

BMJ Open Optimisation of services to prevent dental caries for school-aged children in China: a discrete choice experiment

Lidan Wang,^{1,2,3} Zhu Chen ,² Sixuan Chen,² Xinyu Jin,² Lu Hu,² Jiacheng Jiang,² Hong Yu,¹ Jianguang Xu,¹ Wenhua Xu ¹

To cite: Wang L, Chen Z, Chen S, *et al.* Optimisation of services to prevent dental caries for school-aged children in China: a discrete choice experiment. *BMJ Open* 2024;**14**:e084776. doi:10.1136/bmjopen-2024-084776

► Prepublication history for this paper is available online. To view these files, please visit the journal online (<https://doi.org/10.1136/bmjopen-2024-084776>).

LW and ZC contributed equally.

LW and ZC are joint first authors.

Received 28 January 2024

Accepted 21 November 2024



© Author(s) (or their employer(s)) 2024. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

¹Stomatologic Hospital & College, Key Lab of Oral Diseases Research of Anhui Province, Anhui Medical University, Hefei, Anhui, China

²School of Health Management, Anhui Medical University, Hefei, China

³Centre for Health Policy Research, Anhui Medical University, Hefei, Anhui, China

Correspondence to

Lidan Wang;
wanglidan@ahmu.edu.cn,
Professor Jianguang Xu;
xujianguang@ahmu.edu.cn and
Professor Wenhua Xu;
xuwenhua@ahmu.edu.cn

ABSTRACT

Objectives The objective of this study is to analyse the preferences of guardians of school-aged children for children's caries prevention services (CPS) and their willingness to pay (WTP) for different levels of attributes.

Design Four key attributes were identified through a literature review and expert consultations: preventive service time, preventive effectiveness, distance (driving time to service institution) and service cost (out-of-pocket for CPS). A D-efficient design was used to create a discrete choice experiment questionnaire, and data were collected via face-to-face interviews.

Setting Data collection was conducted between July 2021 and January 2022 in Anhui, China.

Participants Guardians (785) of children aged 3–12 years participated.

Main outcome measures A mixed-logit model was used to estimate preferences and WTP for different attribute levels, and the preference heterogeneity was assessed using a latent class logit model.

Results Preventive effectiveness was the most important attribute, followed by service cost, preventive service time and distance. Guardians preferred CPS with over 90% preventive effectiveness, a distance of 10–25 min, services offered during vacations and lower service cost. Guardians were willing to pay 409 Chinese yuan (CNY) for higher effectiveness, 84 CNY for shorter distances and 87 CNY for services offered during vacation. Guardians with a college education or higher and females prioritise preventive effectiveness, while guardians who had children with a caries history and who had children with better oral health status preferred CPS during vacation.

Conclusions All four attributes influenced guardians' preferences for CPS, with preventive effectiveness being the most important. Guardians were willing to pay extra money for better CPS, and preferences varied according to individual characteristics. These findings provide a reference for policy-makers to provide personalised, demand-based CPS.

BACKGROUND

Dental caries or decay is a disease affecting dental hard tissues and has been related to multifactorial aetiology.¹ Due to its high prevalence, low treatment rate and high retreatment rate, the WHO classifies caries as one of the top three non-communicable

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This study used a discrete choice experiment to capture the preferences of guardians for caries prevention services (CPS).
- ⇒ The results took into account the heterogeneity among guardians and can be used to implement targeted strategies to improve personalised CPS.
- ⇒ Only a limited number of attributes were considered, and other attributes related to CPS could also influence guardians' preferences.
- ⇒ The study's sample was drawn from stomatology departments of hospitals, lacking representation from community setting.

chronic diseases globally.² Nearly 3.5 billion people worldwide are living with oral disease. In 2019, direct spending on oral disease reached US\$387 billion across 194 countries or approximately US\$50 per capita globally.³ A study showed that the incidence of caries among 5-year-old and 12-year-old children in China was 70.90% and 34.50%, respectively, marking an increase of 5.80% and 7.80% from 2007.⁴ In response, China introduced significant public health measures starting in 2008 to prevent caries,^{5–7} setting a goal for pit-and-fissure sealing closure in school-aged children to reach 28% and to reduce caries prevalence in 12-year-old children to below 25% in 2025.

Caries prevention can reduce the incidence of caries effectively. While most research has focused on the clinical effectiveness of caries prevention, fewer studies have explored cost-effectiveness. The effectiveness of fluoride application and fissure sealing in caries prevention has been well documented.^{8–9} Studies in the USA¹⁰ and South Africa¹¹ have demonstrated the cost-effectiveness of preventing dental caries through fluoridation or fissure sealing, consistent with the results of a study in Guangxi, China.¹² The results of these studies demonstrate the feasibility of caries prevention in China.

Despite these preventive strategies, relevant studies demonstrated that while 60.1% of participants had oral health knowledge, the use of caries-sealing treatments in 5 and 12 years in China was just 4.1% and 16.5%, respectively. Therefore, it is necessary to understand the preferences of guardians of school-aged children for child caries prevention services (CPS) in order to improve participation rates.

The discrete choice experiment (DCE), based on stochastic utility theory, identifies the relative importance (RI) of different attributes and the extent to which they influence participants' choices. In recent years, DCE has been widely used in health research fields, involving the selection of clinical and pharmacological treatment options.^{13 14} The application of DCE to oral health has been further developed in recent years.

There is a lack of current research on CPS preferences, limiting the ability of the healthcare system to deliver personalised CPS. Therefore, this study aimed to implement a DCE exploring the preference of guardians towards a potential CPS for school-aged children. Our findings will be important for optimising China's intervention programmes for oral diseases, encouraging school-aged children to participate in CPS and fostering healthy oral habits.

METHODS

Identification of attributes and levels

Following DCE design guideline, we identified attributes through a literature review and expert consultation. First, the DCE commenced with a literature review to identify key attributes relevant to CPS, such as caries type (ie, primary or permanent tooth decay), preventive service time (the date on which the child participates in CPS), preventive effectiveness (the probability of reduction in dental caries following CPS participation), healthcare institution (the type and level of the healthcare institution from which the child receives CPS), distance (the driving time to the healthcare institution by public transport, including buses or subways) and out-of-pocket (OOP) service cost per tooth for CPS.

To refine the attribute list, we conducted an expert consultation involving three clinical and nursing specialists in oral health. As a result, we removed 'caries type' and 'healthcare institution' due to their overlap with other attributes and the lack of relevance in real-world scenarios. Ultimately, the selected attributes included preventive service time, preventive effectiveness, distance and OOP service cost (table 1).

Experimental design

Considering the combinations of attributes and levels, we identified 128 possible choice sets ($4^3 \times 2^1$). However, the use of a full factorial design was inconsistent with actual situations.¹⁵ Therefore, the partial factorial design was used to create an efficient design through Choice Metrics' Ngene software (V.1.1.2) to maximise horizontal

Table 1 Detailed definitions of attributes and levels

Attribute	Level
Preventive service time	1. Workday (Non vacation)
	2. Vacation (Usually weekends and statutory holidays)
Preventive effectiveness	1. Low (The probability of reduction in caries following CPS participation is 60%-70%)
	2. General (The probability of reduction in caries following CPS participation is 70%-80%)
	3. High (The probability of reduction in caries following CPS participation is 80%-90%)
	4. Very high (The probability of reduction in caries following CPS participation is higher than 90%)
Distance (minute)	1. ≥ 50
	2. 25–50
	3. 10–25
	4. ≤ 10
OOP service cost (Chinese yuan, 2023)	1. 10
	2. 30
	3. 60
	4. 100
OOP, out-of-pocket.	

D-efficiency¹⁶ and minimise the overlap among attribute levels. Eight DCE choice sets were finally determined, each containing two hypothetical service options and a 'neither' option. Participants were first asked to choose between 'neither' and accepting the service; if they accepted, they were asked again to choose between service A and service B. A 'neither' option prevented a forced choice set, reducing the overestimation of attribute influence.^{17 18}

To familiarise participants with the DCE process, we introduced all the attributes and their associated levels at the beginning of the survey. Despite these preparatory steps, full comprehension of the attributes and DCE sets could not be guaranteed. Thus, a dominant choice set (table 2) was included after the formal DCE sets to assess response validity.¹⁹ In this set, all attribute levels of service A were superior to service B. Participants who did not choose service A were considered to have failed the test, and their data were excluded from the main analysis.

In addition to the DCE section, the questionnaire included two other sections: section 1, which contained a series of questions regarding guardians' demographic characteristics (eg, sex, age and annual household income) and the guardians' willingness to take their child participate in such services. Section 2, which contained child's oral health status, child's prior experience with fluoridation or fissure sealing, child's experience with caries. A pilot experiment involving 30 participants was conducted in June 2021. Based on the feedback, adjustments were made to enhance the clarity and effectiveness of the questionnaire, ensuring that participants could more precisely engage and reflect their true preferences. The pilot data were also used to optimise the DCE design.

Table 2 Example of the dominant choice set

Attribute	Service A	Service B
Preventive service time	Vacation*	Workday†
Preventive effectiveness	Very high‡	High§
Distance¶ (minute)	≤10	10–25
OOP service cost (CNY)	30	60
Which service would you choose?	<input type="checkbox"/> Service A	<input type="checkbox"/> Service B
	<input type="checkbox"/> Neither (no preference for either and quit)	

*Usually weekends and statutory holidays
 †Non vacation
 ‡The probability of reduction in caries is higher than 90%
 §The probability of reduction in caries is 80%-90%
 ¶The driving time to the healthcare institution by public transport, including bus, subway, etc.
 CNY, Chinese yuan; OOP, out-of-pocket.

Study sample

A multistage randomised cluster sampling method was used to draw the samples for this study from Anhui Province. In the first stage, seven cities were sampled: two from the southern, two from the central and three from the northern regions. In the second stage, one tertiary public hospital was selected from each city. In the third stage, one stomatology department of each hospital was selected. The guardians were included if they (1) attended dental outpatient, (2) had children aged 3–12 years, (3) had knowledge of their children's oral health status and (4) provided informed consent and voluntarily participated. Exclusion criteria were guardians with hearing, reading, comprehension or expression disabilities, as well as those unwilling to participate in the study.

To determine sample size, we adhered to the widely accepted DCE rule of thumb²⁰:

$$n > 500c / (t \times a)$$

In this formula, n is the recommended minimum sample size, t denotes the number of sets, a is the number of choice options per set and c is the maximum number of attribute levels in the DCE. For our study parameters ($t=8$, $a=3$ and $c=4$), the minimum acceptable sample size was calculated to be 84. Therefore, a sample size larger than 84 was deemed sufficient for statistical analysis.

Data collection

The survey was conducted using a face-to-face survey from July 2021 to January 2022. We recruited 15 investigators, all of whom were medical students and arranged rigorous training according to a standard manual. Before the formal survey begins, the investigator first obtains the informed consent of the participants, explaining to them that the survey does not involve the privacy of individuals. After the participants have agreed to participate in the survey, the significance of each attribute level is explained in detail to each participant so that they can understand the choice set correctly. Finally, in order to ensure the

Table 3 Demographic characteristics of participants (N=785)

Variables	Group	N	%
Guardians' information			
Relationship (with the child)	Father	209	26.62
	Mother	512	65.23
	Others	64	8.15
Education	≤High school	380	48.66
	College	357	45.71
	Higher than college	44	5.63
Annual household income (CNY in thousand)	<100	142	18.51
	100–200	193	25.16
	≥200	75	9.78
	Unclear	357	46.54
Willingness to take children participate in caries prevention?	No	48	8.15
	Yes	511	86.76
	Unclear	30	5.09
Child's information			
Sex	Girl	446	56.82
	Boy	339	43.18
Grade	≤First grade	374	47.64
	≥Second grade	411	52.36
Had caries before	No	588	75.10
	Yes	180	22.99
	Unclear	15	1.91
Whether anticaries measures have been taken?	No	589	75.32
	Yes	176	22.51
	Unclear	17	2.17
Oral health status	Healthy without caries	204	25.99
	Mild caries	292	37.20
	Moderate caries	226	28.79
	Severe caries	63	8.03

CNY, Chinese yuan.

accuracy of the survey data, the number of participants to be surveyed by each researcher is limited to no more than 15 per day, and the duration of the survey for each participant is limited to no more than 20 min. During the investigation, a professional investigator provided one-on-one guidance to each participant to complete the questionnaire.

In the formal investigation, data were collected from 826 participants. To ensure the quality of the questionnaires, we formulated strict quality control standards to filter the data. If a questionnaire met any of the following criteria, it was excluded from the final data analysis: (1) participants maintained the unified option from start to finish (11 items were deleted); (2) the questionnaire failed to pass test choice set (13 items were deleted) and

Table 4 The mixed-logit model of main effects

Attributes	Level	Coefficient	SE	WTP (CNY)	95% CI of WTP
ASC\$\$		-6.680***	1.079		
Preventive service time	Workday*†				
	Vacation‡	0.907***	0.080	87***	68 to 106
Preventive effectiveness	Low§†				
	General¶	1.766***	0.105	170***	138 to 202
	High**	2.775***	0.486	267***	165 to 369
	Very high††	4.249***	0.488	409***	295 to 522
Distance‡‡	≥50 min†				
	25–50 min	0.327***	0.056	31***	20 to 43
	10–25 min	0.873***	0.334	84***	20 to 148
	≤10 min	0.841***	0.334	81***	17 to 145
OOP service cost (CNY)		-0.010***	0.001		
AIC	7290.543				
BIC	7431.716				
Log-likelihood	-3627.272				

*p<0.05, **p<0.01, ***p<0.001.

*Non vacation

† reference.

‡ Usually weekends and statutory holidays

§ The probability of reduction in caries is 60%-70%

¶ The probability of reduction in caries is 70%-80%

**The probability of reduction in caries is 80%-90%

††The probability of reduction in caries is higher than 90%

‡‡The driving time to the healthcare institution by public transport, including bus, subway, etc.

\$\$\$The utility of choosing "neither" option

AIC, Akaike information criterion; BIC, Bayesian information criterion; CNY, Chinese yuan; WTP, willingness to pay.

(3) the questionnaire was not fully answered (17 items were deleted).

Statistical analysis

Based on stochastic utility theory, participant i derived utility from alternative j in the selection option set t , and this was represented as:

$$U_{ijt} = X_{ijt}\beta + \varepsilon_{ijt}; i = 1, \dots, 785; j = 1, 2, 3; t = 1, \dots, 8;$$

Where β is a vector of coefficients and X_{ijt} is a vector of variables representing the attributes of alternative j . For the unforced choice model, $j=1, 2, 3$. When the random term ε_{ijt} was assumed to be independently and identically distributed according to the type I extreme value distribution, the model became a conditional logit model.

We explored the mixed-logit model (MLM) that best reflected randomness and individual preferences. When estimating the MLM, we considered different numbers of Halton draws to ensure the stabilisation of the results. OOP service cost was treated as continuous variables, while other attributes were considered categorical variables. We used the dummy coding format for attribute levels, and each coefficient represented the preference weight of a level compared with the reference level. We included an alternative-specific constant (ASC) to capture

the utility of the 'neither' option. Statistical significance was set at $p=0.05$.

We calculated the marginal rates of substitution between OOP service cost and other preventive-related attributes. This could be insightful for decision-makers as it measures how much the participants are willingness to pay (WTP) to improve a particular attribute.

Based on the parameter estimates derived from the MLM, we used the delta method to further compare whether differences among various levels within the same attribute were statistically significant. The RI of each attribute was calculated as the proportion of the sum of utility score ranges for each attribute, helping to understand how much each attribute might contribute to the overall utility in scheme design. The formula is as follows:

$$RI_k = \left(\frac{A_k}{\sum_{k=1}^4 A_k} \right) \times 100\%$$

Where A_k is the difference between the highest and lowest utility between the attribute levels for the k^{th} attribute.

To further explore the heterogeneity of guardian preferences, we conducted a latent class logit (LCL) analysis.²¹ The main aim of the LCL was to further examine

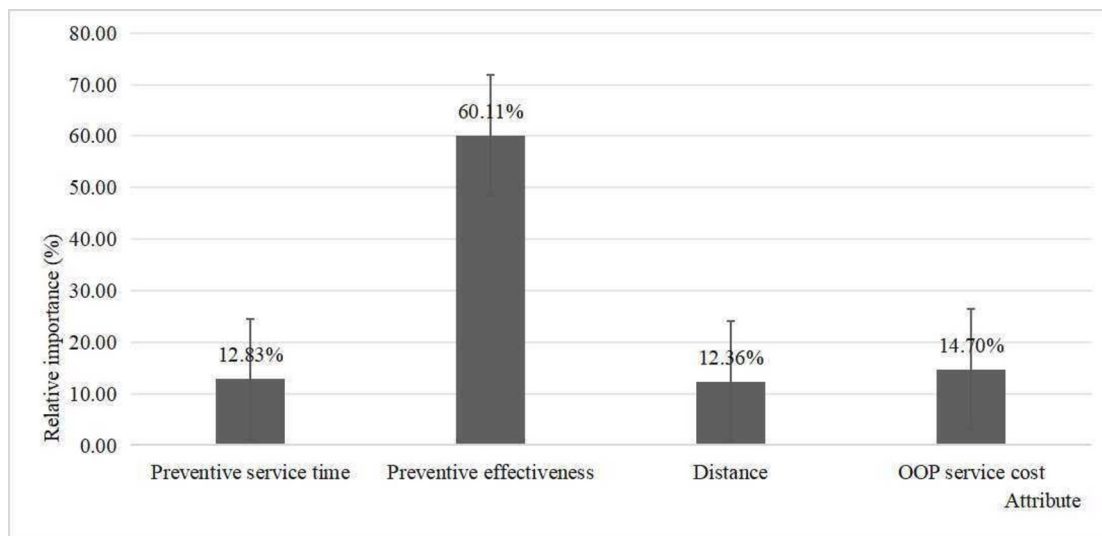


Figure 1 The impact of different attributes on guardians' preferences for caries prevention services, derived from mixed-logit model.

preferences heterogeneity in the participant data and to link differences in preferences to differences in demographic characteristics. The preference heterogeneity is the degree to which preference for CPS vary between guardians, that is, the extent to which different guardians have different preferences. Using the expectation-maximisation algorithm, we constructed an LCL model with different numbers of groups. The Akaike information criterion (AIC) and Bayesian information criterion (BIC) were used to compare the model fit, with lower AIC and BIC values indicating better models.²²

Patient and public involvement

Patients were involved in this study as research participants but did not contribute to the conceptualisation, design, recruitment or interpretation of the study.

RESULTS

Demographic characteristic

A total of 785 valid questionnaires were obtained, yielding an effective response rate of 95.04%. The demographic characteristics of the participants are shown in [table 3](#). Most participants were mothers (65.23%), and 51.34% held a college education or higher. Additionally, 52.36% of guardians had children in second grade or higher of primary school, and 74.01% had children with dental caries. Despite this, 75.32% of guardians reported that their children had not received fluoride or fissure sealing. However, 86.76% expressed willingness to have their children participate in CPS.

Main preference

The mixed-logit analysis results ([table 4](#)) demonstrated that all attributes included in this study significantly influenced the choice of caries prevention among guardians for their children ($p < 0.05$).

The coefficient for opting for 'neither' was negative and statistically significant ($\beta = -6.680$, $p < 0.05$), representing a positive attitude of guardians towards CPS.

Regarding preventive service time, guardians preferred services provided during vacation ($\beta = 0.907$, $p < 0.05$) compared with workdays. Guardians were also more likely to choose services with high preventive effectiveness ($\beta = 4.249$, $p < 0.05$) rather than low effectiveness. Similarly, in terms of distance, guardians favoured closer locations for CPS. However, to our surprise, the distance of ≤ 10 min was not the favourite of the guardians ($\beta = 0.841$, $p < 0.001$); instead, the 10–25 min distance was preferred ($\beta = 0.873$, $p < 0.001$). Regarding service cost (OOP), guardians show a preference for CPS with lower costs ($\beta = -0.010$, $p < 0.001$).

We also estimated the WTP of guardians to improve the attributes' levels of CPS ([table 4](#)). For preventive effectiveness, guardians demonstrated a significant WTP, with 170 Chinese yuan (CNY) for an upgrade from low to general level. Additionally, a 267 CNY was considered acceptable for further enhancement to high level, and 409 CNY for an upgrade from high level to very high level. A similar trend was observed in distance enhancements. Guardians were willing to pay 31 CNY for an upgrade from far to mid-distance, 84 CNY for further advancement to near distance and 81 CNY for an upgrade from near distance to very near distance. Regarding preventive service time, guardians displayed a relatively lower WTP. Specifically, there was a WTP of 87 CNY for converting the preventive service time from workdays to vacation.

The RI shown in [figure 1](#) indicates that preventive effectiveness stands out as the most influential attribute among guardians (60.11%). The importance of preventive service time (12.83%) is comparable to the distance (12.36%) and the OOP service cost (14.70%).

Table 5 The latent class logit model estimates

		Group 1		Group 2	
		Coefficient	SE	Coefficient	SE
Preventive service time	Workday*†				
	Vacation‡	0.126**	0.046	1.793***	0.179
Preventive effectiveness	Low§†				
	General¶	1.301***	0.091	0.297	0.172
	High**	1.889***	0.432	1.808	0.952
	Very high††	3.180***	0.434	1.466	0.952
Distance‡‡	≥50 min†				
	25–50 min	0.262***	0.060	0.323*	0.157
	10–25 min	0.449	0.312	1.529	0.881
	≤10 min	0.440	0.310	1.353	0.881
OOP service cost (CNY)		-0.010***	0.000	0.003	0.002

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

*Non vacation

†Reference.

‡Usually weekends and statutory holidays

§The probability of reduction in caries is 60%-70%

¶The probability of reduction in caries is 70%-80%

**The probability of reduction in caries is 80%-90%

††The probability of reduction in caries is higher than 90%

‡‡The driving time to the healthcare institution by public transport, including bus, subway, etc.

CNY, Chinese yuan; OOP, out-of-pocket.

Patterns of preferences responses and association with participant characteristics

Significant preference differences existed between different subgroups. An LCL model was used to conduct subgroup analyses on participant demographic characteristic revealed that guardian sex and education, annual household income, child's sex, child's oral health status and 'has the child had caries before' significantly influenced guardians' preferences. According to the BIC, the study was confined to two groups (table 5), with group 1 accounting for 74.60% and group 2 for 25.40%.

Although the two groups exhibited similar results, there were some notable differences. The coefficient ($\beta = 3.180 > 1.466$, $p < 0.001$) with different levels showed that the preventive effectiveness seemed to be more important for Group one than group 2. Guardians in group 2 preferred services within a 25–50 min distance than those in group 1 ($\beta = 0.323 > 0.262$, $p < 0.05$).

Notably, guardians in all two subgroups preferred receiving CPS in vacation, especially group 2 ($\beta = 1.793$, $p < 0.001$). Group 1 preferred lower OOP service cost ($\beta = -0.010$, $p < 0.05$), while the preference of group 2 was not statistically significant.

The expected values of the significant predictors are shown in figure 2. Compared with group 2, group 1 has more guardians with a college education or higher (52.47% vs 49.31%), female (73.10% vs 65.77%), had daughters (44.05% vs 40.80%) and had children with poor oral health status (75.19% vs 70.18%). In group 2, there are more guardians with an annual household income

not less than 100 000 CNY (35.34% vs 33.91%) and children with dental caries history (26.06% vs 21.98%).

DISCUSSION

The findings of this study indicate that OOP service cost, preventive service time, preventive effectiveness and distance influence guardians' preferences for CPS. The preferred attributes included a >90% preventive effectiveness, 10–25 min distance, services offered during vacation and lower OOP service cost. To assess CPS with these attributes and levels, they were, respectively, willing to pay 409 CNY, 84 CNY and 87 CNY. Among these attributes, preventive effectiveness had the greatest impact on guardians' preferences.

Our findings suggest that guardians preferred CPS with >90% preventive effectiveness, which is consistent with previous China DCE findings that patients prefer vaccines with greater preventive effectiveness.²³ This finding will provide strong evidence for policy-makers, who should focus more on enhancing preventive effectiveness when developing CPS. Guardians also preferred CPS with lower OOP service cost; yet this factor had a marginal impact on their overall preferences.^{24 25} This outcome is likely associated with annual household income levels, given that CPS is considerably more affordable relative to income. This observation aligns with the results of a study carried out in 2021, China.²⁵ Therefore, reducing OOP service cost may not be the best way to increase the population's acceptance of CPS. Additionally, guardians prefer their child to

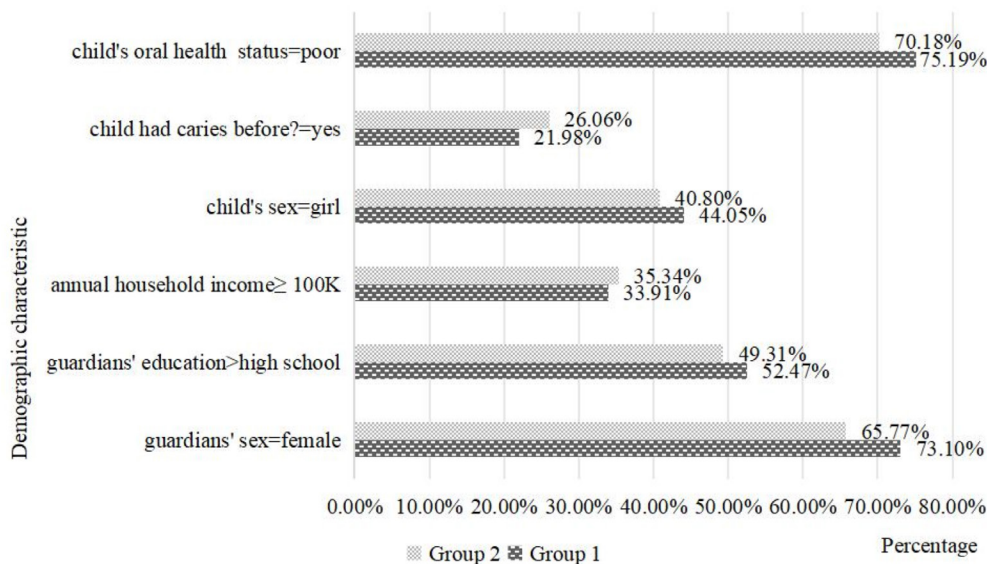


Figure 2 Using the Latent Class Logit model to divide the participants into two subgroups, with an analysis of the proportion of individuals exhibiting various characteristics within each group.

participate in CPS during vacation. This may be related to the time cost, as more than 50% of the guardians had a college education or higher in our study. This educational background suggests that guardians hold professional employment and scheduling CPS during workdays incurs substantial time costs.

To the best of our knowledge, this is the first study that included distance attributes to examine guardians' preference for CPS and found that the guardians preferred the 10–25 min distance. Current literature indicates that the distance attribute has a significant influence on the choice of healthcare services.^{24 26} Surprisingly, guardians did not choose the nearest healthcare institution for the CPS. This preference for a slightly longer distance could be related to the perception that tertiary hospitals, which are often farther away, offer higher-quality care compared with community health service station. This finding is consistent with prior non-DCE research in China, where patients preferred physicians from secondary or tertiary hospitals due to their perceived superior medical expertise compared with those in primary care settings.²⁷ Therefore, it is necessary to train healthcare workers to improve their caries-prevention skills. Continuous medical education and training for dental practitioners should be carried out in remote areas, and dental practitioners should be encouraged to further their studies in advanced stomatology hospitals and stomatology departments of advanced hospitals to improve their caries-prevention skills.

The heterogeneous nature of preferences is an important consideration for policy-makers striving to improve the delivery of personalised CPS. Group 1 primarily consists of female guardians, guardians with a college education or higher. This group preferred CPS with higher preventive effectiveness, which may be attributable to differences in health awareness due to education. Group 2 mainly consists

of guardians who had children with dental caries history, as well as guardians who had children with better oral health. They are more willing to take their children to receive CPS during vacation, maybe because the oral health status of their children was not as poor and the expenditure of time-cost has been taken into consideration. These findings align with the results of previous studies.^{28 29} Relevant healthcare institutions should consider targeted CPS when formulating these programmes.

Although the incidence of caries ranks first among childhood diseases, our study revealed that some guardians did not understand the necessity of caries prevention, and most guardians had poor awareness of children's oral healthcare. This gap underscores the need to enhance oral health education, which can be delivered through dental healthcare providers, primary and secondary school teachers, and community health workers, to augment oral health education. Tailoring CPS to the preferences of different demographic groups and local contexts will better meet the demand for such services.

LIMITATIONS

This study fills a significant gap in our understanding of the preferences of guardians for children's CPS in China. However, it has some limitations. First, there could be a lack of generalisability in the results as the survey was limited to Anhui Province. However, Anhui Province is a populous central region that attracts people from across China, making it a representative location for the study. Second, our scenarios only considered a limited number of attributes, and other attributes related to CPS, could also influence guardians' preferences. Finally, the study population was based on the population of hospital stomatology departments. The sample thus lacks representation from community settings, where willingness to seek CPS may be different. Next, we

would like to conduct further research in the community to compare the preference heterogeneity across different groups.

CONCLUSIONS

Preventive effectiveness emerged as the most prominent factor influencing guardians' CPS preferences. However, preventive service time, distance and OOP service cost were also important factors in guardians' choice. Policy-makers should thus improve the preventive effectiveness of caries prevention to meet the core needs of CPS. Additionally, guardians with college education or higher and female guardians prioritise CPS with higher preventive effectiveness, while guardians had children with better oral health status prefer to receive CPS during vacation. These findings offer insights for the future implementation of policies aimed at increasing CPS uptake in China.

Acknowledgements We thank the medical staff who volunteered to complete our questionnaire despite their busy schedules.

Contributors LW and WX designed the study; ZC, LH, HY, SC, XJ and JJ collected data with the supervision of WX and JX; LW and ZC analysed the data and wrote the original draft; LW, WX and JX revised the draft. All the authors have read and approved the final manuscript. LW is responsible for the overall content as guarantor.

Funding This work was funded by the MOE (Ministry of Education in China) Project of Humanities and Social Sciences (grant number 20YJCZH157).

Disclaimer This study protocol has undergone peer review by the MOE; the MOE has not contributed to the design of the study, nor will it have a role in data collection, analysis, and interpretation or in the dissemination of findings.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by Ethics Committee of Anhui Medical University (approval no. 2021H030). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request. The datasets generated and analysed during the study are not publicly available because of their potential use in identifying participants. The datasets are available from the corresponding author on request.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iDs

Zhu Chen <http://orcid.org/0009-0009-6994-1523>

Wenhua Xu <http://orcid.org/0000-0002-0263-6489>

REFERENCES

- Mathur VP, Dhillon JK. Dental Caries: A Disease Which Needs Attention. *Indian J Pediatr* 2018;85:202–6.
- World Health Organization. Oral health. n.d. Available: https://www.who.int/health-topics/oral-health/#tab=tab_1
- World Health Organization. Global oral health status report: towards universal health coverage for oral health by 2030. n.d. Available: <https://www.who.int/publications/i/item/9789240061484>
- Xiping F. Oral health status of chinese residents: a report on the fourth epidemiological survey of oral health in china. 2018, the 18th Annual Conference of Preventive Dentistry of the Chinese Stomatological Association; 2018:13–4.
- Xiping F. Guideline of Prevent and Control Caries in China. Beijing: People's Medical Publishing House, 2016.
- Yi-ran W, Qi-jin W. Key points and difficulties in prevention and treatment of chronic disease—interpretation of guidelines for prevention and treatment of chronic diseases in China (2017–2025). *Acad J Second Mil Med Univ* 2017;38:828–31.
- Lili M. Action plan for healthy oral affairs (2019–2025). 2019 The 19th National Annual Conference of the Preventive Stomatology Professional Committee of the Chinese Stomatological Association; 2019:26–31.
- Ruff RR, Barry Godin TJ, Niederman R. Noninferiority of Silver Diamine Fluoride vs Sealants for Reducing Dental Caries Prevalence and Incidence: A Randomized Clinical Trial. *JAMA Pediatr* 2024;178:354–61.
- Elawsya ME, Montaser MA, El-Wassefy NA-M, et al. Two-year clinical performance of dual- and light-cure bulk-fill resin composites in Class II restorations: a randomized clinical trial. *Clin Oral Investig* 2024;28:138.
- Janusz CB, Doan TT, Gebremariam A, et al. A Cost-Effectiveness Analysis of Population-Level Dental Caries Prevention Strategies in US Children. *Acad Pediatr* 2024;24:765–75.
- Boachie MK, Molete M, Hofman K, et al. Cost-effectiveness of dental caries prevention strategies in South African schools. *BMC Oral Health* 2023;23:814.
- Tang L, Nong S, Chen K, et al. Cost-effectiveness and cost-benefit analyses of fluoride varnish for caries prevention in Guangxi, China. *BMC Oral Health* 2024;24:534.
- Liu S, Xiang Y, Gu Y, et al. Patient preferences and willingness to pay for central venous access devices in breast cancer: A multicenter discrete choice experiment. *Int J Nurs Stud* 2024;152:104695.
- Howard K, Norris S, Salisbury A, et al. Women's Preferences for Hypofractionated Radiation Therapy for Treatment of Early-Stage Breast Cancer: A Discrete Choice Experiment. *Int J Radiat Oncol Biol Phys* 2024;119:172–84.
- Cookson R. Willingness to pay methods in health care: a sceptical view. *Health Econ* 2003;12:891–4.
- Ryan M, Gerard K. Using discrete choice experiments to value health care programmes: current practice and future research reflections. *APPL HEALTH ECON HEA* 2003;2:55–64.
- Campbell D, Erdem S. Including Opt-Out Options in Discrete Choice Experiments: Issues to Consider. *Patient* 2019;12:1–14.
- Veldwijk J, Lamboij MS, de Bekker-Grob EW, et al. The effect of including an opt-out option in discrete choice experiments. *PLoS One* 2014;9:e111805.
- Wang Y, Zhai P, Jiang S, et al. Blood Donors' Preferences Toward Incentives for Donation in China. *JAMA Netw Open* 2023;6:e2318320.
- de Bekker-Grob EW, Donkers B, Jonker MF, et al. Sample Size Requirements for Discrete-Choice Experiments in Healthcare: a Practical Guide. *Patient* 2015;8:373–84.
- Greene WH, Hensher DA. A latent class model for discrete choice analysis: contrasts with mixed logit. *Transportation Research Part B: Methodological* 2003;37:681–98.
- Hole AR. Modelling heterogeneity in patients' preferences for the attributes of a general practitioner appointment. *J Health Econ* 2008;27:1078–94.
- Qi Z, Huiyao H, Hong F, et al. Research on cancer treatment preference based on discrete choice experiments. *Med Soc (Berkeley)* 2022;35:123–9.
- Na W, Yuan S. Study on the residents' preference of medical institutions based on discrete choice experiment in Ningxia. *Med Soc (Berkeley)* 2022;35:62–6.
- Tiantian G. Parental Vaccine Preferences for Their Children in China: A Discrete Choice Experiment; In: Shandong University, 2021.
- Cuilian W, Linhai Z, Wanxia H, et al. Research of people's preference for primary health care services based on discrete choice experiment. *J Baotou Med Coll* 2021;37:48–53.
- Shuang W, Xiyue D, Zhihui C, et al. Research on residents' demand preference for contracted family doctor services based on discrete selection experiments. *Health Econ Res* 2021;38:18–21.
- Felgner S, Henschke C. Patients' preferences in dental care: A discrete-choice experiment and an analysis of willingness-to-pay. *PLoS One* 2023;18:e0280441.
- Smith SR, Kroon J, Schwarzer R, et al. Parental social-cognitive correlates of preschoolers' oral hygiene behavior: A systematic review and meta-analysis. *Soc Sci Med* 2020;264:113322.