The Impact of Oral Health Perceptions on Oral Diseases Among College Students

-- Examining Mediating Effects based on Oral Health Care Behaviours

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Abstract. Objective: To investigate the mediating effect of oral health-related behaviours among university students on the relationship between oral health knowledge and the number of oral diseases, providing a theoretical basis for improving the oral health status of university students. Methods: A total of 324 valid questionnaires were collected from eight universities in Tianjin. Poisson regression analysis was employed to identify the factors influencing the prevalence of oral diseases among university students and to investigate the mediating mechanism of oral health-related behaviours between oral health knowledge and the prevalence of oral diseases. Results: Among the 324 students, 280 had oral diseases. Oral health knowledge scores ranged from 7 to 22 points, and oral hygiene behaviour scores ranged from 6 to 30 points. Poisson regression analysis results showed that major (P<0.05) and oral health knowledge (P<0.001) significantly influenced the number of oral diseases. Multivariate linear regression analysis indicated that oral health cognition is a crucial factor influencing oral hygiene behaviour (P < 0.001). Mediating effect analysis revealed that oral hygiene behaviour serves as a mediating variable between oral health cognition and the number of oral diseases, with the mediating effect accounting for 62.91% of the total effect. Conclusion: Oral hygiene behaviour partially mediates the relationship between oral health cognition and the number of oral diseases. Improving oral health awareness and promoting good oral hygiene practices are effective strategies for preventing and treating oral diseases.

Keywords: Oral Health Awareness; Number of Oral Diseases; Oral Hygiene Practices; Mediating Effects.

1. Introduction

The Outline of the "Healthy China 2030" Plan also clearly outlines the plan to achieve essentially full coverage of special oral health actions at the county level by 2030 and explicitly calls for the strengthening of oral health. In recent years, the oral health problems of college students in China have been highlighted [1]. In this paper, we analyse oral health cognition and the number of oral diseases among college students through questionnaire surveys, explore the relationship between the two, and, with the help of mediating effect, study the influence mechanism [2] and put forward countermeasure suggestions for improving the oral health level of college students and achieving full life cycle coverage.

2. Objects and Research Methods

(1)Objects

In this study, college students from eight colleges and universities in Tianjin were selected for the survey using a whole-group sampling method. Referring to the Fourth National Oral Health Epidemiological Survey Programme, the survey form and questionnaire were designed to collect basic information, including gender, grade, major, monthly family income, presence of underlying diseases, and the number of oral diseases [3].

There are seven primary oral diseases: missing teeth or dentition, toothache, bleeding gums, bad breath, mouth ulcers, dental caries or decay, and loose teeth.

Oral health cognitive situation: eating habits such as carbonated drinks too cold food, drinking habits, smoking habits, whether it is normal for gums to bleed when brushing teeth, what to do after bleeding gums, whether to see a doctor if there is a hole in the teeth without the pain, what to do after a toothache, etc., what to do after the appearance of oral diseases, the cognition of the relationship between oral hygiene and systemic health, the knowledge related to fluoride toothpaste, and how often to check the teeth [4] options were adjusted for the high superiority indexes and summed to produce an oral health perception score.

Oral health care behavioural situation: the behavioural habits of cleaning the oral cavity in terms of frequency of toothbrush replacement, frequency of tooth brushing, frequency of toothpick use, frequency of flossing, frequency of mouthwash use, and duration of brushing [5] were studied and analysed, and the options were adjusted for high superiority indicators and summed up to derive the oral health care behavioural score.

A total of 331 questionnaires were distributed, and after strict screening based on the quality of completion and the time taken, the final collection of valid questionnaires was 324, yielding a sample validity rate of 97.89%.

(2)Methods

!)Poisson regression

Poisson Distribution (Poisson Distribution) is a kind of discrete probability distribution commonly seen in statistics and probability, published by the French mathematician Siméon-Denis Poisson in 1838. The Poisson regression model, as a type of generalised linear model, is particularly suitable for modelling situations where the expectation and variance of the dependent variable are both equal to some constant λ. In this model, λ represents the average occurrence of events per unit of time. The probability distribution function of the Poisson distribution describes the probability of an event occurring k times at a given time for a given value of λ, where k is a non-negative integer. This distribution assumes that the probability of an event occurring is constant and that the events are independent of each other. This is typically accomplished using maximum likelihood estimation (MLE) in conjunction with an iterative approach. This method allows estimating the parameters α and β in the model based on independent observations Y_i and corresponding explanatory variables X_i, thus obtaining the complete model.

$$P(X = k) = \frac{\lambda^k e^{-\lambda}}{k!}$$

Where X denotes the number of occurrences of a random event, k denotes the number of occurrences, λ denotes the average number of occurrences of a random event per unit of time (or space), e denotes the base of the natural logarithm, and $k!$ denotes the factorial of k.

2)Multiple Linear Regression

Multiple linear regression is a statistical analysis method used to explore the relationship between two or more variables. It is based on linear regression analysis and is used to predict the relationship between variables. The formula for the multiple linear regression model is given below:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n + \varepsilon$$

Where Y is the dependent variable, X_1, X_2, ... , X_n is the independent variable, β_0, β_1, β_2, ... , β_n are the regression coefficients, and ε is the error term. This model can be used to predict future values of variables or to explore the correlation between variables, thus helping researchers discover helpful information and knowledge.

3) Analysis of intermediate variables

The mediating effect testing procedure proposed by Wen Zhonglin et al. (2014) uses a three-stage sequential regression method combined with the Bootstrap method. Step 1: Test the total effect (path c): Firstly, the total effect of the independent variable X on the dependent variable Y is verified through the regression model, and the coefficient c is required to be significant ($P < 0.05$). Step 2: Test the mediator (path a): Analyse the predictive effect of X on the mediator variable M through the regression model, requiring the coefficient a to be significant. Step 3: Test the mediator (path b) and

direct effect (path c'): after controlling for X, build a regression model to examine path b (effect of M→Y): coefficient b is required to be significant; path c' (direct effect of X→Y): if c' is not substantial, then it is a full mediator, and if c' is significant but the absolute value is less than the total effect c, then it is a partial mediator. Finally, the statistical significance of the mediating effect is confirmed when the 95% CI of the mediating effect (a × b) does not contain 0, as calculated by Bootstrap sampling (5000 times).

3. Results

(1)Reliability analysis

Reliability analysis is the reliability study. Before the statistical analysis of the questionnaire, it is necessary to analyse its reliability. Only when the reliability is within the acceptable range can the survey be launched. In this paper, 18 scales are selected for reliability analysis, and the result of *the alpha* reliability coefficient value is 0.640 > 0.6, indicating that the questionnaire has a high degree of reliability and trustworthiness, meeting the prerequisite requirements for subsequent statistical analysis.

(2)General characteristics

Table 1. General characteristics of the study population (n=324)

Variable	Options	Frequency	Percentage	Standard deviation
Sex	Male	142	43.83	0.50
	Female	182	56.17	
Year	Freshman	58	17.90	1.16
	Sophomore	42	12.96	
	Junior	63	19.44	
	Senior and above	161	49.69	
Professional	Non-medical school	138	42.59	0.50
	Medical Schools	186	57.41	
income	≤1500	27	8.33	1.61
	1501-3000	42	12.96	
	3001-5000	61	18.83	
	5001-8000	74	22.84	
	8001-10000	38	11.73	
	≥10000	82	25.31	
underlying diseases	Yes	9	2.78	0.17
	No	315	97.22	
Number of oral diseases	0	44	13.58	1.55
	1	76	23.46	
	2	83	25.62	
	3	64	19.75	
	4	29	8.95	
	5	17	5.25	
	6	8	2.47	
	7	3	0.93	
Oral health perception	7-22	324	100	2.99
Oral health behaviour	6-30	324	100	5.03

Among the 324 cases of Tianjin University students, there were 142 (43.83%) male students and 182 (56.17%) female students. There were 58 (17.90%) freshmen, 42 (12.96%) sophomores, 63 (19.44%) juniors, and 161 (49.69%) seniors and above. There were 138 (42.59%) non-medical school students and 186 (57.41%) medical school students. There were 27 (8.33%) with a monthly family income of less than 1,500 yuan, 42 (12.96%) with 1,500-3,000 yuan, 61 (18.83%) with 3,000-5,000 yuan, 74 (22.84%) with 5,000-8,000 yuan, 38 (11.73%) with 8,000-10,000 yuan, and 82 (25.31%) with more than 10,000 yuan. There were 315 people (97.22%) who had no underlying diseases and were in good health. There were seven primary oral diseases, namely. Missing teeth/dentition,

toothache, bleeding gums, bad breath, mouth ulcers, caries/decay, loose teeth, etc. Only 44 (13.58%) of the students did not have oral problems, 76 (23.46%) suffered from one oral disease, 83 (25.62%) from two, 64 (19.75%) from three, 29 (8.95%) from four, and five (5.25%), eight (2.47%) for six items and three (0.93%) for seven items, with an average of 2.17 oral diseases per person. The oral health perception score was (7-22), and the oral health care behaviour score was (6-30), see Table 1.

(3)Poisson regression analysis of oral health perception and oral diseases

Table 2. Poisson regression analysis of oral health cognition and oral diseases

Variable	Coefficient	Standard error	*z*	*P*	*95%CI*
Sex	-0.086	0.079	-1.09	0.274	(-0.241~0.068)
Year	0.029	0.034	0.86	0.389	(-0.037~0.096)
Professional	0.247	0.081	3.05	0.002	(0.088~0.406)
Income	-0.024	0.024	-0.98	0.329	(-0.072~0.024)
Underlying Disease	-0.195	0.215	-0.91	0.363	(-0.616~0.225)
Oral Health Perception	-0.066	0.013	-5.14	0.000	(-0.091~-0.041)

Of the 324 respondents, 280 had oral diseases, and there were five oral diseases for which Poisson regression analyses were performed. The oral disease was set as the dependent variable, with a mean of 2.1 and a variance of 2.1; the mean was approximately equal to the variance, and the data reflected a discrete nature. The dependent variable showed a tolerance of 1, a variance inflation factor of 1, and no significant covariance. The results of the Poisson regression analysis showed a significant effect of major ($P = 0.002 < 0.05$), oral health perception ($P = 0.000 < 0.001$), and oral diseases, as shown in Table 2. College students had poorer oral health perceptions [6], lacked good oral hygiene habits, and had poorer knowledge of oral health [7], which led to a higher incidence of oral diseases. Non-medical schools have a higher prevalence of oral diseases than medical school students. For every 1-unit increase in the level of oral health awareness, the incidence of oral diseases was significantly reduced by 6.6%. If the cognitive score rises from 10 to 20, the expected reduction in the incidence of oral diseases is about $1-0.93610 \approx 49\%$. Cognitive enhancement has a clear protective effect on the prevention of oral diseases, and the confidence interval excludes null values, making the results robust.

(4)Linear regression analysis of oral health care behaviours

Table 3. Linear regression analysis of oral health behaviours

Variable	Coefficient	Standard error	*t*	*P*	*95%CI*
Sex	0.574	0.554	1.037	0.300	(-0.515,1.663)
Year	-0.532	0.220	-2.422	0.016	(-0.965,-0.100)
Professional	-2.024	0.554	-3.656	0.000	(-3.113,-0.935)
income	0.015	0.171	0.088	0.930	(-0.322,0.352)
Underlying Diseases	0.987	1.637	0.603	0.547	(-2.233,4.207)
Oral Health Perception	0.399	0.091	4.362	0.000	(0.219,0.579)

Oral health care behaviour was set as the dependent variable, and linear regression was used to explore the influencing factors. The results in Table 3 show that grade ($P = 0.016 < 0.05$), profession ($P = 0.000 < 0.05$), and oral health perception ($P = 0.000 < 0.001$) all had significant effects, as shown in Table 3. For every 1-unit improvement in oral health perception, the healthcare behaviour score increased by 0.399 points, indicating a positive association between cognitive level and healthcare behaviour and supporting the theory of "Perceptions-Behaviours" bidirectional promotion.

(5)Poisson regression analysis of the number of oral diseases under mediating variables

The dependent variable was oral disease, and the mediating variable of oral health care behaviour was included in the independent variable for Poisson regression analysis. The results showed that oral health perceptions (P=0.007<0.05) and oral health care behaviours (P=0.000<0.001) were significant, and the absolute value of the coefficient of oral health perceptions decreased from -0.066 to -0.036 after the inclusion of oral health care behaviours, suggesting that perceptions were partially achieved

by promoting oral health care behaviours. See Table 4. Both oral health perceptions and healthcare behaviours significantly reduce the risk of oral diseases, and healthcare behaviours are an essential way in which perceptions play a role. Table 2 shows that oral health perceptions reduced the risk of disease (coefficient=-0.066), and Table 3 shows that health behaviours enhanced perceptions (coefficient=0.399), supporting the mediation pathway of "Perceptions→Behaviours→Disease".

Table 4. Poisson regression analysis of oral diseases with intermediate variables

Variable	Coefficient	Standard error	*z*	*P*	*95%CI*
Sex	-0.047	0.079	-0.60	0.550	(-0.201~0.107)
Year	-0.017	0.035	-.0.49	0.622	(-0.086~0.051)
Professional	0.120	0.082	1.47	0.142	(-0.040~0.281)
Income	-0.019	0.025	-0.78	0.433	(-0.068~0.029)
Underlying Disease	-0.074	0.217	-0.34	0.735	(-0.499~0.352)
Oral Health Perception	-0.036	0.017	-2.67	0.007	(-0.063~-0.009)
Oral health behaviour	-0..082	0.010	-8.13	0.000	(-0.102~-0.062)

(6) Mediation model test

Table 5. Stepwise regression mediation effect model

Outcome	Predictor	*R*	R^2	*F*	β	t	*P*
Number of oral diseases Y	Oral health perception X	0.311	0.097	34.424	-0.151	-5.5867	0.000
Oral health behaviour M	Oral health perception X	0.234	0.055	18.653	0.394	4.319	0.000
Number of oral diseases Y	Oral health behaviour M	0.538	0.289	131.057	-0.155	-11.448	0.000

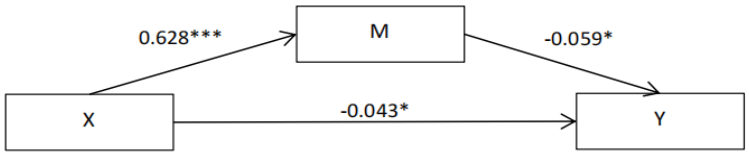

Figure 1. Mediating model relationship between oral health care behaviours in the context of oral cognitive status and oral disease
Note: ***P<0.001, **P<0.01, *P<0.05, below.

Stepwise regression analysis was used to explore whether oral health care behaviours were meaningful. Firstly, regression equation 1 was established with oral cognitive situation X on the number of oral diseases Y; regression equation 2 was established with oral cognitive situation X on oral health care behaviours M; and regression equation 3 was established with oral health care behaviours M on the number of oral diseases Y. The results showed that oral health cognitive situation negatively predicted the number of oral diseases (*P*<0.001); oral health cognition positively predicted oral health care behaviours (*P*<0.001); oral health cognition positively predicted oral health care behaviours (*P*<0.001); and oral health care behaviours can negatively predict the number of oral diseases (*P*<0.001).

Table 6. Breakdown of total, direct and mediating effects

Type of effect	efficiency value	Boot standard error	*Boot95CI*		effect size
			lower limit	limit	
Total effect	-0.151	0.026	-0.201	-0.100	100.00%
Direct effects	-0.095	0.023	-0.139	-0.050	62.91 %
Direct effects	-0.056	0.013	-0.083	-0.029	37.09 %

According to Table 5, the upper and lower limits of Bootsrap95% *CI* for the mediating effect of X on Y and M do not contain 0, indicating that X can act not only as a direct effect on Y but also as a mediator for Y through the variable M. This direct effect (-0.095) and mediating effect (-0.056) account for 62.91% and 37.09% of the total effect (-0.151), respectively, as shown in Table 6.

4. Discussion

This survey involved a total of 324 Tianjin University students, mainly suffering from oral diseases between (0-7), primarily toothache, bleeding gums, dental caries, mouth ulcers and other oral problems, with oral health cognition scores of (7-22) and oral health care behaviour scores of (6-30), which reflects that there are specific differences and room for improvement in students' oral health cognition and behaviour[8]. Oral health perceptions negatively predicted the number of oral diseases, with oral health care behaviours playing a partial mediating role. This suggests that the better the oral health cognitive situation and the more standardised the oral health care behaviour, the lower the incidence of oral diseases.

According to the Knowing, Believing, Acting (KAP) theoretical model, good cognition leads to the formation of positive oral health attitudes, which enhances the willingness to engage in healthy behaviours. The cognition and attitude will be translated into actual oral health behaviours, including brushing twice a day, flossing, and regular visits to the doctor, etc. These behaviours will directly reduce the incidence of dental caries and periodontal disease, thereby reducing the number of oral diseases and improving oral health [9]. This paper verifies this result, suggesting that part of the role of cognition is achieved through the promotion of oral health behaviours, supporting the mediating pathway of "Perceptions→Behaviours→Disease" and verifying part of the mediating role of oral health behaviours.

In addition to the perception of oral health, professionalism is also a crucial factor influencing the prevalence of oral diseases ($P < 0.05$). Medical school students have fewer oral diseases, which suggests that they possess more professional knowledge of dentistry and pay closer attention to oral disease prevention, resulting in fewer oral diseases. Additionally, significance ($P < 0.05$) and grade ($P < 0.05$) were significant for oral healthcare behaviour. At the grade level, this could be the degradation of health behaviours and a decrease in self-health management ability among students in higher grades.

5. Countermeasures

(1)Strengthen oral health education

Colleges and universities should expand the curriculum of oral health-related courses to enable students to systematically learn about oral health and enhance their oral health awareness. Digital health education tools, such as AI quiz applets and short video courses [10], are developed to focus on covering lower-grade and non-medical primary students [11]. The content of the course is systematically set up, and health awareness is strengthened through specific operational demonstrations such as the "Pasteur brushing method", which is complemented by regular lectures and the distribution of publicity materials[12] to popularise oral health knowledge and raise the oral health awareness of university students. At the same time, it fully leverages the characteristics of Chinese medicine and promotes the integration of Chinese medicine into modern dentistry and daily oral health science [13].

(2)Guiding good oral health care behaviour

Colleges and universities should encourage students to develop good oral health care habits, such as regular brushing, flossing, and mouthwash use. Students' interest and participation in oral health care can be stimulated by conducting oral health care knowledge competitions and setting up oral health care demonstration posts.

(3)Provide oral health counselling and services

Colleges and universities can establish oral health consultation centres to offer students professional oral health consultation and examination services. At the same time, stomatologists can be regularly invited to conduct voluntary consultation activities to identify and address students' oral health issues in a timely manner [14].

(4)Establish oral health records

Incorporate oral screening into the physical examination of new students and establish an electronic health record [15] for each student to document their oral health status and healthcare behaviours. This helps schools understand the oral health of their students and provides a basis for developing targeted oral health education programmes.

This study has certain limitations. The representativeness of the sample was limited and could not provide a comprehensive reflection of the oral health status of all college students in Tianjin. In addition, the distribution of the sample in terms of gender, major, and grade may also be biased, resulting in some limitations on the generalisability of the findings. There are also limitations in the research methodology that may have overlooked the influence of some potential variables. The present study is a cross-sectional study, and future studies can be designed to verify the relationship between oral health care behaviours and oral health perceptions and the number of oral diseases from a longitudinal perspective of the

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