scientific reports

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Parental knowledge, attitudes, and practices regarding malocclusion in preschool children

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This cross-sectional study aimed to assess the knowledge, attitudes, and practices (KAP) of parents regarding malocclusion in preschool-aged children in Nanchong City, Sichuan Province, between January and July 2024. Data were collected via questionnaires to gather demographic information and assess parents' KAP, with univariable and multivariable logistic regression analyses used to explore the associations between demographic factors and KAP. Structural equation modeling (SEM) was applied to investigate complex relationships among relevant factors. A total of 2811 valid cases were included, of which 61.2% were female. The mean scores for knowledge, attitude, and practice were 3.71, 26.50, and 40.98, respectively. Positive correlations were found between knowledge and attitude (r = 0.491), knowledge and practice (r = 0.275), and attitude and practice (r = 0.336). SEM revealed that knowledge had a direct effect on both attitude (β = 0.509) and practice (β = 0.204), while attitude also directly influenced practice (β = 0.176). Knowledge indirectly impacted practice through attitude (β = 0.090). Parents showed inadequate knowledge and generally negative attitudes but positive practices. Educational interventions are recommended to improve parental knowledge and attitudes, which may lead to better malocclusion management practices.

Keywords Knowledge, Attitude, Practice, Parent, Malocclusion, Preschool-aged children

Malocclusion is now considered the third most significant oral health issue, following tooth decay and periodontal disease. It is defined as an anomaly in tooth positioning beyond normal limits or a misalignment among the dental arches, jawbone, and cranial bones in any of the three planes[1]. Globally, the prevalence of malocclusion is reported to be approximately 50–80%[2–4]. In China, a systematic review reported that among schoolchildren, 30.1% had Angle Class I malocclusion, 9.9% had Class II, and 4.8% had Class III malocclusion[5].

Numerous studies have shown that malocclusion in schoolchildren can negatively impact psychosocial well-being, aesthetic appearance, and social interactions in the long term[6,7]. Additionally, malocclusion may increase the risk of caries and periodontitis, elevate trauma risk, and cause difficulties in chewing, swallowing, breathing, and speaking, ultimately affecting oral health. Orthodontic treatment has become an integral part of dentistry, helping to prevent oral diseases and improve quality of life[8].

The knowledge, attitude, and practice (KAP) model posit that individual behaviors are driven by knowledge and attitude. In public health, KAP surveys are frequently employed to assess behavioral practices alongside knowledge and risk perception. This model is essential in explaining health-related behaviors[9–11]. Although oral health awareness has become more prevalent in recent years, research on parents' KAP regarding malocclusion in preschool children remains limited. Most existing studies focus on school-aged children and adolescents, with relatively few addressing the preschool age group[12,13]. Furthermore, much of the current research is centered on treatment methods and the evaluation of malocclusion outcomes, with less attention given to the role and influence of parents in early oral health management[14,15]. Several studies suggest that parents' knowledge and attitudes toward oral health have a direct impact on their children's dental health[16].

This study aims to investigate the knowledge, attitudes, and practices of parents regarding malocclusion in preschool children, shedding light on the current understanding and behaviors of parents in this area. By addressing this gap in KAP research, the study provides fresh perspectives for enhancing oral health education and optimizing intervention strategies. It is anticipated that parents' attitudes toward malocclusion will have a significant influence on their proactive behaviors in managing their child's oral health. Additionally, parental knowledge is expected to indirectly impact behavior through its effect on attitudes.We hope to raise parents' awareness of malocclusion, improve their knowledge and practical skills, and effectively prevent and reduce malocclusion, thus promoting better oral health and overall development in children.

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Methods

Study design and participants

This cross-sectional study was conducted between January 2024 and July 2024 at the hospitals of Nanchong City, Sichuan Province, with participants primarily consisting of parents of preschool children. The participants were selected using a convenience sampling method, allowing for the efficient recruitment of parents of preschool children visiting the hospitals during the study period. The study was approved by the Medical Ethics Committee of Nanchong Central Hospital (#2023 (086)), and informed consent was obtained from all participants.

Inclusion Criteria: 1. Parentals of preschool children aged 3–6 years. 2. All participants must clearly understand the study content and sign an informed consent form.

Exclusion Criteria: (1) Parents who refuse to sign the informed consent form. (2) Parents with cognitive impairments or psychological disorders who may not be able to accurately complete the questionnaire or understand the study's purpose. (3) Non-primary caregivers, such as temporary guardians or short-term caretakers, who do not meet the study requirements.

Procedures

The questionnaire design was based on previously published literature[17,18]. After expert review by Dr. Li Song in Orthodontics and Dr. Fu Kaiyuan in Oral and Maxillofacial Surgery, this study underwent a small-scale distribution pre-experiment involving 64 participants. The reliability of the questionnaire was verified using Cronbach's α, which was calculated as 0.903. The final version of the questionnaire, in Chinese, covered four dimensions: (1) Demographic Information, consisting of 10 questions; (2) Knowledge, comprising 10 questions, with questions 2, 7, and 8 being multiple-choice. Full points were awarded for correct answers, with no points for missed or incorrect responses. The remaining questions were single-choice, with correct answers scoring 1 point and unclear or incorrect answers receiving 0 points. The possible scores ranged from 0 to 10, with higher scores indicating better knowledge. (3) Attitudes, consisting of 10 questions using a five-point Likert scale, ranging from "Very familiar" to "Not familiar at all." Total scores ranged from 10 to 50, with higher scores indicating more favorable attitudes. (4) Practices, also consisting of 10 questions using a five-point Likert scale (Strongly agree = 5, Agree = 4, Neutral = 3, Disagree = 2, Strongly disagree = 1), with total scores ranging from 10 to 50. Each question was assigned a score based on the participant's response, representing the frequency or attitude towards a certain behavior. Higher scores indicated better practices. Adequate knowledge, positive attitudes, and proactive practices were defined as scores exceeding 80% of the maximum possible score in each section[19]. This cut-off value was chosen based on established literature in healthcare-related KAP studies, where 80% is commonly used as a threshold to indicate sufficient understanding and engagement with health-related behaviors. The total KAP score was not calculated; instead, scores for each dimension (Knowledge, Attitude, and Practice) were analyzed separately to provide more detailed insights into each component.

The questionnaire was created using the professional online survey platform, Questionnaire Star (https://www.wjx.cn/), developed by Changsha Ranxing Information Technology Co., Ltd.. It was constructed using the WeChat-based Questionnaire Star mini-program, with a QR code generated for participants to access the survey. Participants scanned the QR code through WeChat to complete the questionnaire. To ensure the quality and completeness of the data, each IP address was limited to one submission, and all questions were mandatory. After data collection, the results were exported to an Excel spreadsheet from the Questionnaire Star platform, and team members reviewed the questionnaires for completeness, internal consistency, and validity.、

Sample size calculation

$$n = \left(\frac{Z_{1-\alpha/2}}{\delta}\right)^2 \times p \times (1-p)$$

In this example, n represents the sample size of each group, Z ((1 − α)/2))) = 1.96, α stands for Type I error, which in this case is set to 0.05, δ represents the allowable error, which can generally be considered to be set to 0.05, p is set to 0.5 (because when it is 0.5, the value is maximum).

If there is no previous literature similar to KAP, the sample size is calculated as 384 (maximum) based on the above data. The effective recovery rate of the questionnaire was calculated according to 80%, and the final plan was to collect at least 480 questionnaires.

Statistical analyses

The distribution of scores for each dimension was tested for normality. Data that met normal distribution were represented by mean and standard deviation; data not meeting normal distribution were represented by median, 25th percentile, and 75th percentile. Count data for responses by different demographic characteristics were presented as N (%). Differences in dimension scores between groups: for continuous variables meeting normal distribution, comparisons between two groups were made using the t-test; for variables not meeting normal distribution, comparisons were made using the Wilcoxon-Mann–Whitney test. For comparisons among three or more groups, ANOVA was used if continuous variables met normal distribution and variance homogeneity; otherwise, Kruskal–Wallis analysis of variance was used. Correlation of dimension scores was analyzed using Pearson correlation coefficient if data distribution met normal distribution; otherwise, Spearman correlation coefficient was used.

Dimension scores were used as dependent variables in both univariate and multivariate regression analyses to examine the relationship between demographic data and dimension scores. Variables with $P < 0.1$ from

univariate analysis were included in multivariate regression. In this analysis, P-values were reported to three decimal places, with $P < 0.05$ considered statistically significant. Statistical software used was R 4.3.2.

Based on the KAP theoretical framework, structural equation modeling (SEM) was used to test whether attitudes mediate the relationship between knowledge and practice behaviors, and to calculate and compare the sizes of indirect and direct effects. The criteria for SEM model fit were RMSEA < 0.08, SRMR < 0.08, TLI > 0.8, and CFI > 0.8. If fit criteria were not met, path analysis was used for mediation effect testing. The statistical software used was Stata 18.0.

Results

Basic information on the population

A total of 3,455 samples were initially collected for this study. Exclusions were made for the following reasons: 88 cases where the completion time was under 100 s, 469 cases where the completion time exceeded 600 s, 22 cases where the same option was selected throughout the knowledge dimension, 10 cases with an abnormal value for the child's age, 50 cases where the parent's age was incorrectly entered as the child's age (based on legal marriage age, 22 years for males and 20 years for females), and 5 cases with unidentifiable abnormalities. The exclusion of longer times was based on the assumption that excessively prolonged completion times could indicate interruptions or lack of focus during the survey. The final dataset comprised 2811 valid cases, representing an effective rate of 81.36%. In the formal analysis, the internal consistency for the total scale and subscales was strong, with an overall Cronbach's α of 0.9196. The coefficients for the knowledge, attitude, and practice sections were 0.7413, 0.9318, and 0.9229, respectively. The Kaiser–Meyer–Olkin (KMO) value for the total scale was 0.9382.

Of the 2811 participants, 1720 (61.2%) were female, 1393 (49.6%) were aged between 28 and 34 years, 2097 (74.6%) had a college education or below, 2026 (72.1%) had a family annual income of less than 100,000 RMB, 1638 (58.3%) had two children, and 1684 (59.9%) had children aged 4–6 years. The mean (SD) scores for knowledge, attitude, and practice were 3.71 (2.52), 26.50 (8.16), and 40.98 (5.64), respectively. Knowledge scores varied significantly based on child's age ($P < 0.001$), child's malocclusion status ($P < 0.001$), education level ($P < 0.001$), family history of malocclusion ($P = 0.032$), occupation ($P < 0.001$), current residence ($P < 0.001$), and number of children in the family ($P < 0.001$). Attitude scores varied significantly by child's malocclusion status ($P < 0.001$), age ($P < 0.001$), education ($P < 0.001$), occupation ($P < 0.001$), and current residence ($P < 0.001$). Practice scores also varied by child's age ($P = 0.009$), child's malocclusion status ($P = 0.039$), age ($P = 0.007$), education ($P = 0.003$), occupation ($P < 0.001$), and current residence ($P < 0.001$) (Table 1).

Knowledge, attitude, and practice

In the knowledge dimension, the three questions with the highest percentage of "Uncertain" responses were: "Is tonsillar hypertrophy a risk factor for developing skeletal class III malocclusion in children?" (K6) at 52.5%, "Is malocclusion influenced by genetic factors?" (K1) at 47.4%, and "Can malnutrition in children lead to malocclusion?" (K4) at 45.1% (Table 2).

In the attitude dimension, the three questions with the highest percentage of "Not familiar at all" responses were: "Are you aware of the differences between organic space-occupying lesions in the maxillofacial area and malocclusion?" (A4) at 21.6%, "Are you aware of the specialized examinations for malocclusion?" (A3) at 21%, and "Are you aware of how mandibular retrognathia can affect children's sleep?" (A5) at 18.1% (Table 3).

For all practice items, no more than 8.1% of participants disagreed or strongly disagreed. However, 29.2% indicated they would not necessarily inquire with family or friends about knowledge and treatment processes for malocclusion (P1), 21.3% stated they would not necessarily seek information about malocclusion or read related educational articles on online platforms (P2), and 17.7% reported they would not necessarily accompany their child to regular dental visits (P9) (Table 4).

Correlations between KAP

Correlation analysis showed significant positive correlations between knowledge and attitude ($r = 0.491$, $P < 0.001$), knowledge and practice ($r = 0.275$, $P < 0.001$), and attitude and practice ($r = 0.336$, $P < 0.001$) (Table 5).

Factors associated with KAP

The top 80% of scores for each dimension were used as cut-off values, dividing participants into high and low groups. The number of participants exceeding the cut-off scores for knowledge, attitude, and practice were 1460 (51.94%), 1536 (54.64%), and 1850 (65.81%), respectively (Table S1). Multivariate logistic regression analysis revealed that having a child aged 6 years or older (OR = 0.743, 95% CI [0.580, 0.952], $P = 0.019$), being uncertain about the child's malocclusion status (OR = 0.409, 95% CI [0.215, 0.778], $P = 0.006$), being employed (OR = 2.185, 95% CI [1.622, 2.945], $P < 0.001$), living in an urban area (OR = 1.284, 95% CI [1.077, 1.531], $P = 0.005$), having an annual family income of 100,000–200,000 RMB (OR = 1.394, 95% CI [1.144, 1.698], $P = 0.001$), and having three or more children (OR = 0.724, 95% CI [0.531, 0.987], $P = 0.041$) were independently associated with knowledge (Table 6). Concurrently, higher knowledge scores (OR = 1.469, 95% CI [1.415, 1.526], $P < 0.001$), uncertainty about the child's malocclusion status (OR = 0.375, 95% CI [0.186, 0.757], $P = 0.006$), being aged 28–34 years (OR = 0.665, 95% CI [0.523, 0.847], $P = 0.001$), being aged 35 years or older (OR = 0.638, 95% CI [0.493, 0.826], $P = 0.001$), and holding a Bachelor's degree (OR = 1.361, 95% CI [1.084, 1.709], $P = 0.008$) were independently associated with attitude (Table 7). Additionally, knowledge score (OR = 1.113, 95% CI [1.070, 1.157], $P < 0.001$), attitude score (OR = 1.077, 95% CI [1.063, 1.091], $P < 0.001$), being employed (OR = 1.430, 95% CI [1.043, 1.961], $P = 0.026$), and being self-employed (OR = 1.747, 95% CI [1.210, 2.521], $P = 0.003$) were independently associated with proactive practice (Table 8). Supplementary Table 1 presents the results of univariate and multivariate

N = 2811	N (%)	Knowledge	*P*	Attitude	*P*	Practice	*P*
		Mean (SD)		Mean (SD)		Mean (SD)	
Total score		3.71 (2.52)		26.50 (8.16)		40.98 (5.64)	
Child's age							
Under 4 years	465 (16.5)	3.97 (2.62)		26.95 (8.21)		41.40 (5.37)	
4–6 years	1684 (59.9)	3.83 (2.52)	< 0.001	26.51 (8.09)	0.089	41.10 (5.58)	0.009
6 years and above	662 (23.6)	3.24 (2.39)		26.13 (8.30)		40.40 (5.95)	
Malocclusion status of the child							
Yes	53 (1.9)	4.42 (2.35)		29.94 (8.23)		41.62 (5.79)	
No	2506 (89.1)	3.76 (2.51)	< 0.001	26.77 (8.13)	< 0.001	41.04 (5.62)	0.039
Uncertain	252 (9.0)	3.06 (2.58)		23.08 (7.57)		40.29 (5.80)	
Gender							
Male	1091 (38.8)	3.61 (2.52)	0.073	26.43 (8.37)	0.723	40.75 (5.92)	0.231
Female	1720 (61.2)	3.78 (2.51)		26.54 (8.03)		41.14 (5.46)	
Age							
Under 28 years	457 (16.3)	3.69 (2.41)		27.81 (7.88)		41.00 (5.43)	
28–34 years	1393 (49.6)	3.82 (2.53)	0.05	26.54 (8.19)	< 0.001	41.21 (5.81)	0.007
35 years and above	961 (34.2)	3.57 (2.55)		25.80 (8.17)		40.65 (5.48)	
Education							
College or below	2097 (74.6)	3.46 (2.41)		25.90 (7.93)		40.79 (5.69)	
Bachelor's degree	676 (24.0)	4.43 (2.68)	< 0.001	28.27 (8.63)	< 0.001	41.57 (5.50)	0.003
Master's degree and above	38 (1.4)	4.76 (2.94)		27.76 (7.32)		41.32 (5.14)	
Family history of malocclusion							
Yes	66 (2.3)	4.33 (2.23)	0.032	28.06 (7.90)	0.148	41.48 (5.37)	0.858
No	2745 (97.7)	3.70 (2.52)		26.46 (8.16)		40.97 (5.65)	
Occupation:							
Manual laborer	305 (10.9)	2.82 (2.24)		24.48 (7.46)		39.55 (6.59)	
Employee	822 (29.2)	4.57 (2.54)		27.97 (8.52)		41.59 (5.43)	
Self-employed	314 (11.2)	3.77 (2.55)	< 0.001	27.32 (7.88)	< 0.001	42.11 (5.15)	< 0.001
Unemployed	165 (5.9)	3.24 (2.46)		24.68 (8.42)		40.15 (5.79)	
Other	1205 (42.9)	3.40 (2.40)		26.03 (7.92)		40.76 (5.52)	
Current residence							
Rural	869 (30.9)	3.20 (2.40)	< 0.001	25.36 (7.58)	< 0.001	40.28 (5.79)	< 0.001
Urban	1942 (69.1)	3.94 (2.54)		27.00 (8.36)		41.30 (5.55)	
Family annual income							
100,000 RMB	2026 (72.1)	3.49 (2.49)		26.05 (8.05)		40.65 (5.62)	
100,000 -200,000 RMB	604 (21.5)	4.26 (2.46)		27.74 (8.27)		41.82 (5.53)	
Over 200,000 RMB	181 (6.4)	4.34 (2.67)		27.38 (8.53)		41.96 (5.89)	
Current number of children in the family							
1	957 (34.0)	3.92 (2.56)		26.66 (8.20)	0.316	41.01 (6.31)	
2	1638 (58.3)	3.68 (2.51)	< 0.001	26.49 (8.15)		41.05 (5.23)	0.121
3 or more	216 (7.7)	3.03 (2.23)		25.81 (8.07)		40.39 (5.56)	

Table 1. Demographic characteristics and KAP scores.

regression analyses for Knowledge, Attitudes, and Practices dimensions. These analyses include odds ratios (ORs), confidence intervals (CIs), and p-values, highlighting key predictors for each dimension.

SEM analysis

The SEM demonstrated good model fit, with RMSEA = 0.079, SRMR = 0.074, TLI = 0.857, and CFI = 0.868 (Table S2). Specific effects between KAP are detailed in Table S3. Direct and indirect effects analysis indicated that knowledge had a direct effect on attitude (β = 0.509, $P < 0.001$) and practice (β = 0.204, $P < 0.001$). Attitude also had a direct effect on practice (β = 0.176, $P < 0.001$). Moreover, knowledge had an indirect effect on practice through attitude (β = 0.090, $P < 0.001$) (Table S4 and Fig. 1).

Additionally, the results of confirmatory factor analysis (CFA) are provided in Supplementary Table 3, including fit indices (RMSEA, SRMR, TLI, and CFI) and reliability metrics (AVE and CR). These metrics demonstrate good model fit and internal consistency.

Knowledge	Yes	No	Uncertain
1. Is malocclusion influenced by genetic factors?	951 (33.8%)	527 (18.7%)	1333 (47.4%)
2. Poor oral habits affecting children's oral and maxillofacial development include: (A. Mouth breathing)			
(A. Mouth breathing)	1822 (64.8%)	989 (35.2%)	3 (1.1%)
(B. Thumb sucking)	2131 (75.8%)	680 (24.2%)	1 (0.4%)
(C. Lip biting)	2001 (71.2%)	810 (28.8%)	7 (2.5%)
(D. Tongue thrusting)	1344 (47.8%)	1467 (52.2%)	12 (4.3%)
(E. Chewing on one side)	2065 (73.5%)	746 (26.5%)	11 (3.9%)
(F. Abnormal posture and sleeping positions)	1684 (59.9%)	1127 (40.1%)	
3. Can local obstacles during the primary or mixed dentition period cause malocclusion?	1198 (42.6%)	429 (15.3%)	1184 (42.1%)
4. Can malnutrition in children lead to malocclusion?	1116 (39.7%)	427 (15.2%)	1268 (45.1%)
5. Does malocclusion refer solely to crooked teeth?	744 (26.5%)	967 (34.4%)	1100 (39.1%)
6. Is tonsillar hypertrophy a risk factor for the development of skeletal class III malocclusion in children?	1037 (36.9%)	298 (10.6%)	1476 (52.5%)
7. Symptoms of mouth breathing include			
(A. Sleeping with the mouth open)	2568 (91.4%)	243 (8.6%)	
(B. Predominantly nasal airflow at rest)	1169 (41.6%)	1642 (58.4%)	
(C. Tongue in a low position at rest)	1068 (38%)	1743 (62%)	
(D. Mouth breathing during vigorous exercise)	1575 (56%)	1236 (44%)	
8. When suspecting a child of mouth breathing, which department should be consulted for treatment?			
(A. Oral Medicine)	1887 (67.1%)	924 (32.9%)	
(B. Ear, Nose, and Throat (ENT))	1441 (51.3%)	1370 (48.7%)	
(C. Pediatrics)	1192 (42.4%)	1619 (57.6%)	
(D. Uncertain)	167 (5.9%)	2644 (94.1%)	
9. Does malocclusion affect oral functions such as chewing, swallowing, speech, and temporomandibular joint function?	1832 (65.2%)	153 (5.4%)	826 (29.4%)
10. Can malocclusion lead to dental caries, gingival and periodontal diseases, and apical periodontitis?	1566 (55.7%)	184 (6.5%)	1061 (37.7%)

Table 2. Distribution of knowledge dimension responses.

Attitude	Very familiar	Quite familiar	Somewhat familiar	Not very familiar	Not familiar at all
1. Do you think it is necessary to understand the causes and treatment process of malocclusion?	730 (26%)	1522 (54.1%)	440 (15.7%)	91 (3.2%)	28 (1%)
2. Do you think the information provided by healthcare professionals about malocclusion is comprehensive?	416 (14.8%)	771 (27.4%)	847 (30.1%)	312 (11.1%)	465 (16.5%)
3. Are you aware of the specialized examinations for malocclusion?	76 (2.7%)	198 (7%)	599 (21.3%)	1347 (47.9%)	591 (21%)
4. Are you aware of the differences between organic space-occupying lesions in the maxillofacial area and malocclusion?	96 (3.4%)	187 (6.7%)	570 (20.3%)	1351 (48.1%)	607 (21.6%)
5. Are you aware of how mandibular retrognathia can affect children's sleep?	128 (4.6%)	307 (10.9%)	659 (23.4%)	1207 (42.9%)	510 (18.1%)
6. Are you aware of how malocclusion affects children's dental and maxillofacial development?	116 (4.1%)	296 (10.5%)	697 (24.8%)	1201 (42.7%)	501 (17.8%)
7. Are you aware of how weak chewing can lead to malocclusion in children?	110 (3.9%)	278 (9.9%)	720 (25.6%)	1229 (43.7%)	474 (16.9%)
8. Are you aware of how long-term mouth breathing in children can lead to malocclusion?	140 (5%)	362 (12.9%)	741 (26.4%)	1122 (39.9%)	446 (15.9%)
9. Are you aware that preventing malocclusion in children should start from birth?	159 (5.7%)	391 (13.9%)	719 (25.6%)	1117 (39.7%)	425 (15.1%)
10. Are you aware that early orthodontic treatment can prevent, guide, and intercept the development of malocclusion, and effectively reduce the incidence rate of malocclusion in children?	164 (5.8%)	448 (15.9%)	798 (28.4%)	994 (35.4%)	407 (14.5%)

Table 3. Distribution of attitude dimension responses.

Discussion

Parents demonstrated inadequate knowledge, negative attitudes, but relatively positive practices regarding malocclusion in preschool-aged children. Efforts to enhance parental education and awareness, particularly regarding knowledge and attitudes, are essential to improving proactive behaviors in the early prevention and management of malocclusion.

This study highlights the inadequate knowledge, negative attitudes, and relatively positive practices of parents regarding malocclusion in preschool-aged children. These findings are consistent with other research that has similarly reported poor parental knowledge and attitudes towards dental health conditions, leading to unhealthy oral health behaviors in mothers[20]. However, some studies have shown high awareness of oral health and occlusion among younger patients, parents, and pediatricians[21]. The gap between knowledge and practice suggests that although parents may take proactive steps, their lack of understanding and negative attitudes may limit the overall effectiveness of their actions.

Practice	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1. Will you inquire with family and friends about knowledge and treatment processes for malocclusion?	346 (12.3%)	1417 (50.4%)	821 (29.2%)	144 (5.1%)	83 (3%)
2. Will you search for information about malocclusion or read related educational articles on online platforms or public accounts?	400 (14.2%)	1672 (59.5%)	598 (21.3%)	84 (3%)	57 (2%)
3. Will you pay timely attention to your child's poor oral hygiene habits?	968 (34.4%)	1623 (57.7%)	159 (5.7%)	22 (0.8%)	39 (1.4%)
4. Will you help your child correct poor oral hygiene habits?	1076 (38.3%)	1589 (56.5%)	105 (3.7%)	14 (0.5%)	27 (1%)
5. Will you monitor your child's oral diseases, such as dental caries, in the future?	1104 (39.3%)	1561 (55.5%)	104 (3.7%)	11 (0.4%)	31 (1.1%)
6. Will you help your child establish good oral functional habits, such as using lip closure stickers?	903 (32.1%)	1489 (53%)	309 (11%)	69 (2.5%)	41 (1.5%)
7. Will you proactively create a health and maxillofacial development record for your child?	769 (27.4%)	1503 (53.5%)	474 (16.9%)	38 (1.4%)	27 (1%)
8. Will you pay attention to the balance of your child's diet, such as avoiding overly refined foods and exercising chewing ability?	892 (31.7%)	1649 (58.7%)	222 (7.9%)	22 (0.8%)	26 (0.9%)
9. Will you accompany your child for regular dental visits?	700 (24.9%)	1569 (55.8%)	497 (17.7%)	25 (0.9%)	20 (0.7%)
10. If your child has malocclusion, will you actively cooperate with the doctor?	1020 (36.3%)	1635 (58.2%)	124 (4.4%)	10 (0.4%)	22 (0.8%)

Table 4. Distribution of practice dimension responses.

	Knowledge	Attitude	Practice
Knowledge	1.000		
Attitude	0.491 ($P<0.001$)	1.000	
Practice	0.275 ($P<0.001$)	0.336 ($P<0.001$)	1.000

Table 5. Correlation analysis.

When analyzing the relationships between knowledge, attitudes, and practices, both the multivariate logistic regression and correlation analyses demonstrated significant positive correlations between knowledge and attitude, knowledge and practice, as well as attitude and practice. Specifically, knowledge was a significant predictor of attitude and practice in both the logistic regression and SEM models, indicating that as parents' knowledge improves, their attitudes and practices are likely to follow a similar positive trend. This relationship was further supported by SEM analysis, which revealed that knowledge had a direct effect on both attitude and practice, with attitude also exerting a direct effect on practice. These findings suggest that improving parental knowledge could indirectly enhance practices through a shift in attitudes, a pattern well-established in health education research[22].

The significant differences in KAP scores based on demographic variables such as child's age, malocclusion status, education, occupation, and current residence provide additional insights. For instance, parents with older children (aged 6 years or above) demonstrated lower knowledge scores, which may indicate that malocclusion is often perceived as a more critical issue during early childhood, leading to a decline in parental attention as children grow older. This finding was consistent across both the univariate and multivariate analyses, where parents with older children were significantly less likely to have adequate knowledge (OR = 0.743, P = 0.019), and is supported by previous research showing that parental engagement in preventive dental care tends to diminish as children age[23]. The multivariate regression also confirmed that being employed and living in an urban area were positively associated with higher knowledge scores, reflecting broader access to information and healthcare services in urban settings[24]. These variables, which appeared in both the correlation and regression analyses, suggest that socioeconomic factors play a critical role in shaping parental awareness and attitudes toward malocclusion.

Additionally, education level was a key factor influencing KAP, with parents holding a bachelor's degree or higher demonstrating significantly higher knowledge and attitude scores. This finding aligns with other studies that have shown higher education levels to be associated with better health literacy and more proactive healthcare behaviors[25]. Interestingly, while education had a significant effect on knowledge and attitude, it did not influence practice as strongly, indicating that knowledge and attitudes may not always translate directly into action. This may be due to practical barriers such as time constraints or lack of resources, which limit the extent to which parents can implement what they know.

In terms of practice, parents with a positive attitude were more likely to engage in proactive practices, as shown by the significant direct effect of attitude on practice in the SEM model. This finding is consistent with prior research that emphasizes the importance of fostering positive attitudes to encourage better health behaviors[26]. However, the absence of significant differences in some practice-related variables, such as child's age and parental education, suggests that factors other than knowledge and attitudes may play a role in shaping parental behaviors, such as cultural beliefs or access to dental care. Further research could explore these external influences in more detail.

The findings from this study reveal that parents' KAP regarding malocclusion in preschool-aged children are suboptimal, with notable deficiencies in knowledge and attitudes. Specifically, the distribution of responses

Knowledge	Univariate Analysis		Multivariate Analysis	
	OR (95%CI)	*P*	OR (95%CI)	*P*
Child's age				
Under 4 years				
4–6 years	0.979 (0.796,1.203)	0.840	1.024 (0.827,1.268)	0.831
6 years and above	0.668 (0.526,0.847)	0.001	0.743 (0.580,0.952)	0.019
Malocclusion status of the child				
Yes				
No	0.682 (0.383,1.185)	0.181	0.760 (0.419,1.376)	0.365
Uncertain	0.399 (0.214,0.728)	0.003	0.409 (0.215,0.778)	0.006
Gender				
Male				
Female	1.125 (0.967,1.310)	0.128		
Age				
Under 28 years				
28–34 years	1.131 (0.916,1.398)	0.253		
35 years and above	0.960 (0.768,1.199)	0.718		
Education				
College or below				
Bachelor's degree	1.760 (1.475,2.104)	< 0.001	1.134 (0.921,1.397)	0.235
Master's degree and above	1.827 (0.952,3.642)	0.075	1.184 (0.589,2.381)	0.636
Family history of malocclusion				
Yes				
No	0.611 (0.363,1.005)	0.057	0.715 (0.418,1.225)	0.222
Occupation				
Manual laborer				
Employee	2.945 (2.249,3.870)	< 0.001	2.185 (1.622,2.945)	< 0.001
Self-employed	1.645 (1.196,2.266)	0.002	1.306 (0.936,1.823)	0.116
Unemployed	1.271 (0.866,1.865)	0.220	1.280 (0.867,1.889)	0.214
Other	1.398 (1.084,1.810)	0.010	1.224 (0.941,1.593)	0.132
Current residence				
Rural				
Urban	1.657 (1.410,1.947)	< 0.001	1.284 (1.077,1.531)	0.005
Family annual income				
100,000 RMB				
100,000 -200,000 RMB	1.734 (1.441,2.090)	< 0.001	1.394 (1.144,1.698)	0.001
Over 200,000 RMB	1.664 (1.222,2.278)	0.001	1.281 (0.920,1.785)	0.143
Current number of children in the family				
1				
2	0.784 (0.668,0.920)	0.003	0.893 (0.755,1.056)	0.186
3 or more	0.571 (0.423,0.768)	< 0.001	0.724 (0.531,0.987)	0.041

Table 6. Univariate and multivariate analysis for knowledge dimension.

in the knowledge dimension indicates a considerable level of uncertainty among parents about key aspects of malocclusion. For example, nearly half of the participants were uncertain about whether malocclusion is influenced by genetic factors, whether malnutrition can lead to malocclusion, and whether tonsillar hypertrophy is a risk factor for skeletal class III malocclusion. On the other hand, practices related to monitoring oral hygiene and addressing poor habits were relatively more positive, with a majority of parents willing to engage in proactive behaviors such as monitoring their child's oral diseases and correcting bad habits. However, a substantial proportion still displayed neutral or less engaged responses, particularly regarding regular dental visits and seeking information from healthcare professionals.

The pattern of inadequate knowledge and somewhat better practice outcomes is not uncommon. Studies in other areas of pediatric dental health have shown that parents tend to be more responsive to immediate and practical actions, such as correcting bad habits, than to understanding the underlying causes or long-term impacts of oral conditions[23,27]. However, the lack of knowledge and negative attitudes may limit the effectiveness of these practices. For instance, without understanding the full range of risk factors for malocclusion, parents might overlook critical preventive steps, which could contribute to the persistence of malocclusion and related oral health issues in children[28].

Attitude	Univariate Analysis		Multivariate Analysis	
	OR (95%CI)	*P*	OR (95%CI)	*P*
Knowledge	1.482 (1.429,1.537)	< 0.001	1.469 (1.415,1.526)	< 0.001
Child's age				
Under 4 years				
4–6 years	0.924 (0.750,1.136)	0.452	0.981 (0.776,1.241)	0.874
6 years and above	0.760 (0.598,0.964)	0.024	1.009 (0.770,1.322)	0.951
Malocclusion status of the child				
Yes				
No	0.550 (0.296,0.976)	0.048	0.673 (0.352,1.287)	0.232
Uncertain	0.266 (0.137,0.496)	< 0.001	0.375 (0.186,0.757)	0.006
Gender				
Male				
Female	1.032 (0.886,1.201)	0.689		
Age				
Under 28 years				
28–34 years	0.745 (0.600,0.924)	0.008	0.665 (0.523,0.847)	0.001
35 years and above	0.656 (0.523,0.823)	< 0.001	0.638 (0.493,0.826)	0.001
Education				
College or below				
Bachelor's degree	1.674 (1.401,2.003)	< 0.001	1.361 (1.084,1.709)	0.008
Master's degree and above	2.048 (1.051,4.228)	0.042	1.678 (0.749,3.758)	0.208
Family history of malocclusion				
Yes				
No	0.779 (0.467,1.275)	0.326		
Occupation:				
Manual laborer				
Employee	1.852 (1.421,2.416)	< 0.001	0.847 (0.615,1.167)	0.310
Self-employed	1.426 (1.040,1.959)	0.028	0.961 (0.670,1.379)	0.829
Unemployed	0.835 (0.569,1.222)	0.354	0.700 (0.458,1.069)	0.099
Other	1.275 (0.991,1.641)	0.059	0.949 (0.716,1.258)	0.717
Current residence				
Rural				
Urban	1.464 (1.247,1.719)	< 0.001	1.135 (0.939,1.373)	0.191
Family annual income				
100,000 RMB				
100,000 -200,000 RMB	1.474 (1.225,1.776)	< 0.001		
Over 200,000 RMB	1.539 (1.128,2.113)	0.007		
Current number of children in the family				
1				
2	0.913 (0.778,1.072)	0.267	1.085 (0.875,1.347)	0.457
3 or more	0.870 (0.648,1.171)	0.358	1.046 (0.726,1.506)	0.810

Table 7. Univariate and multivariate analysis for attitude dimension.

To address these gaps, targeted educational interventions should be implemented, particularly focusing on improving parental knowledge about the genetic and environmental factors influencing malocclusion. Healthcare professionals could design and distribute clear, easy-to-understand educational materials, such as pamphlets, videos, or interactive apps, that explain the developmental risks of malocclusion and the importance of early intervention. Schools and community centers could also host workshops aimed at parents, particularly those with lower educational backgrounds or living in rural areas, as these groups showed significantly poorer knowledge scores in the study. The workshops should emphasize the importance of preventive care and regular dental check-ups, offering parents practical tools to monitor their child's oral health effectively[29,30].

For those areas with particularly low awareness, such as the link between mouth breathing and malocclusion or the role of early orthodontic intervention, more specialized strategies could be employed. For example, pediatricians and general dentists could proactively screen for malocclusion during routine check-ups and refer families to specialists when needed. This could be particularly beneficial for parents who may not be aware of which department to consult when suspecting malocclusion, as the results indicate a significant proportion of parents were unsure of whether to visit oral medicine, ENT, or pediatrics[31].

Practice	Univariate Analysis		Multivariate Analysis	
	OR (95%CI)	*P*	OR (95%CI)	*P*
Knowledge	1.249 (1.208,1.293)	< 0.001	1.113 (1.070,1.157)	< 0.001
Attitude	1.097 (1.084,1.110)	< 0.001	1.077 (1.063,1.091)	< 0.001
Child's age				
Under 4 years				
4–6 years	0.918 (0.735,1.142)	0.446	0.948 (0.748,1.200)	0.654
6 years and above	0.762 (0.592,0.978)	0.034	0.867 (0.662,1.135)	0.299
Malocclusion status of the child				
Yes				
No	0.861 (0.464,1.528)	0.620		
Uncertain	0.586 (0.303,1.091)	0.100		
Gender				
Male				
Female	1.048 (0.893,1.229)	0.567		
Age				
Under 28 years				
28–34 years	1.162 (0.929,1.450)	0.185		
35 years and above	0.950 (0.752,1.198)	0.666		
Education				
College or below				
Bachelor's degree	1.308 (1.085,1.580)	0.005	0.881 (0.700,1.107)	0.276
Master's degree and above	1.064 (0.551,2.156)	0.857	0.663 (0.317,1.390)	0.277
Family history of malocclusion				
Yes				
No	1.030 (0.608,1.703)	0.909		
Occupation				
Manual laborer				
Employee	2.155 (1.642,2.829)	< 0.001	1.430 (1.043,1.961)	0.026
Self-employed	2.409 (1.721,3.389)	< 0.001	1.747 (1.210,2.521)	0.003
Unemployed	1.109 (0.757,1.627)	0.597	1.063 (0.708,1.596)	0.768
Other	1.456 (1.129,1.876)	0.004	1.207 (0.919,1.584)	0.177
Current residence				
Rural				
Urban	1.534 (1.299,1.810)	< 0.001	1.206 (0.999,1.456)	0.051
Family annual income				
100,000 RMB				
100,000 -200,000 RMB	1.531 (1.256,1.874)	< 0.001	1.176 (0.943,1.468)	0.151
Over 200,000 RMB	1.479 (1.064,2.087)	0.022	1.138 (0.783,1.654)	0.499
Current number of children in the family				
1				
2	0.952 (0.804,1.127)	0.569		
3 or more	0.885 (0.651,1.208)	0.436		

Table 8. Univariate and multivariate analysis for practice dimension.

Specific efforts should be made to improve parental attitudes, as this dimension was notably weak. Many parents were not familiar with the implications of malocclusion for children's oral and maxillofacial development or the necessity of understanding treatment processes. To improve this, healthcare professionals should take more time during consultations to thoroughly explain treatment options and the potential long-term impacts of untreated malocclusion. Additionally, the findings suggest that interactive educational methods, such as mobile health applications that send reminders for dental visits or provide tips on oral health maintenance, may help increase parental engagement, especially in urban areas where access to technology is more prevalent.

For parents who demonstrated reluctance to seek information about malocclusion online or from professionals, creating a more accessible and trusted source of information is crucial. Government or professional dental associations could develop dedicated online platforms that consolidate resources about malocclusion and dental health for parents. These platforms could include FAQs, testimonials from other parents, and expert advice, making it easier for parents to find reliable information and fostering a community of support[32].

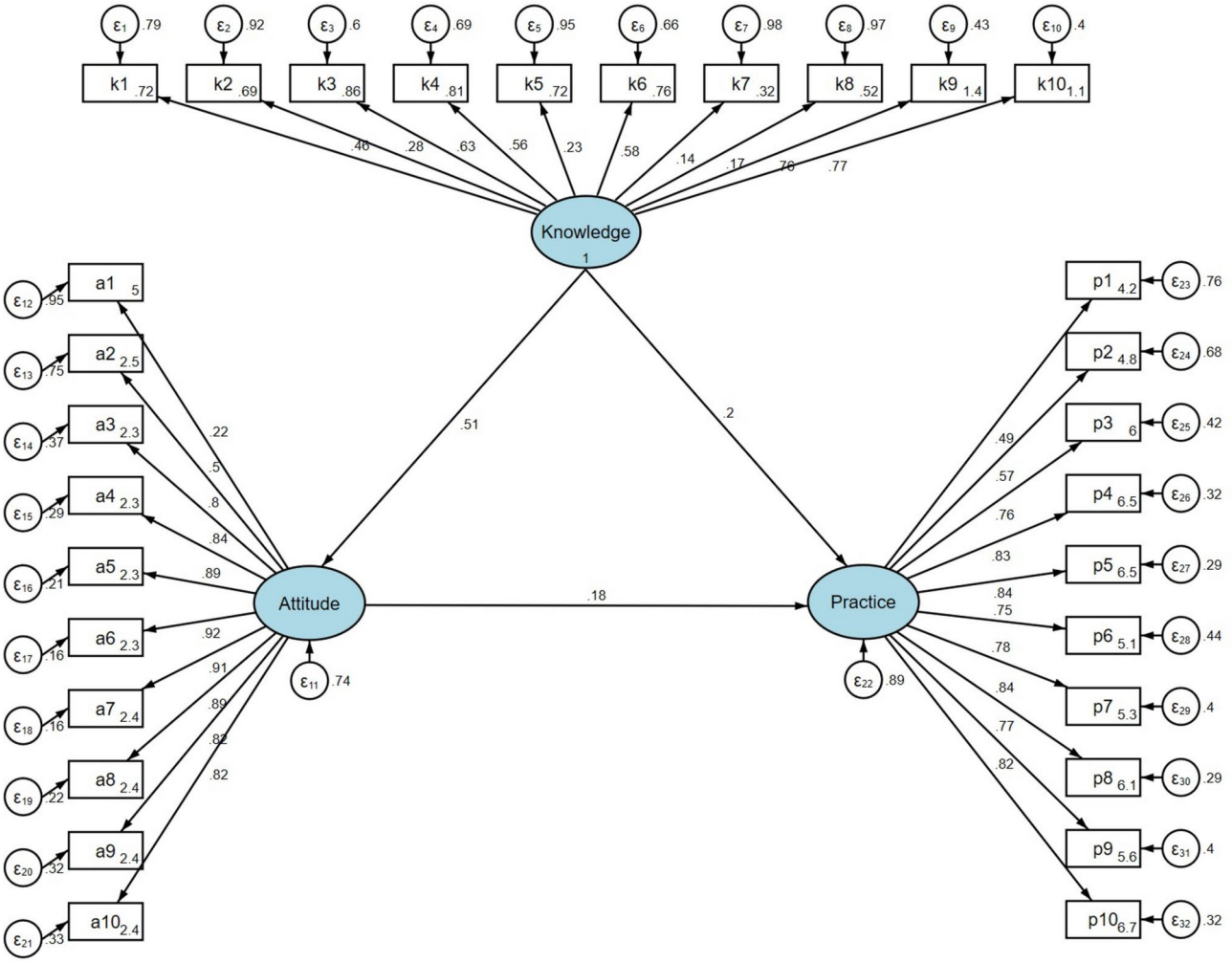

Fig. 1. SEM Path.

This study has several limitations. First, the use of self-reported questionnaires may introduce response bias, as parents might overestimate their knowledge or practices. Second, the cross-sectional design limits the ability to establish causal relationships between knowledge, attitudes, and practices. Finally, the study was conducted in regional hospitals, which may not fully represent the general population, limiting the generalizability of the findings.

In conclusion, parents demonstrated inadequate knowledge, negative attitudes, and relatively positive practices regarding malocclusion in preschool-aged children. The results highlight the need for targeted educational interventions to improve parental understanding and attitudes towards malocclusion, which could further enhance preventive and treatment practices.

Data availability

All data generated or analysed during this study are included in this published article.

Received: 28 November 2024; Accepted: 18 April 2025
Published online: 04 May 2025

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Acknowledgements

Not applicable

Author contributions

X.Z., J.W. carried out the studies, participated in collecting data, and drafted the manuscript. Q.G. performed the statistical analysis and participated in its design. X.Z., J.W. participated in acquisition, analysis, or interpretation of data and draft the manuscript. All authors read and approved the final manuscript.

Funding

This study was supported by the Chuanbei Medical College 2022 Campus level Research and Development Plan Project (No. CBY22-KP03). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Declarations

Competing interests

The authors declare no competing interests.

Ethical approval

The study was approved by the Medical Ethics Committee of Nanchong Central Hospital (#2023 (086)), and informed consent was obtained from all participants. All methods were performed in accordance with the relevant guidelines and regulations.

Additional information

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1038/s41598-025-99314-z.

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