

Dental Expenditure, Progressivity and Horizontal Inequality in Chinese Adults—Based on the 4th National Oral Health Epidemiology Survey

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Research article

Keywords: Dental expenditure, horizontal inequality, Kakwani index, decomposition of concentration index, socioeconomic determinants

Posted Date: May 8th, 2020

DOI: <https://doi.org/10.21203/rs.2.21024/v4>

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Version of Record: A version of this preprint was published at BMC Oral Health on May 11th, 2020. See the published version at <https://doi.org/10.1186/s12903-020-01128-0>.

Abstract

Background: The financial burden of oral diseases is a growing concern as the medical expenses rise worldwide. The aim of this study was to investigate the dental expenditure, analyze its progressivity and horizontal inequality under the general health finance and insurance system, and identify the key social determinants of the inequality for Chinese adults.

Methods: A secondary analysis used the data of 13,464 adults from the 4th National Oral Health Epidemiological Survey (NOHES) in China was undertaken. The dental expenditure was collected and divided into out-of-pocket and health insurance payments. Horizontal inequality index and Kakwani index were used to analyze the horizontal inequality and progressivity, respectively. The decomposition model of the concentration index was set up to explore the associated socioeconomic determinants.

Results: The results showed that a mean dental expenditure per capita of Chinese adults was \$20.55 (95% Confidence Interval-CI: 18.83,22.26). Among those who actually used dental service, the cost was \$100.95 (95%CI: 93.22,108.68). Over 90% of dental spending was due to out-of-pocket expenses. For self-reported oral health, the horizontal inequality index was -0.1391 and for the decayed tooth (DT), it was -0.2252. For out-of-pocket payment, the Kakwani index was -0.3154 and for health insurance payment it was -0.1598. Income, residential location, educational attainment, oral hygiene practice, self-reported oral health, age difference were the main contributors to the inequality of dental expenditure.

Conclusion: Dental expenditure for Chinese adults was at a lower level due to underutilization. The ratio of payments of dental expenditure and utilization was disproportional, whether it was out-of-pocket or insurance payment. Individuals who were more in need of oral care showed less demand for service or not required service in time. For future policy making on oral health, it is worth the effort to further promote the awareness of the importance of oral health and utilization of dental service.

Background

The financial burden of oral diseases is a growing concern as the medical fee rise worldwide. The World Health Organization (WHO) reported that the treatment of oral diseases was the 4th expense in most industrial countries [1]. In the latest research on the global burden of diseases, oral diseases affect the lives of 3.5 billion people worldwide and become a global public challenge[2, 3]. An up-to-date economic estimation claimed that direct treatment costs due to dental diseases worldwide were estimated at 298 billion US dollars(USD) yearly, corresponding to an average of 4.6% of global health expenditure[4]. Another study demonstrated that severe teeth loss was found to imply 67% of losses of global productivity, followed by severe periodontitis (21%) and untreated caries (12%)[5].

Significant inequalities exist in oral health, such as oral health condition, utilization of services and unbalanced expenditures distribution among populations. Low socioeconomic status was found associated with severe caries and less utilization of dental services[6, 7]. Social and demographic factors affect the use of dental services, both directly and through insurance participation[8]. Income inequality is

a potential influence in both social status and utilization of oral health [9]. Dentistry is often unaffordable and/or unavailable, particularly for those in the poor rural areas in the low- or middle-income countries [10].

From 2009, the Chinese government deepened the reform of the medical health care system in which the basic medical health insurance structurally covered 90% of people[11]. However, most of them are not covered for oral diseases and over 85% of dental expenditure are out-of-pocket payments[12]. It is imperative to further analyze and improve the current situation in order to provide equality in health care including oral health.

In the previous NOHES in China, the income-related inequality in oral health was not evaluated[13]. The 4th NOHES conducted in 2015-2016 firstly surveyed this subject to provide information for the future development of oral health-related policies.

This study mainly used the data from the 4th NOHES for secondary analysis aiming to describe the dental expenditure, analyze its progressivity and horizontal inequality, and identify the relevant social determinants for oral health for Chinese adults such as income or health insurance.

Methods

Due to technical limitations, the Methods section is available as a download in the Supplementary Files.

Results

The total dental expenditure per capita was \$20.55(95%CI: 18.83,22.26) for all participants and \$100.95(95%CI: 93.22,108.68) for those who used dental service in the past year. More than 90% of dental expenditure was paid out-of-pocket. The dental expenditure per capita accounted for approximately 4.08% of the total medical expenses per capita. 96.9% of the 13464 participants were enrolled in the basic health insurance, only 2.2% participants did not register in any insurance. However, 77.8% of 2740 who used dental service in the past year reported they paid out-of-pocket for dental service but among these participants, only 2.6% were not enrolled in medical health insurance.

The household income quintile bar charts (Figure 2) showed the trends of dental expenditure, need and service utilization as income level rise. For horizontal analysis, utilization of dental service increased and dental need decreased as the household income level increased. The quintile with the highest prevalence of bad self-reported oral health obtained less utilization of dental service. At the same time, the quintile with less DTuired more utilization of dental service. The proportion of dental expenditure in household income declined as household income level raised. For the poorest quintile in those who used dental service in the past year, such proportion was more than 7% but for the richest this number was less than 1%.

The analysis results showed in Table 1 also demonstrated the inequality in dental expenditure. And the concentration curves showed in Figure 3 were consistent with such results. For self-reported oral health, the horizontal inequality index was -0.1391 and for decayed tooth (DT), it was -0.2252. For out-of-pocket payment, the Kakwani index was -0.3154 and for health insurance payment it was -0.1598. The Kakwani indices and Horizontal inequality indices were negative and statistically significant. Medical care was in favor of the rich but medical need was concentrated in the poor. However, the distribution of self-reported oral health trended to be more balanced. People's assessment to their oral health was more optimistic. Out-of-pocket payments and health insurance payments both benefit the rich, but the former is more concentrated among the rich. In Figure 3, the distribution of the total dental expenditures in both all participants and those who used dental service in the past year were similar to the out-of-pocket payment. The difference was that inequality appeared to be expanding among the population who used dental services.

Discussion

The result from two decomposition models showed high consistency and reliability. Socioeconomic level directly contributed to the inequality of oral medical expenditure. The major contribution from household income, residential location and education attainment indicates the social class determined the inequality of dental expenditure. The positive contribution of teeth brushing habits means that good oral hygiene concentrated in the rich. In the three basic medical insurances, the contribution of the UEBMI was definite in both two models and the contribution of NRCMC seemed important in model 2. Combined with other descriptive results, it may only mean that the UEBMI had a higher capacity to share the financial risk of dental visits than the NRCMC.

The policy of comprehensively deepening medical reform in China has been implemented continuously but we cautiously think about that policy such as increasing the reimbursement ratio of basic medical insurance may not be effective for the equality of dental expenses because of the treatment-oriented utilization model remained unchanged. In the further oral health-related insurance system adjustment, the redistribution of medical expenditure through health insurance needs taking into account socioeconomic factors such as household income, residential location and education attainment.

Limitation

For the first time, this study used a national epidemiological survey data to conduct an equality analysis of health financing for oral diseases. Biases in recall and report were unavoidable in such a cross-sectional survey. In this study, only the questions of the expenditure in the past year was answered to minimize potential recall bias. Besides, logically dental expenditure was made from utilization of dental service, the results of a full sample analysis could be diluted. Thus, one sample with all participants and the other with only those who used dental service in the past year were modeled and analyzed, respectively. The results from the two models showed consistency which supports the reliability of the study.

Based on the limitations of the survey data, the household income was used in this study to represent the ATP. In future research, variables such as wealth deposits and non-food expenditures and income may comprehensively reflect the ATP.

Conclusion

Dental expenditure for Chinese adults was at a lower level due to the underutilization of dental service. The ratio of payments of dental expenditure and utilization was disproportional, regardless it was from out-of-pocket or insurance payment. Individuals who were more in need of oral care showed less demand for service or received dental services untimely. The service inequality was not in favor of low incomes. For future policy making, it is worth the effort to raise the public awareness of the importance of oral health and change the oral care model from treatment-oriented to preventive-initiated, and aid to set a habit for regular dental visits. If an oral health-related insurance system could be adjusted, socioeconomic status should be taken into account as it appears to be the main determinant of dental expenditure.

Abbreviations

ATP (Ability to pay)

CI (Confidence Interval)

DT (Decayed teeth)

HI (horizontal inequality)

NOHES (National Oral Health Epidemiology Survey)

NRCMC (New Rural Cooperative Medical Care)

RMB (Chinese Yuan)

USD (US Dollar)

UEBMI (Urban Employee Basic Medical Insurance)

URBMI (Urban Residents Basic Medical Insurance)

WHO (World Health Organization)

Declarations

Ethics approval and consent to participate

Ethical approval (Approval No: 2014-003) for the study was received from the Ethics Committee of the Chinese Stomatological Association and written informed consent was obtained from each participant.

Consent for publication

Not Applicable.

Availability of data and materials

The database of the 4th NOHES should not be shared publicly as it is a national database and the copyright does not allow. More relevant information about the NOHES can be provided in the official report[29]. The Census data is shared online as a reference[16].

Competing interests

We declare no competing interests.

Funding

The NOHES was funded by the “Scientific Research Fund of National Health Commission of the People’s Republic of China (201502002)”. The funder gave financial support in design, implementation and data acquisition for the whole epidemiology survey.

Acknowledgments

The study was one of the series of articles on the results of the 4th NOHES and thanks to all the colleagues who worked hard throughout the study.

Authors' contributions

MC: Contributed to data analysis, drafted and critically revised the manuscript. CW: Contributed to the conception, design and data acquisition. XW, XF, BT, DH, HL, BW, WW, SZ, WR, XL: They were members of the expert group of the NOHES and were contributed to the design, quality control of the survey and data acquisition. YS: Contributed to the design of the research content and critically revised the manuscript. TX: Contributed to revised the manuscript. All authors have read and approved the manuscript.

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Tables

Table 1 Shares of dental expenditure, utilization of dental service and dental need for all participants.

Quintiles	Household income	Vertical inequality items			Horizontal inequality items		
		Total dental expenditure	Out-of-pocket payment	Health insurance payment	Utilization in the past year	Self-reported oral health	DT
Poorest	3.18%	10.99%	11.09%	9.93%	14.50%	24.50%	23.73%
2 nd	4.42%	12.59%	13.03%	7.86%	18.74%	21.89%	22.90%
Middle	11.78%	18.45%	18.92%	13.41%	17.94%	20.89%	20.55%
4 th	24.16%	23.53%	23.62%	22.65%	22.43%	16.49%	18.67%
Richest	56.46%	34.44%	33.35%	46.15%	26.39%	16.23%	14.16%
Concentration index/Gini coefficient	0.4974	0.1952	0.182	0.3376	0.1215	-0.0176	-0.1036
(standard error)	-0.0039	-0.0309	-0.0325	-0.0621	-0.0128	-0.0021	0.0088
(p value)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Kakwani index/ Horizontal inequality index	/	-0.3022	-0.3154	-0.1598	/	-0.1391	-0.2252
(standard error)	/	-0.031	-0.0327	-0.0621	/	-0.0127	0.0152
(p value)	/	(<0.001)	(<0.001)	-0.01	/	(<0.001)	(<0.001)

Legend: All participants are sorted by household income from poor to rich and evenly divided into five groups. The proportion of interested variables of each group against the whole participants are recorded. Proportion for 'self-reported oral health' here refer to proportion of poor and very poor self-reported oral health population. Household income is the ranking and reference variable refer to the ability to pay.

Table 2 Decomposition of concentration index for dental expenditure.

Variables	Model 1				Model 2			
	Elasticities	Concentration indices	Contributions	Percentage of contributions	Elasticities	Concentration indices	Contributions	Percentage of contributions
Household income	0.0716	0.4975	0.0356	18.24%	0.0715	0.4757	0.0340	50.43%
Central region	-0.0838	-0.0565	0.0047	2.42%	-0.0811	-0.0312	0.0025	3.76%
Western region	-0.0166	-0.0884	0.0015	0.75%	-0.0141	-0.1092	0.0015	2.29%
Area-Urban area	-0.2886	-0.0554	0.0160	8.19%	-0.3363	-0.0441	0.0148	22.02%
Education	0.1227	0.1138	0.0140	7.15%	0.1575	0.0919	0.0145	21.48%
UEBMI	0.0109	0.2668	0.0029	1.49%	0.0413	0.1945	0.0080	11.92%
URBMI	-0.0064	0.0520	-0.0003	-0.17%	0.0007	-0.0071	0.0000	-0.01%
NRCMC	0.0036	-0.1825	-0.0007	-0.34%	0.0215	-0.2233	-0.0048	-7.12%
Other insurance	0.0162	0.3166	0.0051	2.63%	0.0122	0.2540	0.0031	4.60%
Age	0.3584	-0.0466	-0.0167	-8.56%	0.3578	-0.0373	-0.0133	-19.79%
Gender-Female	0.0707	-0.0125	-0.0009	-0.45%	0.0904	-0.0171	-0.0015	-2.30%
Nationality-Han	-0.0056	-0.0688	0.0004	0.20%	-0.0043	-0.2011	0.0009	1.27%
Teeth brushing habit-twice daily	0.0941	0.1494	0.0141	7.20%	0.1053	0.0995	0.0105	15.53%
Self-reported oral health	0.3398	-0.0176	-0.0060	-3.06%	0.4806	-0.0187	-0.0090	-13.32%
DT	-0.0062	-0.1036	0.0006	0.33%	-0.0002	-0.0914	0.0000	0.03%
Dental utilization	0.9682	0.1216	0.1177	60.28%	-	-	-	-
Residual			0.0072	3.70%			0.0062	9.22%
Total			0.1952	100.00%			0.0674	100.00%

Legend: Model 1 enrolled all participants and Model 2 enrolled those who used dental services in the past year.

The reference of central region and western region was eastern region, eastern region had higher economic development level.

Nouns after “-” for variables indicated the references for binary variables.

The UEBMI indicated urban employee basic medical insurance; the URBMI indicated urban resident basic medical insurance; the NRCMC indicated new rural cooperated medical care; other insurance included government medical insurance and private commercial insurance; they were binary variables in the decomposition and the reference was didn't covered by such insurance.

Figures

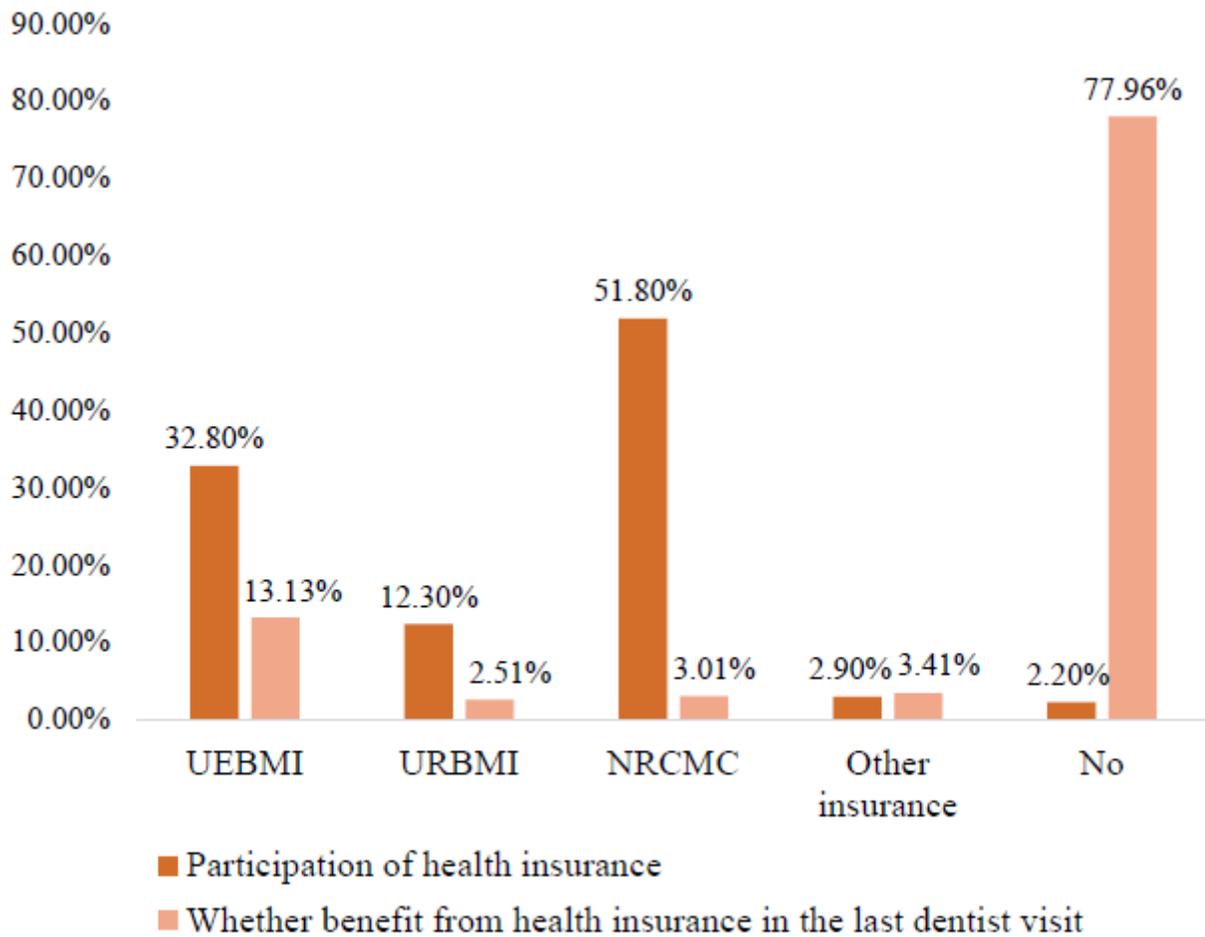


Figure 1

Distribution of different types of health insurance. Comparison between participation of health insurance in all participants (n=13464) and whether participants who used dental service in the past year (n=2740) benefit from these insurance in the last dentist visit. Other insurances include government insurance and private insurance and they are not conflict to the basic medical health insurance system.

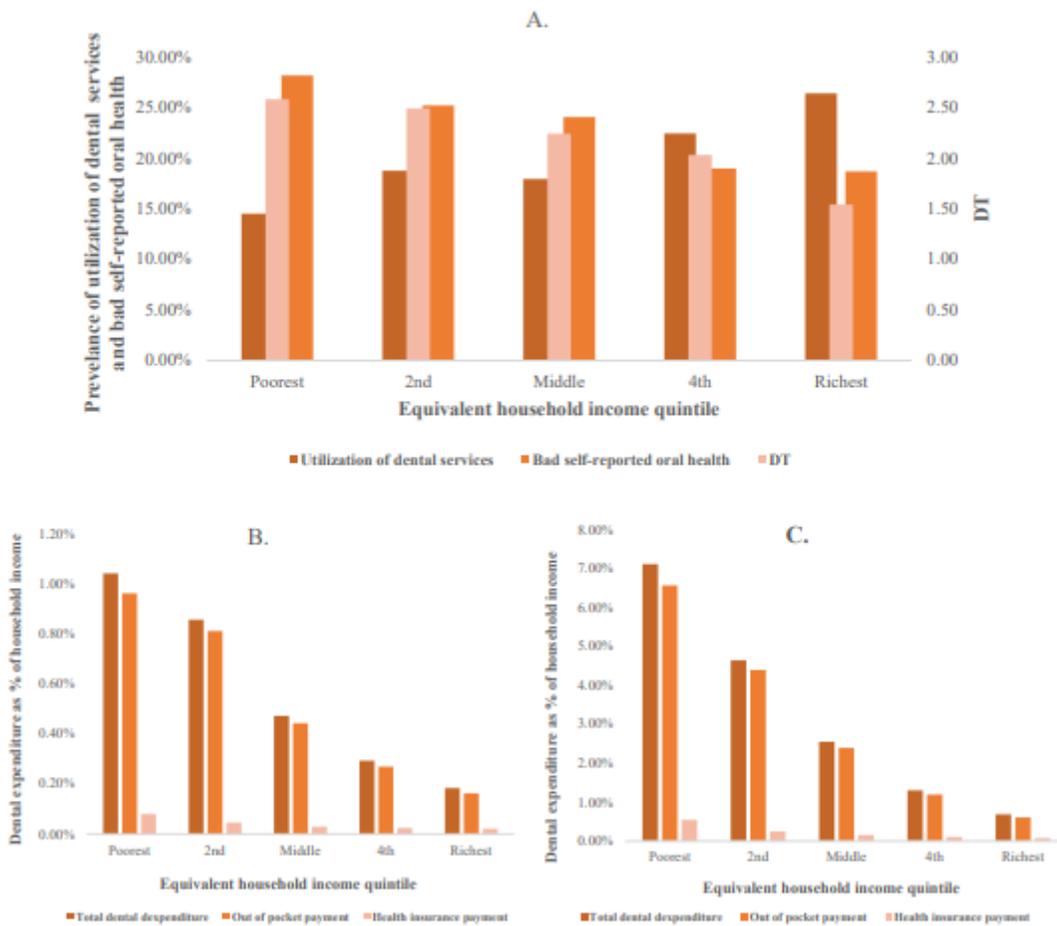


Figure 2

Dental expenditure, dental care and dental needs in different household income groups. (A) Different distributions of dental care and needs in household income groups from poor to rich. The utilization of dental service in the past year indicated the dental care, the DT and the bad self-reported oral health indicated evaluated and subjective dental needs, respectively. (B) Different payment routes as percentage of household income for all participants—averaged by household income quintile. (C) Different payment routes as percentage of household income for those who used dental services in the past year—averaged by household income quintile.

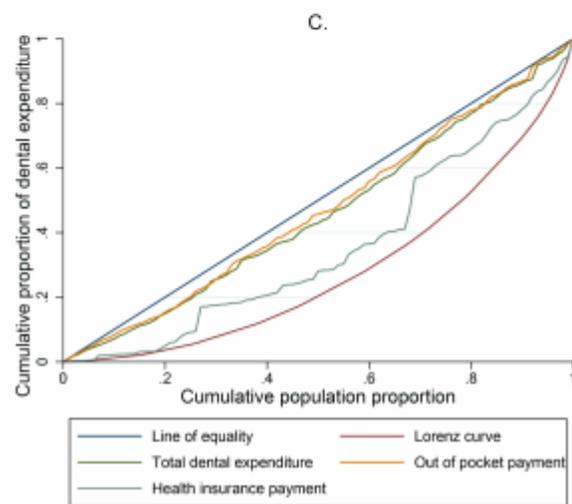
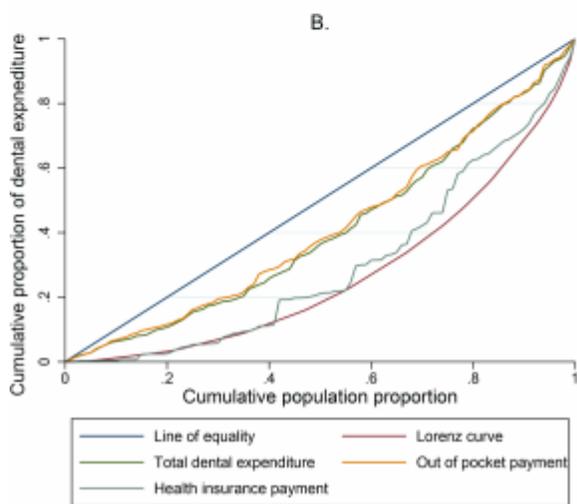
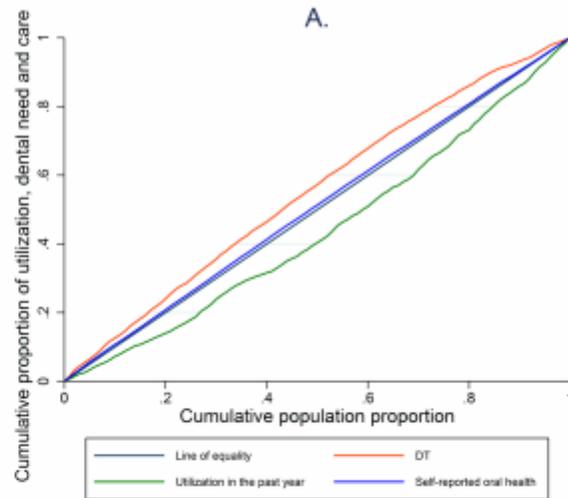


Figure 3

Concentration curves and Lorenz curve for dental expenditure, dental care and dental needs.

(A) Concentration curves for dental need and care. DT and self-reported oral health were variable referred to evaluated and subjective dental need, respectively. Dental services utilization in the past year referred to the situation of dental care. (B) Concentration curves for different payment routes and Lorenz curve for household income in all participants. (C) Concentration curves for different payment routes and Lorenz curve for household income in those who used dental services in the past year.

Supplementary Files

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- [Methods.docx](#)