

Socioeconomic-related inequality in dental care utilization among preschool children in China

Qing Chang¹ | Xiaoli Gao² | Mengru Xu³ | Chunzi Zhang³  | Shuo Du³ |
Xing Wang⁴ | Xiping Feng⁵ | Baojun Tai⁶ | Deyu Hu⁷ | Huancai Lin⁸ | Bo Wang⁴ |
Chunxiao Wang⁹ | Shuguo Zheng³  | Xuenan Liu³ | Wensheng Rong³  |
Weijian Wang³ | Tao Xu³ | Yan Si³ 

¹Department of Second Clinical Division, National Engineering Laboratory for Digital and Material Technology of Stomatology, Beijing Key Laboratory of Digital Stomatology, National Clinical Research Center for Oral Diseases, Peking University School and Hospital of Stomatology, Beijing, China

²Department of Anesthesiology, Beijing Chaoyang Hospital, Capital Medical University, Beijing, China

³Department of Preventive Dentistry, National Engineering Laboratory for Digital and Material Technology of Stomatology, Beijing Key Laboratory of Digital Stomatology, National Clinical Research Center for Oral Diseases, Peking University School and Hospital of Stomatology, Beijing, China

⁴Chinese Stomatological Association, Beijing, China

⁵Shanghai Ninth People's Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China

⁶School & Hospital of Stomatology, Wuhan University, Wuhan, China

⁷West China School of Stomatology, Sichuan University, Chengdu, China

⁸Guanghua School of Stomatology, Hospital of Stomatology, Sun Yetsen University, Guangzhou, China

⁹Chinese Center for Disease Control and Prevention, Beijing, China

Correspondence

Tao Xu and Yan Si, Department of Preventive Dentistry, National Engineering Laboratory for Digital and Material Technology of Stomatology, Beijing Key Laboratory of Digital Stomatology, National Clinical Research Center for Oral Diseases, Peking University School and Hospital of Stomatology, Beijing, China.
Emails: t-xu@live.com (T. X.); siyanyy@163.com (Y. S.)

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Abstract

Objectives: This study aimed to investigate socioeconomic-related inequality in dental care service utilization in the past 12 months among Chinese preschool children and to explore the contribution of various factors to this inequality.

Method: A total of 40 305 children aged 3-5 years from 372 kindergartens who participated in the Fourth National Oral Health Survey in China were included in the final analysis. The method of data weighting in complex sampling was adopted to make the samples more representative. Erreygers-corrected concentration index (EI) was used to measure socioeconomic-related inequality in dental care service utilization. The horizontal inequality index (HI) was employed to analyse horizontal inequality. Decomposition analyses were conducted to explore the contributions of income level, need variables (dmft, caregiver-evaluated oral health status and toothache experience) and nonneed variables (caregiver education level, residential location, age, and sex) to the inequality of health service utilization.

Result: The utilization of oral health services within the past 12 months among the high-, middle- and low-income groups was 17.4% (95% CI: 15.6-19.3), 13.6% (95% CI: 12.2-15.1) and 9.4% (95% CI: 8.1-11.0) respectively. The concentration curve was below the line of equality, and the EI and HI were 0.072 and 0.078, respectively,

Qing Chang and Xiaoli Gao are co-first authors.

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indicating that dental care utilization in children aged 3-5 years was concentrated in those who were better off. The contribution of the need variables to socioeconomic-related inequality in dental services was minimal, and most dental care utilization inequality could be explained by household income, caregiver education attainment and urban-rural disparities, accounting for 32.0%, 49.4% and 20.4% respectively.

Conclusion: This study reveals the existence of pro-rich inequality in dental care utilization among preschool children in China. The decomposition analysis suggests that income, caregiver education background and urban-rural disparities are the main factors contributing to this outcome. Equity-oriented policies and programmes are needed to achieve equitable dental care utilization.

KEYWORDS

China, dental care utilization, inequality, preschool children

1 | INTRODUCTION

Equity is an important indicator of the degree of societal progress. It is one of the important goals pursued by governments in the field of health to ensure that all members of society receive fair and effective health services. According to a report by the World Health Organization (WHO) and the Swedish International Development Cooperation Agency (SIDA) in 1996, equity in health service utilization means that all demanders have the same opportunity to obtain health services and includes horizontal and vertical fairness.¹ Horizontal equity means that people with the same health service needs can obtain the same or similar health services, while vertical equity means that people with different health service needs can obtain different health services.² In research on the equity of health services, the horizontal equity of health services is of greater concern, and health policies tend to improve horizontal equity to ensure that those with the same needs receive the same services.

Health systems in many countries aim to supply equal access to medical and dental services for all residents, reducing differences in health based on geography, ethnicity and socioeconomic status.³ Although individuals should receive dental services as needed regardless of their socioeconomic status, there is evidence that dental care utilization is not distributed equally across different socioeconomic groups in various countries.⁴⁻⁸ A systematic review and meta-analysis of 117 studies indicated that dental care utilization is highly impacted by social, ethnic, economic and educational conditions.⁴ In addition, socioeconomic inequalities in dental service utilization in children have been identified in most developed and developing countries,⁹⁻¹³ such as the UK, Spain and Thailand. In China, the prevalence of children aged 5 years with dental caries increased from 66.0% in the Third National Oral Health Epidemiological Survey (2005) to 71.9% in the Fourth National Oral Health Epidemiological Survey (2015).^{14,15} However, only 15% of children in the Third National Oral Health Epidemiological Survey and 14.6% in the Fourth National Oral Health Epidemiological Survey have visited dentists in the past 12 months. There is a

growing need for dental services among Chinese children, but the utilization of such services by children remains at a relatively low level and is influenced by socioeconomic factors. Utilization differs between urban and rural areas.⁷ Based on the Third National Oral Health Epidemiological Survey in China, 21% of urban children have seen a dentist, while only 9% of rural children have access to a dentist.¹⁴ According to previous studies, dental service utilization among Chinese preschool children may be influenced by caregiver education background, socioeconomic status, perception of their children's oral health status, dental insurance dental fear and demographic factors.¹⁶ Although some studies have found socioeconomic-related inequalities in dental service utilization among adults in China,¹⁷⁻¹⁹ the evidence related to inequality in children's dental service utilization is insufficient.

In recent years, the Chinese government has begun to pay attention to health inequality, and health system reforms were implemented in 2009; as a result, 90% of people are now covered by basic medical health insurance. Although there are two major public health insurance plans for children under 5 years old, the Urban Resident Basic Medical Insurance (URBMI) and the New Cooperative Medical Scheme (NCMS), these plans cover payments only for basic dental healthcare, such as tooth extraction, caries restoration with amalgam or a cheaper composite resin, and several simple dental procedures.²⁰ More than 85% of dental care costs are paid out of pocket.²¹ Furthermore, few people in China have private dental health insurance. Low-income families cannot afford high dental service costs, which represents a serious obstacle to dental service access. If this phenomenon is allowed to continue, the inequality of dental care utilization may continue to increase.

The concentration index (CI), enjoying increasing popularity, has been used to quantify and measure inequality in dental care service utilization, represent inequality visually by means of the concentration curve and identify the factors contributing to inequality in previous studies.^{19,22-24} Inequality in dental care utilization among Chinese adults has been measured in previous studies by means of CI.¹⁷⁻¹⁹ However, evidence related to inequality in dental care

utilization among Chinese preschool children is lacking. Recognizing inequality in dental care utilization among Chinese preschool children and exploring each factor's contribution to this inequality are important to determine what policies may best reduce inequality. Thus, the aim of this study was to investigate socioeconomic-related inequality in dental care service utilization in the past 12 months among Chinese preschool children and explore the contribution of various factors to inequality.

2 | METHOD

The targeted subjects were 3- to 5-year-old children. The data were extracted from the Fourth National Oral Health Survey (2015), which used a multistage, stratified, random, equal proportion sampling method. With reference to the Third National Oral Health Survey (2005), the prevalence of dental caries experience among 5-year-old children was 66%. By considering the estimated caries prevalence rate, a design effect setting of 4.5, a 95% confidence interval setting of 10% with two sides and a nonresponse rate of 20%, the sample size was 13 392 for each age group. All 31 provinces, autonomous regions and municipalities in mainland China were included. First, two urban and two rural districts were randomly selected in each province using probability proportional to size (PPS) sampling. Second, three streets in each urban district and three townships in each rural district were selected using PPS sampling. Third, one kindergarten was randomly selected in each subdistrict. Finally, 36 children with an equal sex distribution of each age group (3, 4 and 5 years) were recruited randomly at each kindergarten using cluster sampling. The detailed sampling methods have been presented in previous articles.^{15,25-27} After parents signed the informed consent form, a total of 40 305 children from 372 kindergartens including public and private were included in the final analysis. The statistics from the sixth census were obtained online from the National Bureau of Statistics to compute the survey weight based on the respondents' province, residential location (urban or rural area), age and gender to obtain an unbiased estimation.²⁸ The study was approved by the Ethics Committee of the Chinese Stomatological Association, Beijing (No. 2014-003).

All participants were clinically examined by trained dentists using disposable dental mirrors and community periodontal index (CPI) probes under artificial light. Caries was assessed in the form of the dmft index according to the WHO criteria.²⁹ The mean inter- and intraexaminer kappa values were higher than 0.8 for dental caries examinations.

The structured questionnaire was revised after the pilot study. Children's caregivers (30 594 parents and 9709 grandparents) were interviewed face to face to answer the questionnaires at the survey site supervised by two or three trained and certified interviewers. The questionnaire included questions about the children's demographic information, number of family members, household income, caregiver education level, toothache experience, caregiver evaluated oral health status and dental visit experience. However,

1362 data points on the number of family members and 14 982 data points on annual household income were missing. The expectation maximization (EM) algorithm was applied to account for the missing values to estimate the parameter more accurately.

The caregivers' perception of their children's oral health was categorized into good, fair, middle and worse or bad. The toothache experience was grouped into never, occasionally, often and unknown. The education level was classified as: junior high school or low, senior high school and college and above. The region of participants' residence was classified into east, middle and west according to the China Health Statistical Yearbook of 2013. We sorted the population by per capita household income and then divided it into three equal parts by the number of people: a high-income group (>25 000 Yuan), a low-income group (<12 500 Yuan) and a middle-income group (12 500-25 000 Yuan). Descriptive analyses were performed to characterize each study variable. Chi-square tests were subsequently used to analyse the association between the different income groups. Statistical significance was set at .05. We examined whether each variable was related to per capita household income.

The inequality of dental care utilization was measured by concentration curves and the Erreygers-corrected concentration index (EI). The concentration curve plots the cumulative proportion of dental service utilization (y-axis) against the cumulative percentage of the population, starting with the poorest and ending with the richest (x-axis).³ The CI is defined as twice the area between the concentration curve and the equality line (the 45-degree line), ranging from -1 to 1. If there is no socioeconomic-related inequality, the concentration curve will be a 45-degree line known as the line of equality, and the CI will be zero. When the curve lies above (below) the line of equality, the index is negative (positive), indicating a disproportionate concentration of dental service utilization among the poor (wealthy).³ Since dental care utilization served as an outcome variable and is a binary variable,^{30,31} EI was applied in this study to correct the CI.²² The natural log of annual household income per capita was used to compute the EI.

We explain socioeconomic-related inequality in dental care utilization by using the CI. Decomposition analyses can be used to decompose the concentration index to discover the contribution of various determinants to inequality.³ The explanatory variables included need variables (dmft index, caregiver-evaluated oral health status and toothache experience), socioeconomic status (annual household income per capita) and other nonneed variables (caregiver education background, residential location, region, age and sex). Whether an individual had visited a dentist within the past 12 months served as an outcome variable to estimate dental care utilization (yes or no). In this study, inequality was decomposed into three sources: (i) the contribution of socioeconomic status, (ii) the contribution of need variables and (iii) the contribution of other nonneed variables.³² Each contribution is the product of the sensitivity of dental care utilization for that factor and the degree of socioeconomic-related inequality. A probit model was used for the decomposition of the CI and EI.

Individuals with worse oral status usually need greater dental care utilization, which cannot be described as inequality. Horizontal equality means that individuals with equal health needs obtain equal medical care. Horizontal inequality can be measured by calculating the EI for need-standardized dental care utilization, which can be obtained by eliminating the contribution of the need variable from overall inequality.³ The horizontal inequality index (HI) is similar to the concentration index. When the index is negative (positive), the inequality is pro-poor (pro-rich).

All statistical analyses were conducted using STATA SE 15.0. The code for decomposition was obtained from the guide to health equity analysis.

3 | RESULTS

Descriptive statistics of the study sample are presented in Table 1. There were more males than females in the different income groups. The age distribution was roughly equal. The higher the income, the higher the proportion of people with advanced education. The middle- and low-income group had the largest proportion of people with a junior high school education or below, while the high-income group had the largest proportion of people with a college education or higher. There were more children living in rural areas in the middle- and low-income groups than in urban areas, while the high-income group showed the opposite result. The low-income group had the largest number of people living in western China, while the high-income group had the largest number of people living in eastern China. The percentages of individuals who used oral health services within the past 12 months in the high-, middle- and low-income groups were 17.4% (95% CI: 15.6-19.3), 13.6% (95% CI: 12.2-15.1) and 9.4% (95% CI: 8.1-11.0) respectively. Dental utilization in the past 12 months increased with annual household income per capita. The chi-square result shows that age and gender were not significantly related to income; however, caregivers' education level, rural-urban locations, the region of China where the children lived and dental care utilization in the past 12 months were significantly associated with annual household income per capita.

The concentration curve lay below the line of equality (Figure 1), indicating that dental care utilization was concentrated in children from high-income families. The positive EI value was 0.072 (Table 2), indicating that pro-rich inequality in the use of oral health services existed among children aged 3-5 years. After correcting the need difference, the HI value remained positive and significant at 0.078 (Table 2). This indicates that the pro-rich trend was maintained even after controlling for the need variables.

The result of decomposition analyses for dental care utilization is shown in Table 3. Caregivers' perception of their children's oral health, toothache experience and dmft had negative contributions, suggesting that they decreased pro-rich inequality in dental care utilization. The contribution of the need variables to socioeconomic-related inequality in dental services was minimal,

and most dental care utilization inequality could be explained by household income, caregiver education attainment and residential location. The dominant contributors to inequality in dental care utilization among children aged 3-5 years were their caregivers' educational attainment and household income, accounting for 49.4% and 32.0% respectively. A higher education level made a considerable pro-rich contribution to inequality at approximately 46.0%. The contribution of residential location (urban or rural) to inequality accounted for 20.4%.

4 | DISCUSSION

In this study, we used the EI to measure socioeconomic-related inequality in dental care service utilization in the past 12 months among Chinese preschool children and to explore the contribution of various factors to this inequality. The results confirmed pro-rich inequality in dental care utilization, in accordance with earlier research.^{10,12} Moreover, even after correcting for differences in need, the findings showed a pro-rich inequality in dental care utilization. Furthermore, socioeconomic-related inequality in dental care utilization was decomposed to explore the contribution of various factors to this inequality. The findings indicate that income, education level and urban-rural disparities were important contributors to pro-rich inequality.

This study suggests that education is a marked contributor to inequality in access to dental care utilization. For preschool children, caregivers play an important role in their dental care utilization. Previous studies have shown that children whose caregivers are well educated are more likely to have dental visits.^{16,25,33-35} Educational background affects health literacy, health behaviour and health service utilization frequency and patterns.^{8,36} Highly educated caregivers may have better knowledge of oral health and a more positive attitude towards dental care utilization than less educated caregivers.^{35,37,38} In a prior study, using the same data source to investigate reasons for not visiting the dentist in the past 12 months, perceptions of 'no dental diseases' and that 'dental disease was not severe' were the main explanations, indicating caregivers' lack of oral health knowledge.²⁵ Inadequate knowledge of oral health and deficient health literacy may create barriers to dental care utilization among less educated populations. Therefore, higher education seems to make a positive contribution to the pro-rich distribution of dental care. The government should strengthen oral health education vertically and horizontally. Caregivers need to raise awareness of oral health care and acquire knowledge of oral health.

In addition, we found that household income contributes to the pro-rich inequality in dental care utilization, which is consistent with previous literature.^{7,10,13,25,39} A study in Belgium found that socioeconomically disadvantaged children not only have worse oral health but also tended to visit dental practitioners less frequently during the 5 years prior to data collection.¹² A cross-sectional study in Brazil found that the use of dental services was

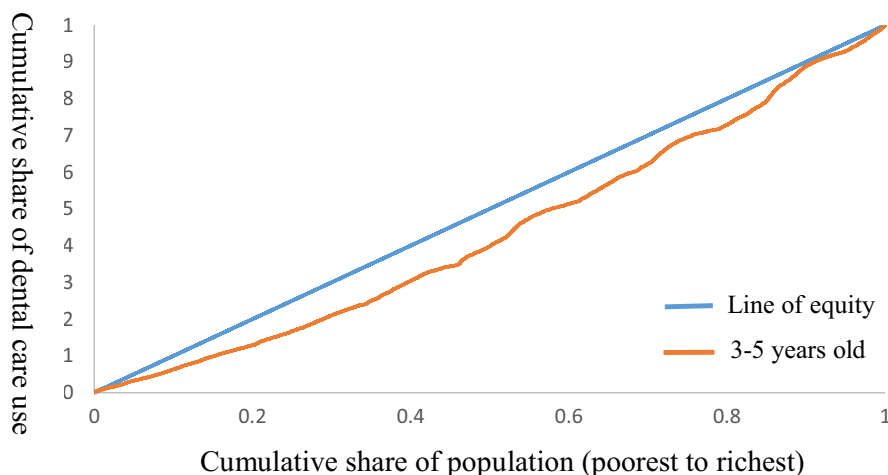
TABLE 1 Characteristics of the study population

	Low-income group	Middle-income group	High-income group	Overall
	% (95% CI)	% (95% CI)	% (95% CI)	
Gender				<i>P</i> = .9841
Male	54.4 (53.5-55.2)	54.4 (53.7-55.1)	54.5 (53.6-55.3)	54.4 (54.1-54.7)
Female	45.6 (44.8-46.5)	45.6 (44.9-46.3)	45.5 (44.7-46.4)	45.6 (45.3-45.9)
Age group				<i>P</i> = .5646
3	30.6 (29.3-31.9)	32.1 (31.0-33.2)	31.4 (30.2-32.7)	31.4 (30.9-31.9)
4	34.6 (33.6-35.7)	34.0 (32.9-35.0)	34.3 (33.2-35.5)	34.3 (33.9-34.7)
5	34.8 (33.2-36.4)	34.0 (32.9-35.1)	34.2 (33.1-35.4)	34.3 (33.9-34.8)
Education level				<i>P</i> < .001
Junior high school or low	70.1 (65.9-74.0)	44.6(40.9-48.4)	31.3 (26.9-36.1)	50.1 (46.0-54.2)
Senior high school	19.6 (17.2-22.3)	28.1(26.1-30.2)	25.7 (23.4-28.2)	24.4 (22.5-26.5)
College and above	10.3 (8.3-12.6)	27.3 (24.0-30.9)	42.9 (38.0-48.0)	25.5 (22.2-29.0)
Location				<i>P</i> < .001
Urban	26.1 (18.7-35.1)	43.8 (35.7-52.3)	58.4 (50.6-65.7)	41.4 (34.9-48.3)
Rural	73.3 (64.9-81.3)	56.2 (47.8-64.3)	41.7 (34.3-49.5)	58.6 (51.7-65.2)
Region				<i>P</i> = .001
West	42.2 (28.0-57.8)	22.2 (14.9-31.8)	18.8 (12.7-27.1)	28.4(19.7-39.2)
Middle	32.6 (19.6-49.1)	37.5 (25.7-51.1)	32.0 (22.0-44.0)	34.3 (23.9-46.5)
East	25.2 (14.8-39.4)	40.2 (28.9-52.7)	49.2 (37.5-60.9)	37.3 (27.0-48.9)
Dental care utilization in past 12 months				<i>P</i> < .001
Yes	9.4 (8.1-11.0)	13.6 (12.2-15.1)	17.4 (15.6-19.3)	13.1 (11.8-14.5)
No	90.6 (89.0-92.0)	86.4 (84.9-87.8)	82.6 (80.7-84.5)	86.9 (85.5-88.2)

Note: Annual household income per capita less than 12 500 is the low-income group, and more than 25 000 is the high-income group. The middle-income group is between 12 500 and 25 000. *P* values are based on chi-square tests for categorical variables.

Abbreviation: CI, confidence interval.

FIGURE 1 Concentration curve of the dental care utilization of 3- to 5-year-old children [Colour figure can be viewed at wileyonlinelibrary.com]



greater among children with a higher family income during early childhood.¹⁰ Children from families with high household incomes have a higher probability of dental visits.^{11,40} In low-income families, individuals not only lack access to dental services but may also be more likely to seek dental treatment rather than prevention.^{10,11} Income differences have an effect on the priority a family gives to oral health and the resources dedicated to it.³⁷ Meeting basic

living needs is more important than oral healthcare for low-income families. Furthermore, the cost of dental treatment is usually high and is often not covered or only partially covered by health insurance plans.²⁰ High out-of-pocket costs create a substantial economic barrier to access to dental visits for the poor. Affordability is typically a major reason for the lack of access to dental services. Studies have shown that increasing the coverage of oral health

insurance is one way to reduce the impact of income on inequality in dental service utilization.

The study confirmed that education and income are both significant determinants of dental care utilization inequality in China. The contribution of income to dental service inequalities can be explained by increased access to dental care services with increased income, whereas education allows for the acquisition of nonmaterial resources (such as knowledge and attitude) that promote better navigation of health resources and seek dental services. The

combination of education and availability of financial resources may enable healthier lifestyle choices, especially for behaviours that involve the dental care system.³⁷

The difference between rural and urban areas contributed to the inequality in dental service utilization, which favoured the rich. Health resources are unevenly distributed across the country. The disparity in the utilization of urban and rural health services may be related to the local economic level and the distribution of health resources.⁴¹ Gillian Jean et al⁴² found inequality in the distribution of dentists relative to socioeconomic factors. Shortages of dentists exist in rural areas, which produce barriers to dental care. Rural children were found to have higher odds of lacking access to dental services than urban children.⁴³ One study demonstrated that the density of paediatric dentists influences dental care utilization among underserved children.⁴⁴ The availability of dentists may be better in urban areas, which contributes to inequality. Moreover, caregivers in urban areas have more oral health information and better attitudes towards children's oral health than caregivers in rural areas.⁴⁵ Therefore, caregivers in urban areas may have a higher perceived need and may be more

TABLE 2 Concentration index by income

	Erreygers-corrected concentration index	Horizontal inequality
3 years old	0.064 (0.049-0.079)***	0.066 (0.051-0.081)***
4 years old	0.066 (0.050-0.081)***	0.075 (0.060-0.091)***
5 years old	0.092 (0.075-0.110)***	0.095 (0.073-0.1124)***
Overall	0.072 (0.063-0.081)***	0.078 (0.068-0.087)***

*** $P < .001$.

TABLE 3 Decomposition of Erreygers-corrected concentration index for dental care utilization among preschool children in China

Variables	Elasticities	CIs	Contributions	percentage contribution(%)
Income ^a	0.4556***	0.0504	0.023	31.96
Need variables				
Caregiver-evaluated oral health status (good)				-4.17
Fair	0.0122	0.0407	0.0005	0.69
Middle	0.0587***	-0.0321	-0.0019	-2.61
Worse or bad	0.0591***	-0.0274	-0.0016	-2.25
Toothache experience (never)				-0.54
Occasionally	0.1661***	0.0167	0.0028	3.84
Often	0.0405***	-0.0776	-0.0031	-4.38
Unknown	0.0015	-0.0037	<-0.0001	<-0.01
dmft (0)				-3.14
>0	0.0935***	-0.0242	-0.0023	-3.14
Other variables				
Gender (Male)				<0.01
Female	-0.0018	-0.0007	<0.0001	<0.01
Education level (junior high school or low)				49.37
Senior high school	0.0354***	0.0676	0.0024	3.33
College and above	0.1042***	0.3179	0.0331	46.04
Location (Urban)				20.40
Rural	-0.1067***	-0.1376	0.0147	20.40
Region (west)				0.77
Middle	-0.0125	0.0039	<-0.0001	0.07
East	0.0031	0.1611	0.0005	0.70
Age group (3 years old)				-0.49
4 years old	0.0076	-0.0018	<0.0001	-0.02
5 years old	0.0346***	-0.0098	-0.0003	-0.47

Note: Aggregated contributions are in bold. *** $P < .001$.

^aNature log of annual household income per capita was calculated in the regression.

likely to take their children to the dentist. More interventions should be implemented to promote oral health education and improve primary dental care, thereby reducing the disparities in oral health resources.

In recent years, the Chinese government has begun to pay attention to fairness issues in the health field and to recognize the importance of oral health. In 2016, the Party Central Committee and the State Council issued the 'Healthy China 2030' Normative Outline, which put forward the goal of 'fairness and justice'. Additionally, in 2017, the General Office of the State Council announced 'China's Medium- and Long-Term Plan for the Prevention and Treatment of Chronic Diseases (2017-2025)', launching a special action of 'three reductions and three gains'. The above policies show that the Chinese government attaches great importance to oral health and oral health inequity. In the present study, we comprehensively and systematically studied the socioeconomic-related inequality in dental care service utilization by Chinese preschool children. This is the first time that national oral health epidemiological survey data have been used to conduct a fairness study. This study not only has a more cross-disciplinary nature but also deepens the understanding of the relevant factors behind the oral health behaviours of preschool children. Therefore, our study can provide evidence for further policy making.

However, it must be acknowledged that this study has several limitations. First, information about dental visits and some related variables was derived from self-reports by caregivers, which may have been inexact due to recall bias. Second, dental insurance is an important factor in equality analysis. Unfortunately, due to the lack of data, dental insurance was not included in this study. Third, only two participants did not answer the questionnaires. However, because information on the number of family members and annual household income is private, some of the data were missing, which could be a source of bias. Per capita household income was obtained by filling in missing values, which may have affected the accuracy of the results. Fourth, the study was cross-sectional in design, so we cannot establish a causal relationship between dental care utilization and the explanatory variables. Finally, other factors, such as the availability of dental care services and dental health resources, might affect dental care utilization. These factors were not included in the analysis because the questionnaire of the Fourth National Oral Health Survey (2015) did not cover related information. The availability of dental care services and dental health resources should be included in future studies.

5 | CONCLUSIONS

The study revealed the existence of pro-rich inequality in dental care utilization among preschool children. The decomposition analysis suggested that income, caregivers' educational background and urban-rural disparities were the main factors

contributing to this pro-rich inequality. Effective ways to improve the equality of dental utilization may be to improve financial and material resources for individuals, strengthen oral health education for caregivers and narrow the differences between urban and rural areas. Equity-oriented policies and programmes are needed to achieve equitable dental care utilization.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

AUTHOR CONTRIBUTIONS

YS designed the study. XW, XPF, BJT, DYH, HCL, BW, CXW, SGZ, XNL, WSR, WJW and YS contributed to the acquisition and interpretation of the data. QC, XLG, MRX, CZZ and SD analysed study data. QC and XLG wrote the manuscript. YS critically reviewed and revised the study. The final manuscript was approved by all authors.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the National Health Commission of the People's Republic of China. Restrictions apply to the availability of these data, which were used under license for this study. Data are available from the authors with the permission of the National Health Commission of the People's Republic of China.

ORCID

Chunzi Zhang  <https://orcid.org/0000-0001-7486-5136>

Shuguo Zheng  <https://orcid.org/0000-0001-6717-5196>

Wensheng Rong  <https://orcid.org/0000-0003-3804-4706>

Yan Si  <https://orcid.org/0000-0002-6657-6550>

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