Dental expenditure, Progressivity and Horizontal inequality in Chinese adults: Based on the 4th National Oral Health Epidemiology Survey

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Research article

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Abstract

Background: The financial burden of oral diseases is getting more important. The aim of this study was to describe the dental expenditure, analyze its progressivity and horizontal inequality under the general health finance and insurance system, and identify the key social determinants of this inequality for Chinese adults.

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

Results: Mean dental expenditure per capita of Chinese adults was $20.55 (95% Confidence Interval, CI: 18.83,22.26) and for those who used dental service in the past year, the number was $100.95(95%CI: 93.22,108.68). More than 90% of the expenditure was out-of-pocket. Horizontal inequality indices and Kakwani indices were both negative and that indicated inequalities were in favor of the rich. The socioeconomic factors including income, urban or rural area and educational attainment were the main contributors to the inequality of dental expenditure.

Conclusion: Dental expenditure for Chinese adults was not too much under a pretty low utilization. The payments of dental expenditure were regressive. People with the most oral health need didn't meet appropriate dental services. Socioeconomic characteristic including household income, area and education was the main determinant while oral hygiene practice and self-reported oral health were the main individual determinants for the inequality of dental expenditure.

Background

The financial burden of oral diseases is getting more important. World Health Organization(WHO) reported the treatment of oral diseases was the 4th expensive in most industrial countries [1]. In the latest research of global burden of disease, 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 dollar(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 global productivity losses due to dental diseases, followed by severe periodontitis (21%) and untreated caries (12%)[5].

Significant inequalities exist in oral health. Oral health status, utilization of services and expenditures usually distribute unbalanced among populations. Low socioeconomic status is associated with severe caries and the 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 has the potential effect in

both functional and social dimensions of oral health[9]. Dentistry is often unavailable, unaffordable, and inappropriate for particularly the rural poor in low- or middle-incomeuntries[10].

From 2009, Chinese government deepened the reform of medical health care system and the basic medical health insurance structure covered 90% people completed[11]. However, most people are unprotected against oral diseases and over 85% of dental expenditure are out-of-pocket payment[12]. The current situation needs to be updated and associated determinants should be analyzed to improve the situation.

In the previous NOHES in China, the income-related inequality in oral health was not concerned[13]. The 4th NOHES conducted in 2015-2016 firstly surveyed this project with a view to providing information for future development of oral health related policies.

This study used the 4th NOHES data and census data was assisted for secondary analysis, aiming to describe the dental expenditure, analyze its progressivity and horizontal inequality and identify the key social determinants 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 were paid out-of-pocket. 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 didn't 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 a 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, dental utilization increased and dental need decreased as the household income level increased. The quintile with highest prevalence of bad self-reported oral health obtained the less dental utilization. At the same time, the quintile with less DTuired more dental utilization. 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 result showed in Table 1 also demonstrated great inequality in dental expenditure. And the concentration curves showed in Figure 3 were corresponding with such result. Both 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. Out-of-pocket payment and health insurance payment benefit the rich, but the former are more concentrated among the rich. Figure 3 displayed the distribution of 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 the inequality appeared to be expanding among population who used dental services.

Discussion

The result from two decomposition models showed high consistency and reliability. Socio-economic level directly contributed to the inequality of oral medical expenditure. The major contribution from household income, area and education may indicate the social class determined the inequality of dental expenditure. Individual factors of teeth brushing habit contributed positively a lot. It indicated good oral hygiene concentrated in the rich. In the three basic medical insurance, the contribution of UEBMI was definite in both two models. It didn't mean that health insurance played an important role in promoting equality. On the contrary, basic health insurance gave little impact on expenditure and can't share the patients' financial risk. The policy of comprehensively deepening medical reform in China has been implemented continuously. 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 the treatment-oriented utilization model remained unchanged. The redistribution of medical expenditure through health insurance needs taking into account socioeconomic factors such as household income, urban or rural area.

Limitation

For the first time, this study used national epidemiological survey data to conduct an equality analysis of health financing for oral diseases. Recall bias and report bias are unavoidable in such cross-sectional surveys. In this study, only the question of the expenditure in the past year was answered by looking back to minimize recall bias. Besides, logically dental expenditure was made from dental utilization, the results of a full sample analysis may 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. Fortunately, the consistent results of the two models can reflect the reliability of the research method.

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 not too much under a pretty low utilization. The payments of dental expenditure were regressive. People with the most oral health need didn't meet appropriate dental services. Socioeconomic characteristic including household income, area and education was the main

determinant while oral hygiene practice and self-reported oral health status were the main individual determinants for the inequality 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

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

Consent for publication

Not Applicable.

Availability of data and materials

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

Competing interests

We declare no competing interests.

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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.

References

1. Petersen PE: **The World Oral Health Report 2003: continuous improvement of oral health in the 21st century–the approach of the WHO Global Oral Health Programme**. *Community Dent Oral Epidemiol* 2003, **31 Suppl 1**:3-23.
2. Kassebaum NJ, Smith AGC, Bernabe E, Fleming TD, Reynolds AE, Vos T, Murray CJL, Marcenes W, Collaborators GBDOH: **Global, Regional, and National Prevalence, Incidence, and Disability-Adjusted Life Years for Oral Conditions for 195 Countries, 1990-2015: A Systematic Analysis for the Global Burden of Diseases, Injuries, and Risk Factors**. *J Dent Res* 2017, **96**(4):380-387.
3. Peres MA, Macpherson LMD, Weyant RJ, Daly B, Venturelli R, Mathur MR, Listl S, Celeste RK, Guarnizo-Herreno CC, Kearns C *et al*: **Oral diseases: a global public health challenge**. *Lancet* 2019, **394**(10194):249-260.
4. Listl S, Galloway J, Mossey PA, Marcenes W: **Global Economic Impact of Dental Diseases**. *J Dent Res* 2015, **94**(10):1355-1361.
5. Righolt AJ, Jevdjevic M, Marcenes W, Listl S: **Global-, Regional-, and Country-Level Economic Impacts of Dental Diseases in 2015**. *J Dent Res* 2018, **97**(5):501-507.
6. Schwendicke F, Dorfer CE, Schlattmann P, Foster Page L, Thomson WM, Paris S: **Socioeconomic inequality and caries: a systematic review and meta-analysis**. *J Dent Res* 2015, **94**(1):10-18.
7. Singh A, Peres MA, Watt RG: **The Relationship between Income and Oral Health: A Critical Review**. *J Dent Res* 2019, **98**(8):853-860.

8. Srivastava P, Chen G, Harris A: **Oral Health, Dental Insurance and Dental Service use in Australia**. *Health Econ* 2017, **26**(1):35-53.
9. Moeller J, Starkel R, Quinonez C, Vujicic M: **Income inequality in the United States and its potential effect on oral health**. *J Am Dent Assoc* 2017, **148**(6):361-368.
10. Watt RG, Daly B, Allison P, Macpherson LMD, Venturelli R, Listl S, Weyant RJ, Mathur MR, Guarnizo-Herreno CC, Celeste RK *et al*: **Ending the neglect of global oral health: time for radical action**. *Lancet* 2019, **394**(10194):261-272.
11. Li C, Yao NA, Yin A: **Disparities in dental healthcare utilization in China**. *Community Dent Oral Epidemiol* 2018, **46**(6):576-585.
12. Hu DY, Hong X, Li X: **Oral health in China–trends and challenges**. *Int J Oral Sci* 2011, **3**(1):7-12.
13. Qi XQ: **Investigation report of the third national oral health survey in China**. *Beijing:People's Medical Publishing House* 2008.
14. Lu HX, Tao DY, Lo ECM, Li R, Wang X, Tai BJ, Hu Y, Lin HC, Wang B, Si Y *et al*: **The 4th National Oral Health Survey in the Mainland of China: Background and Methodology**. *Chin J Dent Res* 2018, **21**(3):161-165.
15. World Health Organization: **Oral Health Surveys: Basic Methods. 5th ed**. Geneva: World Health Organization; 2013.
16. Ma. J: **TABULATION ON THE POPULATION CENCUS OF THE PEOPLE'S REPUBLIC OF CHINA**. In. http://www.stats.gov.cn/tjsj/pcsj/rkpc/6rp/indexch.htm: National Bureau of Statistics; 2011.
17. Caplan DJ, Slade GD, Gansky SA: **Complex sampling: implications for data analysis**. *J Public Health Dent* 1999, **59**(1):52-59.
18. He S, Thomson WM: **An oral epidemiological comparison of Chinese and New Zealand adults in 2 key age groups**. *Community Dent Oral Epidemiol* 2018, **46**(2):154-160.
19. Owen O'Donnell, Eddy van Doorslaer, Adam Wagstaff, Lindelow M: **Analyzing Health Equity Using Household Survey Data: A Guide to Techniques and Their Implementation**. *The World Bank* 2007.
20. Wagstaff A, van Doorslaer E, Paci P: **On the measurement of horizontal inequity in the delivery of health care**. *J Health Econ* 1991, **10**(2):169-205; discussion 247-169, 251-166.
21. Cisse B, Luchini S, Moatti JP: **Progressivity and horizontal equity in health care finance and delivery: what about Africa?** *Health Policy* 2007, **80**(1):51-68.
22. Xu M, Cheng M, Gao X, Wu H, Ding M, Zhang C, Wang X, Feng X, Tai B, Hu D *et al*: **Factors associated with oral health service utilization among adults and older adults in China, 2015-2016**. *Community Dent Oral Epidemiol* 2019.
23. Andersen RM: **Revisiting the behavioral model and access to medical care: does it matter?** *J Health Soc Behav* 1995, **36**(1):1-10.
24. O'Donnell O vDE, Wagstaff A, Lindelow M: **Analysing health equity using household survey data: a guide to techniques and their implementation.** . Washington, DC: World Bank.; 2008.

25. Shen J, Listl S: **Investigating social inequalities in older adults' dentition and the role of dental service use in 14 European countries**. *The European Journal of Health Economics* 2018, **19**(1):45-57.
26. Zaitsu T, Saito T, Kawaguchi Y: **The Oral Healthcare System in Japan**. *Healthcare (Basel)* 2018, **6**(3).
27. Bindi M, Paganelli C, Eaton KA, Widstrom E: **The healthcare system and the provision of oral healthcare in European Union member states. Part 8: Italy**. *Br Dent J* 2017, **222**(10):809-817.
28. Teusner DN, Brennan DS, Gnanamanickam ES: **Individual dental expenditure by Australian adults**. *Aust Dent J* 2013, **58**(4):498-506.
29. Wang X: **The Fourth National Oral Health Epidemiological Survey Report**: People's Health Publishing House; 2018.
30. Bilger M: **Progressivity, horizontal inequality and reranking caused by health system financing: a decomposition analysis for Switzerland**. *J Health Econ* 2008, **27**(6):1582-1593.
31. Ravaghi V, Quinonez C, Allison PJ: **The magnitude of oral health inequalities in Canada: findings of the Canadian health measures survey**. *Community Dent Oral Epidemiol* 2013, **41**(6):490-498.
32. Fisher J, Selikowitz HS, Mathur M, Varenne B: **Strengthening oral health for universal health coverage**. *Lancet* 2018, **392**(10151):899-901.
33. Niederman R, Huang SS, Trescher AL, Listl S: **Getting the Incentives Right: Improving Oral Health Equity With Universal School-Based Caries Prevention**. *American Journal of Public Health* 2017, **107**(S1):S50-S55.
34. Birch S, Listl S: **The Economics of Oral Health and Health Care**. *Social Science Electronic Publishing* 2015.

Tables

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

Quintiles	Household income	Vertical inequality items			Horizontal inequality items		
		Total dental expenditure	Out-of-pocket payment	Health insurance payment	Dental 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%
2nd	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%
4th	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.

UEBMI indicated urban employee basic medical insurance; URBMI indicated urban resident basic medical insurance; 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

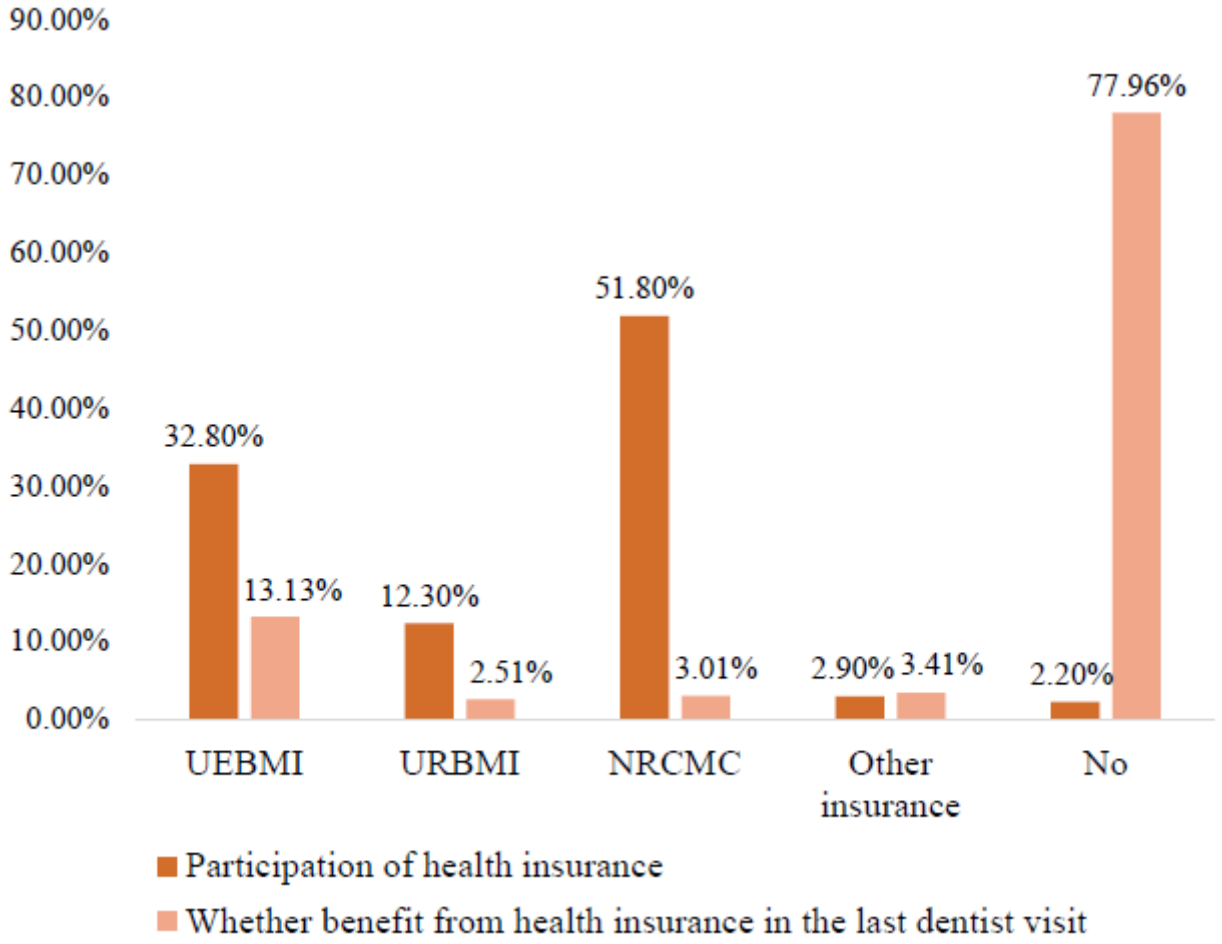

Figure 1

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 includes government insurance and private insurance and they are not conflict to the basic medical health insurance system.

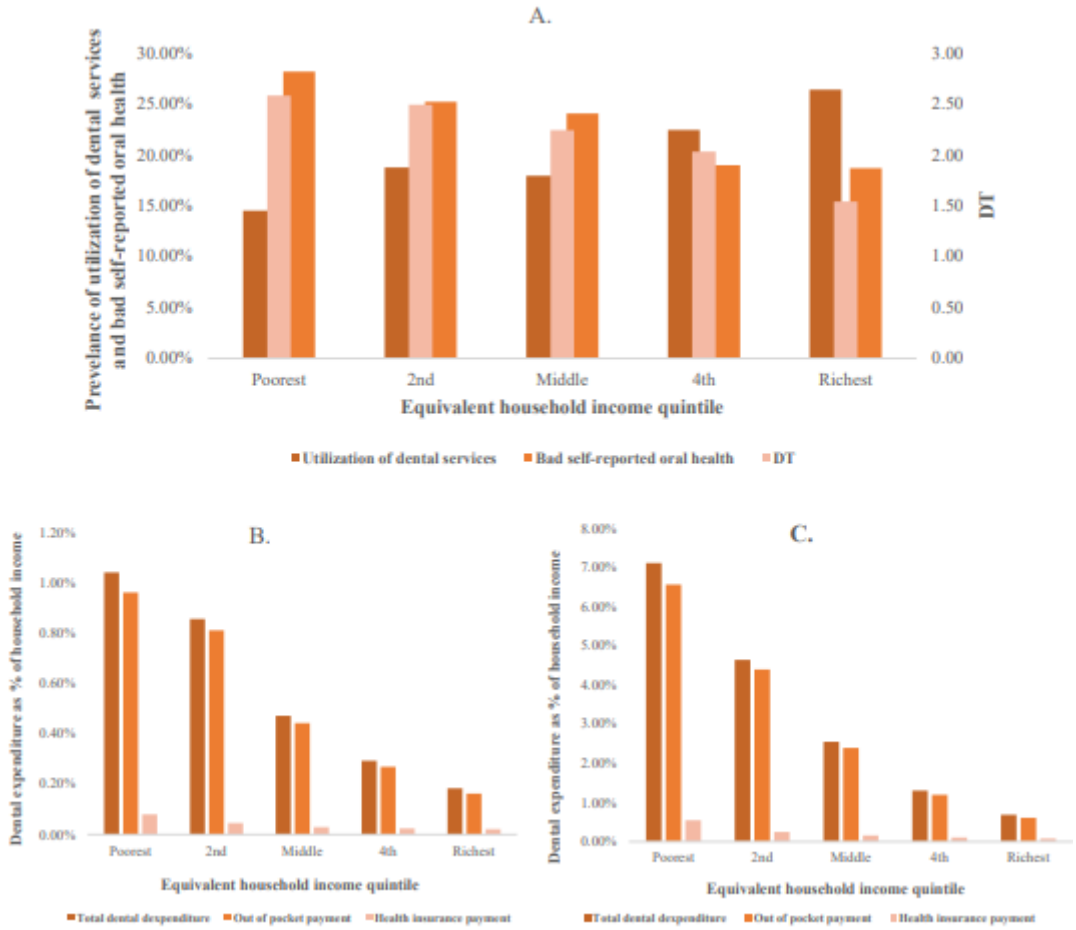

Figure 2

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.

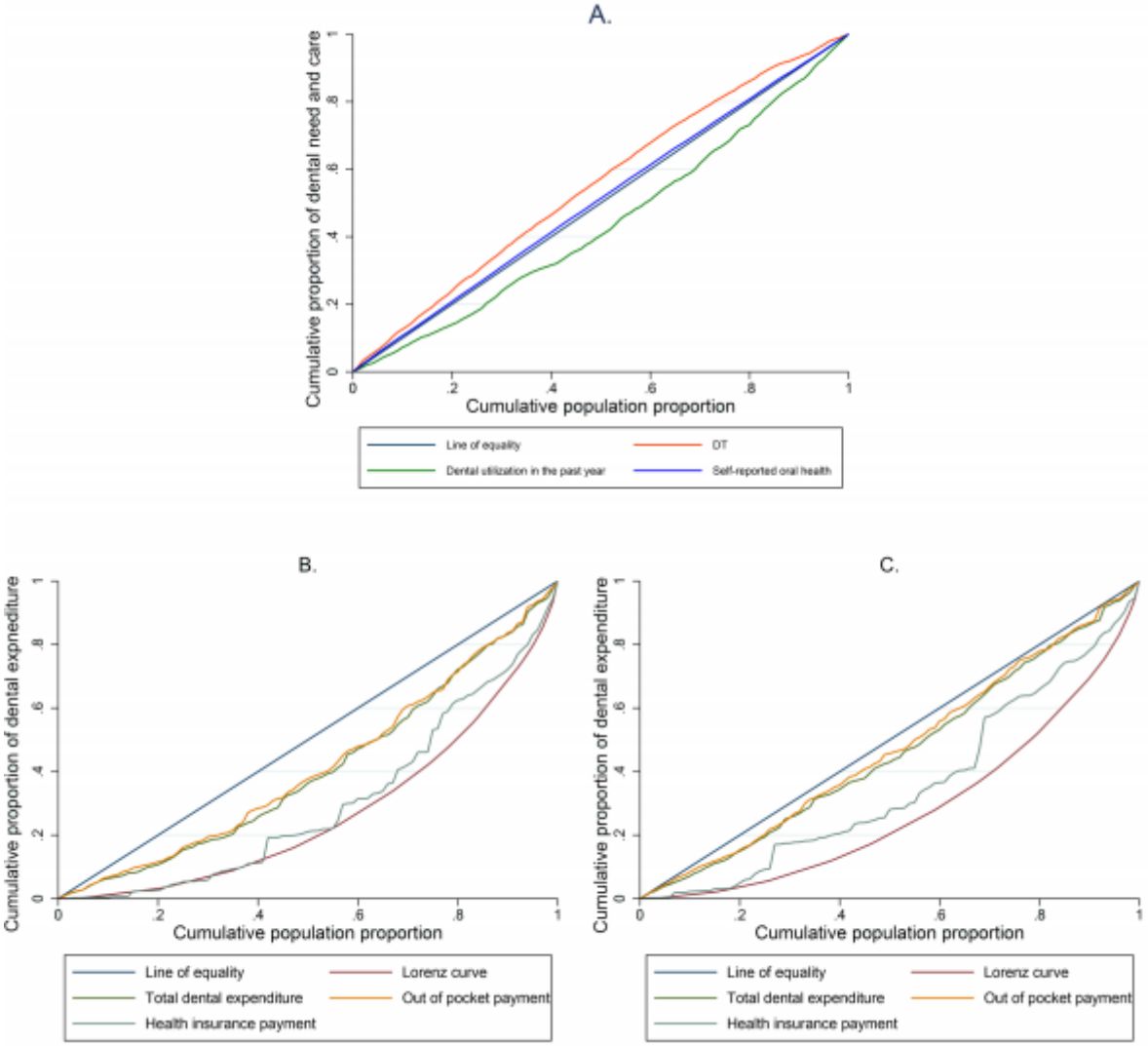

Figure 3

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