* 1. **Data Sources**

The 4th NOHES in China was a pathfinding survey used a multistage, random, stratified, equal volume sampling method. Groups of 35-44 years old and 65-74 years old adults were selected representing young adults and the elderly under the WHO guideline. A 55-65 years old group was additionally investigated to know more about the middle-aged. All 13,464 participants were included as a representative sample of Chinese adults. The detailed sampling methods can be found in the series of publications[14]. Based on the 5th edition of the WHO Oral Health Survey[15], oral health examination and oral health-related questionnaires were conducted. The 6th Census statistics data from the National Bureau of Statistics online[16] was used to computed the weight based on the sample’s province, residential location (urban or rural area), age and gender in order to obtain an unbiased estimation[17, 18].

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

* 1. **Expenditure estimation and distribution of health insurance**

The questions for dental expenditure and out-of-pocket payment were given as “How much have you paid for a dental visit last year?” and “What was the self-paid ratio in the above dental expenditure?” The health insurance payment was calculated as the difference between total expenditure and out-of-pocket payment. Information like household income and expenditure was avoided because of privacy concerns, the demographic and socioeconomic characteristics of these 15.5% participants who did not report the two key information were unbalanced with the total population, missing values of key variables were filled by medians. Dental expenditure incurred when participants used dental service. Only 2740 people of the total 13464 participants used dental services in the past year and the expenditures of these two populations were both estimated. The expenditure was converted according to the 2016 Chinese Yuan (RMB) to the USD exchange rate that 100USD was equivalent to 664.23RMB. According to the data from the National Bureau of Statistics, the medical expenditure per capita was equivalent to 504.61USD(<http://data.stats.gov.cn/easyquery.htm?cn=C01&zb=A0O0K&sj=2016>) and the dental expenditure per capita as a proportion of it was roughly calculated.

The basic medical insurance consists of urban employee basic medical insurance (UEBMI), urban resident basic medical insurance(URBMI) and new rural cooperative medical care(NRCMC). Other health insurances include government medical insurance for government officials and private commercial health insurance, accounting for a small proportion. The UEBMI is covered by urban employees and has the highest reimbursement ratio and the highest paid premiums. The URBMI and the NRCMC are covered by urban and rural residents based on household registration, respectively. The URBMI has higher reimbursement in hospitalization and outpatient treatment for severe diseases than NRCMC. Among the public health insurance, many basic oral therapeutic services have been included or adjusted in the catalog of basic medical insurance. However, the thresholds and reimbursement for different types of insurance are different.

* 1. **Horizontal inequality and progressivity**

The inequality can be assessed through variation in interesting variables such as health needs, medical services and expenditure across quintiles of income[19]. In the household income quintiles figure, participants are sorted by household income from poor to rich and divided evenly into five groups. As income increase, the change of expenditure, oral health need, and dental service indicated whether inequality exists. And this figure will give an intuitive, qualitative description of inequality. Besides, a complete picture can be drawn by concentration curves. And the associated horizontal inequality index and Kakwani index are described as follows:

 The horizontal equality indicates that people with equal health need to obtain equal medical care[20]. When the index is negative and the concentration curve of medical need is above the concentration curve of medical care, the inequality is in favor of the rich[21]. In this case, poor people with more medical needs receive less medical care. The formula of horizontal inequality is:

*HI=CM-CN*

The *CM* and the *CN* are the concentration indices for medical care and need, respectively. The formula of them are:

*CM*=

*CN*=

When people are sorted by the variable of ability to pay (ATP) from poor to rich, the cumulative proportion of utilization graphs the concentration curve of medical care(*Lu*). As the utilization of dental service is treatment-oriented in China[22]d based on the behavior model of Anderson[23], an evaluated health variable for objective needs and the other subjective ones which reflect the demand for dental care should be considered at the evaluation of *CN*. Consider DT (Decayed teeth) reflected the unsatisfied primary dental need, it is used to be an evaluated need variable. Correspondingly, the self-reported oral health status represented the subjective medical need. The self-reported oral health was an ordered five categorical variables in the questionnaire and higher ratings indicate worse self-perceived oral health. The two variables form two concentration curves for medical needs(*Ln*). The HI is twice the area of curves between the *Lu* and the *Ln* and rank from -1 to 1.

The vertical equality refers to a balanced proportion of medical expenses against people’s ATP. A progressive payment route means the extent to which medical expenditure rise as a proportion of people’s ATP when his or her ATP rises. If it is converse, the payment is regressive. If people with different income levels have the same ratio of their medical expenses to their ATP, it is believed that the funding is balanced[21].

The Kakwani index is used most widely for progressivity research[24]. The Kakwani index is defined as the difference between concentration index (*Cp*) and Gini coefficient(*G*), in other words, it is twice the area between the concentration curve of payment route(*Lp*) and the Lorenz curve of ATP(*Lg)*. In this study, household income was used to represent the ATP.

The formulas of *Cp, G* and Kakwani index(*πk*) are as follow:

*Cp*=

*G*=

*πk=Cp-G*

Similar to the HI, people are sorted by household income from low to high and the cumulative proportion of dental expenditure in different payment routes or household income is graphed. *Cp* ranks from -1 to 1 and the value of Gini coefficient ranges from 0 to 1[25]. As the dental expenditure concentrated in the population who used dental service in the past year, based on the consideration of different socioeconomic characteristics distribution, the Kakwani indices of total participants and those who used dental service in the past year were calculated and compared to strengthen the validity of results. For HI or Kakwani index, the positive or negative of the index indicates that the inequality is concentrated in the rich or the poor, and the magnitude of the value reflects the degree of such inequality.

* 1. **Decomposition of concentration indices**

Two models were constructed to decompose the contributions of the dental expenditure concentration index and the first of them enrolled all participants while the second one enrolled only participants used dental service in the past year. It was decomposed into four sources: (i)socioeconomic characteristics which consist of household income, region, residential location, education attainment and the coverage of different types of health insurance;(ii) the need variables which include evaluated need(DT) and subjective need (the level of self-reported oral health status), and oral health behavior (teeth brushing habit); (iii) socio-demographic characteristics which include age groups, gender, nationality;(iv) medical care variable which refers specifically to the utilization of dental service in the past year only in the first model. According to the nonlinear model, the concentration index for dental expenditure (*Cp*) can be decomposed as:

*Cp*=kxk/)Ck+GCε/

Where is the mean of dental expenditure, Ck is the concentration index for xk variable and xk is the mean of xk, GCε is the generalized concentration index for the error term(ε). The *Cp* is equal to a weighted sum of the concentration indices of the k variables, where the kxk/ indicates elasticity of for xk.

SPSS 22.0 was used to be the data processing software to deal with the distribution of dental expenditure and health insurance. STATA 14.0 was used to drew the figures of inequalities and set up the decomposition models. The code for decomposition was referenced in the guide of health equity analysis[24].