage rosacea.						362(70.43)
Attitude	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**	

1. I don't consider my rosacea to be a significant issue. (N)	8(1.56)	43(8.37)	54(10.51)	252(49.03)	157(30.54)
2. When my rosacea causes anxiety, I proactively seek help from a doctor. (P)	243(47.28)	228(44.36)	40(7.78)	1(0.19)	1(0.19)
3. Having rosacea makes me feel self-conscious about my appearance. (N)	149(28.99)	219(42.61)	86(16.93)	54(10.51)	5(0.97)
4. Please indicate your level of agreement with the following factors that should be avoided as much as possible:					
4.1 Exposure to ultraviolet (UV) radiation. (P)	288(56.03)	181(35.21)	33(6.42)	8(1.56)	4(0.78)
4.2 Emotional stress. (P)	231(44.94)	217(42.22)	54(10.51)	11(2.14)	1(0.19)
4.3 High-intensity physical exercise. (P)	163(31.71)	182(35.41)	129(25.10)	37(7.20)	3(0.58)
4.4 Alcohol consumption. (P)	221(43.00)	216(42.02)	50(9.73)	21(4.09)	6(1.17)
4.5 Extreme temperature fluctuations. (P)	235(45.72)	196(38.13)	63(12.26)	16(3.11)	4(0.78)
4.6 Spicy foods. (P)	219(42.61)	214(41.63)	63(12.26)	16(3.11)	2(0.39)
4.7 Extremely high or low environmental humidity. (P)	172(33.46)	216(42.02)	103(20.04)	20(3.89)	3(0.58)
4.8 Poor-quality sleep. (P)	211(41.05)	188(36.58)	89(17.32)	20(3.89)	6(1.17)

4.9 Excessive facial cleaning. (P)	232(45.14)	209(40.66)	46(8.95)	23(4.47)	4(0.78)
4.10 Inappropriate use of skincare products. (P)	256(49.81)	203(39.49)	33(6.42)	16(3.11)	6(1.17)

Practice	**Always**	**Often**	**Sometimes**	**Occasionally**	**Never**
1. Sunscreen Measures:					
1.1 Using a sunshade umbrella. (P)	116(22.57)	153(29.77)	81(15.54)	87(16.93)	73(14.20)
1.2 Wearing sunglasses. (P)	49(9.53)	46(8.95)	97(18.70)	141(27.43)	187(36.38)
1.3 Wearing a hat. (P)	60(11.67)	154(29.97)	95(18.48)	102(19.84)	103(20.04)
1.4 Using a sun-protective mask. (P)	88(17.12)	83(16.15)	196(20.62)	70(13.62)	167(32.49)
1.5 Applying sunscreen with a simplified formula, primarily composed of inorganic sunscreens. (P)	70(13.62)	94(18.29)	196(20.62)	116(22.57)	128(24.90)
2. Facial Cleansing Habits:					
2.1 Avoiding washing the face with excessively hot or cold water. (P)	158(30.74)	159(30.93)	75(14.59)	96(18.68)	26(5.06)
2.2 Cleaning the face with fingers rather than facecloths, etc. (P)	192(37.35)	122(23.74)	83(16.15)	57(11.09)	60(11.67)

2.3 Minimizing localized facial massages and friction. (P)	188(36.58)	132(25.68)	109(21.21)	54(10.51)	31(6.03)
2.4 Preventing over-cleansing. (P)	184(35.80)	182(35.41)	74(14.40)	40(7.78)	34(6.61)
3. Skincare and Cosmetic Product Usage:					
3.1 Avoiding the use of "three-no" skincare products. (P)	309(49.22)	79(15.37)	42(8.17)	14(2.72)	70(13.62)
3.2 Using sunscreen and makeup cautiously. (P)	253(49.22)	73(14.20)	52(10.12)	55(10.70)	81(15.76)
3.3 Selecting skincare products with low irritability that are suitable for your skin. (P)	268(52.14)	156(30.35)	47(9.13)	18(3.50)	23(4.47)
3.4 For moderate to severe cases, simplifying the skincare routine. (P)	289(56.23)	128(24.90)	54(10.51)	22(4.28)	21(4.09)
4. Daily Lifestyle and Treatment:					
4.1 Receiving formal medical treatment when necessary. (P)	235(45.72)	151(29.38)	81(15.76)	34(6.61)	13(2.53)
4.2 Managing and calming emotions. (P)	154(29.96)	132(25.68)	152(29.57)	61(11.87)	15(2.92)
4.3 Maintaining a regular daily rhythm, reducing late nights. (P)	112(21.79)	141(27.43)	163(31.71)	87(16.93)	11(2.14)
4.4 Reducing the consumption of spicy, high-sugar, and oily foods. (P)	102(19.84)	121(23.54)	178(34.63)	95(18.48)	18(3.50)
4.5 Engaging in appropriate physical exercise. (P)	91(17.70)	82(15.95)	171(33.27)	95(18.48)	75(14.59)

Supplementary table 2. Pearson correlation analysis.

	Knowledge	Attitude	Practice
Knowledge	1		
Attitude	0.533 (P<0.001)	1	
Practice	0.536 (P<0.001)	0.592 (P<0.001)	1

Supplementary table 3. Model Fit.

Indicator	Reference Standard	Observed Result
CMIN/DF	1-3 Excellent, 3-5 Good	3.709
RMSEA	<0.08 Good	0.073
IFI	>0.8 Good	0.818
TLI	>0.8 Good	0.802
CFI	>0.8 Good	0.817

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Knowledge, Attitudes and Practices among Rosacea Patients in Chongqing, China: A Cross-sectional Study

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Knowledge, Attitudes and Practices among Rosacea Patients in Chongqing, China: A Cross-sectional Study

Running title: KAP toward Rosacea

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Abstract

Background: This study aimed to investigate the knowledge, attitude, and practice (KAP) of rosacea patients towards rosacea.

Objective: The objective was to assess the KAP levels among rosacea patients to inform potential educational interventions.

Design: A web-based cross-sectional study was conducted.

Participants/Setting: The study was conducted from November 2022 to October 2023 among rosacea patients attending the Dermatology Department of Southwest Hospital, Chongqing, using a self-administered questionnaire.

Intervention: No specific intervention was applied; the focus was on understanding existing knowledge, attitudes, and practices.

Main Outcome Measures: The primary outcome measures included KAP scores regarding rosacea.

Statistical Analyses Performed: Multivariate logistic regression analysis and structural equation modeling were employed to analyze the associations between KAP scores and demographic factors.

Results: A total of 514 valid questionnaires were collected, with 458 (89.11%) respondents being females. The mean KAP scores were 7.14 ± 2.98 (possible range: 0 - 12) for knowledge, 52.57 ± 7.07 (possible range: 13 - 65) for attitude, and 62.77 ± 13.24 (possible range: 18 - 90) for practice. Multivariate analysis indicated that knowledge, attitude, being male, aged 25-30 years, and having health insurance were independently associated with proactive practice. Additionally, structural equation modeling revealed that knowledge directly influenced both attitude and practice, while attitude also directly impacted practice (all $P < 0.001$).

Conclusions: The study found that rosacea patients had inadequate knowledge, a positive attitude, and suboptimal practices regarding their condition. It is recommended that comprehensive patient education and support programs be developed to enhance knowledge, foster positive attitudes, and improve practice behaviors among rosacea patients.

Keywords: knowledge; attitude; practice; rosacea; cross-sectional study

Strengths and limitations of this study

- The study effectively gathered a substantial sample size of 514 valid responses, allowing for robust statistical analysis of knowledge, attitude, and practice among rosacea patients.
- Multivariate logistic regression and structural equation modeling provided insightful relationships between knowledge, attitude, and practice, highlighting key factors influencing proactive care among rosacea patients.
- The study's reliance on self-administered questionnaires may introduce response bias, as participants might overreport positive attitudes or practices related to rosacea management.
- The cross-sectional design limits causal inferences about the relationships between knowledge, attitude, and practice, making it challenging to determine long-term trends or effects.

Introduction

Rosacea, often referred to as acne rosacea, is a prevalent inflammatory skin condition that predominantly afflicts the central face [1, 2]. It is characterized by chronic inflammatory facial dermatosis, featuring symptoms such as transient or persistent erythema, flushing, dryness, and skin burning, along with telangiectasia, vascular inflammation, inflammatory papules, pustules, and red or watery eyes [3]. Notably, it is more frequently observed in women than in men [4]. Recent international studies have reported a rosacea prevalence of approximately 5.5%, with the condition affecting up to 3.48% of the Chinese population [5, 6]. Moreover, the accompanying subjective symptoms of rosacea, including sensations of burning, stinging, and pruritus, can further diminish patients' quality of life and disrupt their sleep patterns [7, 8]. Hence, understanding patients' knowledge, attitudes, and practices regarding rosacea is crucial for improving treatment outcomes and enhancing their quality of life.

The Knowledge, Attitude, and Practice (KAP) survey functions as a research tool, illuminating a group's comprehension, beliefs, and actions on a specific subject, particularly within the realm of health literacy, where it is based on the premise that knowledge positively influences attitudes, which in turn mold behaviors [9-11]. Considering that patients' self-management is crucial for the management and control of diseases, when patients actively engage and take appropriate measures to manage their conditions, it often leads to symptom alleviation, improved quality of life, and reduced healthcare resource utilization. It is noteworthy that there is currently lacking of KAP studies in this direction. Therefore, this study aimed to investigate the KAP of rosacea patients towards their condition.

Methods

Study design and participants

This cross-sectional study was conducted between November 2022 and October 2023 among rosacea patients, at the Dermatology Department of Southwest Hospital, Chongqing. The inclusion criteria were: (1) A diagnosis conforming to the 2021 Chinese Rosacea Diagnosis and Treatment Expert Consensus, which delineates persistent erythema and hypertrophic alterations in the central facial area as core diagnostic criteria. A rosacea diagnosis could be established with the presence of one or more of these defining features. Key characteristics of rosacea included intermittent flushing, papules and/or pustules, telangiectasia, and specific ocular manifestations (such as eyelid telangiectasia, eyelid inflammation, keratitis, conjunctivitis, and keratoconjunctivitis), with the presence of two or more of these primary features warranting a rosacea diagnosis. (2) Individuals aged 18 or older, who possessed the capacity for independent thinking and responding to survey questions. Exclusion criteria encompassed: (1) Patients concurrently afflicted with facial allergic or inflammatory conditions, such as allergic dermatitis, steroid-dependent dermatitis, or common acne, as determined by the consensus of two or more experienced dermatologists in distinguishing these from similar facial dermatitis. (2) Patients contending with severe comorbidities, including cardiovascular diseases, lupus erythematosus, endocrine system disorders, hematological disorders, or confirmed tumors. (3) Nursing or pregnant women. (4) Individuals who declined to provide informed consent. This study has received ethical approval from ethics committee of Southwest Hospital, Chongqing (Approval No. KY2023027) and obtained informed consent from the research participants.

Questionnaire Introduction

A questionnaire with four dimensions was developed based on the guidelines for rosacea management and the Chinese Rosacea Diagnosis and Treatment Guidelines (2021 edition) and previous literatures [12, 13]. A rigorous refinement process was executed, involving input from three dermatology experts, resulting in the elimination of redundant or

overlapping questions and the clarification of items with unclear wording. Prior to the official survey, a preliminary pilot test was conducted involving 32 participants. A pilot study involving 30 valid questionnaires revealed an overall Cronbach's α coefficient of 0.904. The Cronbach's α coefficient for the knowledge dimension was 0.823, for the attitude dimension it was 0.833, and for the practice dimension it was 0.825.

The final questionnaire, written in Chinese, comprised four distinct sections: (1) Demographic Information, collecting participant details such as age, gender, residence, education, employment, and income. (2) The knowledge dimension included 12 questions related to rosacea, where participants received 1 point for each correct answer and 0 for incorrect or uncertain responses. (3) The attitude dimension comprised 13 questions rated on a five-point Likert scale, gauging participants' attitudes toward rosacea. (4) The practice dimension contained 18 questions also rated on a five-point Likert scale, evaluating participants' rosacea management practices. Scores exceeding 70% of the maximum in each section indicates adequate knowledge, positive attitude, and proactive practice [14].

Questionnaire Distribution and Quality Control

The questionnaire was administered in a paper-based format. Following the confirmation of a diagnosis in the outpatient department, based on meeting diagnostic criteria, validated by multiple doctors, and supported from image analysis. Patients were encouraged to contemplate their responses independently, with any uncertainties addressed through conversational clarification rather than inducing specific answers. The patients themselves completed the questionnaire, and ensured the quality and comprehensiveness of responses, all questionnaire items were made mandatory. A research team, consisting of three doctors trained as research assistants responsible for questionnaire promotion and distribution, diligently assessed all submissions for completeness, internal consistency, and logical

coherence. Submissions exhibiting logical errors, incomplete answers, or uniform responses across all items were categorized as invalid.

Statistical analysis

The sample size was 5-10 times the number of questionnaire items [15]. The number of independent variables in this questionnaire was 43. Therefore, the required sample size was at least 215. Considering an estimated rate of invalid questionnaires of 20%, at least 269 participants were required.

Data analysis was conducted using Stata 17.0 (Stata Corporation, College Station, TX, USA). Continuous variables were described as mean ± standard deviation (SD), and between-group comparisons were performed using t-tests or analysis of variance (ANOVA). Categorical variables were presented as n (%). Pearson correlation analysis was employed to assess the correlations between KAP scores. In multivariate analysis, 70% score distribution of the total score was used as the cut-off value. Univariate variables with $P<0.05$ were enrolled in multivariate regression. Structural equation modeling (SEM) was employed to test the following hypotheses: 1) knowledge had impacts on attitude; 2) knowledge had impacts on practice; 3) attitude had impacts on practice. Two-sided P-values <0.05 were regarded as statistically significant.

Patient and Public Involvement

Not applicable.

Results

Initially, a total of 518 questionnaires were collected, excluding 1 questionnaire with residence selected "D", 1 questionnaire with outliers in education, and 2 questionnaires with outliers in the knowledge section. The remaining valid questionnaires were 514, with a validity rate of 99.23%. Among them, 458 (89.11%) were females, 146 (28.40%) were in the

age group of 31-40 years, 399 (77.63%) were residing in urban areas, 333 (64.79%) were educated with college/bachelor's degree and above, 275 (53.50%) were employed, and with mean duration of rosacea diagnosis of 27.07±32.28 months.

The mean KAP scores were 7.14 ± 2.98 (possible range: 0 - 12), 52.57 ± 7.07 (possible range: 13 - 65), and 62.77 ± 13.24 (possible range: 18 - 90), respectively. The KAP scores varied from patients with different gender, age, residence, education, employment status, monthly Per capita Income, marital status (all of $P < 0.01$). Additionally, the availability of health insurance is more likely to affect patients practice ($P < 0.001$) (**Table 1**).

Table 1. Baseline characteristics and KAP scores.

Variables	n (%)	Knowledge		Attitude		Practice	
		Mean±SD	P	Mean±SD	P	Mean±SD	P
Total	514	7.14±2.98		52.57±7.07		62.77±13.24	
Gender			0.001		<0.001		<0.001
Male	56(10.89)	5.89±3.46		47.50±8.37		53.11±14.97	
Female	458(89.11)	7.30±2.88		53.19±6.64		63.95±12.53	
Age			<0.001		<0.001		<0.001
<25 years	122(23.74)	8.56±2.42		54.39±6.38		66.84±12.41	
25-30 years	111(21.60)	8.11±2.34		55.38±5.76		64.80±10.51	
31-40 years	146(28.40)	6.92±2.71		52.14±7.00		62.77±12.41	
41 years and above	135(26.26)	5.32±3.18		49.09±7.24		57.42±15.08	
Residence			<0.001		<0.001		<0.001
Rural	70(13.62)	5.76±3.69		49.96±8.78		55.20±16.84	
Urban	399(77.63)	7.44±2.84		53.37±6.56		64.16±12.37	
Suburban	45(8.75)	6.71±2.53		49.60±6.89		62.22±10.32	
Education			<0.001		<0.001		<0.001
Junior high school or below	80(15.56)	5.01±3.44		46.82±8.20		52.99±17.04	
High school / Technical school	101(19.65)	6.00±3.01		51.77±6.47		61.22±10.55	
College/Bachelor's and above	333(64.79)	8.00±2.43		54.20±6.15		65.59±11.68	
Employment Status			<0.001		<0.001		0.006
Employed	275(53.50)	7.66±2.48		53.71±6.37		64.25±11.82	
Other	239(46.50)	6.55±3.37		51.27±7.61		61.06±14.54	
Monthly Per Capita Income (CNY)			<0.001		<0.001		<0.001
<5000	189(36.77)	6.52±3.20		49.75±7.65		59.47±15.34	
5000-10000	164(31.91)	7.15±2.56		52.66±6.34		62.84±12.74	
>10000	161(31.32)	7.87±2.95		55.80±5.53		66.58±9.62	

Marital Status			<0.001	<0.001		<0.001
Married	262(50.97)	6.55±3.11		51.24±7.88	60.19±14.77	
Unmarried	195(37.94)	8.53±2.19		54.68±5.93	66.41±11.14	
Other	57(11.09)	5.12±2.61		51.51±4.67	62.19±9.04	
Health Insurance Type			0.977	0.718		<0.001
With insurance	483(93.97)	7.14±2.99		52.60±6.98	62.24±13.00	
Without insurance	31(6.03)	7.13±2.83		52.13±8.48	70.97±14.41	
Duration of disease (months)	27.07±32.28					

The distribution of knowledge dimensions revealed that the three knowledge items with the highest correctness rates were as follows: "*Fluctuations in temperature, sun exposure, emotional changes, or the consumption of spicy foods can swiftly trigger facial flushing in rosacea patients.*" (K5) with 93.58%, "*The primary clinical manifestations of rosacea include intermittent facial flushing, persistent erythema or papules, pustules, and dilated capillaries.*" (K1) with 87.16%, and "*The severity of rosacea is closely linked to post-diagnosis skincare practices, with excessive cleaning and improper skincare routines potentially exacerbating the condition.*" (K7) with 79.38%. The three items with the lowest correctness rates were "*Rosacea is a chronic, recurring inflammatory skin condition and does not typically involve eye symptoms.*" (K8) with 27.24%, "*Rosacea predominantly affects females aged 20-50, with children and the elderly being less susceptible to the condition.*" (K4) with 28.40%, and "*Rosacea is more commonly observed in individuals with darker skin tones compared to those with lighter skin tones.*" (K3) with 33.27%. (**Supplementary Table 1**).

When it comes to patients' attitudes towards rosacea, 79.57% consider the condition a major problem to varying degrees (A1). The vast majority (91.64%) reported that they would actively seek help from a doctor if the disease made them feel anxious (A2). 71.6% felt very low self-esteem or low self-esteem about their appearance caused by the disease (A3). The most strongly agreed risk factors to avoid were UV exposure (A4.1), inappropriate use of

skincare products (A4.10), and extreme temperature fluctuations (A4.5), with 56.03%, 49.81%, and 45.72%, respectively (**Supplementary Table 1**).

Specific sunscreen practices showed that participants always protected themselves from the sun by using sunshade umbrella. (P1.1, 22.57%) and sun-protective mask (P1.4, 17.12%). Regarding facial cleansing habits, 30.74%, 37.35%, 36.58%, and 35.80% avoided excessively hot or cold water (P2.1), the use of facecloths (P2.2), facial friction motions (P2.3), and excessive cleaning (P2.4), respectively. 52.14% always chose skincare products that were less irritating and suitable for them (P3.3). 45.72% reported that they were firm in their choice of formal medical treatment when necessary (4.1). It is worth noting that the largest proportion of people were not firm in reducing staying up late (P4.3), reducing the intake of spicy, surgery and oily food (P4.4), and exercising properly (P4.5), sometimes doing it but sometimes not, with 31.71%, 34.63%, and 33.27%, respectively (**Supplementary Table 1**).

Correlation analysis showed that significant positive correlations were found between knowledge and attitude ($r = 0.533$, $P<0.001$), as well as practice ($r = 0.536$, $P<0.001$). Meanwhile, there was also correlation between attitude and practice ($r = 0.592$, $P<0.001$) (**Supplementary Table 2**).

Multivariate logistic regression analysis shown that being male (OR = 0.311, 95% CI: 0.113-0.858, P = 0.024), aged 31-40 years (OR = 0.342, 95% CI: 0.144-0.810, P = 0.015), aged 41 years and above (OR = 0.295, 95% CI: 0.097-0.899, P = 0.032), lived in rural (OR = 2.354, 95% CI: 1.032-5.369, P = 0.042), graduated from high school or technical school (OR = 6.860, 95% CI: 1.357-34.688, P = 0.020), educated to college/bachelor's degree and above (OR = 7.043, 95% CI: 1.641-5.761, P = 0.017), and with monthly per capita income greater than 10,000 yuan (OR = 3.074, 95% CI: 1.641-5.761, P < 0.001) were independently associated with good knowledge (**Table 2**). Meanwhile, knowledge score (OR = 1.384, 95% CI: 1.253-1.529, P < 0.001), being male (OR = 0.258, 95% CI: 0.122-0.545, P < 0.001), and

with monthly per capita income greater than 10,000 yuan (OR = 4.264, 95% CI: 1.925-9.443, P < 0.001) were independently associated with positive attitude (**Table 3**). Furthermore, knowledge score (OR = 1.360, 95% CI: 1.209-1.529, P < 0.001), attitude score (OR = 1.132, 95% CI: 1.082-1.184, P < 0.001), being male (OR = 0.357, 95% CI: 0.136-0.943, P = 0.038), aged 25-30 years (OR = 0.482, 95% CI: 0.243-0.958, P = 0.037), and having health insurance (OR = 0.239, 95% CI: 0.094-0.608, P = 0.003) were independently associated with proactive practice (**Table 4**).

Table 2. Univariate and multivariate logistic regression analysis of good knowledge.

Variables	Univariate		Multivariate	
	OR (95%CI)	**P**	**OR (95%CI)**	**P**
Gender				
Male	0.365(0.142 0.939)	0.037	0.311(0.113, 0.858)	0.024
Female	ref		ref	
Age				
Below 25 years	ref		ref	
25-30 years	0.520(0.297 0.912)	0.023	0.537(0.274, 1.050)	0.069
31-40 years	0.217(0.117 0.400)	<0.001	0.342(0.144, 0.810)	0.015
41 years and above	0.097(0.044 0.216)	<0.001	0.295(0.097, 0.899)	0.032
Residence				
Rural	1.359(0.754 2.449)	0.307	2.354(1.032, 5.369)	0.042
Urban	ref		ref	
Suburban	0.280(0.085 0.928)	0.037	0.591(0.159, 2.204)	0.434
Education				
Junior high school or below	ref		ref	
High school / Technical school	9.630(2.178 42.575)	0.003	6.860(1.357, 34.688)	0.020

College/Bachelor's and above	12.332(2.963 51.321)	0.001	7.043(1.641, 5.761)	0.017
Employment Status				
Employed	ref			
Other	0.844(0.545 1.307)	0.447		
Monthly Per Capita Income (in CNY):				
<5000	ref		ref	
5000-10000	0.694(0.375 1.287)	0.247	0.724(0.363, 1.446)	0.361
>10000	2.601(1.562 4.332)	<0.001	3.074(1.641, 5.761)	<0.001
Marital Status				
Married	ref		ref	
Unmarried	2.666(1.692 4.199)	<0.001	1.535(0.737, 3.198)	0.253
Other	0.102(0.014 0.759)	0.026	0.091(0.011, 0.763)	0.027
Health Insurance Type				
With insurance	0.839(0.351 2.006)	0.694		
Without insurance	ref			
Time Since Diagnosis (months)	0.998(0.992 1.005)	0.669		

Table 3. Univariate and multivariate logistic regression analysis of positive attitude.

Variables	Univariate		Multivariate	
	OR (95%CI)	**P**	**OR (95%CI)**	**P**
Knowledge score	1.418(1.311 1.533)	<0.001	1.384(1.253, 1.529)	<0.001
Gender				
Male	0.252(0.142 0.447)	<0.001	0.258(0.122, 0.545)	<0.001
Female	ref			
Age				
Below 25 years	ref		ref	
25-30 years	2.000(0.920 4.341)	0.080	2.279(0.865, 6.009)	0.096
31-40 years	0.753(0.412 1.377)	0.357	1.180(0.448, 3.109)	0.737
41 years and above	0.399(0.223 0.713)	0.002	0.881(0.311, 2.500)	0.812
Residence				
Rural	0.330(0.192 0.568)	<0.001	0.719(0.336, 1.539)	0.395
Urban	ref		ref	
Suburban	0.488(0.247 0.963)	0.039	0.550(0.231, 1.314)	0.179
Education Level				
Junior high school or below	ref			
High school / Technical school	2.242(1.203 1.181)	0.011	0.439(0.176, 1.095)	0.078
College/Bachelor's and above	4.524(2.658 7.701)	<0.001	0.817(0.336, 1.986)	0.656
Employment Status				
Employed	ref		ref	
Other	0.608(0.399 0.924)	0.020	1.061 (0.582,1.932)	0.847
Monthly Per Capita Income (CNY)				

<5000	ref			
5000-10000	2.231(1.375 3.619)	0.001	1.810(0.979, 3.345)	0.058
>10000	6.398(3.373 12.134)	<0.001	4.264(1.925, 9.443)	<0.001
Marital Status				
Married	ref		ref	
Unmarried	2.785(1.717 4.516)	<0.001	1.618(0.696, 3.759)	0.263
Other	3.804(1.569 9.222)	0.003	6.391(2.150, 19.000)	0.001
Health Insurance Type				
With insurance	1.473(0.658 3.294)	0.346		
Without insurance	ref			
Time Since Diagnosis (months):	1.007(0.999 1.015)	0.075		

Table 4. Univariate and multivariate logistic regression analysis of proactive practice.

Variables	Univariate		Multivariate	
	OR (95%CI)	**P**	**OR (95%CI)**	**P**
Knowledge score	1.568(1.420 1.732)	<0.001	1.360(1.209, 1.529)	<0.001
Attitude score	1.205(1.159 1.253)	<0.001	1.132(1.082, 1.184)	<0.001
Gender				
Male	0.217(0.096 0.489)	<0.001	0.357(0.136, 0.943)	0.038
Female	ref			
Age				
Below 25 years	ref			
25-30 years	0.623(0.371 1.046)	0.074	0.482(0.243, 0.958)	0.037
31-40 years	0.403(0.245 0.662)	<0.001	0.618(0.268, 1.429)	0.261
41 years and above	0.232(0.135 0.400)	<0.001	0.855(0.324, 2.255)	0.751
Residence				
Rural	0.762(0.445 1.305)	0.322	1.340(0.585, 3.070)	0.489
Urban	ref		ref	
Suburban	0.445(0.214 0.924)	0.030	1.276 (0.524, 3.103)	0.591
Education Level				
Junior high school or below	ref		ref	
High school / Technical school	2.876(1.373 6.024)	0.005	2.153(0.771, 6.009)	0.143
College/Bachelor's and above	4.265(2.224 8.177)	<0.001	1.695(0.637, 4.505)	0.290
Employment Status				
Employed	ref		ref	
Other	0.668(0.465 0.961)	0.030	0.771(0.460, 1.290)	0.322
Monthly Per Capita				

Income (CNY):				
<5000	ref		ref	
5000-10000	1.069(0.676 1.688)	0.776	1.051(0.579, 1.908)	0.869
>10000	2.658(1.711 4.129)	<0.001	1.761(0.941, 3.294)	0.077
Marital Status				
Married	ref		ref	
Unmarried	1.736(1.187 2.539)	0.004	0.790(0.393, 1.591)	0.510
Other	0.317(0.144 0.699)	0.004	0.317(0.119, 0.848)	0.022
Health Insurance Type				
With insurance	0.396(0.189 0.827)	0.014	0.239(0.094, 0.608)	0.003
Without insurance	ref		ref	
Time Since Diagnosis (months):	0.997(0.991 1.002)	0.256		

The SEM demonstrate a highly favorable model fit indices, suggesting a well-fitting model (**Supplementary Table 3**), and showed that knowledge had direct effects on attitude (β = 0.667, p <0.001) and practice (β = 1.840, p <0.001). Moreover, attitude also have a direct impact on practice (β = 1.689, p <0.001) (**Figure 1**).

Discussion

Patients had inadequate knowledge, positive attitude and suboptimal practice towards rosacea. Multivariate logistic regression analysis showed that knowledge score, attitude score, being male, aged 25-30 years, and having health insurance were associated with proactive practice. SEM showed that knowledge had direct effects on attitude and practice, attitude also have a direct impact on practice. This study may contribute to reveal the extent of patients' understanding of their respective medical conditions, as well as their attitudes and practices regarding treatment and self-management.

This study underscores the need for targeted interventions to enhance clinical practice for rosacea patients. It is evident from the results that patients generally possess inadequate knowledge, exhibit a positive attitude, and engage in suboptimal practices regarding their condition. The mean scores for KAP, with a wide range of possible values, reveal significant room for improvement across all three domains. These findings align with previous studies that have highlighted knowledge deficits among rosacea patients [16]. Notably, the study identifies various demographic and socioeconomic factors that influence patients' KAP scores. For instance, gender, age, residence, education level, employment status, and monthly per capita income all play a role in shaping patient KAP. This mirrors the findings of similar research, which underscores the importance of tailoring interventions to specific patient profiles. Furthermore, the availability of health insurance emerged as a crucial factor influencing patient practice, emphasizing the need for policy-level improvements to ensure affordable access to treatment and care. Multivariate logistic regression analysis reveals that male patients, those aged 31-40 and 41 years and above, residents of rural areas, individuals with higher education levels, and those with higher incomes demonstrate a greater likelihood of possessing good knowledge about rosacea. Similarly, a positive attitude is more prevalent among those with higher knowledge scores, males, and individuals with higher incomes. Importantly, both knowledge and attitude have a significant influence on proactive practice, suggesting that interventions aimed at enhancing knowledge and cultivating a positive attitude can lead to improved practice behaviors [9, 17]. In conclusion, this study's findings provide valuable insights for tailoring interventions to address the specific needs and disparities within the rosacea patient population [18, 19].

The study's assessment of rosacea patients' knowledge highlights several areas of deficiency and misconceptions. While a substantial proportion of patients correctly identified the

primary clinical manifestations of rosacea, including intermittent facial flushing, and dilated capillaries. Additionally, misconceptions about the prevalence of rosacea in individuals with darker skin tones and the affected demographic, including children and the elderly, were evident. Patients also displayed limited awareness of the triggers for facial flushing and the possibility of effectively managing rosacea symptoms and recurrence. Furthermore, misconceptions were apparent regarding the involvement of eye symptoms. The study also identified a knowledge gap regarding the role of skin barrier function and the benefits of skin barrier repair in rosacea management. Moreover, there was limited awareness of the appropriateness of specific medications for mild and persistent erythema. Patients demonstrated partial knowledge about skincare products containing skin barrier repair ingredients and the potential benefits of complementary physical therapies. To address these deficiencies, clinical practice can benefit from tailored educational initiatives, effective trigger management, and the range of treatment options, both pharmaceutical and physical therapies [20-22].

The assessment of rosacea patients' attitudes reveals significant variations in their perceptions and behaviors. While the majority of participants reported not considering rosacea a significant issue. Furthermore, a notable number of respondents expressed a lack of proactive help-seeking behavior when experiencing anxiety due to their condition. These findings highlight the need for interventions aimed at fostering a better understanding of the psychosocial aspects of rosacea. A substantial proportion of participants acknowledged feeling self-conscious about their appearance due to rosacea, which is consistent with a previous study emphasizing the psychosocial impact of the condition [23]. Additionally, the study identified factors that patients consider important to avoid, such as exposure to ultraviolet (UV) radiation, emotional stress, and inappropriate use of skincare products. These perceptions align with existing recommendations for rosacea management [12, 13]. To

improve clinical practice, healthcare professionals should emphasize the psychosocial impact of rosacea and provide support for patients in coping with self-consciousness. Furthermore, patient education should emphasize the importance of avoiding trigger factors, aligning patient attitudes with established guidelines for rosacea management [24, 25].

The assessment of rosacea patients' practice behaviors reveals a range of practices. While a considerable number of patients regularly employ sun-protective measures, such as using sunshade umbrellas, wearing sunglasses and applying sunscreen, there is room for improvement in promoting these practices more consistently, especially in patients who never use them. In terms of facial cleansing habits, patients exhibit a variety of behaviors, with opportunities for improvement in avoiding the use of excessively hot or cold water and minimizing localized facial massages and friction, which are essential in rosacea management. Encouraging the avoidance of "three-no" skincare products can be further emphasized to enhance patient practices [26]. For daily lifestyle and treatment practices, promoting formal medical treatment when necessary, emotion management, regular daily routines, a balanced diet, and appropriate physical exercise can be areas of focus for enhancing clinical practice [27, 28]. The selection of suitable skincare and cosmetic products, and the importance of daily lifestyle choices and treatment adherence [29, 30].

The results of this study indicate a significant positive correlation between KAP among rosacea patients, affirming the interconnectedness of these aspects in managing the condition. The SEM further underscores the interdependence of these factors, demonstrating that knowledge has a direct and substantial impact on attitude and practice, while attitude itself directly influences practice behaviors. These findings suggest that interventions aiming to enhance patient knowledge can lead to more positive attitudes and, subsequently, improved practice behaviors. To improve clinical practice for rosacea patients, healthcare providers

should focus on comprehensive educational programs that address these three interrelated components, thereby promoting a holistic approach to rosacea management [31].

While our findings highlight the need for comprehensive patient education and support programs, we acknowledge the practical challenges in implementing these recommendations. The proposed interventions would require additional healthcare resources, including dedicated healthcare professionals for patient education, time allocation for psychological support, and infrastructure for educational program delivery. The financial implications would include costs for developing educational materials, training healthcare providers, and potentially hiring additional staff. Given current healthcare resource constraints, a phased implementation approach could be considered. For instance, starting with cost-effective digital education platforms and gradually expanding to more resource-intensive interventions based on available funding and staffing. Healthcare facilities could also explore partnerships with patient advocacy groups and utilize existing resources to minimize additional financial burden. Future research should include cost-effectiveness analyses of these interventions to help healthcare providers and policymakers make informed decisions about resource allocation.

Strengths and Limitations of the Study

The study successfully gathered a substantial sample size of 514 valid responses, enabling robust statistical analysis of knowledge, attitude, and practice (KAP) among rosacea patients. The use of multivariate logistic regression and structural equation modeling provided valuable insights into the relationships between knowledge, attitude, and practice, highlighting key factors influencing proactive care among rosacea patients. However, the study's reliance on self-administered questionnaires may introduce response bias, as participants might overreport positive attitudes or practices related to rosacea management. The cross-sectional design limits the ability to make causal inferences about the relationships

between knowledge, attitude, and practice, making it challenging to determine long-term trends or effects. Additionally, the study was conducted in a single dermatology department in Chongqing, which may limit the generalizability of the findings to a broader population or different geographic regions. Despite these limitations, our findings provide valuable insights into the KAP of rosacea patients and highlight areas for targeted interventions.

Conclusion

In conclusion, patients had inadequate knowledge, positive attitude and suboptimal practice towards rosacea. Comprehensive patient education and support programs should be considered to improve the management of rosacea, with a focus on increasing knowledge, fostering positive attitudes, and enhancing practice behaviors among rosacea patients.

List of abbreviations

Knowledge, attitude, and practice KAP

Structural equation modeling SEM

Declarations

Ethics approval and consent to participate

All procedures were performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. This study has approved by the ethics committee of Southwest Hospital, Chongqing (Approval No. KY2023027) and obtained informed consent from the research participants. The study was carried out in accordance with the applicable guidelines and regulations.

Consent for publication

Not Applicable

Availability of data and materials

All data generated or analysed during this study are included in this published article [and its supplementary information files].

Competing interests

None

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Authors' contributions

L YY and G L carried out the studies, participated in collecting data, and drafted the manuscript. H TX performed the statistical analysis and participated in its design. H TX and G L participated in acquisition, analysis, or interpretation of data and draft the manuscript. All authors read and approved the final manuscript. And Lan Ge is the guarantor.

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Figure Legends

Figure 1. SEM for KAP.

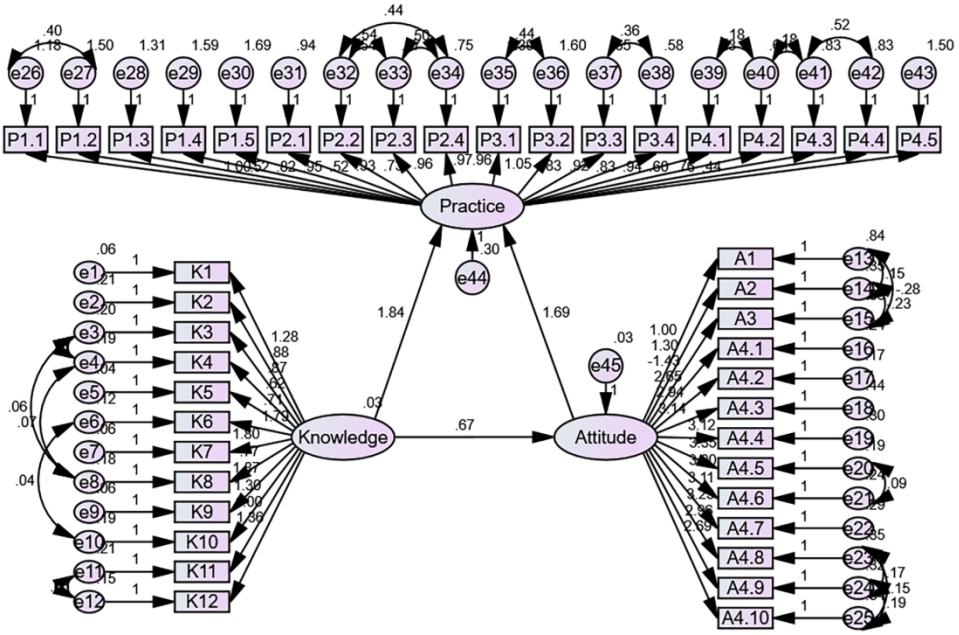

Figure 1. SEM for KAP.

170x115mm (300 x 300 DPI)

Supplementary Table 1. Knowledge, Attitude and Practice.

Item, n (%)	Correct Rate
1. The primary clinical manifestations of rosacea include intermittent facial flushing, persistent erythema, or papules, pustules, and dilated capillaries.	148(87.16)
2. Rosacea is associated with genetic factors, and individuals may experience a tendency for facial flushing from an early age, often with family members exhibiting similar symptoms.	62(37.35)
3. Rosacea is more commonly observed in individuals with darker skin tones compared to those with lighter skin tones.	111(33.27)
4. Rosacea predominantly affects females aged 20-50, with children and the elderly being less susceptible to the condition.	146(28.40)
5. Fluctuations in temperature, sun exposure, emotional changes, or the consumption of spicy foods can swiftly trigger facial flushing in rosacea patients.	421(93.58)
6. While rosacea is challenging to cure and lacks a definitive treatment, it is possible to effectively manage symptoms and reduce the risk of recurrence.	383(64.79)

7. The severity of rosacea is closely linked to post-diagnosis skincare practices, with excessive cleaning and improper skincare routines potentially exacerbating the condition.					488(79.38)
8. Rosacea is a chronic, recurring inflammatory skin condition and does not typically involve eye symptoms.					150(27.24)
9. Impaired skin barrier function can trigger rosacea and skin sensitivity symptoms, making skin barrier repair a fundamental aspect of rosacea treatment.					411(78.02)
10. Mild and persistent erythema does not require specific medication; instead, repairing the skin barrier, practicing sun protection, and maintaining emotional stability are often sufficient.					256(53.70)
11. Skincare products containing ingredients like ceramides and hyaluronic acid, known for their skin barrier repair properties, can help alleviate symptoms.					314(61.09)
12. In addition to pharmaceutical treatments, physical therapies such as laser, radiofrequency, and beauty treatments can serve as effective complementary approaches to manage rosacea.					382(70.43)
Attitude	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**

1. I don't consider my rosacea to be a significant issue. (N)	8(1.56)	43(8.37)	54(10.51)	252(49.03)	157(30.54)
2. When my rosacea causes anxiety, I proactively seek help from a doctor. (P)	243(47.28)	228(44.36)	42(8.18)	1(0.19)	1(0.19)
3. Having rosacea makes me feel self-conscious about my appearance. (N)	149(28.99)	219(42.61)	86(16.93)	54(10.51)	5(0.97)
4. Please indicate your level of agreement with the following factors that should be avoided as much as possible:					
4.1 Exposure to ultraviolet (UV) radiation. (P)	288(56.03)	181(35.21)	37(7.2)	8(1.56)	4(0.78)
4.2 Emotional stress. (P)	231(44.94)	217(42.22)	54(10.51)	11(2.14)	1(0.19)
4.3 High-intensity physical exercise. (P)	163(31.71)	182(35.41)	129(25.10)	37(7.20)	3(0.58)
4.4 Alcohol consumption. (P)	221(43.00)	216(42.02)	59(9.73)	21(4.09)	6(1.17)
4.5 Extreme temperature fluctuations. (P)	235(45.72)	196(38.13)	63(12.26)	16(3.11)	4(0.78)
4.6 Spicy foods. (P)	219(42.61)	214(41.63)	63(12.26)	16(3.11)	2(0.39)
4.7 Extremely high or low environmental humidity. (P)	172(33.46)	216(42.02)	103(20.04)	20(3.89)	3(0.58)
4.8 Poor-quality sleep. (P)	211(41.05)	188(36.58)	89(19.32)	20(3.89)	6(1.17)

4.9 Excessive facial cleaning. (P)	232(45.14)	209(40.66)	46(8.95)	23(4.47)	4(0.78)
4.10 Inappropriate use of skincare products. (P)	256(49.81)	203(39.49)	33(6.42)	16(3.11)	6(1.17)

Practice	**Always**	**Often**	**Sometimes**	**Occasionally**	**Never**
1. Sunscreen Measures:					
1.1 Using a sunshade umbrella. (P)	116(22.57)	153(29.77)	81(15.54)	87(16.93)	73(14.20)
1.2 Wearing sunglasses. (P)	49(9.53)	46(8.95)	91(17.70)	141(27.43)	187(36.38)
1.3 Wearing a hat. (P)	60(11.67)	154(29.97)	95(18.48)	102(19.84)	103(20.04)
1.4 Using a sun-protective mask. (P)	88(17.12)	83(16.15)	106(20.62)	70(13.62)	167(32.49)
1.5 Applying sunscreen with a simplified formula, primarily composed of inorganic sunscreens. (P)	70(13.62)	94(18.29)	106(20.62)	116(22.57)	128(24.90)
2. Facial Cleansing Habits:					
2.1 Avoiding washing the face with excessively hot or cold water. (P)	158(30.74)	159(30.93)	75(14.59)	96(18.68)	26(5.06)
2.2 Cleaning the face with fingers rather than facecloths, etc. (P)	192(37.35)	122(23.74)	83(16.15)	57(11.09)	60(11.67)

2.3 Minimizing localized facial massages and friction. (P)	188(36.58)	132(25.68)	109(21.21)	54(10.51)	31(6.03)
2.4 Preventing over-cleansing. (P)	184(35.80)	182(35.41)	74(14.40)	40(7.78)	34(6.61)
3. Skincare and Cosmetic Product Usage:					
3.1 Avoiding the use of "three-no" skincare products. (P)	309(49.22)	79(15.37)	42(8.17)	14(2.72)	70(13.62)
3.2 Using sunscreen and makeup cautiously. (P)	253(49.22)	73(14.20)	52(10.12)	55(10.70)	81(15.76)
3.3 Selecting skincare products with low irritability that are suitable for your skin. (P)	268(52.14)	156(30.35)	47(9.13)	18(3.50)	23(4.47)
3.4 For moderate to severe cases, simplifying the skincare routine. (P)	289(56.23)	128(24.90)	54(10.51)	22(4.28)	21(4.09)
4. Daily Lifestyle and Treatment:					
4.1 Receiving formal medical treatment when necessary. (P)	235(45.72)	151(29.38)	81(15.76)	34(6.61)	13(2.53)
4.2 Managing and calming emotions. (P)	154(29.96)	132(25.68)	152(29.57)	61(11.87)	15(2.92)
4.3 Maintaining a regular daily rhythm, reducing late nights. (P)	112(21.79)	141(27.43)	163(31.71)	87(16.93)	11(2.14)
4.4 Reducing the consumption of spicy, high-sugar, and oily foods. (P)	102(19.84)	121(23.54)	178(34.63)	95(18.48)	18(3.50)
4.5 Engaging in appropriate physical exercise. (P)	91(17.70)	82(15.95)	171(33.27)	95(18.48)	75(14.59)

Supplementary table 2. Pearson correlation analysis.

	Knowledge	Attitude	Practice
Knowledge	1		
Attitude	0.533 (P<0.001)	1	
Practice	0.536 (P<0.001)	0.592 (P<0.001)	1

Supplementary table 3. Model Fit.

Indicator	Reference Standard	Observed Result
CMIN/DF	1-3 Excellent, 3-5 Good	3.709
RMSEA	<0.08 Good	0.073
IFI	>0.8 Good	0.818
TLI	>0.8 Good	0.802
CFI	>0.8 Good	0.817