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Exploring the state and influential factors of dental caries in preschool children aged 3–6 years in Xingtai City

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Abstract

Objective To explore the main factors affecting early dental caries among preschool children aged 3–6 years in Xingtai City to formulate effective preventive measures.

Methods A cross-sectional study was conducted on 570 preschool children aged 3–6 years in Xingtai City through questionnaire surveys and oral examinations to understand their dental caries situation. Multifactorial logistic regression analysis was used to analyse the main influencing factors for the occurrence of dental caries in preschool children.

Results Univariate analysis showed statistically significant differences in age ($\chi^2=2.636$, $p=0.008$), father's education level ($\chi^2=4.207$, $p<0.001$), mother's education level ($\chi^2=4.217$, $p<0.001$), daily tooth brushing frequency ($\chi^2=3.160$, $p=0.002$), age of starting tooth brushing ($\chi^2=8.756$, $p<0.001$), mouth rinsing after meals ($\chi^2=89.401$, $p<0.001$), *Streptococcus mutans* positivity ($\chi^2=133.503$, $p<0.001$), non-sweet snack consumption frequency ($\chi^2=5.962$, $p<0.001$), snack flavour preference ($\chi^2=116.119$, $p<0.001$), use of fluoridated toothpaste ($\chi^2=75.639$, $p<0.001$), regular oral examinations ($\chi^2=98.711$, $p<0.001$), sugary drink consumption frequency ($\chi^2=10.370$, $p<0.001$) and sweet food consumption frequency ($\chi^2=9.261$, $p<0.001$) between the caries and non-caries groups. Multifactorial analysis revealed that older age (odds ratio [OR] = 5.342, 95% confidence interval [CI]: 1.434–6.631), later initiation of tooth brushing (OR = 3.244, 95% CI: 2.413–5.424), *S. mutans* positivity (OR = 5.357, 95% CI: 4.529–8.563), high snack consumption frequency (OR = 3.452, 95% CI: 2.634–5.442), high sugary drink consumption frequency (OR = 4.414, 95% CI: 2.534–6.451) and high sweet food consumption frequency (OR = 4.531, 95% CI: 3.421–6.354) were risk factors for dental caries. Higher father's educational level (OR = 0.724, 95% CI: 0.564–0.891), higher mother's educational level (OR = 0.641, 95% CI: 0.601–0.813), high daily tooth brushing frequency (OR = 0.572, 95% CI: 0.423–0.864), mouth rinsing after meals (OR = 0.743, 95% CI: 0.643–0.813), use of fluoridated toothpaste (OR = 0.657, 95% CI: 0.553–0.931) and regular oral examinations (OR = 0.443, 95% CI: 0.352–0.747) were protective factors against dental caries (all $p<0.05$).

Conclusion Multiple factors result in early dental caries in preschool children aged 3–6 years; however, the most influential factors are older age and high snack consumption, as well as high sugary and sweet food/drink consumption.

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Keywords Preschool children, Caries, Influencing factors

Introduction

Oral health constitutes a critical component of overall health. Despite the escalating attention oral health is receiving, dental caries persist as the most prevalent health issue among children, particularly early childhood caries (ECC) [1]. The American Academy of Pediatric Dentistry defines ECC as the presence of one or more carious lesions, tooth loss due to caries or any filled tooth surfaces in primary teeth in children under the age of 6 years [2]. Deciduous teeth, the main masticatory organs in children aged < 10 years, can cause pain and mastication difficulties if affected by ECC and left untreated. Furthermore, developing ECC in these teeth can adversely impact the development of permanent teeth, resulting in malocclusion, potentially affecting weight gain and predisposing children to behavioural and psychological issues, all of which may severely hinder normal growth and psychosomatic health [3–6]. Due to the high prevalence of ECC among certain populations and the resulting potential impact on health, ECC has been universally recognised as an international public health issue [7, 8]. Early prevention and treatment of dental caries can foster healthy growth in children, improve their quality of life and alleviate the burden of healthcare costs.

Dental caries, a prevalent oral disease that can occur at any age, is influenced by a multitude of factors, especially among the paediatric population where the prevalence of caries is exceedingly high. Caries not only lead to tooth loss but also accompany conditions such as mastication and swallowing difficulties, pain and secondary complications, including pulpitis, infections and osteomyelitis of the alveolar bone [9]. Research indicates that the probability of caries in children exceeds 50% [10–12], with its prevalence fluctuating based on gender, dietary habits, residential area and ethnicity. In addition, the prevalence of caries tends to increase with age. Among the factors influencing the development of ECC, unhealthy dietary habits, improper tooth brushing techniques and inadequate awareness of the detriments of caries are all key determinants [13].

The onset of ECC is associated with multiple factors. Research initially linked ECC to improper or prolonged bottle or breastfeeding [14]. Bottle feeding, especially during night-time sleep, increases the risk of dental caries in children. However, this is neither the sole nor the primary cause of ECC formation. The intake of juices and carbonated beverages also correlates with the occurrence of ECC. Some studies argue that tooth brushing habits and frequency are associated with the onset and progression of caries [15]. The educational level of a child's parents also correlates with the occurrence and severity of ECC. Parents with lower levels of education tend to have children with higher rates of caries [16]. Additionally, ECC is more common in single-parent families, families where parents have a lower educational level and families where the mother is illiterate [17]. Therefore, the occurrence of ECC is related to feeding methods, dietary habits, oral hygiene behaviours and certain parental characteristics [14–17].

Delayed treatment of dental caries will not only cause pulpitis and periapical periodontitis but also affect the development of children; it will affect the eruption of permanent teeth and the development of the dental arch. In severe cases, it will induce bacteraemia and endanger a child's life [18]. Some foreign epidemiological surveys show that oral diseases, especially caries, are correlated with digestive, cardiovascular and immune system diseases [19]. Patients with a hiatus hernia often have severe tooth loss; individuals with gastroesophageal reflux disease exhibit noticeable caries; patients with gastrointestinal disorders and tooth loss have more severe gastric acid reflux than those patients without tooth loss; and patients with anorexia nervosa and bulimia nervosa have noticeable tooth loss in their oral cavities [20–22]. These studies suggest a possible link between caries and other diseases, indicating the need for simultaneous treatment of the consequences of both dental caries and systemic diseases [12].

Domestic research on the influencing factors of children's dental caries primarily focuses on the relationship between children's caries and gender, age, dietary habits, oral hygiene behaviours and the parents' attitudes towards children's oral health and oral health knowledge [23, 24]. There are also surveys analysing the correlation between preschool children's caries and the educational level of their parents, as well as their parents' knowledge, attitudes and behaviours related to the prevention and treatment of deciduous tooth caries [11, 24]. Overall, however, research in this area is not comprehensive enough. Based on previous research, the authors of this study hypothesise that multiple factors, including dietary habits, oral hygiene habits, socioeconomic factors (parental education) and the presence of *Streptococcus mutans*, lead to the high prevalence of ECC in preschool children (3–6 years old) in Xingtai City. It is further hypothesised that good oral hygiene habits (e.g. frequent brushing, flossing, mouthwash), healthy dietary habits (e.g. low sugar intake, frequent consumption of non-sweet snacks), higher parental education and regular dental care are protective factors against ECC. Therefore, this study performs relevant research to provide a reference for optimising the oral health status of preschool

children aged 3–6 years in Xingtai City and improving their oral hygiene level.

Study participants and methods

Study participants

This was a cross-sectional study. The participants of this research were preschool children aged 3–6 years in Xingtai City. A three-stage stratified random cluster sampling method was adopted. In the first stage, based on geographical location, a random sampling method was employed to sample from four districts and 12 counties under Xingtai City at a ratio of 1:4, resulting in a total of four sampled areas: Xiangdu District, Licheng County, Longyao County and Pingxiang County. In the second stage, a random sampling method was used to randomly select two preschools from each area, for a total of eight. In the third stage, a random cluster sampling method was applied to select one class from each of the small, medium and large classes in each preschool. Three classes were selected from each school, totalling 24 classes. A questionnaire survey was conducted for all related informants in the homes of the preschool children aged 3–6 years in each class (see Appendix 1 of the supplementary material for questionnaire details). The survey was conducted after the completion of oral health examinations in the children's garden, filled out by the individuals who usually care for the children and collected immediately after completion. Pass 15.0 software was used to calculate the sample size. The expected prevalence rate was 0.6, the expected effect size was 0.2, the significance level (α) was 0.05, the statistical power was 0.8, and considering the loss to follow-up rate of 0.3, the sample was calculated through the software. The volume requirement was at least 600 cases to meet the above study parameter requirements. A total of 600 people were surveyed, and 600 questionnaires were recovered, of which 570 were determined as valid. The valid recovery rate was 95%, and the non-response rate was 0%. The reasons for questionnaire exclusion were the lack of basic information completed (8), the inconsistency in the logic before and after the questionnaire (12) and the parents' unwillingness to accept a follow-up examination (10). This study was approved by the Ethics Committee of Hebei Eye Hospital. Written informed consent was obtained from all parents/local guardians of the children.

Research methods

Oral examinations were performed on all children by dentists specialising in stomatology from the research team's hospital dental clinic, and blood samples were collected for *S. mutans* detection. There was a total of six examiners – all dental clinical practitioners – and they received systematic training before conducting the questionnaire survey (i.e. the questionnaire survey process and clinical examination specifications). The examiners conducted mock checks to ensure their examinations were aligned. In the simulated inspection, the inspectors were tested for standard consistency, and the kappa value was 0.89. Caries examinations were conducted under natural light combined with a probe. The diagnostic criteria for caries were as follows [25]: cavities observable in the pits, fissures or smooth surfaces, enamel destruction or softening of the floor or wall of the cavity that can be probed. The decayed, missing and filled teeth (DMFT) index recommended by the World Health Organization is the most commonly used dental caries index in epidemiological studies and measures the prevalence of dental caries based on the presence of cavitation caries lesions. After the examination, the caries average (the sum of DMFT/number of examinees) was calculated based on the diagnostic results [25]. A detection kit was used to wipe the oral tooth surface and mucous membrane with a swab; the swab was then immersed in the culture medium and incubated anaerobically at a constant temperature for 48 h. The number of *S. mutans* present in the saliva was estimated based on the colour of the culture medium. *Streptococcus mutans* detection was completed, and the results were provided by the hospital's testing centre as required.

The survey questionnaire included the following content. (1) General situation: the child's gender, age, grade, whether they are an only child, whether the mother mainly takes care of the daily life and whether they live with the parents; parents' age, education and profession. (2) Children's oral health behaviours: tooth brushing habits, age of starting tooth brushing, mouth rinsing after meals, frequency of eating sweets and drinking sugary beverages. The questionnaires were distributed to the parents of the children by trained full-time staff who also guided the parents in filling them out.

Statistical analysis

Data were summarised using Excel 2019, and statistical analysis was performed using SPSS 26.00. In this study, the number of cases (%) was used for descriptive statistics of the count data, and the chi-squared test (χ^2) was used for a comparison between groups, expressed as the odds ratio (OR) (95% confidence interval [CI]). Binary logistic regression analysis was performed using the presence of dental caries (yes = 1, no = 0) as the dependent variable to identify significant suspected risk factors. The significant suspected risk factors in the single-factor analysis were coded. The variable grouping and coding are detailed in Table 1. A stepwise logistic regression analysis was also performed. The partial maximum likelihood estimation backward method (introduction standard $p \leq 0.05$, exclusion standard $p \geq 0.10$) was used to include and exclude these factors to construct a logistic regression analysis

Table 1 Variable grouping and encoding

Variable	Group	Value
Age	3	1
	4	2
	5–6	3
Father's Education Level	Elementary and below	1
	Middle school (junior high, high school)	2
	Associate degree	3
	Bachelor's degree and above	4
Mother's Education Level	Elementary and below	1
	Middle school (junior high, high school)	2
	Associate degree	3
	Bachelor degree and above	4
Daily Tooth Brushing Frequency	0	1
	1	2
	≥ 2	3
Age of Starting Brushing Teeth	< 2	1
	2–3	2
	> 3	3
Streptococcus Mutans Infection	Yes	1
	No	2
Rinsing Mouth After Meals	Yes	1
	No	2
Non-sweet Snack Eating Frequency	Multiple times a day	1
	Once a day	2
	Occasionally	3
Snack Flavor Preference	Likes sweets	1
	No preference for sweets	2
Use of Fluoride Toothpaste	Yes	1
	No	2
Regular Oral Examination	Yes	1
	No	2
Frequency of Sugary Drink Consumption	Once every 1–2 days and above	1
	Once every 3–4 days	2
	Once every 5–6 days and below	3
Frequency of Sweet Food Consumption	Once every 1–2 days and above	1
	Once every 3–4 days	2
	Once every 5–6 days and below	3

model. When $p<0.05$, the difference was statistically significant (both were two-tailed tests).

Results

Basic situation

Among the 570 respondents, 76.8% were mothers, 22.8% were fathers and 0.4% were others. The sampling survey results showed that among the 570 preschool children aged 3–6 years, 290 were boys (50.9%). There were 173 students in grade 1 of kindergarten (30.4%), 194 students in grade 2 of kindergarten (34.0%) and 203 students in grade 3 of kindergarten (35.6%). The age distribution was as follows: 145 were 3 years old (25.4%); 173 were 4 years old (30.4%); 198 were 5 years old (34.7%); and 54 were 6 years old (9.5%). The average age was 3.98±0.95 years. Out of all the children, 421 were only children (73.9%) and 149 had siblings (26.1%). In daily life, 386 were mainly taken care of by their mothers (67.7%). A total of 542 children lived with their parents (95.1%) and 28 did not live with their parents (4.9%).

Univariate analysis of caries risk factors

In this study, caries lesions were detected in 341 of the 570 preschool children (a prevalence rate of 59.8%). The results showed that there were statistically significant differences between the two groups in terms of age ($\chi^2=2.636$), father's education level ($\chi^2=4.207$), mother's education level ($\chi^2=4.217$), daily tooth brushing frequency ($\chi^2=3.160$), age when started brushing teeth ($\chi^2=8.756$), the proportion of mouth rinsing after meals ($\chi^2=89.401$), *S. mutans* positive ($\chi^2=133.503$), non-sweet snack consumption frequency ($\chi^2=5.962$), snack flavour preference ($\chi^2=116.119$), use of fluoridated toothpaste ($\chi^2=75.639$), regular oral examinations ($\chi^2=98.711$), sugary drink consumption frequency ($\chi^2=10.370$) and sweet food consumption frequency ($\chi^2=9.261$) (all $p<0.05$). No statistically significant differences were found between the two groups in terms of gender, the proportion of only-children, the proportion of mothers taking care of the children in daily life, the proportion of children living with their parents, the proportion of breastfeeding time and the proportion of malnutrition ($p>0.05$). See Table 2 for details.

Multifactorial analysis of caries influencing factors

The regression analysis results showed that older age (OR=5.342, 95% CI: 1.434–6.631) was an influencing factor. This indicates that older children are 5.342 times more likely to develop dental caries. Another influencing factor was the later initiation of tooth brushing (OR=3.244, 95% CI: 2.413–5.424), indicating that children who start brushing their teeth later are 3.244 times more likely to have caries compared with those who started earlier. Another influencing factor was *S. mutans* positivity (OR=5.357, 95% CI: 4.529–8.563), indicating that children who tested positive for the bacteria are 5.357 times more likely to have caries compared with those who tested negative. Children with a high snack consumption frequency (OR=3.452, 95% CI: 2.634–5.442) are 3.452 times more likely to have caries compared with those who have a lower snack consumption. In addition, children with a high sugary drink consumption frequency (OR=4.414, 95% CI: 2.534–6.451)

Table 2 Univariate analysis of factors influencing dental caries

Factors	Dental Caries Group ($n=341$) n (%)	Non-Dental Caries Group ($n=229$) *n* (%)	χ^2 Value	*P* Value
Gender (Male/Female)	181/160	99/130	3.307	0.069
Age (Cases)			2.636	0.008
3	80 (23.46)	65 (28.38)		
4	93 (27.27)	80 (34.93)		
5–6	168 (49.27)	84 (36.68)		
Only Child (Cases)	249 (73.02)	172 (75.11)	0.310	0.578
Mother as Primary Caregiver (Cases)	210 (61.58)	176 (76.86)	0.122	0.726
Father's Education level (Cases)			4.207	< 0.001
Primary School or Below	23 (6.74)	12 (5.24)		
Secondary School (Junior/Senior)	124 (36.36)	53 (23.14)		
Technical Secondary School	99 (29.03)	62 (27.07)		
University or Above	95 (27.86)	102 (44.54)		
Mother's Education level (Cases)			4.217	< 0.001
Primary School or Below	24 (7.04)	11 (4.80)		
Secondary School (Junior/Senior)	132 (38.71)	63 (27.51)		
Technical Secondary School	101 (29.62)	58 (25.33)		
University or Above	84 (24.63)	97 (42.36)		
Living with Parents (Cases)	325 (95.31)	217 (94.76)	0.088	0.767
Daily Toothbrushing Frequency (Times)			3.160	0002
0	10 (2.93)	4 (1.75)		
1	64 (18.77)	22 (9.61)		
≥ 2	267 (78.30)	203 (88.65)		
Starting Age for Toothbrushing (Years)			8.756	< 0.001
< 2	67 (19.65)	103 (44.98)		
2–3	118 (34.60)	98 (42.79)		
> 3	156 (45.75)	28 (12.23)		
Rinsing Mouth After Meals (Cases)	123 (36.07)	175 (76.42)	89.401	< 0.001
Duration of Breastfeeding (Months)			1.263	0.207
< 6	52 (15.25)	41 (17.90)		
6 ~ 12	121 (35.48)	87 (37.99)		
> 12	168 (49.27)	101 (44.10)		
Streptococcus Mutans Positive (Cases)	279 (81.82)	78 (34.06)	133.503	< 0.001
Frequency of Non-Sweet Snacks Consumption (Cases)			5.962	< 0.001
Multiple Times Daily	167 (48.97)	68 (29.69)		
Once Daily	112 (32.84)	72 (31.44)		
Occasionally	62 (18.18)	89 (38.86)		
Snack Flavor Preference (Cases)			116.119	< 0.001
Prefers Sweet Snacks	297 (87.10)	103 (44.98)		
No Preference for Sweet Snacks	44 (12.90)	126 (55.02)		
Use of Fluoride Toothpaste (Cases)	122 (35.78)	167 (72.93)	75.639	< 0.001
Regular Dental Check-ups (Cases)	107 (31.38)	169 (73.80)	98.711	< 0.001
Frequency of Sugar-Sweetened Beverages Consumption (Cases)			10.370	< 0.001
Once or Twice Daily or More	191 (56.01)	36 (15.72)		
Once Every 3 ~ 4 Days	102 (29.91)	91 (39.74)		
Once Every 5 ~ 6 Days or Less	48 (14.08)	102 (44.54)		
Frequency of Sweet Food Consumption (Cases)			9.261	< 0.001
Once or Twice Daily or More	182 (53.37)	41 (17.90)		
Once Every 3 ~ 4 Days	107 (31.38)	90 (39.30)		
Once Every 5 ~ 6 Days or Less	52 (15.25)	98 (42.79)		
Malnutrition (Cases)	56 (16.42)	34 (14.85)	0.213	0.644

are 4.414 times more likely to have caries compared with those who have a lower consumption. Another influencing factor was high sweet food consumption frequency (OR=4.531, 95% CI: 3.421–6.354), indicating that children with high sweet food consumption frequency are 4.531 times more likely to have caries compared with those who have a lower consumption. All of these results had *p*-values of <0.05 and were risk factors for caries. A high father's educational level (OR=0.724, 95% CI: 0.564–0.891) indicates that these children are less likely to have caries (by a factor of 0.724) compared with those who have fathers with a lower education level. A high mother's educational level (OR=0.641, 95% CI: 0.601–0.813) is similar to the educational level of fathers; children with mothers who have a higher education level are less likely to have caries (by a factor of 0.641) compared with those who have mothers with a lower education level. High daily tooth brushing frequency (OR=0.572, 95% CI: 0.423–0.864) indicates that children who brush their teeth more frequently are less likely to have caries (by a factor of 0.572). Children who rinse their mouths after meals (OR=0.743, 95% CI: 0.643–0.813) are less likely to have caries (by a factor of 0.743) compared with children who do not rinse after meals. The use of fluoridated toothpaste (OR=0.657, 95% CI: 0.553–0.931) indicates that children who use fluoridated toothpaste are less likely to have caries (by a factor of 0.657) compared with children who use non-fluoridated toothpaste. Children who have regular oral examinations are less likely to have caries (by a factor of 0.443) compared with those who do not (OR=0.443, 95% CI: 0.352–0.747) (all $p<0.05$). These factors are protective against caries, as shown in Table 3.

Discussion

Dental caries is the most common chronic non-communicable oral disease during childhood [26–28], severely affecting children's growth and development [29]. Despite the past efforts of dentists and researchers to combat dental caries, the prevalence remains high. Statistics show that 60–90% of children worldwide are affected by dental caries [30].

The findings of this investigation reveal that the prevalence of dental caries among preschool children aged 3–6 years in Xingtai City remains considerable; the prevalence also progressively rises with age, aligning with the results of other studies [31]. This finding may be closely associated with children's dietary preferences and parental habits. Existing research has confirmed *S. mutans* as the primary pathogen that causes dental caries. This bacteria adheres to the teeth's surface through both sucrose-dependent and independent mechanisms. Bacterial metabolism results in the production of acidic substances. If a tooth is exposed to an acidic environment for a prolonged period, the prevalence of caries increases [32]. Deciduous teeth emerge during infancy, representing a significant change in the oral environment from the neonatal period. This change provides optimal conditions and space for microbial growth. Microorganisms lingering on newly emerged deciduous teeth increase the prevalence of caries [33]. Dental caries exhibit extensive erosion, high morbidity and subtle early symptoms, but they quickly proliferate at later stages, affecting the normal development of children's teeth. Under normal conditions, oral physiological status maintains an ecological balance. However, when oral hygiene is poor or sugar intake substantially increases, the number of cariogenic bacteria in the plaque escalates, thereby increasing the prevalence of caries. Studies have proven that excessive daily sugar intake enhances the risk of caries [34]. Additionally, poor habits, such as neglecting to brush teeth before bedtime or rinsing the mouth after meals, significantly increase the risk of dental diseases. This study's results also indicate that mouth rinsing after meals, snacking, *S. mutans* infection, daily tooth brushing frequency, age when brushing started, usage of fluoridated toothpaste, preference for sweets or snacks and regular oral examinations are crucial factors influencing

Table 3 Multifactorial logistic regression analysis of factors affecting early childhood caries

Variables	β	S.E	Wald	OR	95%CI	*P* value
Age (years)	1.527	0.643	7.523	5.342	1.434 ~ 6.631	0.003
Father's Education Level	2.438	0.663	7.634	0.724	0.564 ~ 0.891	0.001
Mother's Education Level	0.924	0.674	8.143	0.641	0.601 ~ 0.813	0.013
Daily Tooth Brushing Frequency	0.627	0.642	7.744	0.572	0.423 ~ 0.864	0.027
Age of Starting Brushing Teeth	0.529	0.422	6.143	3.244	2.413 ~ 5.424	0.043
Streptococcus Mutans Infection	1.231	0.462	5.316	5.357	4.529 ~ 8.563	0.049
Rinsing Mouth After Meals	1.925	0.432	8.131	0.743	0.643 ~ 0.813	0.001
Snack Consumption Frequency	0.424	0.235	7.634	3.452	2.634 ~ 5.442	0.002
Use of Fluoride Toothpaste	0.526	0.754	7.233	0.657	0.553 ~ 0.931	< 0.001
Regular Oral Examination	1.627	0.744	8.131	0.443	0.352 ~ 0.747	< 0.001
Frequency of Sugary Drink Consumption	2.242	0.424	1.231	4.414	2.534 ~ 6.451	0.007
Frequency of Sweet Food Consumption	1.434	0.846	1.425	4.531	3.421 ~ 6.354	0.016

the prevalence of dental caries, all of which is consistent with related research findings [35]. Limiting children's intake of excessive sweets, controlling the daily consumption frequency and quantity of desserts, sugary drinks and snacks, as well as ensuring teeth cleanliness all have beneficial effects in preventing caries. Deciduous teeth are susceptible to caries and are more likely to experience recurrent caries disease after filling or preventative treatment than permanent teeth. Parents should take their children for regular oral examinations every 3–6 months. Regular group check-ups in kindergartens also represent an important aspect of dental caries prevention and treatment for children.

The correlation between the level of parental education and the prevalence of dental caries in children is receiving increased attention. Research indicates that children from families where the parents have a higher level of education have access to a good education and parental guidance, thereby reducing their chances of developing oral diseases [36]. Conversely, in families where parents have a lower level of education, the children are less likely to be equipped with appropriate oral health knowledge, which increases the probability of oral diseases. Herndon postulated that in addition to age, parental education and income are closely related to the prevalence of caries [37]. In addition, Mathur suggested that a low level of maternal education is significantly related to the occurrence of dental caries in children [38]. This study also found a significant correlation between the level of the mother's education and the prevalence of caries in preschool children aged 3–6 years: the higher the level of the mother's education is, the lower the prevalence of caries in preschool children aged 3–6 years. This is likely because individuals with a higher level of education often possess good oral health knowledge. This study found that the mother's educational level is positively correlated with oral healthcare knowledge in preschool children aged 3–6 years. The higher the level of maternal education is, the more oral healthcare knowledge they possess. The results of this study demonstrate that the higher the level of parental education is, the lower the probability that preschool children aged 3–6 years will develop caries.

The strength of the current study is that it used multivariate logistic regression analysis to examine the factors influencing the prevalence of ECC in preschool children. This approach allows for the assessment of the independent effects of various factors while controlling for the effects of other variables. This comprehensive analysis provides a clearer picture of the interplay between multiple risk and protective factors in the development of ECC from which reliable conclusions can be drawn, compared with studies that focus on a single factor at a time. By analysing the combined impact of multiple factors, we can go beyond simply identifying risk factors; insights into how these factors work together to increase or decrease ECC risk are easier to identify.

However, there are some limitations to this study. First, this research did not collect the oral health habits of every preschool child aged 3–6 years, necessitating further studies on the relationship between these habits and the prevalence of caries. Second, this study is based on the data analysis of preschool children aged 3–6 years in Xingtai City. The temporal relationship between exposure and outcome cannot be determined, and the influence of deciduous dental caries on the formation of permanent dental caries may exist. Finally, the research participants were preschool children aged 3–6 years sampled in the Xingtai City area; therefore, the results extrapolated to the population of preschool children aged 3–6 years in China may not be entirely representative.

Conclusion

The prevalence of early dental caries in preschool children aged 3–6 years is influenced by multiple factors, the most influential of which are older age, high consumption of snacks and high sugary and sweet food/drink consumption. Therefore, targeted health promotion and education should be strengthened to help children adopt a rational and standard diet and establish correct oral cleaning habits to reduce the prevalence of dental caries and improve children's oral health status.

Supplementary Information

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Supplementary Material 1

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Data availability

Data is provided within the manuscript or supplementary information files "Appendix 1 Childhood Caries Questionnaire".

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the Declaration of Helsinki. This study was approved by the Ethics Committee of Hebei Eye Hospital. Written informed consent was obtained from all parents/local guardians and their children.

Consent for publication
The manuscript is not submitted for publication or consideration elsewhere.

Competing interests
The authors declare no competing interests.

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