# Socioeconomic inequality in overweight and obesity in China

**By Shuaifei Li**

**Student Number: 7274228**

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Supervisor: Professor Paul Makdissi

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# Content

# [Abstract]

This paper analyzes the socioeconomic inequality in overweight and obesity in China, using the concentration index and the achievement index. Concentration index can reflect the direction and the magnitude of the socioeconomic inequality and achievement index can take average health problem level into consideration. The decompositions of these two indices are also applied in this paper to explore the inequality resources. Children and adults are analyzed separately because of their different criteria of being obese. The results illustrate that for most Chinese demographic groups, the rich are more likely to be overweight and obese. Another finding is that the socioeconomic overweight/obesity inequalities are prevalent in China and these inequalities vary across different groups.



**Keywords:**

Overweight, Obesity, SES, inequality, China, Concentration index, Achievement index, health problem

# 1. Introduction

Obesity is a big problem negatively affecting people's health. Individuals with obesity or overweight are more likely to be attacked by various diseases such as heart disease, high blood pressure and diabetes than those having normal weight. With diversity of diet and more nutrition intake, people in the world have become increasingly healthier. On the other side, both the excess nutrition intake and less time to do exercise contribute to the prevalence of overweight and obesity. From a research by WHO, overweight and obesity have been increasing for years in economically developing countries and for longer time in developed countries (WHO. 2000) In this situation, obesity is a topic to which should be paid more attention. In the past two decades, health inequality in China has been increased rapidly (Wang and Fan, 2005) and there is a relationship between Socioeconomic Status (SES) and obesity. Some researches have explored the relationship between income (one kind of measurement of SES) and obesity. Different income can affect individuals' lifestyle and food intake, which are two key elements affecting individuals' overweight or obesity (Wang, 2001). In this case, the socioeconomic health inequalities seem to be more significant.

The purpose of this paper is to study the socioeconomic inequalities in obesity in China and to illustrate the differences of these inequalities between groups by gender, age and area. China is the developing country with the largest population and a rapid growth rate. One possible factor leading to the different obesity problem between

China and the US is the economic condition. With the rapid Chinese economic development, obesity pattern in China may coincide with that in the US. In this case, the obesity problem in China is more typical. Chinese government is now paying more attention to health and obesity problems. This makes the topic of this paper policy related.

Despite the wide availability of studies of socioeconomic obesity inequality, the literature has not offered yet an application on China. The objective of this paper is to fill this gap. Qi Zhang and Youfa Wang (2004) have studied the socioeconomic inequality of obesity in America using the concentration index, which is a measurement I use in my paper. Moreover, I will also make an improvement in this paper by adding another measurement called achievement index, which can take the average level of health into consideration (Wagstaff, 2002). Both the concentration index and the achievement index are overall measures of inequality so a decomposition of these indices can help us understand the sources of health inequalities (Clarke et al., 2003). Therefore, I will make a decomposition of Concentration Index to analyze the Chinese obesity inequalities.

# 2. Literature Review

## 2.1 Literature on obesity

There have been many papers discussing the topics of obesity in China. Some papers

discussed about the trend of obesity. For example, Wang et al. (2006) made a meta-analysis and got the result that there existed a considerable increase in prevalence of overweight and obesity irrespective of gender, age or geographic area during a decade from 1992 to 2002. Another paper discussed association between obesity and diseases by Liu et al. (2004). They used multiple logistics regression to capture the effect of obesity and found that higher Body Mass Index (BMI) is significantly correlated with some diseases such as high-blood- pressure. By using multilevel linear probability models, Chen and Meltzer (2008) found that in Chinese rural area, the more equivalent income and income inequality have a positive relationship with obesity but they did not find any significant relationship in the urban counterparts. Since the obesity problem in China is becoming increasingly severe and it has many negative effects, paying more attention to this problem is necessary.

Two typical papers about Chinese obesity by Wang (2001) and Xu et al. (2005) both explored the relationship between the socioeconomic status and the obesity level. They got a consistent conclusion that Chinese individuals seem more likely to be overweight or obese when they have higher SES. The first paper made family income as the SES indicator and used the children data in three countries, i.e. China, Russia and the US, but the US has a contrary situation where lower SES groups are more likely to be obese. One of the reasons for this inconsistency between US and China may be the different lifestyle. For example, meat is relative more expensive in China while vegetables is relative expensive in the US. Richer families can afford more

meat than poor families so that the higher SES tends to be more overweight or obese. On the other hand, the richer in US have better access to vegetables and fruits and have a healthier body shape (Wang, 2001). For the second paper, it concluded that "SES is negatively associated with overweight and obesity in developed societies and positively associated in developing countries". They used the family average income per capita (FAI) as an indicator of SES and found overweight and obesity were more likely to occur on urban people, women and higher FAI category. In urban area, FAI category did not have any significant effects on the overweight and obesity. But in rural areas, the level of FAI category matters and lower FAI were less likely to be obese and overweight (Xu et al. 2005).

In addition, some other papers discussed socioeconomic obesity inequality. Through two sets of logistic regressions, Singh et al. (2010) studied social inequalities childhood obesity in the US. They use the binary outcomes of obesity and overweight as dependent variables while some social and behavioral variables like age, gender and race etc. as covariates. Finally, they got the conclusion that socioeconomic inequalities in childhood obesity and overweight persisted and increased between 2003 and 2007. The conclusion consists with Miech et al.'s (2006) result that increasing disparities in obesity between different income groups of adolescents existed. Another method to measure socioeconomic obesity inequality is concentration index that was applied by Wang and Zhang (2004). The concentration curve was also mentioned in this paper to analyze the inequality. The data were

collected from National Health and Nutrition Examination Survey III (NHANES III, 1988-1994 US). They also used BMI to measure obesity and used family income per capita last year to measure SES. The observations had been divided into demographic groups by gender, age and race/ethnicity. They had four age groups: 18-29, 30-39, 40-49 and 50-59 as well as four race/ethnicity groups: non-Hispanic white, non-Hispanic black, Mexican American and "other". From the results, considerable socioeconomic disparities existed among the American population but the inequality patterns were substantially different by demographic groups. However, I did not find any paper making a research on the obesity inequality in China using the concentration index or concentration curve.

### 2.2 Literature on socioeconomic health inequality

There are several methods to measure health inequality. Wagstaff, Paci and Doorslaer (1991) put forward six measures of inequality, i.e., the range, the Gini coefficient, pseudo-Gini coefficient, dissimilarity index, slope index of inequality and concentration index. Among those, Gini coefficient and concentration index use the similar conceptual framework. However, Gini coefficient only measures the pure health inequality while the concentration index can measure socioeconomic health inequality. Besides, the concentration index "reflects the experiences of the entire population and it is sensitive to the distribution of the population across socioeconomic groups" (Wagstaff et al., 1991). Therefore, the concentration index is more popular and most widely used in measuring health inequality. Zhang and Wang

(2004) used the concentration index, which can give a quantitative summary, to study the socioeconomic inequality of obesity in USA. The concentration index can tell us both the direction of the correlation and the severity of inequality. However, concentration indices have some limitations including regardless of the average level of health. In order to overcoming this shortcoming, Wagstaff (2002) put an extended approach of concentration index forward, i.e. achievement index. This index associates the average health level to the overall health inequality. Another limitation is the "mirror problem" (Clarke et al., 2002). This refers that there is an inconsistency between the rankings of health attainments and health shortfalls when the concentration index is used". Erreygers (2009a and 2009b) made a correction of concentration index, i.e. E (h), to solve this problem.

Clarke, Gerdtham and Connelly (2003) proposed a disaggregation of health inequality. They came up with two approaches, i.e. "decomposition by the index components" and "decomposition by population subgroups". The first method considers the different aspects of health such as physical health and mental health and each component contributes to the overall health inequality. The second method divides the population into identifiable groups by age, gender or geographic area and the inequalities within and between subgroups can make a difference. In this paper, obesity cannot be divided into aspects so that only the second approach is applied. Makdissi, Sylla and Yazbeck (2013) used the decomposition approach proposed by Clarke et al. (2003) to measure socioeconomic health inequality in the US and

extended the techniques to the achievement indices.

Another thing need to be taken into consideration is the nature of variable. The concentration index value may have arbitrariness problem when the self-reported health is responded as qualitative vocabularies like “excellent”, “fair” or “bad” (Erreygers, 2006). Zheng (2006) also pointed out the concerns of using concentration index to measure health inequality when ordinal variable is applied. For cardinal variable, the numerical value of the difference between two levels is important. It includes non-ratio-scale and ratio-scale variable. Ration-scale variable can be used without variable nature problem when computing concentration index (Erreygers and Van Ourti, 2011). Luckily, in this paper, I use the Body Mass Index (BMI) to measure obesity and overweight. Since BMI is a ratio-scale variable, the arbitrariness problem can be neglected in this paper.

This paper bases on the composition by Zhang and Wang (2004), who discussed the socioeconomic inequality of obesity in the US. However, besides the concentration index they used, I also computed the achievement index proposed by Wagstaff (2002) for each group and decompose these indices to see the sources of the health inequalities using Makdissi et al. (2013) method. Another difference between this paper and Zhang and Wang’s paper is that they used US data while I use the Chinese data.

The purpose of this paper is analyzing the socioeconomic obesity inequality in China by several demographic groups using concentration index and achievement index respectively. A decomposition of these two indices is also included to capture the sources of inequalities. The following parts consist of the methodology, data, empirical results, discussion and conclusion

# 3. Methodology

In this paper, I plan to use two indices: concentration index, achievement index and decomposition of the indices, to analyze the socioeconomic inequality in obesity.

***Concentration index***

The concentration index and The Gini index have the similar conceptual framework. The concentration index can be regarded as an extension of the Gini index to some degree since the Gini index only measure pure inequality by ranking health on the horizontal axis while concentration index can measure socioeconomic inequality by ranking SES on the horizontal axis. Wagstaff et al. (1991) compared six methods of measuring health inequality and recognized concentration index as the most appropriate one among those measurement in their paper: "This index provides a measure of the extent of inequalities in health that are systematically associated with socioeconomic status … … it reflects the experiences of the entire population and it is sensitive to the distribution of the population across socioeconomic groups." Besides,

Wagstaff et al. pointed out that concentration index is also available when accessing bad health, e.g. obesity in this paper. Moreover, concentration index can be interpreted easily by the corresponding concentration curve (Kakwani et al., 1997). Therefore, I will use concentration index as the first method to study socioeconomic obesity inequalities in Chinese population

Concentration index can be acquired by plotting a concentration curve, which represents the cumulative proportions of the population in the horizontal axis, ranked by SES (equivalent income in this paper) from the lowest to the highest, against the cumulative proportion of population in the vertical axis, ranked by health level also from lowest to highest. See Figure 1, if health is equally distributed across the SES (equivalent income), the concentration curve will be the 45° line coinciding with the diagonal. At point E, the first half of population ranked by equivalent income has 50% of the total health.

Take the example of lower SES, if the vertical axis represents a good health and the lower SES are less healthy, then the concentration curve lies below the 45° line. At point G, the bottom 25% of people ranked by SES account for only 17% of the total health. On the other hand, if the vertical axis represents a bad health and the lower SES are still less healthy, then the concentration curve lies above the 45° line. At point B, 52% of all population ranked by SES account for 75% of total health (here it is a bad health). (See Figure. 1)

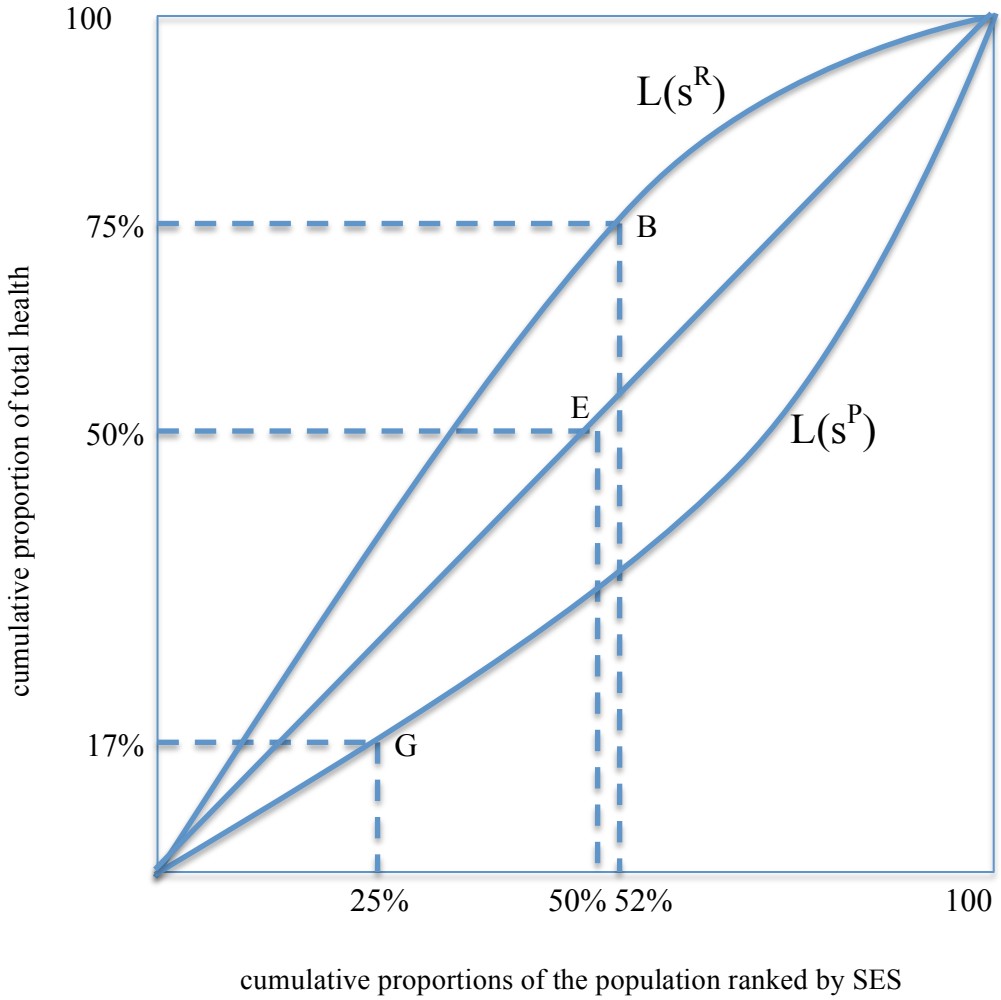


Figure 1. Concentration curve

In this paper, I study a kind of bad health, i.e. obesity, the concentration curve L ($s^R$) lying above the diagonal means the poor bear a greater weight burden than the rich. The curves like that is called "regressive curves" by some economics literatures (Wang and Zhang, 2004). The concentration curves like L ($s^P$) lying below the diagonal are referred to as "progressive curves", which means the obesity is concentrated more heavily among the rich than the poor. In this figure, s represents cumulative share of population.

The degree of socioeconomic inequality in obesity distribution can be illustrated using the distance between the concentration curve and the diagonal. The greater the distance is, the higher the obesity inequality degree. Concentration index is defined as twice the area between the concentration curve and the diagonal. Concentration index (C) can be calculated by a mathematical formula:

$$C = 1 - 2 \int_0^1 L(s)\, ds \quad (1)$$

The maximum value of C is +1and the minimum value of C is -1. In the case of obesity (ill health), the corresponding concentration curve of positive C lies below the diagonal (obesity is concentrated amongst the rich) while the corresponding curve of negative C is above the diagonal (obesity is concentrated amongst the poor). Three special cases refer to C equals 1, -1 and 0. When concentration index is 1, all the obesity concentrated in the hands of the richest person; when concentration index is -1, all the obesity concentrated in the hands of the poorest person; when concentration index is 0, the concentration curve coincide with the diagonal and there is no socioeconomic inequality in obesity.

***Achievement index***

Since concentration index does not take the average health status into consideration, Wagstaff (2002) introduced achievement index to resolve this problem. He pointed out that achievement index can reflect the health and health inequality in average level between the poor and the rich. Overall achievement is a weighted average of health levels and can be measured by the formula:

$$A = \mu(1 - C) \quad (2)$$

Where μ is the average level of health status.[1] Makdissi et al. (2013) called the achievement index a "failure" index when associated with a health problem. In this paper, obesity is a kind of health problem and the greater value of A seems bad. Assume obesity is concentrated in the poor rather than the better-off people (C<0). The overall achievement will be larger than the mean of the obesity level and seem worse if there is an inequality. On the other hand, assume obesity is concentrated in the rich (C>0). The achievement index will be lower than the average obesity level and seem better than just looking at the mean value. Although with the same distribution of obesity or the same average obesity, two groups may have different achievement. Achievement includes both the average health (μ) and the health inequality (C) and can reflect a synthetical level.

***Decomposition of the health concentration index and health achievement***

Clarke et al. (2003) proposed two ways to decompose the concentration index. The first way considers the different aspects of health and the second way considers the inequalities within and between groups. In this paper, obesity cannot be divided into aspects so that only the second approach is applied. The overall concentration index is the combination of three components：

$$C = C_B + C_W + C_T \quad (3)$$

Where $C_B$ is the socioeconomic obesity inequality between groups, $C_W$ represents

[1] See more details in wagstsff's paper in 2002

the within group component and $C_T$ is the transvariation term[2] (also called error term in some papers).

By making the obesity of every individual equal the mean obesity level of his (her) group and calculating the concentration index, we can get the socioeconomic obesity inequality between groups ($C_B$). Within group inequality can be obtained by:

$$C_W = \sum_{j=1}^{J} \sigma_j \frac{\mu_j}{\mu} C_j \quad (4)$$

J represents the amount of groups, $\sigma_j$ is the population share of group j among all the observations, $\mu_j$ is the average obesity level of group j, $\mu$ is the mean obesity of all

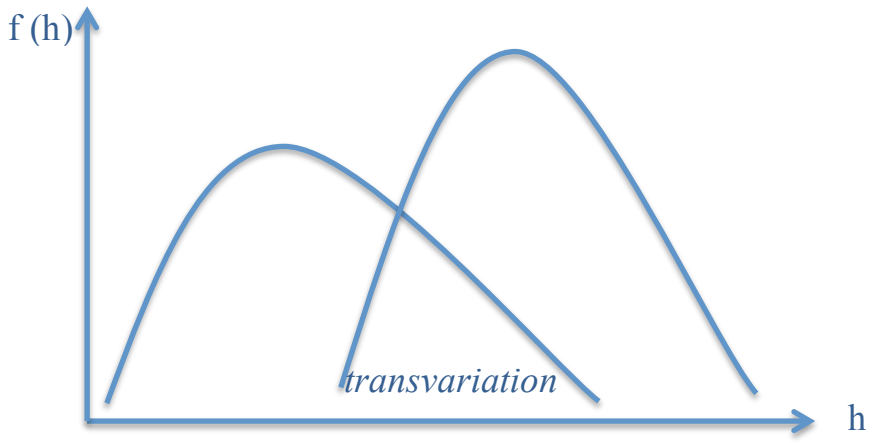


Figure 2. Transvariation term

individuals and $C_j$ is the concentration index of group j. The third term of transvariation can be illustrated using Figure 2.

Makdissi et al. (2013) extended the techniques to the achievement indices:

$$A = \sum_{j=1}^{J} \sigma_j A_j + A_T \quad (5)$$

[2] Some references identify $C_T$ as a residual impact. However, Dagum (1997) gives an analytical interpretation to this term. It is explained by the overlap between densitices.

$A_j$ is the health achievement of group j and $A_T$ is "due to the difference between the rank of observations within their group and their rank in the overall population." (Makdissi et al., 2013).

# 4. Data

***Data resources***

Analysis in this paper will be based on the cross-sectional data in 2006 from China Health and Nutrition Survey (CHNS). An international cooperation by the Carolina Population Center at the University of North Carolina and the National Institute of Nutrition and Food Safety at the Chinese Center for Disease Control and Prevention contributed to the project of CHNS. There have been 9 waves constructed by the survey, i.e., 1989, 1991, 1993, 1997, 2000, 2004, 2006, 2009 and 2011. The cross-sectional data in 2006 is the most updated wave available. The data was draw from 9 out of 31 provinces using a multistage, random cluster process. For each province, the survey selected two cities and four counties of each city. Communities were randomly selected in these counties from cities, suburbs, townships and villages and 20 households were randomly selected in every community. This is not a representative sample of the whole Chinese population since the survey only referred 9 provinces (see Figure 3). However, these provinces are substantially different in geography, economic development, public resources, and health indicators so the data still can be used in this paper.


Figure 3. Provinces included in CHNS in 2006

***Variables***

Two key variables in this paper are obesity level and the SES. I use the Body Mass Index (BMI)[3] to measure the obesity level. According to WHO report (2006), BMI over 25 implies that the individual is overweight and BMI over 30 means obesity for adults. However, Asian people and Western people belong to different races so that they should have different standards of obesity. I use the criteria set by National Health and Family Planning Commission of the People's Republic of China (2013) that an individual is overweight when BMI > 24 and obese when BMI > 28. I construct two variables as $h_1 = max\,[BMI - 24, 0]$ (indicating overweight) and $h_2 = max\,[BMI - 28, 0]$ (indicating obesity). It is worth noting that Children have a different criterion of BMI[4] considering both the age and the typical values for other

[3] $BMI = \frac{weight\ (kg)}{height(m)^2}$

[4] I use the criterion for children in the website of http://140.128.171.15/Calculate/Calculation.htm

children of the same age (Center for Disease Control, 2013).

The other key variable is the SES of each individual. SES is complex and multidimensional. It includes many aspects such as education, income and occupation. All of these factors can be used as a measure of SES although each has its limitations. As many other papers, I use the income to be the indicator of SES in this paper. However, we cannot just compare the pure income of two households with different sizes. There exists economy of scale in household consumption so that a smaller household may need higher income per capita to achieve the same consumption level than a larger household. Therefore, we need to transform pure income into an equivalent income. Buhmann et al. (1987) introduce a parametric form to analyze equivalence scales:

$$m(n) = n^{\theta} \tag{6}$$

Where n is the household size, $m(n)$ is the equivalence scale and $\theta$ is the equivalence scale elasticity. When $\theta = 0$, the household consumes pure public goods. In this case, one more person causes no extra welfare cost for his or her household. When $\theta = 1$, the household consumes pure private goods and there is no economy of scale. For all $\theta$ between 0 and 1, there are some economies of scale in household consumption. In most literature, $\theta$ = 0.5 and this value is also used by OECD so that I use 0.5 as the equivalence scale elasticity in this paper. Therefore, I have the equivalent income representing SES in this paper:

$$y_i = \frac{I_i}{\sqrt{n_i}} \tag{7}$$

Where $y_i$ is the equivalent income of each individual in household $i$, $I_i$ is the total household income and $n_i$ is the size of household $i$.

***Groups***

The data in this paper is divided into several groups by age, gender and area. Children and adults are analyzed separately because of the different BMI criteria. See Table 4 below:

| |
|---|
| *Children:* |
| NO.1: boy & girl (2 groups) |
| NO.2: children in urban & children in rural (2 groups) |
| NO.3: boy in urban & boy in rural & girl in urban & girl in rural (4 groups) |
| *Adult:* |
| NO.1: male & female (2 groups) |
| NO.2: adult in urban & adult in rural (2 groups) |
| NO.3: over 65 years old & under 65 years old (2 groups) |
| NO.4: male in urban & male in rural & female in urban & female in rural (4 groups) |
| NO.5: male over 65 & male under 65 & female over 65 & female under 65 (4 groups) |
| NO.6: over 65 in urban & under 65 in urban & over 65 in rural & under 65 in rural (4 groups) |
| NO.7: male in urban over 65 & male in rural over 65 & female in urban over 65 & female in rural over 65 & male in urban under 65 & male in rural under 65 & female in urban under 65 & female in rural under 65 (8 groups) |

Table 1. Groups of data

The decompositions of the concentration index and the achievement index are based on these groups.

***Observations***

This paper refers 11213 observations including 9260 adults and 1953 children. I separate children and adult when analyzing because of their different obesity criteria. The more detail sample sizes is showed by Table 2, Table 3 and Table 4.

| | *Urban* | *Rural* | *Total* |
|---|---|---|---|
| *Male* | *1464* | *2861* | *4325* |
| *Female* | *1652* | *3283* | *4935* |
| *Total* | *3116* | *6144* | *9260* |

Table 2. Sample sizes and some characteristics of adults over 18 years old, CHNS 2006

| *Gender* | *Area* | *Age* | *Observations* |
|---|---|---|---|
| *Male* | *Urban* | *>= 65* | *286* |
| | | *< 65* | *1178* |
| | *Rural* | *>= 65* | *449* |
| | | *< 65* | *2412* |
| *Female* | *Urban* | *>= 65* | *341* |
| | | *< 65* | *1311* |
| | *Rural* | *>= 65* | *555* |
| | | *< 65* | *2728* |
| *Total* | | | *9260* |

Table 3. Sample sizes and some characteristics including age of adults, CHNS 2006

| | *Urban* | *Rural* | *Total* |
|---|---|---|---|
| *Boy* | *273* | *771* | *1044* |
| *Girl* | *274* | *635* | *909* |
| *Total* | *547* | *1406* | *1953* |

Table 4. Sample sizes and some characteristics of children under 18, CHNS 2006

# 5. Empirical results

## *Adults*

### *(1) Inequality indices*

Table 5 shows us the overall concentration index and achievement index of the whole adults as well as these two indices by gender, area and age respectively and Figure 4 represents the concentration curves for the whole adult population towards both overweight and obesity. As for the whole observations, the concentration index for both overweight and obesity are positive (0.052394 and 0.055572), which means that rich people in China burden more weight.

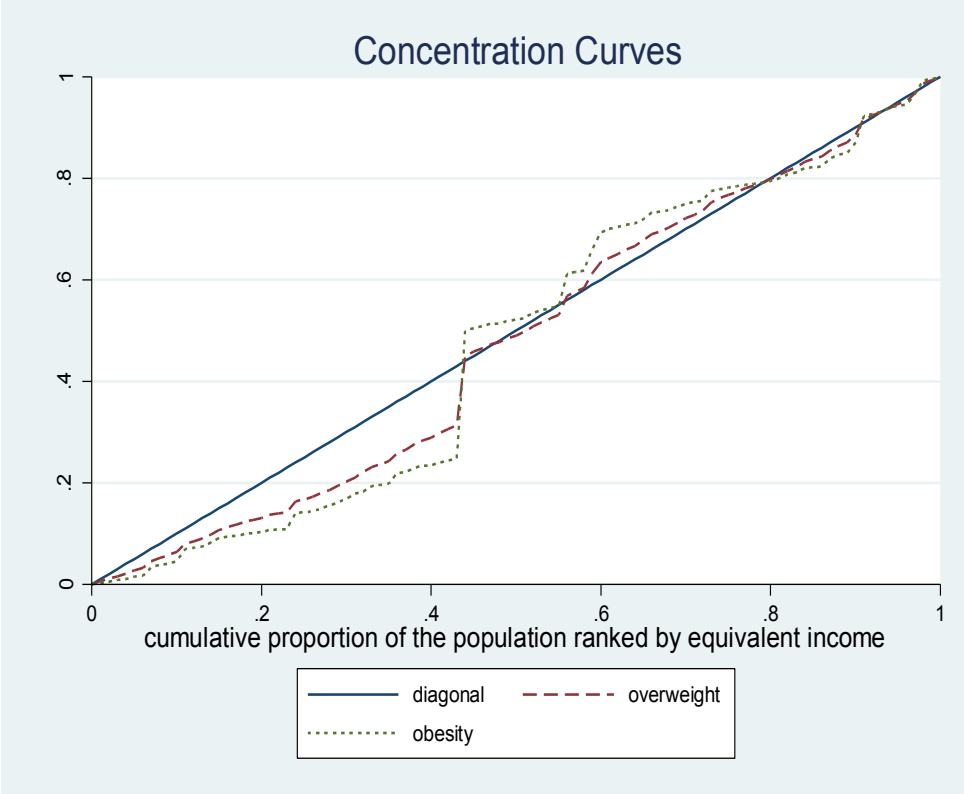


Figure 4 concentration curves of overweight and obesity for the whole adult population

***Gender, Area and Age groups respectively***

From a more disaggregated level, all the groups by gender, area or age show the consistent result of positive concentration index that both overweight and obesity are concentrated on the rich. Only considering the gender, women suffer severer socioeconomic inequality than men in terms of both overweight and obesity and the gap of obesity inequality between men and women is much larger than the one of overweight.

People in rural bear larger socioeconomic overweight inequality but less obesity inequality than people in urban. It should be noting that the urban observations have the largest concentration index (0.130970) among all the one-dimension groups in Table 5, which means people in urban have the most serious obesity inequality problem (rich urban people are further more likely to be obese than others). On the other hand, men have the least concentration index of 0.130970 and they bear the least obesity inequality than other groups in Table 5. Concentrating on the age groups, older people have larger concentration indices than younger in terms of both overweight and obesity. It means that the old suffer a higher degree of obesity and overweight socioeconomic inequality.

When obesity is an ill health and concentrated on the rich, larger value of "failure" (AI) is bad meaning higher socioeconomic inequality. In gender groups and age groups, achievement index, which shows different ranks from concentration index,

indicates that men have a higher degree of inequality on overweight and obesity (than women) and so do younger people (than the old). However, in the area group, AI shows a consistent result with CI for overweight people but not for obese people.

| **Overweight / obese** | **Group** | **CI** | **AI** |
|---|---|---|---|
| Overweight | Total | 0.052394 | 1.575612 |
| Obese | Total | 0.055572 | 0.817223 |
| | **Gender** | | |
| Overweight | Male | 0.041340 | 1.633631 |
| | Female | 0.059660 | 1.529455 |
| | $C_W/A_W$ | *0.079553* | *1.578112* |
| | $C_B$ | *0.000137* | |
| | *Transvariation* | *-0.027296* | *-0.002500* |
| | *Total* | *0.052394* | *1.575612* |
| Obese | Male | 0.013270 | 0.943353 |
| | Female | 0.093745 | 0.712130 |
| | $C_W/A_W$ | *0.052217* | *0.820126* |
| | $C_B$ | *0.000577* | |
| | *Transvariation* | *0.002778* | *-0.002903* |
| | *Total* | *0.055572* | *0.817223* |
| | **Area** | | |
| Overweight | Urban | 0.051063 | 1.504953 |
| | Rural | 0.072736 | 1.577903 |
| | $C_W/A_W$ | *0.065780* | *1.553355* |
| | $C_B$ | *-0.003409* | |
| | *Transvariation* | *-0.009977* | *0.022257* |
| | *Total* | *0.052394* | *1.575612* |
| Obese | Urban | 0.130970 | 0.625534 |
| | Rural | 0.076219 | 0.867525 |
| | $C_W/A_W$ | *0.091545* | *0.786095* |

| | | | |
|---|---|---|---|
| | $C_B$ | *-0.012411* | |
| | *Transvariation* | *-0.023562* | *0.031128* |
| | *Total* | *0.055572* | *0.817223* |
| | **Age** | | |
| Overweight | Under 65 | 0.047923 | 1.598791 |
| | Over 65 | 0.073477 | 1.468883 |
| | $C_W/A_W$ | *0.052215* | *1.575910* |
| | $C_B$ | *0.000114* | |
| | *Transvariation* | *0.000065* | *-0.000298* |
| | *Total* | *0.052394* | *1.575612* |
| Obese | Under 65 | 0.052982 | 0.842868 |
| | Over 65 | 0.066879 | 0.699574 |
| | $C_W/A_W$ | *0.055103* | *0.817629* |
| | $C_B$ | *-0.011414* | |
| | *Transvariation* | *0.011883* | *-0.000406* |
| | *Total* | *0.055572* | *0.817223* |

Table 5. Concentration index and achievement index of adult by gender, area and age and the decomposition of them

***Gender & Area groups***

Then, the groups have been extended to two dimensions, taking any two of three social characteristics (gender, area and age) into consideration (see Table 6). Among the Gender & Area groups, men in urban have a negative concentration index towards overweight (-0.000501), which means SES is negatively related to the overweight for urban males. Besides, "urban men" also has the least serious obesity inequality problem with the CI of 0.012238 among all four groups in Group set 1. On the other hand, male in rural having the largest concentration index to overweight (0.105510) shows the severest overweight inequality problem. Urban women have the second largest CI to overweight (0.085939) and the largest one to obesity (0.181952).

| Group set | Overweight | | Obesity | |
|---|---|---|---|---|
| **1. Gender & Area** | **CI** | **AI** | **CI** | **AI** |
| Male in urban | -0.000501 | 1.242428 | 0.012238 | 0.399547 |
| Male in rural | 0.105510 | 1.735871 | 0.106377 | 1.106546 |
| Female in urban | 0.085939 | 1.728401 | 0.181952 | 0.817422 |
| Female in rural | 0.030967 | 1.447193 | 0.016991 | 0.666866 |
| $C_W/A_W$ | *0.065285* | *1.554179* | *0.090144* | *0.787307* |
| $C_B$ | *-0.003631* | | *-0.012580* | |
| *Transvariation* | *-0.009260* | *0.021433* | *-0.021992* | *0.029916* |
| *Total* | *0.052394* | *1.575612* | *0.055572* | *0.817223* |
| **2. Gender & Age** | | | | |
| Male < 65 | 0.034942 | 1.771467 | 0.003224 | 1.084022 |
| Male >= 65 | 0.108320 | 0.946646 | 0.233978 | 0.240381 |
| Female < 65 | 0.058578 | 1.450079 | 0.112828 | 0.886493 |
| Female >= 65 | 0.071946 | 1.870021 | 0.052831 | 0.676727 |
| $C_W/A_W$ | *0.052550* | *1.575352* | *0.054199* | *0.891491* |
| $C_B$ | *-0.000940* | | *-0.001368* | |
| *Transvariation* | *0.000784* | *0.000260* | *0.002741* | *0.154270* |
| *Total* | *0.052394* | *1.575612* | *0.055572* | *1.045761* |
| **3. Area & Age** | | | | |
| Urban < 65 | 0.073139 | 1.297626 | 0.220177 | 0.450703 |
| Urban >= 65 | 0.019341 | 2.279008 | -0.003029 | 1.286804 |
| Rural < 65 | 0.075163 | 1.678107 | 0.081467 | 0.956321 |
| Rural >= 65 | 0.033992 | 1.085912 | -0.036317 | 0.431861 |
| $C_W/A_W$ | *0.066404* | *1.552317* | *0.100259* | *0.785929* |
| $C_B$ | *-0.003108* | | *-0.011686* | |
| *Transvariation* | *-0.010902* | *0.023295* | *-0.033001* | *0.259833* |
| *Total* | *0.052394* | *1.575612* | *0.055572* | *1.045761* |

Table 6. Concentration index and achievement index of adult by two-dimension groups

The failure index (AI) shows a consistent rank for overweight inequality with the concentration index. For the obese population, the achievement ranks of rural males and urban females reverse the results of CI and the ranks of other two groups are the same as CI. To conclude, the degrees of overweight and obesity imparity of men living in rural area and women living in urban area are larger by both CI and AI.

***Gender & Age groups***

The second group set illustrates the problems of in socioeconomic equalities in overweight and obesity by the gender and age. All the four groups have the positive concentration indices in terms of both overweight and obesity. Therefore, each group has a positive relationship between SES and overweight and obesity inequality. In other word, rich people suffer more weight burden than poor people. This result coincides exactly with the result of overall observations. AI and CI present totally different results of both overweight and obesity SES inequality for men over 65. To be specific, elder men have the highest degree of inequalities for both overweight and obesity problems regarding CI (0.108320 for overweight and 0.233978 for obesity) but the smallest values of "failure" (0.946646 for overweight and 0.240381 for obesity) within all four groups. On the contrary, for both overweight and obesity, young men show a totally inverse result with the lowest degree of socioeconomic inequality regarding CI (0.034942 for overweight and 0.034942 for obesity) and relatively large AI (1.771467 for overweight and 1.084022 for obesity). As for women, both the young and the old have the moderate overweight and obesity

inequality compared to old men and young men.

***Area & Age groups***

Moving on to the third group set，which includes age and area, the most interesting thing is the negative concentration indices, in terms of obesity, being applied on elder people living in both urban and rural areas. In other words, for those over 65 years old living in both urban areas and rural areas, the poor are more likely to be obese than their socioeconomic better-offs. Moreover, the obesity inequality for rural old people is more obvious than urban elders with the CI of -0.036317 and -0.003029. But the urban old people have a higher "failure" index. For overweight people, a positive correlation between SES and overweight exists in these two groups (urban >= 65 and rural >= 65) although the inequality levels, reflected by the difference of CI and zero, are both low. In addition, people under 65 living in rural areas have the largest socioeconomic overweight inequality (0.075163) among all four Area & Age groups and a slightly larger inequality towards obesity (0.081467). However, the group of under 65 in urban has the most serious problem of obesity inequality (0.220177), instead of group of under 65 in rural. Overall, the people under 65 living in rural and under 65 living in urban show higher degree of inequality than other two groups, namely "over 65 in rural" and "over 65 in urban", in terms of both CI and AI.

***Gender & Area & Age groups***

Table 7 describes a further decomposition of adults by 8 groups and it includes all the

three characteristics (area, gender and age). When measuring overweight, "men <65 urban" is the only group has the negative CI, which means overweight prefers poor people in this group, while other groups all have a different direction of inequality. But the value of CI is small (-0.036211) for this group with the second smallest AI among all groups. It makes the overweight inequality problem for "men <65 urban" not so serious. The obesity inequality shares the same direction with overweight at CI of -0.096541 so that poor men under 65 living in urban have a higher risk to be obese.

| | **Overweight** | | **Obesity** | |
|---|---|---|---|---|
| **Group** | **CI** | **AI** | **CI** | **AI** |
| Men < 65 urban | -0.036211 | 1.208086 | -0.096541 | 0.397319 |
| Men < 65 rural | 0.107317 | 1.930606 | 0.105756 | 1.289235 |
| Men >=65 urban | 0.113473 | 1.378179 | 0.303580 | 0.402632 |
| Men >=65 rural | 0.055040 | 0.706504 | -0.004709 | 0.146111 |
| Women <65 urban | 0.145946 | 1.375386 | 0.356225 | 0.496799 |
| Women <65 rural | 0.029866 | 1.461616 | 0.025985 | 0.669123 |
| Women >=65 urban | 0.006362 | 2.950348 | -0.036764 | 1.942914 |
| Women >=65 rural | 0.035330 | 1.378214 | -0.022542 | 0.650552 |
| $C_W/A_W$ | *0.067828* | *1.549949* | *0.094109* | *0.783876* |
| $C_B$ | *-0.004250* | | *-0.013504* | |
| *Transvariation* | *-0.011184* | *0.025663* | *-0.025033* | *0.033346* |
| *Total* | *0.052394* | *1.575612* | *0.055572* | *0.817223* |

Table 7. Concentration index and achievement index of adult by three-dimension groups

Another three groups, namely, old men living in rural, old women living in rural and old women living in urban, also present a negative CI, which implies obesity

concentrate more on the poor for these groups. However, because the ranks of socioeconomic obesity inequality are not so high (8, 7 and 5), the negative relationships between SES and obesity are relatively weak for these three groups.

Two groups should also be noticed are “Women <65 urban” and “Men >=65 urban” because of the higher degree of inequality. Younger urban females have the largest concentration indices among all 8 groups for both overweight (0.145946) and obesity (0.356225). It seems that the most significant weight inequality problem exists among those women who are under 65 and living in urban. Next, elder urban males are ranked at 2, in terms of concentration indices, for both overweight inequality and obesity inequality, so that the two kinds of inequality problems are also serious within this group. Besides, “women >=65 urban” group has the highest socioeconomic inequality in both overweight and obesity from the “failure” index.

In addition, the degrees of overweight inequality for old women in urban and the obesity inequality for old men in rural are the lowest respectively. The age is a very crucial element for urban women since the largest overweight inequality gap exists between “urban women under 65” and “urban women above 65”

***(2) Decomposition***

***Decomposition of achievement***

Transvariation term in achievement index captures the difference between the ranks

within the group and the ranks in overall population. Table 8 displays the contribution of transvariation[5] to the total achievement for each group set. The transvariation term in "gender", "area", "age", "gender & area" and "gender & area & age" group sets all occupies a very small percentage of the total figure when measuring obesity. This indicates that not lots of differences exist between the socioeconomic inequality within their groups and the inequality of total population. However, the differences between the group obesity inequality and the total obesity inequality is a little large in "gender & age" and "area & age" group sets as the shares of transvariation for both group sets excess 10%. When focused on overweight inequality, all the shares of transvariation for every adult group set are very small so that the inequalities within groups are almost equal to the overall inequality.

| **Group set** | **Overweight** | **Obesity** |
|---|---|---|
| Gender | -0.16% | -0.36% |
| Area | 1.41% | 3.81% |
| Age | -0.02% | -0.05% |
| Gender & Area | 1.36% | 3.66% |
| Gender & Age | 0.02% | 14.75% |
| Area & Age | 1.48% | 24.85% |
| Gender & Age & Area | 1.63% | 4.08% |

Table 8. Contribution of transvariation to total AI for each adult group set

***Decomposition of concentration index***

From Table 9, we can see the decomposition of concentration index for each group

[5] The value of transvariation can be seen in Table 5 6 7

sets. We first consider overweight, within groups socioeconomic inequality explains almost all (99.66% and 99.66%) the total inequality for "age" groups and "gender & age" groups. Both the "between groups inequality" and transvariation account for a tiny part of the total inequality. The share of "between groups inequality" for males and females is only 0.26% but the transvariation contributes a very large negative part (52.10%) to the total inequality. The other four group sets ( area, gender & area, area & age and gender & area & age) have similar inequality distribution to three terms ($C_W, C_B$ and transvariation). The $C_W$ takes around 125% of the total inequality, $C_B$ takes around negative 5% and transvariation takes around -25%.

| **Overweight /Obesity** | **Group set** | **$C_W$** | **$C_B$** | **Transvariation** |
|---|---|---|---|---|
| Overweight | Gender | 151.84% | 0.26% | -52.10% |
| | Area | 125.55% | -6.51% | -19.04% |
| | Age | 99.66% | 0.22% | 0.12% |
| | Gender & Area | 124.60% | -6.93% | -17.67% |
| | Gender & Age | 100.30% | -1.79% | 1.50% |
| | Area & Age | 126.74% | -5.93% | -20.81% |
| | Gender & Age & Area | 129.46% | -8.11% | -21.35% |
| Obesity | Gender | 93.96% | 1.04% | 5.00% |
| | Area | 164.73% | -22.33% | -42.40% |
| | Age | 99.16% | -20.54% | 21.38% |
| | Gender & Area | 162.21% | -22.64% | -39.57% |
| | Gender & Age | 97.53% | -2.46% | 4.93% |
| | Area & Age | 180.41% | -21.03% | -59.38% |
| | Gender & Age & Area | 169.35% | -24.30% | -45.05% |

Table 9. Relative contribution to total inequality in CI for each adult group set

Next, we consider the obesity, the within groups inequality for gender groups (93.96%), age groups (99.16%) and gender & age groups (97.53%) are all near the total inequality. However, the small percentages of between groups inequality and transvariation only refer to gender groups and gender & age groups while these two percentages for age groups are large but have opposite directions (-20.54% and 21.38%). The within groups inequality explains over 150% of the total inequality for four groups of "Area", "Gender & Area" and "Gender & Age & Area" while the between groups inequality and transvariation both contribute negative proportion to the overall index

## *Children*

### *(1) Inequality indices*

Table 10 describes children's situation about overweight and obesity inequalities. It includes the results of overall children and two groups of children by gender and area respectively. The overall inequality figures for children have the same direction with adults, both SES positively relating to weight burden. The degree of unequal obesity is slightly higher than the one of unequal overweight, just as adults. However, Both the CIs measuring children's overweight and obesity are almost 3 times of those measuring overall adults' status. It seems that a more severe inequality happens on children and children in rich family have a higher possibility of being overweight and obese than rich adults.

***Gender groups***

It is worth noting that different genders have different inequality directions for children. Specifically, poor boys are more likely to be overweight and obese with negative CIs while rich girls are so with positive CIs. Boys are so different since most of other groups even including adults groups have a positive relationship between SES and weight burden. Besides, girls are also needed much attention because of the extremely large CIs (0.582134 for overweight and 0.610006 for obesity). These two values are larger than any other groups also even including adults groups. It implies that the overweight problem and the obesity problem are very serious among rich girls. From the concentration curves, we can also see that the imparity gap between boys and girls is huge considering both the direction and the degree.

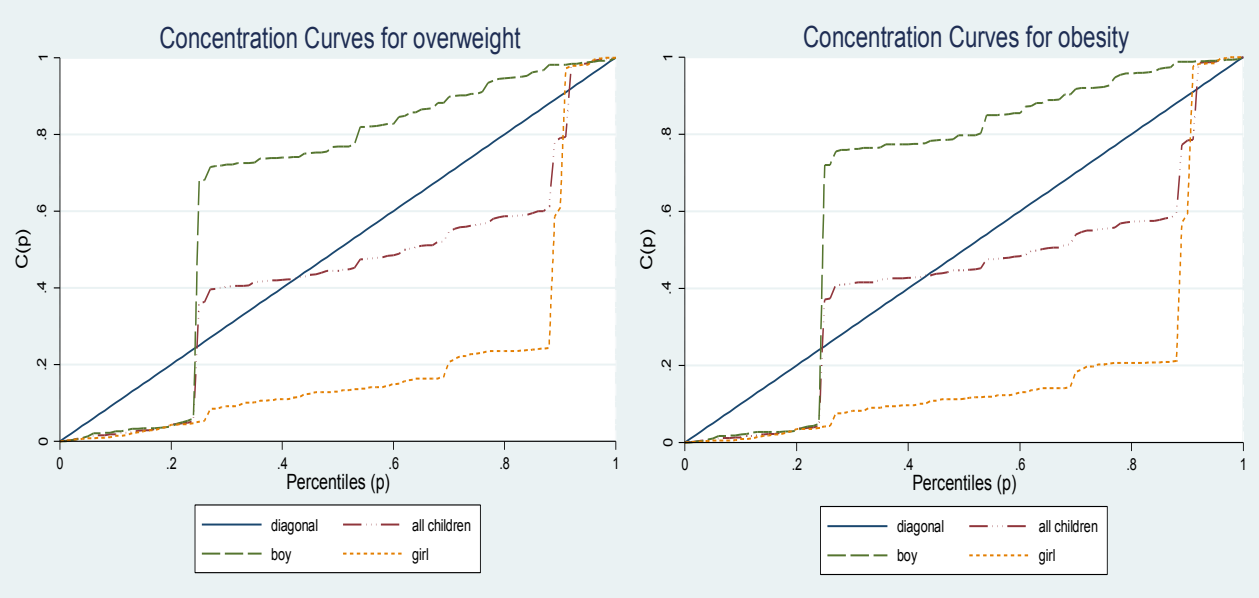


Figure 5. Concentration curves for boys and girl towards overweight and obesity

However, the achievement shows that boys suffer more serious overweight/obesity inequality problems than girls since the overweight and obesity "failure" indices are

both larger than 4.5 for boys while the "failure" for girls towards overweight and obesity are both less than 2. This is due to the different inequality directions between boys and girls. Poor boys are more likely to be overweight/obese and so are rich girls. In this case, the social cost of this kind of inequality problem for boys is higher than the cost for girls. Therefore, the overweight/obesity socioeconomic inequality for boys is severer.

| **Gender** | **Boy** | **Girl** | $C_W/A_W$ | $C_B$ | ***Transvariation*** | ***Total*** |
|---|---|---|---|---|---|---|
| **CI** | | | | | | |
| Overweight | -0.292066 | 0.582134 | *0.149791* | *0.000395* | *0.001624* | *0.151810* |
| Obesity | -0.323710 | 0.610006 | *0.154232* | *0.000459* | *0.001660* | *0.156351* |
| **AI** | | | | | | |
| Overweight | 4.760452 | 1.807135 | *3.385867* | | *-0.008040* | *3.377827* |
| Obesity | 4.503915 | 1.598149 | *3.151462* | | *-0.007896* | *3.143566* |
| **Area** | **Urban** | **Rural** | $C_W/A_W$ | $C_B$ | ***Transvariation*** | ***Total*** |
| **CI** | | | | | | |
| Overweight | 0.103198 | 0.173742 | *0.165187* | *-0.028589* | *0.015212* | *0.151810* |
| Obesity | 0.110675 | 0.178853 | *0.171626* | *-0.031336* | *0.016061* | *0.156351* |
| **AI** | | | | | | |
| Overweight | 1.546311 | 4.016372 | *3.324553* | | *3.377827* | *3.377827* |
| Obesity | 1.254231 | 3.799548 | *3.086651* | | *0.056915* | *3.143566* |

Table 10. Concentration index and achievement index of children by gender and area

***Area groups***

A positive relationship between SES and overweight (obesity) exists in both of the area groups. Besides, from the table, it is obvious that rural children suffer more inequality than urban children in terms of both overweight and obesity. Moreover，

AIs also give the consistent results when rural children have higher AIs towards both overweight and obesity (lower AI means larger inequality when CI>0). Besides, the socioeconomic imparity is slightly larger among obese population than overweight population.

***Area & Gender groups***

In this paper, area and gender are also taken into consideration together when analyzing children's weight (see table 11). "Rural boy" now play a different role within all four groups as it has negative concentration indices (-0.299467 and -0.321598 for overweight and obesity). In this case, boys in poor rural families are highly more tend to be overweight and obese than those in rich rural families. Besides, the achievement indices in overweight and obesity for rural boys are both the largest among all four groups. The negative CIs and the largest AIs both prove the serious unequal overweight and obesity problems among rural boys.

Rural girls have a totally different situation from rural boys. The most significant inequality problem occurs on rural girls with the largest positive CIs towards both overweight (0.643774) and obesity (0.665857). Both of them are more than the half of the extreme positive value[6]. It implies that for girls in rural places, the richer their family is the more overweight or obese she is. The weight burden is highly concentrated on girls in rich rural households.

[6] The upper limit of CI is 1 and lower limit of CI is -1

| | Overweight | | Obesity | |
|---|---|---|---|---|
| **Gender & Area** | **CI** | **AI** | **CI** | **AI** |
| Urban boy | 0.170335 | 1.287615 | 0.184956 | 0.978571 |
| Urban girl | 0.043013 | 1.814354 | 0.049490 | 1.539100 |
| Rural boy | -0.299467 | 5.768886 | -0.321598 | 5.527109 |
| Rural girl | 0.643774 | 1.913890 | 0.665857 | 1.726653 |
| $C_W/A_W$ | *0.162753* | *3.334247* | *0.169089* | *3.096103* |
| $C_B$ | *-0.028487* | | *-0.031215* | |
| *Transvariation* | *0.017544* | *0.043580* | *0.018477* | *0.047463* |
| *Total* | *0.151810* | *3.377827* | *0.156351* | *3.143566* |

Table 11. Concentration index and achievement index of children gender & area

Two of the urban groups both show a positive overweight concentration index and a slightly larger obesity concentration index than overweight concentrate index. In other words, the degree of obesity inequality is a little higher than that of overweight inequality. Urban boys have larger CIs than urban girls meaning that they face severer overweight and obesity inequality problems. Besides, the achievement index also gives a consistent result of larger socioeconomic inequality for urban boys with concentration index. However, the inequality gap between boys and girls in urban is not so large as this gap in rural.

***(2) Decomposition***

***Decomposition of achievement***

From Table 12, we can see that the share of transvariation terms are all less than 2%.

A tiny percentage illustrates the little differences between the inequality within each groups and the inequality within the total population. Transvariation term contributes a negative proportion, although it is very small, to the total figure for gender groups.

| ***Group set*** | ***Overweight*** | ***Obesity*** |
|---|---|---|
| *Gender* | *-0.24%* | *-0.25%* |
| *Area* | *1.58%* | *1.81%* |
| *Gender & Area* | *1.29%* | *1.51%* |

Table 12. Contribution of transvariation to total AI for each children group set

| ***Overweight/Obesity*** | ***Group set*** | $C_W$ | $C_B$ | ***Transvariation*** |
|---|---|---|---|---|
| *Overweight* | *Gender* | *98.67%* | *0.26%* | *1.07%* |
| | *Area* | *108.81%* | *-18.83%* | *10.02%* |
| | *Gender & Area* | *107.21%* | *-18.76%* | *11.56%* |
| *Obesity* | *Gender* | *98.64%* | *0.29%* | *1.06%* |
| | *Area* | *109.77%* | *-20.04%* | *10.27%* |
| | *Gender & Area* | *108.15%* | *-19.96%* | *11.82%* |

Table 13. Relative contribution to total inequality in CI for each children group set

***Decomposition of concentration index***

The decomposition of concentration index is shown in Table 13. Consider overweight inequality first, the inequality within gender groups occupies 98.67% of the total inequality and the contribution from between groups and transvariation are very small. However, the within groups inequality, for both “area” and “gender & area” group sets, explains more than 100% of the total inequality (108.81% and 107.21% respectively) and transvariation term explains more than 10%. The excess inequality

is reduced by the negative percentages of between groups inequality. The decomposition of obesity inequality for each children group sets is similar to that of overweight inequality including both sign and value.

# 6. Discussion

As far as I know, there are no previous studies analyzing the socioeconomic inequality in overweight and obesity, using concentration index, among Chinese population. This paper may be the first one discussing this topic. Besides the concentration index, which is the most popular index used by other literatures to measure health inequality, I also use the achievement index as a supplement. At a more disaggregated point, the decomposition of CI and AI in this paper helps us know more about the sources of these inequalities.

Starting with adults, although some demographic groups together with their disaggregated groups show confused results, we can still get some conclusions. Firstly, we can find that most of the demographic groups have a positive concentration index toward overweight and obesity. It means in China, a prevalent relation for adult is that individuals with higher socioeconomic status are more likely to be overweight or obese. In other words, the weight burden prefers rich Chinese rather than the poor for most groups. However, there still are some exceptional groups.

Although the effects of area characteristic on socioeconomic inequality in overweight and obesity vary across different demographic groups, age and gender difference still seem meaningful. In rural areas, age differences are significant. For elder people in rural places, the poor are more likely to be obese regardless the gender of them. But for young people, obesity prefers the rich men and women. This implies in rural areas, age difference is the main difference of socioeconomic inequality in obesity. However, when measuring SES inequality in overweight, both the rich young and the rich old are preferred by this health problem.

The gender difference is notable among adult living in urban places. For young people, the differences include both direction and magnitude. Overweight and obesity both prefer poor young males and rich young females in urban. Besides, the inequality is small for these men but very large for these women. For old people living in urban, men have much more socioeconomic inequality in both overweight and obesity than women (although the directions of obesity inequality are different).

When consider the "failure" index, we can find the results in part 4 always show a different ranks of concentration index and achievement. It is due to the average overweight and obesity levels. For example, in urban areas, old women have the largest average overweight and obesity and young men have the smallest average values; in rural areas, young men have the largest average value and old men have the smallest one. So that when the difference of mean overweight value between groups

is large, ranks by CI and AI are so different.

As for the decomposition of achievement, the within groups overweight inequality is not obviously different from the overall overweight inequality for all the group sets. The within groups obesity inequality also close to the overall figure for most groups but for the "Gender & Age" and "Area & Age", the differences between the within group figure and overall figure seem large. As for the concentration index, the sources of total overweight and obesity inequality vary according to different group sets. However, we can still see that most of the inequalities come from within groups.

Considering children next, the gender difference is considerable. To be specific, boys in poor families suffer more overweight and obesity inequality and so do girls in rich families. Many factors contribute to this gender disparity, such as the attitude towards obesity, the food intake structure or the parents' attitude. Besides the difference of direction of the association, the magnitude overweight inequality and obesity inequality for girls is much larger than for boys. However, the area differences are not significant among overall children. In both rural and urban area, overweight and obesity prefer children in rich families, just consistent with the association between SES and weight status in many other groups. The children in rural areas suffer a little more overweight/obesity inequality than children in urban areas. If we consider boys and girls separately, the area differences become large. In rural places, I found a negative association between SES and overweight/obesity among boys but the

relationship is reverse among boys in urban. Besides, the degree of inequality is higher for rural boys than urban boys. As for girls, rural area shows an extreme large socioeconomic inequality in overweight and obesity while urban area just has a little weight status inequality relative to rural. These findings suggest that children in rural places suffer more socioeconomic weight inequality.

Another thing need to be noticed is that although rural boys have a lower degree of socioeconomic inequality in overweight/obesity, which is measured by the absolute value of concentration index, than rural girls, the much larger "failure" indices for rural boys imply a severer overweight/obesity inequality problem than rural girls. This can be explained by the social cost. The social cost is larger when the health problems occurred on the poor than occurred on the rich. Because the rich have more resources, more income or even more social network to solve these health problems but the poor do not. Therefore, the negative relationship between SES and overweight/obesity among boys means more social cost than the positive one between SES and overweight/obesity among girls. The problem for rural boys is more serious.

Just like adults, the decomposition of achievement illustrates that there is not many differences between the within group inequality and the overall inequality. For concentration index, the sources of inequality vary across group sets but for all the group sets, the most proportion of inequalities comes from within group.

One conclusion in the paper by Zhang and Wang (2004) stated that SES was negatively related to the obesity among both white men and women in the United States. But this result in does not apply to China that rich people are more likely to be obese in general. One important cause of this difference I believe is the food price and food intake structure. In America, meat is relative cheap than vegetables and fruits so that the poor prefer to buy more meat when the rich prefer more vegetables and fruits. Besides, the poor people America always eat cheap fast food, which have high calories. On the other side, meat is more expensive than vegetables and fruits in China so that rich Chinese people prefer to consume more meat and the poor have to eat more vegetables. Due to this kind of difference food price system, it is reasonable that these two countries have national different general relationship between SES and obesity. Besides, some other factors also make gender differences or area differences to the inequality pattern such as social attitude and personal lifestyle. Baker and Wardle (2002) believed that different education and occupation both contribute to the gender differences in inequality. In order to get the real situation about the overweight/obesity inequality, gender difference and area difference should be considered together. The effects of these two factors are interactional.

# 7. Conclusion

I used the traditional concentration index in this paper to measure the socioeconomic inequality in overweight and obesity firstly in China. This kind of index shows the

direction of association between SES and weight status as well as the magnitude of such inequality. The positive concentration index means the health problem prefer the rich people while the negative one means the health problem is concentrated on the poor. The value of CI is between -1 to 1 and the larger the absolute value the higher degree of inequality. However, this index ignores the average overweight/obesity level so a "failure" index (AI) was introduced to this paper. The higher "failure" index is the larger inequality is. "Failure" index also considers the different social cost of different directions of relationship between SES and weight status. The social cost is lower when a health problem is concentrated on the rich than on the poor. In order to know more about the inequality sources, I also applied a decomposition of the achievement index as well as the concentration index.

Firstly, I found the facts about socioeconomic overweight/obesity inequality in China are so different from the United States. But one thing is the same that direction and the magnitude of the socioeconomic overweight/obesity vary across groups. In China, the weight burden prefers the rich in most of the demographic groups. However, rural boys and urban men under 65 years old show negative associations between SES and overweight/obesity. Secondly, in rural area, the age difference is the main difference for inequality of adults. In urban area, the gender difference is more significant among adults. Thirdly, boys especially the rural boys in poor families suffer more overweight and obesity inequality. Fourthly, the largest proportion of inequalities comes from within groups.

In conclusion, the socioeconomic inequality in overweight and obesity exists among Chinese population and the direction and degree of these inequalities vary across groups. However, most of the groups show a positive relation between SES and overweight/obesity.

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