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To the Graduate Council:

I am submitting herewith a thesis written by Yuling Lin entitled "Dietary Inequality among the Elderly in the United States: Decomposing Inequality in the Healthy Eating Index." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Economics.

Steven T. Yen, Major Professor

We have read this thesis and recommend its acceptance:

Kim Jensen, Seong-Hoon Cho

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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Kim Jensen

Seong-Hoon Cho

Acceptance for the Council:

Vice Chancellor and Dean of Graduate Studies

AG-VET-MED.

Thesis
2006
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DIETARY INEQUALITY AMONG THE ELDERLY IN THE UNITED STATES: DECOMPOSING INEQUALITY IN THE HEALTHY EATING INDEX

A Thesis
Presented for the
Master of Science
Degree
The University of Tennessee, Knoxville

Yuling Lin
May 2006

DEDICATION

This thesis is dedicated to my husband, Hao-Hsiang Liao, and my dear family. Hao-Hsiang, thank you for your support and understanding while I have continued my education. Mom and Dad you have always believed in me, encouraged me and supported me in my goals. I can not begin to thank you all enough for the encouragement and support you have given me.

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I thank my husband, Hao-Hsiang Liao, whose kind words and patience have enabled me to abide stressful times at school. I thank my parents, David Lin and Hsiu-Ying Tseng, and my parents in law, who supported and encouraged me all the time. I am inspired by them, and am grateful for their love, and their support of my career goals. Thanks for my friends, whose suggestions and encouragement made this work possible.

ABSTRACT

This study uses the concentration index methodology to investigate the inequality in nutritional intake among American elderly. The concentration index provides a summary measure of socioeconomic inequality of the variables in question. Its decomposition enables comparisons across individuals with different characteristics such as gender, age, households income levels, and government program participation. Data are drawn from the 1994–96 Continuing Survey of Food Intakes by Individuals collected by the U.S. Department of Agriculture. Analysis is carried out for the Health Eating Index and one of its components, namely intake of fruits. Results suggest that high education level, receiving the food stamps, doing more exercise, and being on diet have improved the HEI among the elderly. However, unequal distribution of income appears to contribute to the inequalities in HEI. With respect to fruit consumption, income inequality has contributed to the unequal distribution of fruit consumption. Better education, more frequent exercise, being a meal planner, and being on a diet reduce the inequality in fruit consumption. Gender does not affect the inequality in HEI or in fruit consumption.

INDEX OF CONTENTS

Chapter Page

Chapter I Introduction 1
Chapter II Literature Review 5
2.1 Measuring Inequalities in Health 6
2.2 Fruit Consumption 7
Chapter III Methodology 10
Chapter IV Data and Sample 16
4.1 CSFII 1994–96 16
4.2 Healthy Eating Index 17
Chapter V Results 33
5.1 Concerns with the HEI 33
a. Regression Results 33
b. Decomposition Results 40
5.2 Concerns with Components of HEI – Fruits, Milk, and Saturated Fat 49
a. Regression Results 53
b. Decomposition results 70
Chapter VI Summary and Concluding Remarks 82
References 84
Vita 90

INDEX OF TABLES

Table Page

Table 1. HEI Component Definitions 18
Table 2. Components of the Healthy Eating Index and Scoring System 20
Table 3. The Definitions for HEI Component Serving 21
Table 4. Variable Definitions and Sample Statistics 23
Table 5. Sample Statistics and Concentration Indices of the CSFII Dataset 25
Table 6. Descriptive Statistics of the HEI by Dietary Status 28
Table 7. Ordinary Least-Squares Regressions (Dependent Variable = HEI) 35
Table 8. Elasticities and Concentration Indices Calculated Based on the HEI Regressions 41
Table 9. Regressor Contributions to Concentration Indices of HEI and Changes of Concentration Indices 43
Table 10. Oaxaca-Type Decompositions for Change in Inequality in HEI, 1995–96 47
Table 11. Oaxaca-Type Decompositions for Change in Inequality in HEI, 1994–96 50
Table 12. Ordinary Least-Squares Regressions (Dependent Variable = Fruits) 57
Table 13. Ordinary Least-Squares Regressions (Dependent Variable = Milk) 61
Table 14. Ordinary Least-Squares Regressions (Dependent Variable = Saturated Fat) 66
Table 15. Elasticity and Concentration Indices Calculated Based on the HEI – Fruits Component Regressions 71
Table 16. Regressor Contributions to Concentration Indices and Changes of Concentration Indices Based on the HEI – Fruits Component Regressions 73
Table 17. Oaxaca-Type Decompositions for Change in Inequality in Fruit Consumption, 1995–96 77
Table 18. Oaxaca-Type Decompositions for Change in Inequality in Fruit Consumption, 1994–96 80

INDEX OF FIGURES

Figure Page

Figure 1. Ill Health Concentration Curve 11
Figure 2. Good Health Concentration Curve 13
Figure 3. Income Share among Whole Sample 30
Figure 4. Income Share among Individuals Who Need Improvement 31
Figure 5. Income Share among Individuals with Poor Diet 32
Figure 6. HEI Concentration Curve, the Elderly Sample. 34
Figure 7. Concentration Curve of the HEI Component – Fruits, the Elderly Sample. 52
Figure 8. Concentration Curve of the HEI Component – Milk, the Elderly Sample. 54
Figure 9. Concentration Curve of the HEI Component – Saturated Fat, the Elderly Sample 55

CHAPTER I INTRODUCTION

Large inequalities that exist in the health sector between the poor and the wealthy have continued to be a public health issue, in industrialized and developing countries alike (Wagstaff et al., 2003). In industrialized countries, inequalities in health favor the higher income groups and the inequality is pervasive in the United States. From a global perspective, a strong association is found between inequalities in health and inequalities in income across countries (van Doorslar et al., 1997.)

The issues of health inequalities have become increasingly important for the United States government because many of these inequalities are avoidable and fundamentally unfair. Therefore, the government has focused on narrowing the health gap between disadvantaged groups and communities and the rest of the country, as well as improving health overall. To address this goal, the Healthy People 2010 initiative of the U.S. Department of Health and Human Services (2000) is designed to achieve two comprehensive goals. The first goal is to help individuals of all ages increase life expectancy and improve their quality of life. The second is to eliminate health disparities among different segments of the population.

A number of studies have used the concentration index (CI) methodology to explore the problems of inequalities in health. Zhang and Wang (2004), for example, use the CI to assess socioeconomic inequality in the distribution of obesity among American adults aged 18–60 years old, which suggested that gender, age, and ethnicity could be important factors in socioeconomic inequality in obesity.

The Healthy Eating Index (HEI) was developed by the U.S. Department of Agriculture (USDA) to provide a single summary of diet quality based on different aspects of a healthy diet (Bowman et al., 1998). In the field of health economics, linear and logistic regression analyses are the classical approaches to study the association between social economic status (SES) and HEI. In general, the coefficients are reported to indicate the magnitude and direction of the association. A positive coefficient means a direct relationship between the dependent variable and independent variable while a negative coefficient represents a negative relationship. Economists have used the HEI to assess the diet quality of different target population or the effects of government welfare policies (Cosentino et al., 2002).

However, there are some limitations to the regression models. First, although linear regression analysis can help examine whether there is an association between SES and the HEI, it is not powerful enough to measure the inequality or to tell how severe the inequality in HEI is. Second, comparing inequalities across studies over time using traditional regression analysis is difficult, since the validity of the regression analysis is based on assumptions such as independence between study variables over time. Last, from a statistical perspective, linear regression analysis assesses the relationship between the outcome and explanatory variables on average but it ignores the possibility that the effects of explanatory variables may vary across the distribution. To resolve theses methodological issues, a variety of inequality measures have been employed in the literature on health inequalities.

There are three requirements for a legitimate index of inequality in health. First of all, the index should reflect the socioeconomic dimension to inequalities in

health. Secondly, the index should reflect the experiences of the entire population. Finally, the index should also be sensitive to changes in the distribution of the population across socioeconomic groups. To resolve these problems, economists have developed summary indices such as the Gini coefficient and the CI.

Based on the 1994–96 CFSII, the sample used in this study, the diets of most people (70 percent of the sample) are in the "needs improvement" range. Approximately 12 percent of the sample had a good diet, and 18 percent had a poor diet (Bowman et al., 1998). Furthermore, according to data from the USDA (Lin, 2005), 25 percent of higher income Americans (with household income exceeding 185 percent of the poverty level) ages 60 and older had a good diet, compared with only 13 percent for the lowest income group (with household income below 130 percent of poverty level). A large proportion of the lowest income older Americans (18.5 percent) have a poor diet, compared with others (13.1 percent and 9.2 percent for low-income and higher-income individuals, respectively).

The HEI scores generally increase as household income and educational level increase. During 1994–96, people with household incomes at 50 percent of the poverty threshold or below had an average HEI score of 60. In contrast, people with household incomes three times the poverty threshold had an average HEI score of 65 (Bowman et al., 1998). These different mean scores suggest the existence of inequality in the HEI.

An analysis of the inequality in elderly people's diet quality, as measured by the HEI, can reveal how the inequality is related to household income and other socio-demographic characteristics. This thesis will follow the CI methodology of Wagstaff, van Doorslaer and Watanabe (2003) in estimating and decomposing inequalities in diet quality. This study will use the HEI as a measure of diet quality

and examine its inequality among the elderly. It is the first study, to our knowledge, to measure the degree of inequality in HEI among the elderly using the CI methodology.

Inequality in the health sector is fundamentally unfair and should be avoided in the society. Good health should not be a privilege among the better-off. The wealthy people have more resources to buy more and better-quality food, which may lead to higher dietary quality and therefore better health conditions. However, it is social injustice if only the wealthy people have better dietary conditions. One important goal of a modern-day society is the pursuit of an equal status for everyone in the society. The government needs to take care of every citizen and make the society well and equal. In the United States, although there are many government programs targeting the poor, inequalities in the health sector still exists.

The objective of this study is to ascertain how socioeconomic and demographic factors influence the inequality in HEI among the elderly in the United States. This study uses a summary inequality index, CI, to assess the degree of inequality in HEI and one of its components, fruit consumption, across socioeconomic groups using national representative survey data from the 1994–96 CFSII. Inequalities across the elderly with different socioeconomic characteristics, such as income, educational level, and participation in government welfare programs will be estimated. Implications to reduce health disparities across socioeconomic groups will be drawn.

CHAPTER II LITERATURE REVIEW

Sehili et al. (2005) investigated inequalities in physically healthy days in the United States during 1993–99 across socioeconomic and demographic groups. Low-to-middle income groups had the highest increases in inequalities during this time whereas the least educated, Asian/Pacific Islanders, American Indians and Alaska Natives, the oldest, the youngest, and the richest had the lowest. Inequalities increased during 1993–99 and varied substantially across groups. The American Indians/Alaska Natives experienced the highest inequalities whereas Asians/Pacific-Islanders exhibited the lowest inequalities.

In the 1990s, economists exploited the analogy between taxes and poor health outcomes as burdens that may be unevenly apportioned to members of different socioeconomic status (SES) groups, and have applied techniques of analyzing income inequality to analyze inequality in general health status. For example, using cross sectional data, Kunst et al. (1995) investigated the association between educational level and several health indicators and the extent to which the size of socioeconomic inequalities in self-reported health varied among industrialized countries. Compared with other industrialized countries in the study period from 1983–90, the largest inequalities were observed for men and women aged 15–64 in the United States. Another study analyzed the relationship between geographical inequalities in income and the prevalence of common chronic medical conditions and mental health disorders, and compared it with the relationship between family income and these health problems (Sturm et al., 2002). Craig (2005) compared the results of single-level and multi-level logistic regression models estimating the association between income inequality and

self-assessed health in local authorities in Scotland, which suggested a significant positive association between income inequality and health across local authorities in Scotland.

2.1 Measuring Inequalities in Health

The literature on health inequality measurements has benefited substantially form cross-fertilization, both within the discipline of economics (primarily form the literature on income inequality and the literature on health inequality measurements) and between the disciplines of economics, epidemiology, and public health (see, e.g., Wagstaff et al., 1991; Mackenbach et al.,1997). For example, the Gini coefficient has been used to measure the pure health inequality (Le Grand 1987, 1989). Concentration index is an index to measure socioeconomic inequalities in health (Wagstaff et al., 1991; Kakwani, Wagstaff, and van Doorlsaer, 1997).

Concentration indices and curves have now become standard measurement tools in the literature on equality and inequality in health. These indices were first introduced by Wagstaff et al. (1989) and have been used frequently to describe and measure the degree of inequalities in various measures of health. Wagstaff et al. (1991) reviewed and compared the properties of the CI with alternative measures of health inequality and conclude that it shares the same properties as one of two relative index of inequalities measures that are used by epidemiology but that concentration curves have an additional advantage in terms of their visual representation of the location of deviations from proportionality and the possibility to perform checks for a dominance relationship.

Wagstaff et al. (1991) identified six measures of inequalities that have been

used to date in the literature in the inequalities in health. They are: the range, the Gini coefficient (and associated Lorenz curve), a pseudo-Gini coefficient (and associated pseudo-Lorenz curve), the index of dissimilarity, the slope index of inequalities (and the associated relative index of inequalities) and the concentration index (and the associated concentration curve). It was suggested that only two of these – the slope index of inequalities and the concentration indices – are likely to present an accurate picture of socioeconomic inequalities in health. To measure the health inequalities, it is assumed that a health variable measures ill health. The variable might be an index of self-assessed health (Wagstaff and van Doorslaer, 1994), or it might be a measure of malnutrition (Wagstaff and Watanabe, 2000).

Gravelle et al. (2003) measure and decompose income related inequalities in self assessed health in England, Scotland, and Wales, in 1979–95, and conclude that reductions in pro-rich health inequality can be achieved by reducing income inequalities, reducing the effect of income on health, or both.

2.2 Fruit Consumption

Diets that are high in fruits and vegetables lower an individual's risk of chronic disease and contribute to healthy aging (USDA, 2000). Homebound seniors often have low intake of fruits and vegetables and limited access to fruits and vegetables with the most protective nutrients and photochemicals. Studies have supported the links between increased vegetable, fruits, and fiber consumption, and lower rates of several cancers, coronary heart disease (CHD), neural tube defects, and cataracts (Kushi et al., 1995).

Evidence for the importance of fruits and vegetable intake to health and quality of life with aging is widely recognized. Diet-related factors are thought to

account for about 30% of cancers in developed countries. Adequate intakes of fruits and vegetables probably lower the risk for several types of cancer, especially cancers of the gastrointestinal tract (Key et al., 2002). Joshipura et al. (1999) suggested that consuming fruits and vegetables can reduce an individual's risk of cardiovascular disease.

From the 2000 edition of the Dietary Guidelines for Americans (USDA, 2000), fruits and vegetables are key parts of our daily diet. Eating plenty of fruits and vegetables of different kinds, as part of the healthful eating patterns described by these guidelines, may help protect people against many chronic diseases. Fruits and vegetables provide essential vitamins and minerals, fiber, and other substances that are important for good health. Most people eat fewer servings of fruits and vegetables than are recommended. Therefore, adults are advised to choose a variety of fruits and vegetables and consume at least two servings of fruits each day.

According to the Dietary Guidelines for Americans (USDA, 2005), increased intakes of fruits, vegetables, whole grains, and fat-free or low-fat milk and milk products are likely to have important health benefits for most Americans. Diets rich in foods containing fiber, such as fruits, vegetables, and whole grains, may reduce the risk of coronary heart disease. Fruits are good source of vitamins A and C, folate, and potassium, which may reduce the risk of kidney stones and bone loss.

Since consuming fruits have many health advantages, the U.S. government has established programs to help people obtain sufficient intake of fruits, especially for the population with low income or disabilities (Johnson et al., 2004). Therefore, in this study, not only the inequalities in the HEI among the elderly will be

discussed, but also inequalities in fruit consumption among the elderly will be dealt with.

CHAPTER III METHODOLOGY

A few summary indices of health inequality have been used in the literature, including the Gini coefficient (Le Grand, 1987; Andrew et al., 2004; Gravelle et al., 2003; Asada et al., 2004), the index of inequality, the relative index of inequality, and the concentration index (CI) (Wagstaff et al., 1991). Of these summary indices, Wagstaff et al. (1991) argue that the CI is the most appropriate measure of health inequality because it meets the three basic requirements of a health inequality index. To begin with, it reflects the socioeconomic dimension in health inequality. Secondly, it reflects the experiences of the whole population. Lastly, it is sensitive to changes in the distribution of the variable of interest across socioeconomic groups. Furthermore, the CI leads itself to graphical representation that is more easily and initiatively interpreted. Therefore, in this study, the CI will be used to measure the degree of inequality in HEI and its relative important components within the elderly population in the United States.

Suppose the purpose is to measure inequalities in health by income, or some other measures of socioeconomic status (SES) of interest. The household income (or other measures) is ranked, starting with the most disadvantaged. Let p be the cumulative proportion of people, so ranked. Figure 1 shows the ill-health concentration curve, which is the curve labeled $L(p)$. It plots the cumulative proportion of ill health (on the y-axis) against the cumulative proportion of individuals (on the x-axis), ranked by living standards. If the curve $L(p)$ coincides with the diagonal, everyone, irrespective of their economic status, enjoys the same level of ill health. As more likely, if $L(p)$ lies above the diagonal, inequalities in ill health favor the better-off, which is called pro-rich. On the other hand, if $L(p)$ lies

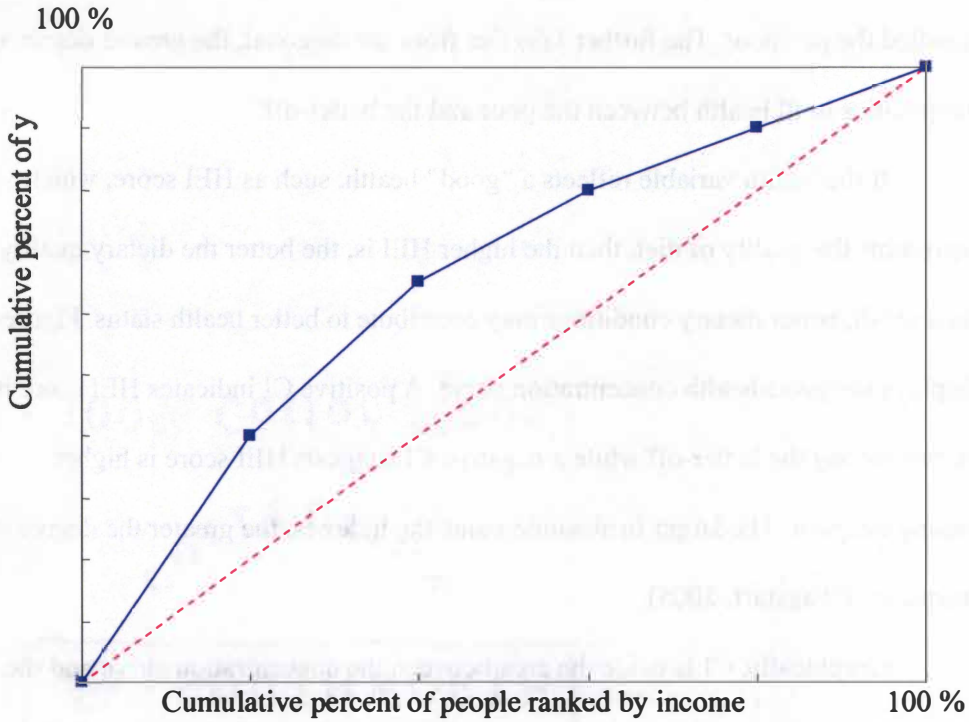

Figure 1. Ill Health Concentration Curve

below the diagonal, inequalities exist to the disadvantages of the better-off, which is called the pro-poor. The further *L(p)* lies from the diagonal, the greater degree of inequalities in ill health between the poor and the better-off.

If the health variable reflects a "good" health, such as HEI score, which represents the quality of diet, then the higher HEI is, the better the dietary quality. As a result, better dietary conditions may contribute to better health status. Figure 2 displays the good-health concentration curve. A positive CI indicates HEI score is higher among the better-off while a negative CI suggests HEI score is higher among the poor. The larger in absolute value the index is, the greater the degree of inequality (Wagstaff, 2005).

Graphically, CI is twice the area between the concentration curve and the diagonal, or equivalently one minus twice the area underneath the concentration curve. Let y be the outcome variable, which for this study is the HEI score or one of its components for the elderly in the United States, and n is the sample size, $\bar{y}$ is the sample mean of y, and R is the fractional rank of the i th person in the income distribution. Then, the concentration index, denoted C, can be calculated using equation (1) (Kakwani et al., 1997)

$$C = \frac{2}{n\bar{y}} \sum_{i=1}^{n} y_i R_i - 1 \qquad (1)$$

This measure, C, like the Gini coefficient, is a measure of relative inequality, so that a doubling of everyone's health outcome (HEI) leaves C unchanged. The coefficient C takes a value of zero when $L(p)$ coincides with the diagonal and is negative (positive) when $L(p)$ lies below (above) the diagonal.

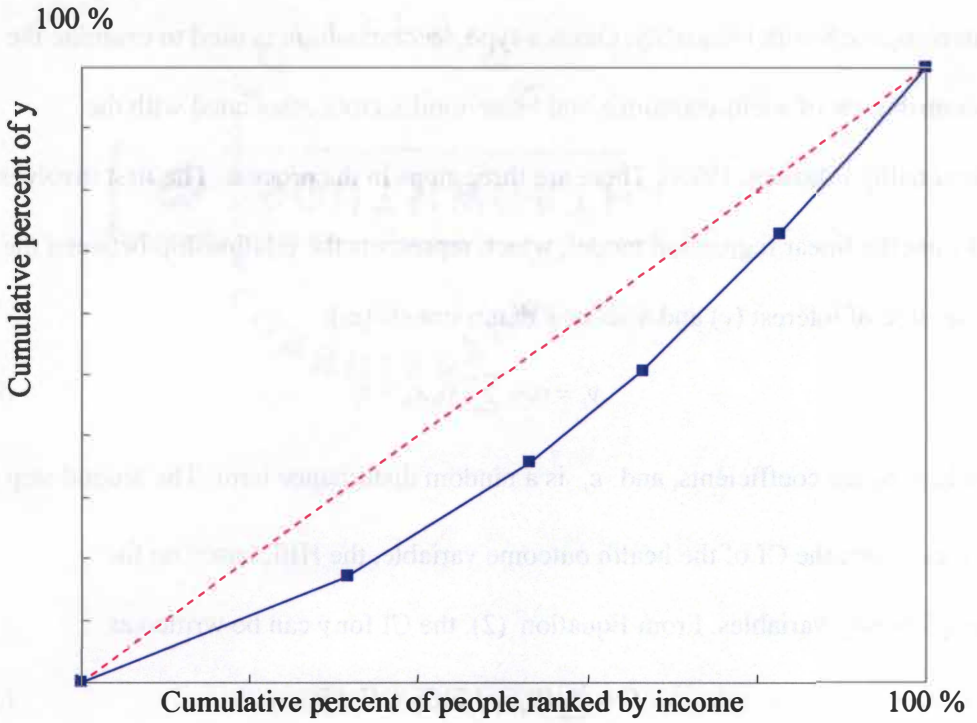

Figure 2. Good Health Concentration Curve

Wagstaff, van Doorslaer and Watanabe (2003) introduce a procedure to decompose health inequality. Oaxaca-type decomposition is used to examine the contribution of socio-economic and behavioral factors associated with the inequality (Oaxaca, 1973). There are three steps in the process. The first involves fitting the linear regression model, which represents the relationship between the variable of interest (y) and a set of k determinants (x_k):

$$y_i = \alpha + \sum_k \beta_k x_{ki} + \varepsilon_i \tag{2}$$

where β_k are coefficients, and ε_i is a random disturbance term. The second step is to calculate the CI of the health outcome variable, the HEI, based on the explanatory variables. From Equation (2), the CI for y can be written as

$$C = \sum_k (\beta_k \bar{x}_k / \bar{y}) C_k + G_\varepsilon / \bar{y} \tag{3}$$

where $\bar{x}_k$ the sample mean of x_k, C_k is the CI for x_k and, in the last term, G_ε is a generalized index for the disturbance term, defined as

$$G_\varepsilon = \frac{2}{n} \sum_{i=1}^{n} \varepsilon_i R_i \tag{4}$$

In empirical analysis, ε_i and β_k can be replaced by their estimates from the regression of Equation (2). The relationship is assumed to hold in any time period t. The final step is to decompose C using the results calculated in the previous steps.

The most general approach to unraveling the causes of changes in inequalities will be to allow for the possibility that all the components of the decompositions in Equation (3) have changed and simply to take the difference:

$$\Delta C = \sum_k (\beta_{kt} \bar{x}_{kt} / \bar{y}_t) C_{kt} - \sum_k (\beta_{kt-1} \bar{x}_{kt-1} / \bar{y}_{kt-1}) C_{kt-1} + \Delta(G_{\varepsilon t} / \bar{y}_t) \tag{5}$$

Another approach will be to apply an Oaxaca-type decomposition (Oaxaca, 1973)

to Equation (3). Denote the elasticity of y with respect to x_k at time t as η_{kt} and apply Oaxaca's method. Then, Equation (6) will be used as follows:

$$\Delta C = \sum_k \eta_{kt}(C_k - C_{kt-1}) + \sum_k C_{kt-1}(\eta_{kt} - \eta_{kt-1}) + \Delta(G_{st} / \bar{y}_t) \tag{6}$$

with an alternative being

$$\Delta C = \sum_k \eta_{kt-1}(C_k - C_{kt-1}) + \sum_k C_k(\eta_{kt} - \eta_{kt-1}) + \Delta(G_{st} / \bar{y}_t) \tag{7}$$

As can be seen in this approach, the extent to which overall changes in health inequalities are due to changes in inequalities in the determinants of HEI and changes in their elasticities.

Equations (6) and (7) are obtained by applying Oaxaca-type decomposition to Equation (3). They demonstrate, for each explanatory variable x_k or for all x_k combined, the percentage to which changes in health inequalities are associated with changes in inequality in the explanatory variables (the first term of the right-hand side), rather than to changes in their elasticities (the second term of the right-hand side). For example, the overall contribution of per-capita income to the change of inequality in health eating indices among the elderly is composed of two separate parts. The first is the change of the inequality in per-capita income times its elasticity, and the second is the change of elasticity times its concentration index. Equations (6) and (7) differ in the choice of time period for elasticity in the first term and concentration indices in the second term.

CHAPTER IV DATA AND SAMPLE

In this thesis, data are drawn from the 1994–96 Continuing Survey of Food Intakes by Individuals (CSFII) (USDA, 1998), and the Healthy Eating Index (HEI).

4.1 CSFII 1994–96

The CSFII is a national representative sample of non-institutionalized individuals of all ages living in the United States, which is conducted by the Agricultural Research Service (ARS) of the USDA. Also, the CSFII contains extensive information about demographic and socioeconomic characteristics. Information regarding food and nutrient intakes of each respondent is gathered over two nonconsecutive days of dietary recalls.

The CFSII 1994–96 included a target population of non-institutionalized individuals in all fifty states and Washington, DC. Compared with earlier surveys, the CSFII 1994–96 contains an over-sampling of the low-income population. Three years of continuous data collection began in 1994. In each following survey year, each individual from a nationally representative sample of individuals of all ages is asked to provide food intake information for two nonconsecutive days (day 1 and day 2) through the administration of in-person, 24 hour dietary recalls spaced 3–10 days apart. Trained interviews visited each household and obtained data on relevant demographic, economic and health related characteristics of household members.

4.2 Healthy Eating Index

The HEI is a summary measure of diet quality designed by the Center for Nutrition Policy and Promotion at USDA (CNPP-USDA) in order to monitor changes in patterns of food consumption over time (USDA, 1995). The index measures how well diets conform to the recommendations of the Dietary Guidelines and the Food Guide Pyramid. Scores for the HEI range from 0 (worst) to 100 (perfect) and are based on the USDA guidelines. A person's overall HEI score is the simple sum of 10 component scores. Table 1 presents the definitions for all HEI components. Components 1–5 measure the degrees to which a person's diet conforms to the USDA's Food Guide Pyramid serving recommendations for the five major food groups (grains, vegetables, fruits, milk, and meat). Components 6 and 7 measure the calorie intake from total fat and saturated fat consumption as a percentage of total food energy intakes. Components 8 and 9 measure total cholesterol and sodium intakes, and component 10 examines the amount of variety in a person's diet (Bowman et al., 1998). An HEI score over 80 implies a "good" diet, a score between 51 and 80 indicates a "need for improvement", and a score below 51 suggests a "poor" diet. Aggregated across individuals, the measure provides a baseline to monitor the dietary quality of Americans. Table 2 shows the criteria for each component score. Scores for components 1 to 5 are calculated by different servings, which are defined by the USDA's Food Guide Pyramid Booklet (USDA, 1992). However, in the column of Criteria for Maximum Score of 10, the number of servings depends on Recommended Energy Allowance and changes with different age categories. The definitions for each serving can be seen in Table 3.

Data used to compile the HEI statistics are based on the second day of

Table 1. HEI Component Definitions.

Component	Definition
1 Grain consumption	The degree to which a person's diet conforms to the USDA Food Guide Pyramid serving recommendations for grains group (bread, cereal, rice, and pasta)
2 Vegetable consumption	The degree to which a person's diet conforms to the USDA Food Guide Pyramid serving recommendations for vegetate group (bread, cereal, rice, and pasta)
3 Fruit consumption	The degree to which a person's diet conforms to the USDA Food Guide Pyramid serving recommendations for fruits group (bread, cereal, rice, and pasta)
4 Milk consumption	The degree to which a person's diet conforms to the USDA Food Guide Pyramid serving recommendations for milk group (milk, yogurt, and cheese)
5 Meat consumption	The degree to which a person's diet conforms to the USDA Food Guide Pyramid serving recommendations for meat group (meat poultry, fish, dry beans, eggs, and nuts)

Table 1. Continued.

Component		Definition
6	Total fat intake	Total fat consumption as a percentage of total food energy intake
7	Saturated fat intake	Total saturated fat consumption as a percentage of total food energy intake
8	Cholesterol intake	Total cholesterol intake
9	Sodium intake	Total sodium intake
10	Food variety	The variety in a person's diet

Source: USDA The Healthy Eating Index, 1994–96.

Table 2. Components of the Healthy Eating Index and Scoring System

Component	Score Range[1]	Criteria for Minimum Score of 0	Criteria for Maximum Score of 10
1 Grain consumption	0 to 10	6–11 servings[2]	0 serving
2 Vegetable consumption	0 to 10	3–5 servings[2]	0 serving
3 Fruit consumption	0 to 10	2–4 servings[2]	0 serving
4 Milk consumption	0 to 10	2–3 servings[2]	0 serving
5 Meat consumption	0 to 10	2–3 servings[2]	0 serving
6 Total fat intake	0 to 10	30% or less energy from fat	45% or more energy from fat
7 Saturated fat intake	0 to 10	Less than 10% energy from saturated fat	15% or more energy from saturated fat
8 Cholesterol intake	0 to 10	300 mg or less	450 mg or more
9 Sodium intake	0 to 10	2400 mg or less	4800 mg or more
10 Food Variety	0 to 10	8 or more difficult items in a day	3 or fewer different items in a day

Source: USDA The Healthy Eating Index: 1994–96.

[1]People with consumption or intakes between the maximum and minimum ranges or amounts were assigned scores proportionately.

[2]Number of servings depend on Recommended Energy Allowance. All amounts are on a per day basis.

Table 3. The Definitions for HEI Component Serving

Component	What Counts as a Serving
Grains	1 slice of bread
	1 ounce of ready-to-eat cereal
	1/2 cup of cooked cereal, rice, or pasta
Vegetables	1 cup of raw leafy vegetables
	1/2 cup of other vegetables, cooked or chopped raw
	3/4 cup of vegetables juice
Fruits	1 medium apple, banana, orange
	1/2 cup of chopped, cooked, or canned fruits
	3/4 cup of fruit juice
Milk	1 cup of milk or yogurt
	1-1/2 ounces of natural cheese
	2 ounces of process cheese
Meat	2-3 ounces of cooked lean meat, poultry, or fish
	1/2 cup cooked dry beans
	1 egg counts as 1 ounce of lean meat
	2 tablespoons of peanut butter
	1/3 cup of nuts counts as 1 ounce of meat.

Source: USDA's Food Guide Pyramid Booklet (USDA, 1992).

food intake. This study examines a sample of 2,122 respondents 65 of age and older that completed the CFSII are represented in the HEI.

The explanatory variables in this study include the natural logarithm of per-capita household income (Income), age in years (Age), highest grade completed (Education), exercise frequency (Exercise), number of cigarettes smoked (Cigarettes). Also included are dummy variables indicating other characteristics of the individuals: gender (Male), urbanization (Suburban, City), regions (Northeast, Midwest, West), race (Black, White), ethnicity (Hispanic), employed full or part time (Employed), head of household (Head), receiving of food stamp benefits (Food tamps), being a Meal planner, drinking of any alcohol (Alcohol), being On diet, and being a Vegetarian. Table 4 gives the variable definitions and sample statistics. Income is used to represent the household income level after household size is accounted for. One might contend that the income variable is endogenous. However, as Wagstaff, van Doorslaer and Watanabe (2003) have argued, modeling income as endogenous does have its merits, but the resulted CI may not indicate the true inequality. Thus, this study follows Wagstaff, van Doorslaer and Watanabe (2003) and treats income as exogenous.

Table 5 shows the sample statistics and concentration indices of the CFSII dataset. The mean HEI score increased during the sample period, from 66.13 in 1994 to 66.94 in 1996. The mean HEI score for the pooled 1994–96 sample is 66.46, which indicates that the average American diet of the elderly under 65 age "needs improvement" according to the Center for Nutrition Policy and Promotion (CNPP) suggestions. It can be seen that mean household size decreased gradually, whereas mean of the education level increased, during the

Table 4. Variable Definitions and Sample Statistics

Variable	Definition	Mean[a] (1994–96)
HEI	Healthy Eating Index	66.459 (14.077)
Income	Natural logarithm of per-capita household income	9.912 (0.791
Education	Highest grade completed (years)	11.456 (3.523)
Age	Age in years	73.616 (6.767)
Exercise	Exercise frequency	4.391 (2.034)
Cigarettes	Number of cigarettes smoked	2.301 (7.406)
Dummy variables	(yes = 1, no = 0)	
Suburban	Resides in the suburban area	0.418
City	Resides in the central city	0.289
Rural	Reside in the rural area (reference)	0.293
Northeast	Resides in the Northeast	0.215
Midwest	Resides in the Midwest	0.281
West	Resides in the West	0.171
South	Resides in the South (reference)	0.333
White	Race is White	0.842
Black	Race is Black	0.106
Other races	Of other races (reference)	0.052
Male	Gender is male	0.517

Table 4. Continued.

Variable	Definition	Mean[a] (1994–96)
Head	A householder	0.945
Hispanic	Of the Hispanic origin	0.964
Food stamps	Receiving food stamps in last 12 months	0.044
Meal planner	A meal planner	0.600
On diet	Being on diet	0.252
Vegetarian	A vegetarian	0.033
Alcohol	Drinking of any alcohol in year run	0.445
Employed	Employed full or part-time	0.126

Source: Continuing Survey of Food Intakes by Individuals (CFSII), 1994–96).

[a] Standard deviations in parentheses. Samples size is 2,122 for the elderly.

Table 5. Sample Statistics and Concentration Indices of the CSFII Dataset

	1994–96		1994		1995		1996	
Variable	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
HEI score	66.459	14.077	66.126	14.251	66.395	13.943	66.935	14.097
Grains score	6.260	2.681	6.253	2.819	6.191	2.640	6.375	2.583
Vegetables score	6.349	3.408	6.406	3.366	6.303	3.374	6.355	3.509
Fruits score	5.069	3.898	5.096	3.888	5.118	3.904	4.963	3.907
Milk score	5.069	3.595	5.177	3.586	5.135	3.651	4.846	3.511
Meat score	6.408	3.102	6.376	3.144	6.403	3.071	6.451	3.108
Total fat score	7.062	3.468	6.805	3.529	7.086	3.476	7.313	3.369
Saturated fat score	6.954	3.843	6.843	3.790	6.771	3.960	7.364	3.692
Cholesterol score	8.016	3.689	7.998	3.711	7.969	3.718	8.108	3.621
Sodium score	7.370	3.376	7.272	3.466	7.501	3.363	7.275	3.292
Variety score	7.903	2.939	7.898	2.958	7.917	2.878	7.885	3.015
Education	11.456	3.523	11.286	3.520	11.357	3.591	11.802	3.401
Age	73.616	6.767	73.695	6.749	74.145	6.847	72.703	6.577
Income	9.912	0.791	9.911	0.757	9.863	0.772	9.987	0.850
Exercise	4.391	2.034	4.486	2.020	4.421	2.012	4.236	2.078
Cigarettes	2.301	7.406	1.905	6.863	2.462	7.983	2.497	7.050
White	0.842		0.837		0.836		0.858	
Black	0.106		0.102		0.114		0.097	
Male	0.517		0.503		0.507		0.549	
Northeast	0.215		0.212		0.227		0.201	
Midwest	0.281		0.300		0.256		0.300	
West	0.171		0.177		0.169		0.167	
City	0.289		0.303		0.289		0.274	
Suburban	0.418		0.386		0.452		0.399	
Head	0.945		0.925		0.952		0.957	
Hispanic	0.964		0.963		0.962		0.969	

Table 5. Continued.

	1994–96		1994		1995		1996	
Variable	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Employed	0.126		0.111		0.105		0.177	
Food stamps	0.044		0.025		0.061		0.040	
Meal planner	0.600		0.595		0.604		0.601	
On diet	0.252		0.258		0.241		0.262	
Vegetarian	0.033		0.038		0.029		0.035	
Alcohol	0.445		0.432		0.441		0.467	
Sample size (n)	2122		650		896		576	
Estimated CIs	0.028		0.031		0.024		0.029	
Std. dev. of C	0.003		0.005		0.004		0.005	

three years. The mean of age increased slightly from 1994 to 1995, but the rate of increase slowed down by 1996. The exercise frequency decreased during the survey years, indicating the elderly do less exercise as age increased. The mean number of cigarettes smoked increased from 1.91 per day in 1994 to 2.5 per day in 1996. Except for the milk and sodium consumption score, all other components of HEI improved during the three years. In addition, compared to the consumption of vegetables and fruits in 1994, the elderly ate less vegetables and fruits on average in 1996.

Table 6 presents the sample statistics for the whole sample (n = 2122) and two sub-samples by nutritional status: the "needs improvement" sample (HEI < 71; n = 1234) and the risky sample (HEI < 51; n = 338), classified according to definition by the CNPP (Bowman et al., 1998). Fifty eight percent of the pooled sample eat a diet classified as "need improvement", whereas sixteen percent eat a diet classified as "poor diet". Figures 3-5 show the income share among these categories.

Over the period 1994 to 1996, the elderly with income below $10,000 per year constituted 20% of the total sample. About 23% of the elderly had an HEI under 71 (need improvement), and 31% had an HEI under 51 (a poor diet). These statistics indicate individuals with a poor diet constituted much of the low-income sample. On the other hand, 19% of the elderly sample has income above forty thousand dollars per year, while 15% of the "need improvement" sample and 10% of the "poor diet" sample have income about forty thousand.

Table 6. Descriptive Statistics of the HEI by Dietary Status

	Whole sample		Need improvement		Poor diet	
Sample (*n*)	2122		1234		338	
Income						
≤ 10,000	417	19.65%	282	22.85%	104	30.77%
10,000–20,000	663	31.24%	425	34.44%	118	34.91%
20,000–30,000	394	18.57%	202	16.37%	46	13.61%
30,000–40,000	255	12.02%	144	11.67%	37	10.95%
≥ 40,000	393	18.52%	181	14.67%	33	9.76%
Region						
Northeast	457	21.54%	242	19.61%	61	18.05%
Midwest	597	28.13%	345	27.96%	86	25.44%
South	706	33.27%	461	37.36%	144	42.60%
West	362	17.06%	186	15.07%	47	13.91%
Urbanization						
City	614	28.93%	345	27.96%	106	31.36%
Suburban	886	41.75%	495	40.11%	116	34.32%
Rural	622	29.31%	394	31.93%	116	34.32%
Race						
White	1787	84.21%	1005	81.44%	277	81.95%
Black	224	10.56%	166	13.45%	51	15.09%
Gender						
Male	1097	51.7%	669	54.21%	194	57.4%
Female	1025	48.3%	565	45.79%	144	42.6%
Employed						
Yes	268	12.63%	162	13.13%	39	11.54%
No	1854	87.37%	1072	86.87%	299	88.46%

Table 6. Continued.

	Whole sample		Need improvement		Poor diet	
Sample(*n*)	2122		1234		338	
On diet						
Yes	535	25.21%	239	19.37%	54	15.98%
No	1587	74.79%	995	80.63%	284	84.02%
Cigarettes						
< 10	168	7.92%	132	10.70%	21	6.21%
≥ 10	110	5.18%	78	6.32%	48	14.20%
0	1844	86.90%	1024	82.98%	269	79.59%
Alcohol						
Yes	945	44.53%	520	42.14%	137	40.53%
No	1177	55.47%	714	57.86%	201	59.47%
Vegetarian						
Yes	72	3.39%	33	2.67%	9	2.66%
No	2050	96.61%	1201	97.33%	329	97.34%

Note: Classified according to definition by the CNPP: "Need Improvement" sample constitute individuals with HEI below 71, and "Poor diet" sample constitute individuals with HEI below 51.

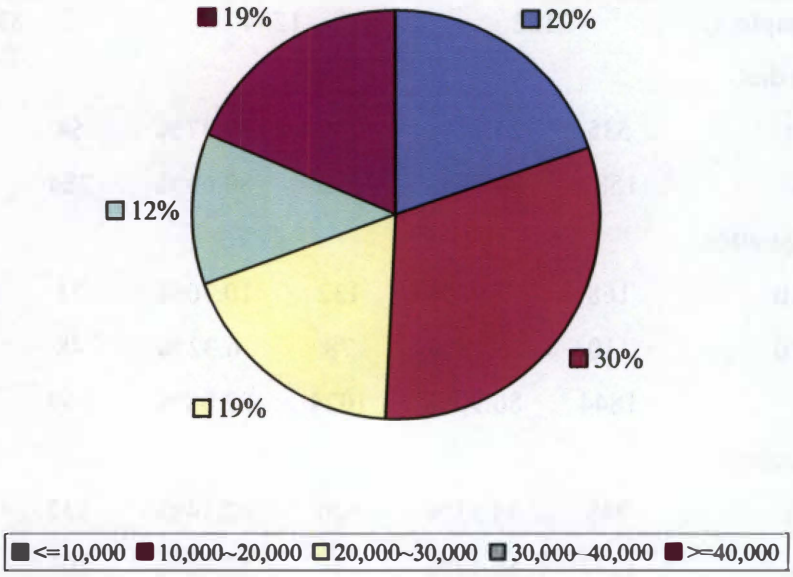

Figure 3. Income Share among Whole Sample

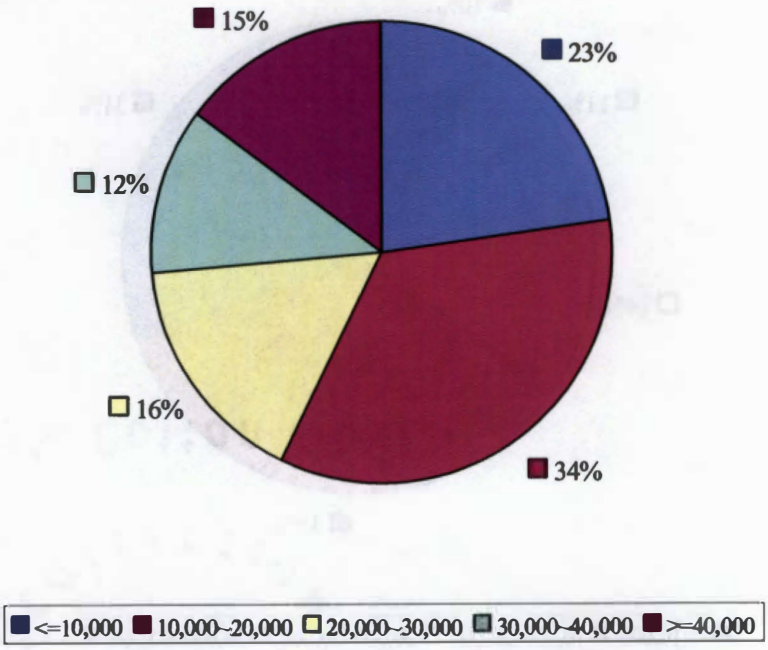

Figure 4. Income Share among Individuals Who Need Improvement

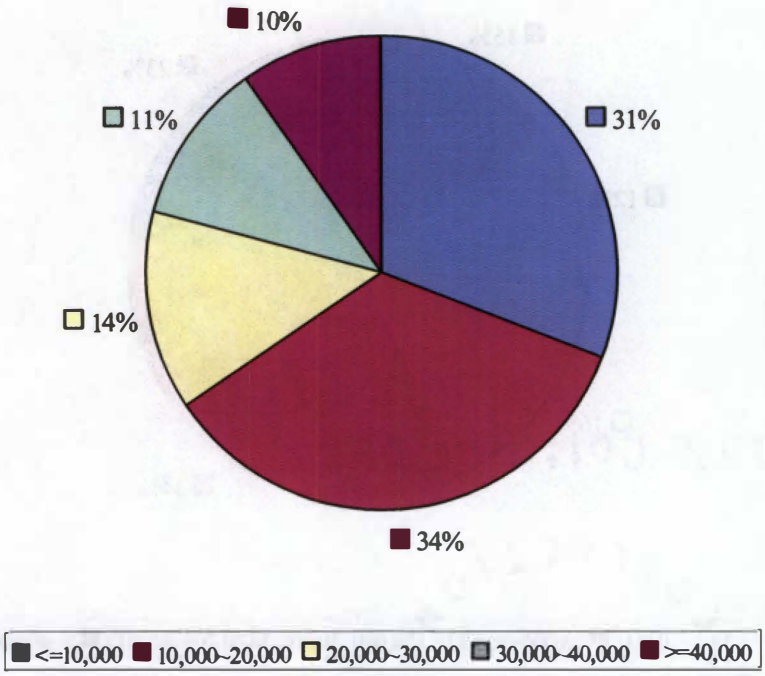

Figure 5. Income Share among Individuals with Poor Diet

CHAPTER V RESULTS

5.1 Concerns with the HEI

The HEI scores were constructed by the USDA's Center for Nutrition Policy and Promotion (CNPP) from reported food intakes, and then presented the healthfulness of the respondents' diets. The mean values of the HEI for the three years are presented in Table 2. The increasing trend, from 66.13 in 1994 to 66.94 in 1996, suggests an improvement in diets among the elderly.

The CIs for the HEI are 0.031, 0.024, and 0.029, respectively, for the three survey years. These values and their corresponding standard errors are presented in Table 4. The equality in HEI improved from 1994 to 1995, but deteriorated in 1996, suggesting that health inequality increased slightly in 1996. Figure 6 presents the concentration curve, which shows that the lower income groups are slightly disfavored in terms of equality, except for the highest 20% income group.

a. Regression Results

Two sets of regression results for the HEI are presented in Table 7, one for the unrestricted model and the other for the restricted model. The restricted model was estimated for each sample with insignificant variables (at the 15% level) excluded, supported by an F-test for linear restrictions (Gujarati, 2003, pp. 266–273). Specifically, denote the sample size as n, the coefficients of determination as R_u^2 and R_r^2, and the numbers of regressors (constants included) as k_u and k_r, where subscripts u and r indicate unrestricted and restricted regressions, respectively. Then, a test for the linear restrictions can be based on the

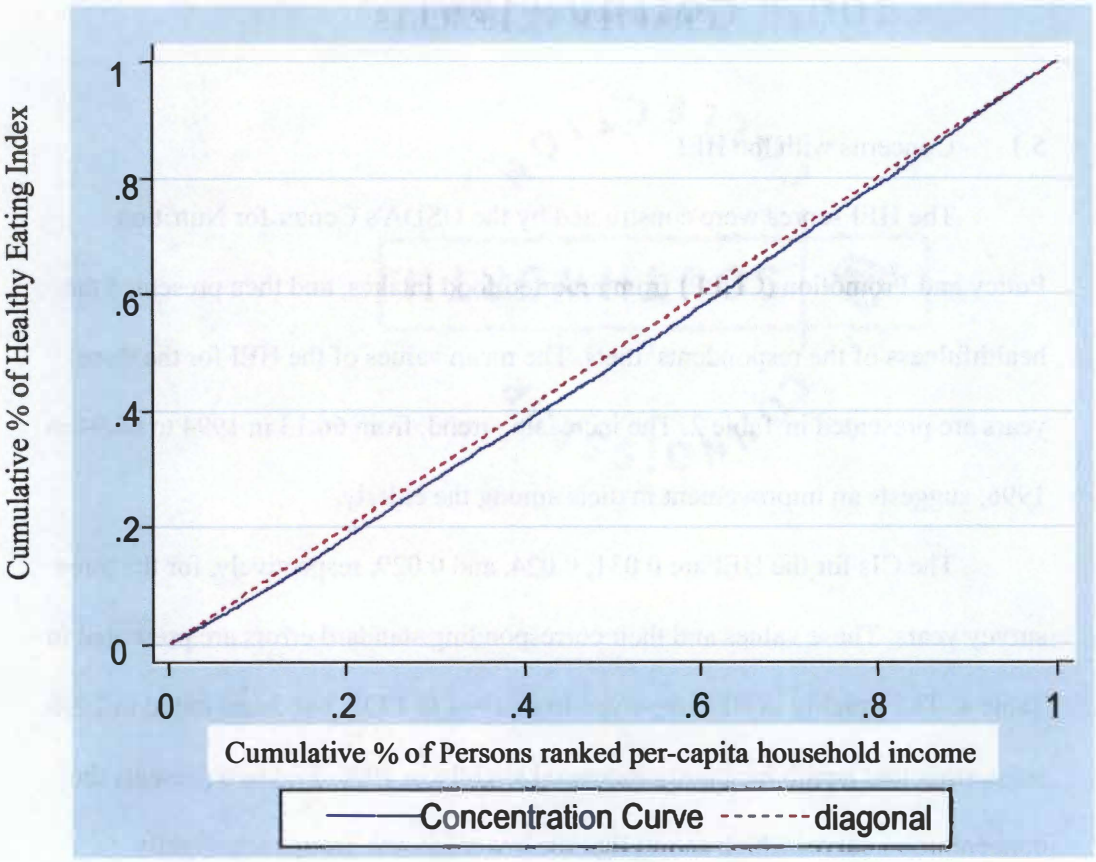

Figure 6. HEI Concentration Curve, the Elderly Sample.

Table 7. Ordinary Least-Squares Regressions (Dependent Variable = HEI)

	1994–96		1994		1995		1996	
Variable	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted
Constant	40.363***	42.597***	38.291***	33.632***	44.286***	45.264***	35.956***	39.845***
	(6.111)	(4.118)	(11.468)	(7.509)	(9.564)	(6.287)	(11.184)	(7.711)
Income	2.301***	2.247***	2.824***	2.609***	2.005***	1.995**	2.107***	2.045***
	(0.436)	(0.414)	(0.817)	(0.753)	(0.698)	(0.650)	(0.774)	(0.742)
Education	0.626***	0.644***	0.622***	0.710***	0.651***	0.626***	0.766***	0.839***
	(0.095)	(0.092)	(0.172)	(0.163)	(0.148)	(0.139)	(0.188)	(0.179)
Age	0.002		–0.097		0.065		–0.002	
	(0.046)		(0.086)		(0.070)		(0.088)	
Suburban	0.586		2.145*	2.009*	–1.111		1.133	
	(0.710)		(1.308)	(1.090)	(1.134)		(1.303)	
City	1.152		0.997		0.299		2.226	
	(0.792)		(1.413)		(1.278)		(1.515)	
Northeast	2.724***	2.676***	4.474***	4.284***	1.926		1.71	
	(0.832)	(0.789)	(1.575)	(1.336)	(1.250)		(1.613)	
Midwest	1.624**	1.448**	0.509		1.097		3.314	1.971*
	(0.747)	(0.732)	(1.366)		(1.187)		(1.413)	(1.190)
West	1.906**	1.877**	3.114*	3.122**	0.197		2.736*	
	(0.898)	(0.870)	(1.685)	(1.455)	(1.383)		(1.686)	

Table 7. Continued.

	1994–96		1994		1995		1996	
Variable	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted
White	–3.598	–3.086**	–0.807		–2.406		–12.131***	–12.931**
	(2.288)	(1.333)	(3.528)		(4.050)		(4.724)	(4.551)
Black	–6.495***	–5.629***	–3.312		–5.636	–3.264**	–14.376***	–14.593**
	(2.445)	(1.556)	(3.877)		(4.281)	(1.400	(4.950)	(4.815)
Male	–3.257***	–3.068***	–1.380		–5.357***	–5.574***	–1.322	
	(0.705)	(0.580)	(1.307)		(1.094)	(1.066)	(1.326)	
Employed	–1.839**	–1.856**	–1.987		–1.179		–2.995**	–3.269**
	(0.888)	(0.871)	(1.749)		(1.485)		(1.446)	(1.404)
Exercise	–0.577***	–0.576***	–0.085		–0.595***	–0.512**	–1.024***	–0.986***
	(0.147)	(0.143)	(0.272)		(0.233)	(0.225)	(0.268)	(0.256)
Hispanic	0.736		–3.230	–4.349	–0.390		11.101**	11.897**
	(2.704)		(4.362)	(2.886)	(4.631)		(5.524)	(5.387)
Household	1.400		2.361		–1.249		4.178	
	(1.366)		(2.288)		(2.201)		(2.850)	
Food stamps	–3.675***	–3.645**	–6.625**	–7.186***	–2.683		–5.156**	–4.748**
	(1.264)	(1.255)	(2.789)	(2.741)	(1.818)		(2.426)	(2.401)
Meal planner	–0.403		–0.313		–1.544	–1.582	2.027	3.020***
	(0.719)		(1.335)		(1.114)	(1.083)	(1.370)	(1.113)

Table 7. Continued.

	1994–96		1994		1995		1996	
Variable	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted
On diet	4.787***	4.850***	4.513***	4.799***	5.170***	5.129***	4.562***	4.742***
	(0.657)	(0.653)	(1.21)	(1.186)	(1.029)	(1.017)	(1.238)	(1.215)
Vegetarian	1.548		3.831	4.145	0.720		–1.185	
	(1.601)		(2.760)	(2.679)	(2.630)		(3.029)	
Cigarettes	–0.215***	–0.220***	–0.246***	–0.232***	–0.158***	–0.187***	–0.315***	–0.332***
	(0.039)	(0.038)	(0.078)	(0.075)	(0.056)	(0.055)	(0.078)	(0.076)
Alcohol	–0.294		0.376		–0.540		–0.943	
	(0.625)		(1.144)		(0.975)		(1.172)	
R squared	0.1583	0.1566	0.1743	0.1645	0.1516	0.1417	0.2321	0.2210
F (overall, sig.)	18.71		6.25		7.42		7.93	
DF'S	[21, 2089]		[21,622]		[21,872]		[21,551]	
p-value	0.0001		0.0001		0.0001		0.0001	
F (restrictions)		29.94		12.46		18.27		13.24
DF'S		[132,097]		[10,633]		[8,885]		[12,560]
p-value		0.0001		0.0001		0.0001		0.0001

Note: Standard errors are in parentheses Asterisks indicate levels of significance: *** = 1%, ** = 5%, * = 10%. All variables

remaining in the restricted model are significant at the 0.15 level or lower.

F-statistic.

$$\Delta C = F = \frac{(R_u^2 - R_r^2)/(k_u - k_r)}{(1 - R_u^2)/(n - k_u)} \tag{8}$$

which has degrees of freedom ($k_u - k_r$) and ($n - k_u$). All variables remaining in the restricted model are significant at the 0.15 level or lower.

The estimated coefficients on Income are positive for all three years, which suggests that higher income groups have the ability to purchase relatively expensive foods, such as fresh fruits and meat, resulting in better diet quality. However, the absolute value of the coefficient dropped dramatically from 1994 to 1995, which implies the degree of influence on HEI decreased. Better diet is positively associated with Education, suggesting that older people with higher education level possess a better dietary status. Therefore, education may be a predictor of people's ability to translate nutrition guidance information into better dietary practices. For the pooled (1994–96) sample, the coefficient estimate for Black is significantly negative, which suggests that African Americans tend to have less healthy diets than their white counterparts. The coefficient for Male was significant and negative for the pooled sample and in 1995, which suggests that females have a more healthful diet than males. Furthermore, the coefficient for Employed was negative and significant for the pooled sample and in 1996, suggesting that older people who are employed have a less healthful diet. The coefficient for Exercise was significantly negative for the pooled sample and in 1995, which implies that the older people who exercise more regularly have a less healthful diet. Also, the coefficient of Food Stamps was significant and negative (except for 1995), which suggests that people who receive food stamps usually have poor diets.

The coefficient estimates for the On diet variable were all significant and positive for all samples, which suggests older people who are on diet have more healthy diets than others. The coefficient estimates for Cigarettes were all significant and negative throughout, suggesting that diets for smokers are inferior to those for others.

b. Decomposition Results

The elasticities of HEI with respect to the explanatory variables, calculated from the regression estimates, and concentration indices of the explanatory variables are shown in Table 8. As shown in Table 8, the elasticity estimates from the unrestricted and restricted regressions are similar, in terms of magnitudes and statistical significance. In addition, significant variables in the unrestricted regression model are also significant in the restricted model.

Table 9 presents the decomposition results based on Equation (5), which are estimates of the contributions of explanatory variables to the good health (high HEI) concentration indices as well as the change in year 1996 with respect to previous years. Income and Education favored the better-off for all three survey years. Ethnicity, gender, and geographical area do not contribute to inequality, neither does Employed. Residing in the central city favors the poor: the magnitude becomes slightly positive from 1995 to 1996. Exercise disfavored the poor, which suggests that regular exercise does not represent an advantage among the poor. Receipts of food stamp benefits disfavored the poor, with food stamp recipients having lower HEI scores. In addition, variable On diet favored the poor in 1994 but disfavored the poor in 1995 and 1996. Cigarettes did not have an effect on the inequality in HEI. The values of contribution to C from the restricted regression are

Table 8. Elasticities and Concentration Indices Calculated Based on the HEI Regressions

	Elasticities						Concentration indices		
	1994		1995		1996		1994	1995	1996
Variable	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted			
Income	0.423***	0.391***	0.298***	0.296***	0.314***	0.305***	0.043	0.044	0.047
Education	0.106***	0.121***	0.111***	0.107***	0.135***	0.148***	0.067	0.083	0.077
Suburban	0.013*	0.012*	–0.008		0.007		0.000	0.000	0.000
Northeast	0.014***	0.014***	0.007		0.005		0.000	0.000	0.000
Midwest	0.002**		0.004		0.015		0.000	0.000	0.000
West	0.008	0.008**	0.001		0.007*		0.000	0.000	0.000
White	–0.010		–0.030		–0.156***	–0.166**	0.000	0.000	0.000
Black	–0.005		–0.010	–0.006**	–0.021***	–0.021**	0.000	0.000	0.000
Male	–0.010		–0.041***	–0.043***	–0.011		0.000	0.000	0.000
Employed	–0.003		–0.002		–0.008**	–0.009***	0.000	0.000	0.000
Exercise	–0.006		–0.040***	–0.034**	–0.065***	–0.062**	–0.030	–0.043	–0.023
Hispanic	–0.047	-0.063	–0.006		0.161**	0.172**	0.000	0.000	0.000
Food stamps	–0.004**	-0.004***	–0.003		–0.005**	–0.004**	–0.573	–0.555	–0.593
Meal planner	–0.003		-0.014	–0.014	0.018	0.027***	–0.102	–0.077	–0.108
On diet	0.018***	0.019***	0.019***	0.019***	0.018***	0.019***	–0.013	0.035	0.036
Cigarettes	–0.007***	0.007***	–0.006***	–0.007***	–0.012***	–0.012***	0.000	0.000	0.000

Note: Asterisks indicate levels of significance in the ordinary least-squares regression results: *** = 1%, ** = 5%, * = 10%. As suggested by Equation (3), the significance of each regression coefficient translates into significance of the corresponding elasticity.

Table 9. Regressor Contributions to Concentration Indices of HEI and Changes of Concentration Indices

	Contributions to *C*					
	1994		1995		1996	
Variable	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted
Income	0.0182***	0.0168***	0.0132***	0.0131***	0.0148***	0.0143***
Education	0.0071***	0.0081***	0.0092***	0.0089***	0.0104***	0.0114***
Suburban	0.0000		0.0000		0.0000	
Northeast	0.0000		0.0000		0.0000	
Midwest	0.0000		0.0000		0.0000	
West	0.0000		0.0000		0.0000	
White	0.0000		0.0000		0.0000	
Black	0.0000		0.0000		0.0000	
Male	0.0000		0.0000		0.0000	
Employed	0.0000		0.0000		0.0000	
Exercise	0.0002		0.0017***	0.0015**	0.0015***	0.0014***
Hispanic	0.0000		0.0000		0.0000	
Food stamps	0.0023**	0.0025***	0.001		0.0027**	0.0025**
Meal planner	0.0003		0.0011	0.0011	–0.0020	–0.0029***
On diet	–0.0002***	–0.0002***	0.0007***	0.0006***	0.0007***	0.0007***
Cigarettes	0.0000		0.0000		0.0000	

Table 9. Continued.

	Change			
	1996–94		1996–95	
Variable	Unrestricted	Restricted	Unrestricted	Restricted
Income	–0.0034	–0.0025	0.0016	0.0012
Education	0.0034	0.0034	0.0012	0.0026
Suburban	0.0000		0.0000	
Northeast	0.0000		0.0000	
Midwest	0.0000		0.0000	
West	0.0000		0.0000	
White	0.0000		0.0000	
Black	0.0000		0.0000	
Male	0.0000		0.0000	
Employed	0.0000		0.0000	
Exercise	0.0013	0.0014	–0.0002	
Hispanic	0.0000		0.0000	
Food stamps	0.0004		0.0010	0.0025
Meal planner	–0.0022	–0.0029	–0.0030	–0.0040
On diet	0.0009	0.0009	0.0000	
Cigarettes	0.0000		0.0000	

Note: Asterisks indicate levels of significance in the ORDINARY LEAST SQUARES regression results: *** = 1%, ** = 5%, * = 10%. As suggested by Equation (3), the significance of each regression coefficient translates into significance of the corresponding regressor contribution.

fairly close to those from the unrestricted regression. One notable difference occurs for Meal planner for the 1996 sample, which suggests the variable has a negative and significant contribution to the CI in HEI, whereas the corresponding effects are not significant for 1994 and 1995.

Oaxaca-type decomposition results, based on Equations (6) and (7), provide more information, because the decomposition allows the comparisons of the inequality between two periods. Two sets of comparisons were carried out: between 1996 and 1994 and between 1996 and 1995. The year 1996 was chosen in both comparisons because the estimates for the most recent year were desired.

The results of the 1995–96 decomposition are presented in Table 10. For a given explanatory variable, the columns with a header "$dC*\eta$" report contributions of each respective explanatory variable to the change of inequality in HEI due to the change in concentration index of the explanatory variable itself, and the columns with a header "$d\eta*C$" indicate the contribution due to the change in elasticity of each explanatory variable. The estimated contribution of Income favored the poor and improved the equality. Education improved the equality in regard to the change of concentration index of the explanatory variable itself and the change in estimated elasticity. Exercise improved the equality and favored the poor in regard to the change in estimated elasticity. Food stamp participation improved the equality over the 1994–96 periods. The estimated contributions in the restricted model have the same effects as those in unrestricted model, except for the On diet variable which became significant, which suggests being on a diet improved the equality in HEI. The decomposition results from the unrestricted model are very similar to those of the restricted model for the most part. According to the restricted model, income, better education, doing exercise frequently,

Table 10. Oaxaca-Type Decompositions for Change in Inequality in HEI, 1995–96

	Equation (6)				Equation (7)							
	$dC*\eta$		$d\eta*C$		$dC*\eta$		$d\eta*C$		Total	%	Total	%
Variable	Unres.	Res.	Unres.	Variable	Unres	Res.	Unres	Res.	Unres.	Res.	Unres.	Variable
Income	0.0009	0.0008	0.0007	0.0004	0.0008	0.0008	0.0007	0.0004	0.0015	92.43	0.0012	28.98
Education	–0.0007	–0.0008	0.0020	0.0034	–0.0006	–0.0006	0.0020	0.0034	0.0014	81.91	0.0028	68.09
Age	0.0000		0.0007		0.0000		0.0007		0.0007	39.50		
Subarban	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
City	0.0003		–0.0006		0.0000		–0.0006		–0.0005	–31.68		
Northeast	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Midwest	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
West	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
White	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Black	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Male	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Employed	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Exercise	–0.0013	–0.0013	0.0011	0.0012	–0.0008	–0.0007	0.0011	0.0012	0.0003	17.31	0.0005	12.95
Hispanic	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Head	–0.0003		–0.0008		0.0001		–0.0008		–0.0008	–45.31		
Food stamps	0.0002	0.0002	0.0008	0.0023	0.0001	0.0000	0.0008	0.0023	0.0009	56.16	0.0023	56.43

Table 10. Continued.

	Equation (6)				Equation (7)							
	$dC*\eta$		$d\eta*C$		$dC*\eta$		$d\eta*C$		Total	%	Total	%
Variable	Unres.	Res.	Unres.	Res.	Unres.	Res.	Unres	Res.	Unres	Res.	Unres	Res.
Meal planner	–0.0006	–0.0008	–0.0025	–0.0032	0.0004	0.0004	–0.0025	–0.0032	–0.0021	–123.43	–0.0028	–67.13
On diet	0.0000		0.0000		0.0000		0.0000		0.0000	–0.07		0.69
Vegetarian	0.0000		0.0002		0.0000		0.0002		0.0002	13.17		
Cigarettes	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Alcohol	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Total	–0.0016	–0.0019	0.0016	0.0041	0.00011	0.0000	0.0016	0.0041	0.0017	100.00	0.0041	100.00

receiving food stamps in twelve months improved the equality for the HEI, whereas being a meal planner improved the inequality in HEI.

Results of Oaxaca-type decomposition for 1994–96 are presented in Table 11. The long-term change indicates that deteriorating income inequality has contributed to the unequal distribution of diets among the elderly while increasing income outweighed such effects. Better education, more exercise, receipt of food stamp benefits, and being on diet, have favored the poor and improved the equality in HEI.

5.2 Concerns with Components of HEI – Fruits, Milk, and Saturated Fat

The HEI score is the sum of 10 components, each representing different aspects of a healthy diet. The mean values of the components of HEI for the three years are also presented in Table 4. Fruits and milk had the lowest mean scores, both with an average of 5.07 on a scale of 0 to 10 over 1994–96. The average saturated fat score was 6.95 over the three years. Fruit consumption increased slightly from 5.10 in 1994 to 5.12 in 1995, but declined to 4.96 in 1995. During the 1994–96 period, there was a decline in milk consumption while the score for saturated fat increased from 6.84 in 1994 to 7.36 in 1996. For the three survey years, the CIs for fruit consumption were 0.076, 0.078, and 0.071, respectively; the series suggests an improvement of equality in fruit consumption during the three-year period. Compared with other components of HEI, the CIs for fruit consumption are larger than those for other components, suggesting the existence of inequality in fruit consumption among the elderly. Figure 7 shows the concentration curve for fruit consumption. The CIs for milk consumption were 0.028, 0.064, and 0.076 over the three years, which indicates an increasing trend of

Table 11. Oaxaca-Type Decompositions for Change in Inequality in HEI, 1994–96

	Equation (6)				Equation (7)							
	$dC*\eta$		$d\eta*C$		$dC*\eta$		$d\eta*C$		Total	%	Total	%
Variable	Unres.	Res.	Unres.	Res.	Unres.	Res.	Unres	Res.	Unres.		Res.	
Income	0.0013	0.0012	-0.0047	–0.0037	0.0017	0.0016	–0.0051	–0.0040	–0.0034	344.86	–0.0025	–998.23
Education	0.0015	0.0016	0.0019	0.0018	0.0011	0.0013	0.0022	0.0021	0.0034	–342.50	0.0034	1367.35
Age	0.0000		–0.0008		0.0002		–0.0010		–0.0008	81.39		
Subarban	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
City	–0.0005		0.0000		–0.0002		–0.0002		–0.0004	42.82		
Northeast	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Midwest	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
West	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
White	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Black	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Male	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Employed	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Exercise	–0.0004	–0.0004	0.0018	0.0019	0.0000		0.0014	0.0014	0.0013	–133.09	0.0014	580.88
Hispanic	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Head	0.0005		–0.0007		0.0003		–0.0004		–0.0001	14.28		
Food stamps	0.0001	0.0001	0.0003	–0.0001	0.0001	0.0001	0.0003	–0.0001	0.0004	–40.34	0.0000	–3.83

Table11. Continued.

	Equation (6)				Equation (7)							
	$dC*\eta$		$d\eta*C$		$dC*\eta$		$d\eta*C$		Total	%	Total	%
Variable	Unres.	Res.	Unres.	Res.	Unres.	Res.	Unres	Res.	Unres.		Res.	
Meal planner	–0.0001	–0.0001	–0.0022	–0.0028	0.0000		–0.0023	–0.0029	–0.0022	227.66	–0.0029	–1185.31
On diet	0.0009	0.0009	0.0000		0.0009	0.0009	0.0000		0.0009	–89.58	0.0009	375.53
Vegetarian	0.0002		–0.0001	–0.0001	–0.0006	–0.0006	0.0006	0.0005	0.0001	–5.51	–0.0001	–36.39
Cigarettes	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Alcohol	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Total	0.0034	0.0033	–0.0044	–0.0030	0.0035	0.0033	–0.0045	–0.0030	–0.0010	100.00	0.0002	100.00

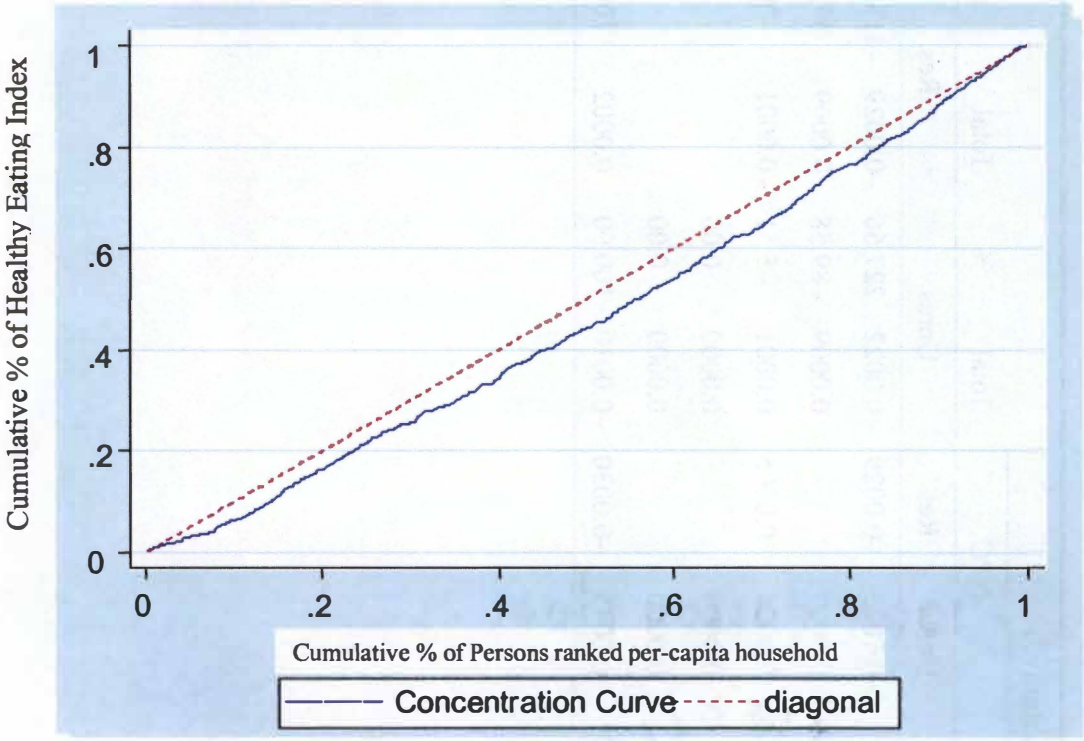

Figure 7. Concentration Curve of the HEI Component – Fruits, the Elderly Sample.

inequality in milk consumption. For saturated fat consumption, the CIs were 0.043, 0.021, and 0.026 over the three survey years. These findings suggest that the inequalities in saturated fat consumption improved greatly over these three years and the middle income groups are the most disfavored in terms of equality. Figure 8 shows the concentration curve for milk, which reveals that the lowest 70% income group were disfavored in terms of equality. Figure 9 graphs the concentration curve for saturated fat, which shows inequalities in saturated fat consumption existed among income groups.

a. Regression Results

The regression results for fruit consumption are presented in Table 12. In the unrestricted model, the estimated coefficients of Income, similar to results for the HEI, were positive across all three years, suggesting that higher-income individuals tend to consume more fruits than lower-income individuals. Education level was positively associated with fruit consumption, suggesting that individuals with better education have better dietary condition in terms of fruits than other people do.

For the pooled 1994–96 sample, the coefficient estimates for Employed and Exercise were all significantly negative. These results suggest that the elderly people who are employed tend to have less healthy fruit consumption than people who are already retired, as do elderly people who exercise more than others. The coefficient for Male was also negative, which indicates that males consume less fruits than females.

The coefficients for On diet were all significant and positive for the three years, which suggests older individuals who are on diet consume more fruits than

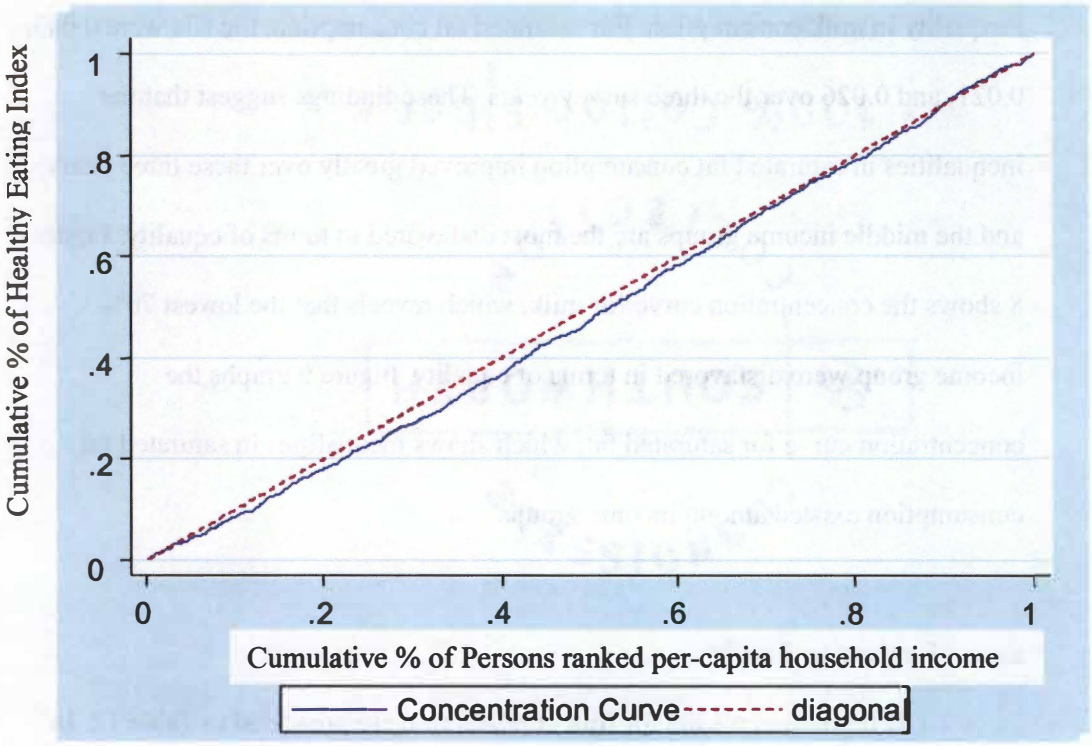

Figure 8. Concentration Curve of the HEI Component – Milk, the Elderly Sample.

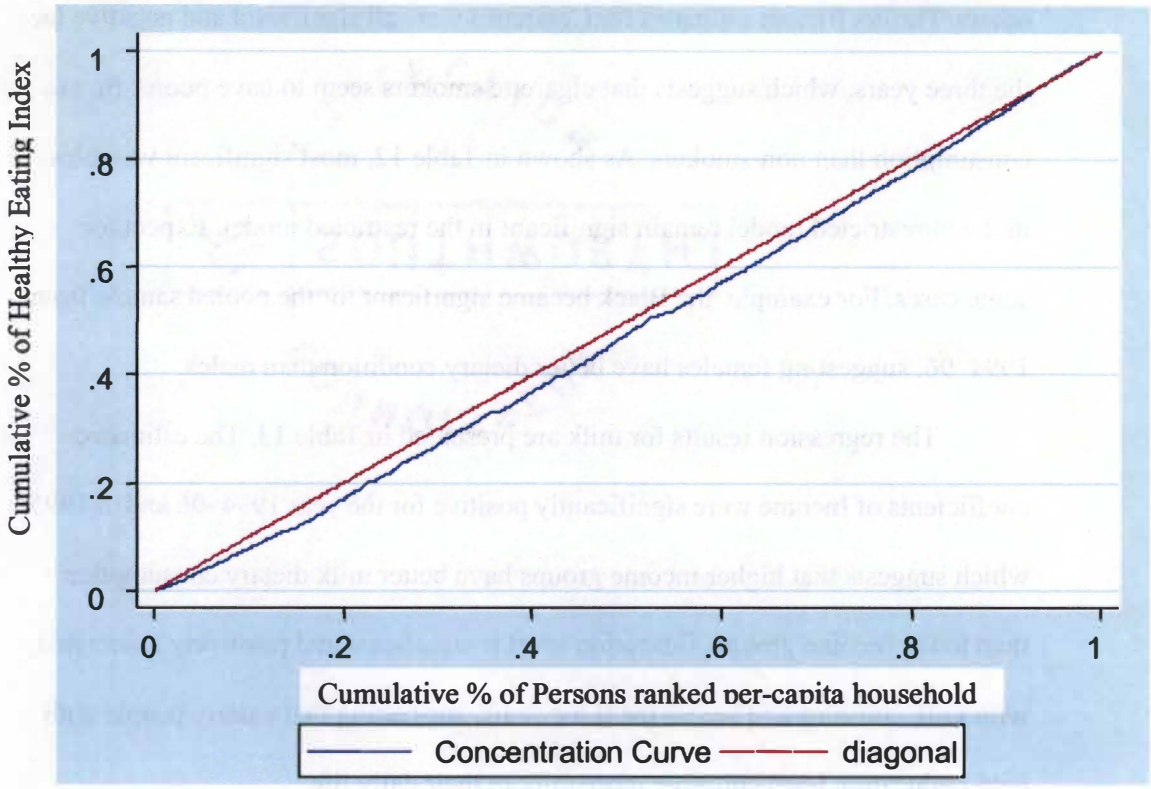

Figure 9. Concentration Curve of the HEI Component – Saturated Fat, the Elderly Sample.

others. The coefficient estimates for Cigarettes were all significant and negative for the three years, which suggests that cigarette smokers seem to have poorer fruits consumption than non-smokers. As shown in Table 12, most significant variables in the unrestricted model remain significant in the restricted model. Expect for some cases. For example, the Black became significant for the pooled sample from 1994–96, suggesting females have better dietary condition than males.

The regression results for milk are presented in Table 13. The estimated coefficients of Income were significantly positive for the year 1994–96 and in 1995, which suggests that higher income groups have better milk dietary consumption than lower income groups. Education level is significant and positively associated with milk consumption across the three years, suggesting that elderly people with better education level consume more milk in their daily life.

For the pooled 1994–96 sample, the coefficient estimate for Midwest is significantly positive, which suggests individuals residing in the Midwest tend to consumer more milk than other those who live in other regions. The reason why milk is consumed more in the Midwest may be the relatively low price or the eating habits. The coefficient for Male was significantly positive for 1994–96 and became more significantly positive in 1996, suggesting that males are likely to consume more milk than females. The estimated coefficients of Hispanic were significantly negative for 1994–96 and in 1995, suggesting that Hispanics consume less milk than non-Hispanics. In 1994 and 1996, the coefficients for Hispanic were significantly positive. The coefficient estimates for On diet were all significant and positive across the three years, suggesting elderly individuals who were on diet are likely to have better milk consumption than others. The coefficient estimates for Cigarettes were all significantly negative for the all years, except for 1995, which

Table 12. Ordinary Least-Squares Regressions (Dependent Variable = Fruits)

Variable	1994–96		1994		1995		1996	
	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted
Intercept	–2.317	–1.089	–1.015	–3.123*	–1.321	0.449	–5.655*	–2.359
	(1.744)	(1.096)	(3.279)	(1.982)	(2.687)	(1.845)	(3.294)	(2.218)
Income	0.459***	0.450***	0.583**	0.597***	0.419**	0.413**	0.428*	0.377*
	(0.124)	(0.116)	(0.234)	(0.213)	(0.196)	(0.186)	(0.228)	(0.210)
Education	0.176***	0.178***	0.143***	0.139***	0.199***	0.216***	0.194***	0.176***
	(0.027)	(0.026)	(0.049)	(0.046)	(0.042)	(0.039)	(0.055)	(0.053)
Age	0.016		–0.022		0.021		0.034	
	(0.013)		(0.024)		(0.020)		(0.026)	
Suburban	0.255		0.277		0.342		0.016	
	(0.203)		(0.374)		(0.319)		(0.384)	
City	0.223		0.205		0.125		0.603	0.546
	(0.226)		(0.404)		(0.359)		(0.446)	(0.357)
Northeast	0.661***	0.698***	0.957**	0.812**	0.709**	0.697**	0.135	
	(0.237)	(0.225)	(0.450)	(0.372)	(0.351)	(0.310)	(0.475)	
Midwest	0.712***	0.717***	0.397	0.983**	0.963**	0.898***	0.756*	0.729**
	(0.213)	(0.209)	(0.391)	(0.406)	(0.334)	(0.298)	(0.416)	(0.364)
West	0.664***	0.726***	1.114**		0.167		0.801*	0.821*
	(0.256)	(0.244)	(0.482)		(0.389)		(0.497)	(0.442)

Table 12. Continued.

Variable	1994–96		1994		1995		1996	
	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted
White	0.177		1.615	0.637*	0.084		–2.146	
	(0.653)		(1.009)	(0.406)	(1.138)		(1.392)	
Black	–0.203	–0.431*	0.946		–0.248		–2.216	
	(0.698)	(0.269)	(1.109)		(1.203)		(1.458)	
Male	–0.961***	–0.842***	–0.320	–0.521**	–1.756***	–1.634***	–0.241	
	(0.201)	(0.165)	(0.374)	(0.297)	(0.307)	(0.295)	(0.391)	
Employed	–0.467*	–0.507**	–0.639		–0.245		–0.626	–0.728*
	(0.253)	(0.249)	(0.500)		(0.417)		(0.426)	(0.413)
Exercise	–0.096**	–0.088**	–0.022		–0.098		–0.151*	–0.118
	(0.042)	(0.041)	(0.078)		(0.065)		(0.079)	(0.076)
Hispanic	–0.663		–1.650		–1.175	–1.248*	2.222	
	(0.772)		(1.247)		(1.301)	(0.660)	(1.627)	
Head	0.583		–0.167		0.564		1.987**	1.593**
	(0.390)		(0.654)		(0.619)		(0.840)	(0.794)
Food stamps	0.429		–0.125		–0.641	–0.737	–0.653	
	(0.361)		(0.797)		(0.511)	(0.503)	(0.715)	
Meal planner	–0.176		0.206		–0.583*	–0.541*	0.129	
	(0.205)		(0.382)		(0.313)	(0.306)	(0.404)	

Table 12. Continued.

Variable	1994–96		1994		1995		1996	
	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted
On diet	0.983*** (0.188)	0.969*** (0.186)	0.878** (0.346)	0.912*** (0.338)	1.112*** (0.289)	1.095*** (0.286)	1.026*** (0.365)	0.997*** (0.357)
Vegetarian	0.151 (0.457)		1.097 (0.789)		–0.208 (0.739)		–0.817 (0.892)	
Cigarettes	–0.049*** (0.011)	–0.053*** (0.011)	–0.062*** (0.022)	–0.059*** (0.021)	–0.035** (0.016)	–0.038*** (0.015)	–0.065*** (0.023)	–0.072*** (0.022)
Alcohol	–0.045 (0.178)		0.047 (0.327)		0.059 (0.274)		–0.405 (0.345)	
R squared	0.6697	0.1057	0.1046	0.0941	0.1438	0.1369	0.1326	0.1198
F (overall, sig.)	197.00		3.46		6.97		4.01	
DF'S	[21,2089]		[21,622]		[21,872]		[21,551]	
p-value	0.0001		0.0001		0.0001		0.0001	
F (restrictions)		22.56		8.25		6.97		7.65
DF'S		[11,2099]		[8,635]		[10,883]		[10,526]
p-value		0.0001		0.0001		0.0001		0.0001

Note: Standard errors are in parentheses Asterisks indicate levels of significance: *** = 1%, ** = 5%, * = 10%. All variables

remaining in the restricted model are significant at the 0.15 level or lower.

Table 13. Ordinary Least-Squares Regressions (Dependent Variable = Milk)

	1994–96		1994		1995		1996	
Variable	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted
Constant	0.248***	0.017	–0.082	1.685	0.440***	0.475	0.224	3.106***
	(0.078)	(1.456)	(0.137)	(1.870)	(0.121)	(1.644)	(0.143)	(0.941)
Income	0.103***	0.250**	0.129***		0.085**	0.462***	0.120**	
	(0.026)	(0.109)	(0.044)		(0.041)	(0.175)	(0.051)	
Education	0.025***	0.111***	0.035*	0.141***	0.016	0.083**	0.016	0.119***
	(0.009)	(0.024)	(0.018)	(0.041)	(0.015)	(0.038)	(0.017)	(0.044)
Age	0.171	0.027**	0.131	0.031	–0.020		0.565*	
	(0.188)	(0.012)	(0.339)	(0.021)	(0.315)		(0.327)	
Suburban	0.061		–0.332		–0.027		0.594	0.587***
	(0.213)		(0.376)		(0.352)		(0.403)	(0.330)
City	0.022		0.332		–0.362		0.075	0.567
	(0.223)		(0.412)		(0.341)		(0.428)	(0.387)
Northeast	0.406**		0.195		0.523*		0.356	
	(0.201)		(0.362)		(0.323)		(0.369)	
Midwest	0.337	0.326*	0.729		–0.113	0.704***	0.586	
	(0.244)	(0.169)	(0.460)		(0.383)	(0.273)	(0.434)	
West	0.248***		1.035		1.979**		–2.716**	
	(0.078)		(0.865)		(0.946)		(1.060)	

Table 13. Continued.

	1994–96		1994		1995		1996	
Variable	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted
White	0.620		–0.117	1.428***	0.607	1.525***	–4.397***	–2.812**
	(0.635)		(0.946)	(0.418)	(1.022)	(0.363)	(1.119)	(1.203)
Black	–0.730	–1.440***	0.534		0.414		1.150***	–4.695***
	(0.676)	(0.253)	(0.345)		(0.298)		(0.364)	(1.260)
Male	0.636***	0.798***	–0.136	0.625**	–0.231	0.545**	–0.348	1.188***
	(0.192)	(0.156)	(0.482)	(0.332)	(0.407)	(0.240)	(0.383)	(0.283)
Employed	–0.310		–0.032		–0.075		–0.122*	
	(0.241)		(0.071)		(0.066)		(0.072)	
Exercise	–0.065*	–0.066*	1.881*		–3.236***		2.603**	–0.104
	(0.040)	(0.039)	(1.114)		(1.098)		(1.289)	(0.068)
Hispanic	–1.399*	–0.856**	0.947*	–2.402***	0.368	–2.615***	–0.289	2.568**
	(0.744)	(0.419)	(0.572)	(0.823)	(0.539)	(0.695)	(0.781)	(1.423)
Household	0.428		–0.373	0.861	–0.488		0.029	
	(0.343)		(0.701)	(0.568)	(0.457)		(0.640)	
Food stamps	–0.390		–0.082		0.440***		0.224	
	(0.321)		(0.137)		(0.121)		(0.143)	
Meal planner	–0.299		–0.762**	–0.670**	–0.139		–0.022	
	(0.195)		(0.357)	(0.344)	(0.304)		(0.373)	

Table 13. Continued.

Variable	1994–96		1994		1995		1996	
	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted
On diet	0.410**	0.403**	0.436		0.134		0.852***	0.858***
	(0.177)	(0.175)	(0.324)		(0.278)		(0.329)	(0.320)
Vegetarian	0.096		–0.439		0.978	1.074	–0.626	
	(0.439)		(0.593)		(0.805)	(0.708)	(0.798)	
Cigarettes	–0.018*	0.019*	0.030		–0.032**	–0.036***	–0.031	–0.037**
	(0.011)	(0.010)	(0.021)		(0.015)	(0.015)	(0.023)	(0.020)
Alcohol	–0.035		0.242		–0.043		–0.438	
	(0.167)		(0.302)		(0.257)		(0.313)	
R squared	0.6904	0.0696	0.7035	0.0761	0.6913	0.074	0.7042	0.1220
F (overall, sig.)	224.37		71.21		94.13		63.61	
DF'S	[21,2090]		[21,623]		[21,873]		[21,552]	
p-value	0.0001		0.0001		0.0001		0.0001	
F (restrictions)		15.70		7.19		8.96		7.81
DF'S		[10,2100]		[7,636]		[8,885]		[10,562]
p-value		0.0001		0.0001		0.0001		0.0001

Note: Standard errors are in parentheses Asterisks indicate levels of significance: *** = 1%, ** = 5%, * = 10%. All variables remaining in the restricted model are significant at the 0.15 level or lower.

means Cigarette smoking has a negative association with milk consumption. That is, smokers tend to have less healthy milk consumption than non-smokers.

The regression results for saturated fat are presented in Table 14. The criterion for maximum score of 10 for saturated fat intake is less than 10% energy from saturated fat intake, while the criterion for minimum score of 0 for saturated fat intake is 15% or more energy from saturated fat intake. The estimated coefficients for Income were all significant and positive for the all survey years, suggesting that elderly individuals with higher income tend to have a healthier diet than their less affluent counterparts in that saturated fat contributes to a lower proportion of their energy. The estimated coefficient for City was significantly positive for 1994–96 and for 1996, which implies that those residing in the central city tend to have a lower percentage of energy intake from saturated fat. The reason might be that the elderly who live in the central city can easily receive dietary information from media channels and thus have a healthier diet in terms of better saturated fat consumption. The coefficient estimates for White and Black were significantly negative across the three years, except for 1996, suggesting that white and black elderly people tend to have a poorer diet in terms of saturated fat consumption. The estimated coefficient for Hispanic is significantly positive for 1994–96 and for 1995, which indicates Hispanics are likely to have better dietary consumption in terms of saturated fat than non-Hispanics. The coefficients for On diet dummy variable were all significantly positive for the all survey years, suggesting that elderly people who are on diet tend to have better dietary consumption in saturated fat. The coefficient estimates for Cigarettes dummy variable were significant and slightly negative across the three years, except for 1995, which suggest that smokers are likely to have poorer dietary condition in terms of saturated fat

Table 14. Ordinary Least-Squares Regressions (Dependent Variable = Saturated Fat)

	1994–96		1994		1995		1996	
Variable	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted
Constant	0.601***	3.316***	0.758***	1.209	0.384***	7.149***	0.707***	3.825*
	(0.085)	(1.142)	(0.141)	(2.082)	(0.137)	(0.976)	(0.165)	(2.032)
Income	0.033	0.439***	0.020	0.678***	0.077*		0.010	0.488***
	(0.027)	(0.108)	(0.044)	(0.196)	(0.044)		(0.052)	(0.189)
Education	0.017*		0.008		0.039**	0.084**	0.008	
	(0.010)		(0.018)		(0.017)	(0.038)	(0.020)	
Age	0.094		0.286		–0.222		0.383	
	(0.211)		(0.366)		(0.348)		(0.393)	
Suburban	0.507**		0.319		0.462		0.743*	
	(0.224)		(0.397)		(0.373)		(0.438)	
City	0.338	0.457***	0.413		0.162	0.587*	0.577	0.551
	(0.239)	(0.191)	(0.418)		(0.373)	(0.307)	(0.476)	(0.358)
Northeast	–0.175	0.416**	–0.409	0.620*	–0.629*		0.624	
	(0.221)	(0.205)	(0.391)	(0.354)	(0.366)		(0.410)	
Midwest	0.304		–0.124		0.291	–0.711**	0.730*	
	(0.247)		(0.448)		(0.397)	(0.305)	(0.451)	
West	0.601***	0.408	0.758***		0.384***		0.707***	
	(0.085)	(0.232)	(0.141)		(0.137)		(0.165)	

Table 14. Continued.

Variable	1994–96		1994		1995		1996	
	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted
White	–2.017***	–2.125***	–1.773***	–1.797***	–2.387***	–2.456**	–1.296	–1.378*
	(0.395)	(0.644)	(0.568)	(0.608)	(0.385)	(1.196)	(1.403)	(0.726)
Black	–1.634***	–1.831***	–1.299*	–1.363**	–1.840***	–2.057*	–0.956	–1.441*
	(0.468)	(0.694)	(0.719)	(0.741)	(0.542)	(1.259)	(1.477)	(0.874)
Male	–0.390*	–0.551***	–0.224		–0.474	–0.444*	–0.456	
	(0.205)	(0.167)	(0.366)		(0.327)	(0.267)	(0.392)	
Employed	–0.188		–0.466		0.049		–0.435	
	(0.255)		(0.514)		(0.431)		(0.413)	
Exercise	–0.117***	–0.118***	–0.065		–0.112*	–0.112*	–0.163**	–0.163**
	(0.042)	(0.041)	(0.076)		(0.069)	(0.067)	(0.077)	(0.073)
Hispanic	1.681***	1.676**	–0.392		3.146***	3.045**	0.012	
	(0.561)	(0.769)	(0.839)		(0.800)	(1.367)	(1.501)	
Head	–0.188		0.034		–1.008*	–1.536***	0.758	
	(0.343)		(0.602)		(0.523)	(0.628)	(0.751)	
Food stamps	0.035		–0.616		0.262		–0.332	
	(0.366)		(0.697)		(0.569)		(0.678)	
Meal planner	0.247		0.344	0.467	0.032		0.564	0.748***
	(0.206)		(0.362)	(0.302)	(0.329)		(0.399)	(0.315)

Table 14. Continued.

	1994–96		1994		1995		1996	
Variable	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted
On diet	1.032***	1.034***	1.188***	1.179***	0.952***	0.924***	0.823**	0.944***
	(0.181)	(0.189)	(0.321)	(0.330)	(0.297)	(0.305)	(0.338)	(0.344)
Vegetarian	0.443		1.025*		–0.563		0.801	
	(0.420)		(0.607)		(0.803)		(0.612)	
Cigarettes	–0.033***	0.037***	–0.057**	–0.063***	–0.007		–0.063**	–0.071***
	(0.012)	(0.011)	(0.026)	(0.021)	(0.016)		(0.024)	(0.022)
Alcohol	–0.186		0.076		–0.311		–0.264	
	(0.182)		(0.326)		(0.292)		(0.339)	
R squared	0.7797	0.0522	0.7880	0.0694	0.7593	0.0494	0.7880	0.0761
F (overall, sig.)	409.55		137.43		202.74		137.43	
DF'S	[21,2090]		[21,623]		[21,873]		[21,623]	
p-value	0.0001		0.0001		0.0001		0.0001	
F (restrictions)		10.50		6.78		4.59		5.80
DF'S		[11,2099]		[7,636]		[8,883]		[8,564]

Table 14. Continued.

	1994–96		1994		1995		1996	
Variable	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted
p-value		0.0001		0.0001		0.0001		0.0001

Note: Standard errors are in parentheses Asterisks indicate levels of significance: *** = 1%, ** = 5%, * = 10%. All variables remaining in the restricted model are significant at the 0.15 level or lower.

consumption than nonsmokers.

b. Decomposition results

Since fruit component has the largest concentration index among the 10 components of the HEI, only the decomposition results for fruits are presented in this study. The elasticities of fruits with respect to the explanatory variables and the concentration indices of the explanatory variables are shown in Table 15. Tables 16 shows the decomposition results based on Equation (5), which are estimates of the contributions of explanatory variables to the good fruit consumption (high component 3 score) concentration indices as well as the change for year 1996 with respect to previous years. Income and Education favored the better-off and improved the inequality in fruit consumption during these three survey years. Gender, ethnicity, geographical regions, and employment status had no effects on the inequality in fruit consumption. Exercise disfavored the poor and improved the inequality in fruit consumption. Being a meal planner disfavored the poor in 1995, but favored the poor in 1994 and 1996. In addition, being on diet favored the poor in 1994 but disfavored the poor in the other two years. Cigarette smoking did not seem to have contributed to the inequality in fruit consumption.

Table 17 presents the Oaxaca-type decomposition results for change in inequality in fruit consumption from 1995 to 1996. The estimated contribution of Income disfavored the poor. Education favored the poor and improved the equality via the change in estimated elasticity, whereas Exercise disfavored the poor and improved the inequality due to the change in its concentration index. Being a meal planner contributed to the inequality and disfavored the poor.

Table 15. Elasticity and Concentration Indices Calculated Based on the HEI – Fruits Component Regressions

	Elasticities						Concentration indices		
	1994		1995		1996				
Variable	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted	1994	1995	1996
Income	1.134**	1.161***	0.807**	0.796**	0.862*	0.758*	0.043	0.044	0.047
Education	0.317***	0.308***	0.441***	0.480***	0.461***	0.419***	0.067	0.083	0.077
Age	–0.319		0.300		0.493		–0.008	–0.009	–0.009
Suburban	0.021		0.030		0.001		0.000	0.000	0.000
City	0.012		0.007		0.033	0.030	0.006	–0.072	–0.043
Northeast	0.040**	0.034**	0.031**	0.031**	0.005		0.000	0.000	0.000
Midwest	0.023	0.058**	0.048**	0.045***	0.046*	0.044**	0.000	0.000	0.000
West	0.039		0.006		0.027	0.028*	0.000	0.000	0.000
White	0.265	0.105	0.014		–0.371		0.000	0.000	0.000
Black	0.019		–0.006		–0.043		0.000	0.000	0.000
Male	–0.032	–0.051**	–0.174***	–0.162***	–0.027		0.000	0.000	0.000
Employed	–0.014		–0.005		–0.022*	–0.026	0.000	0.000	0.000
Exercise	–0.019		–0.084		–0.129	–0.101	–0.030	–0.043	–0.023
Hispanic	–0.312		–0.221	–0.235*	0.434		0.000	0.000	0.000
Head	–0.030		0.105		0.383**	0.307**	–0.025	–0.011	–0.016
Food stamps	–0.001		–0.010	–0.011	–0.008		–0.573	–0.555	–0.593

Table 15. Continued.

	Elasticities						Concentration indices		
	1994		1995		1996				
Variable	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted	1994	1995	1996
Meal planner	0.024		–0.069*	–0.064*	0.016		–0.102	–0.077	–0.108
On diet	0.044**	0.046***	0.052***	0.052***	0.054***	0.053***	–0.013	0.035	0.036
Vegetarian	0.008		–0.001		–0.006		0.038	–0.232	–0.222
Cigarettes	–0.023***	–0.022***	–0.017**	–0.018***	–0.033***	–0.036***	0.000	0.000	0.000
Alcohol	0.004		0.005		–0.038		0.000	0.000	0.000

Note: Asterisks indicate levels of significance in the ordinary least-squares regression results: *** = 1%, ** = 5%, * = 10%. As suggested by Equation (3), the significance of each regression coefficient translates into significance of the corresponding regressor eslaticity.

Table 16. Regressor Contributions to Concentration Indices and Changes of Concentration Indices Based on the HEI – Fruits Component Regressions

	Contributions to *C*					
	1994		1995		1996	
Variable	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted
Income	0.0038**	0.0499***	0.0028**	0.0353**	0.0030*	0.0356*
Education	0.0016***	0.0205***	0.0028***	0.0397***	0.0026***	0.0324***
Age	0.0002		–0.0002		–0.0003	
Suburban	0.0000		0.0000		0.0000	
City	0.0000		0.0000		–0.0001	–0.0013
Northeast	0.0000		0.0000		0.0000	
Midwest	0.0000		0.0000		0.0000	
West	0.0000		0.0000		0.0000	
White	0.0000		0.0000		0.0000	
Black	0.0000		0.0000		0.0000	
Male	0.0000		0.0000		0.0000	
Employed	0.0000		0.0000		0.0000	
Exercise	0.0000		0.0003		0.0002*	0.0023
Hispanic	0.0000		0.0000		0.0000	
Head	0.0001		–0.0001		–0.0005	–0.0049***

Table 16. Continued.

	Contributions to *C*					
	1994		1995		1996	
Variable	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted	Restricted
Food stamps	0.0000		0.0004	0.0061	0.0003	
Meal planner	–0.0002		0.0004	0.0049	–0.0001	
On diet	0.0000	–0.0006***	0.0001***	0.0018***	0.0001***	0.0019***
Vegetarian	0.0000		0.0000		0.0001	
Cigarettes	0.0000		0.0000		0.0000	
Alcohol	0.0000		0.0000		0.0000	

Note: Asterisks indicate levels of significance in the ordinary least-squares regression results: *** = 1%, ** = 5%, * = 10%. As suggested by Equation (3), the significance of each regression coefficient translates into significance of the corresponding regressor contribution.

Table 16. Continued.

	Change			
	1996–94		1996–95	
Variable	Unrestricted	Restricted	Unrestricted	Restricted
Income	–0.0008	–0.0143	0.0002	0.0003
Education	0.0010	0.0119	–0.0002	–0.0073
Age	–0.0005		–0.0001	
Suburban	0.0000		0.0000	
City	–0.0001	–0.0013	–0.0001	–0.0013
Northeast	0.0000		0.0000	
Midwest	0.0000		0.0000	
West	0.0000		0.0000	
White	0.0000		0.0000	
Black	0.0000		0.0000	
Male	0.0000		0.0000	
Employed	0.0000		0.0000	
Exercise	0.0002	0.0023	–0.0001	0.0023
Hispanic	0.0000		0.0000	
Head	–0.0005	–0.0049	–0.0004	–0.0049

Table 16. Continued.

	Change			
	1996–94		1996–95	
Variable	Unrestricted	Restricted	Unrestricted	Restricted
Food stamps	0.0003		–0.0001	–0.0061
Meal planner	0.0001		–0.0005	–0.0049
On diet	0.0002	0.0025	0.0000	0.0001
Vegetarian	0.0001		0.0001	
Cigarettes	0.0000		0.0000	
Alcohol	0.0000		0.0000	

Table 17. Oaxaca-Type Decompositions for Change in Inequality in Fruit Consumption, 1995–96

	Equation (6)				Equation (7)							
	$dC*\eta$		$d\eta*C$		$dC*\eta$		$d\eta*C$		Total	%	Total	%
Variable	Unres.	Res.	Unres.	Res.	Unres.	Res.	Unres	Res.	Unres.		Res.	
Income	0.0003	0.0031	–0.0010	–0.0173	0.0004	0.0047	–0.0011	–0.0190	–0.0008	860.93	–0.0143	378.84
Education	0.0004	0.0045	0.0006	0.0073	0.0003	0.0033	0.0008	0.0085	0.0010	–1165.48	0.0119	–314.78
Age	–0.0001		–0.0005		0.0000		–0.0006		–0.0005	608.89		
Subarban	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
City	-0.0001	-0.0015	0.0000	0.0002	0.0000		-0.0001	–0.0013	–0.0001	129.53	–0.0013	34.71
Northeast	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Midwest	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
West	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
White	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Black	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Male	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Employed	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Exercise	–0.0001	–0.0007	0.0002	0.0030	0.0000		0.0002	0.0023	0.0002	–200.59	0.0023	–61.30
Hispanic	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Head	0.0002	0.0026	–0.0008	–0.0075	0.0000		–0.0005	–0.0049	–0.0005	584.92	–0.0049	129.79
Food stamps	0.0000		0.0003		0.0000		0.0003		0.0003	–342.10		

Table 17. Continued.

	Equation (6)				Equation (7)							
	$dC*\eta$		$d\eta*C$		$dC*\eta$		$d\eta*C$		Total	%	Total	%
Variable	Unres.	Res.	Unres.	Res.	Unres.	Res.	Unres	Res.	Unres.		Res.	
Meal planner	0.0000		0.0001		0.0000		0.0001		0.0001	–74.24		
On diet	0.0002	0.0026	0.0000	–0.0001	0.0002	0.0023	0.0000	0.0002	0.0002	–220.40	0.0025	–67.26
Vegetarian	0.0001		0.0000		–0.0002		0.0002		0.0001	–81.46		
Cigarettes	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Alcohol	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Total	0.0034		–0.0010		0.0004		–0.0011		–0.0001	100.00	–0.0038	100.00

Results of Oaxaca-type decomposition for 1994–96 are presented in Table 18. The long-term change indicates that deteriorated income inequality has contributed to the more unequal distribution of fruit consumption. Income disfavored the poor and improved the inequality in fruit consumption. Education, Exercise, Food stamp benefits, Meal plan, and On diet favored the poor and improved the equality, which ameliorate the inequality in fruit consumption. The inequality caused age to further disfavor the poor. As in the case of the HEI, cigarettes smoking also had no effects on the inequality in fruit consumption. On comparison, the restricted model produces very similar results (regression estimates, elasticities and regressor contributions to inequality) to those of the unrestricted model

Table 18. Oaxaca-Type Decompositions for Change in Inequality in Fruit Consumption, 1994–96

	Equation (6)				Equation (7)							
	$dC*\eta$		$d\eta*C$		$dC*\eta$		$d\eta*C$		Total	%	Total	%
Variable	Unres.	Res.	Unres.	Res.	Unres.	Res.	Unres	Res.	Unres.		Res.	
Income	0.0002	0.0021	0.0001	–0.0017	0.0002	0.0022	0.0001	–0.0017	0.0002	–32.71	0.0004	–2.64
Education	–0.0002	–0.0022	0.0000	–0.0051	–0.0002	–0.0026	0.0000	–0.0051	–0.0002	22.16	–0.0076	45.17
Age	0.0000		–0.0001		0.0000		–0.0001		–0.0001	17.24		
Subarban	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
City	0.0001	0.0009	–0.0001	–0.0022	0.0000		–0.0001	–0.0022	–0.0001	16.56	–0.0022	12.95
Northeast	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Midwest	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
West	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
White	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Black	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Male	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Employed	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Exercise	–0.0002	–0.0020	0.0001	0.0043	–0.0001		0.0001	0.0043	0.0000	–0.06	0.0043	–25.65
Hispanic	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Head	–0.0001	–0.0015	–0.0002	–0.0033	0.0000		–0.0002	–0.0033	–0.0003	35.03	–0.0033	19.82
Food stamps	0.0000		–0.0001	–0.0061	0.0000	0.0004	–0.0001	–0.0061	–0.0001	7.93	–0.0056	33.47

Table 18 Continued.

	Equation (6)				Equation (7)							
	$dC*\eta$		$d\eta*C$		$dC*\eta$		$d\eta*C$		Total	%	Total	%
Variable	Unres.	Res.	Unres.	Res.	Unres.	Res.	Unres	Res.	Unres.		Res.	
Meal planner	0.0000		–0.0005	–0.0049	0.0002	0.0020	–0.0005	–0.0049	–0.0003	44.95	–0.0030	17.60
On diet	0.0000	0.0001	0.0000		0.0000	0.0001	0.0000		0.0000	–0.79	0.0001	–0.72
Vegetarian	0.0000		0.0001		0.0000		0.0001		0.0001	–10.30		
Cigarettes	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Alcohol	0.0000		0.0000		0.0000		0.0000		0.0000	0.00		
Total	–0.0003	–0.0028	–0.0008	–0.0189	0.0000	0.0021	–-0.0008	–0.0189	–0.0007	100.00	–0.0169	100.00

CHAPTER VI SUMMARY AND CONCLUDING REMARKS

This study uses the concentration index methodology to investigate the inequality in nutritional intakes among American elderly. Data are drawn from the 1994–96 Continuing Survey of Food Intakes by Individuals collected by the U.S. Department of Agriculture. Analysis is carried out for the Health Eating Index and one of its components, namely intake of fruits.

Results obtained in this study can be summarized as follows. First, unequal distribution of income may contribute to the inequalities in the HEI. Second, high education level appears to have improved the equality of HEI among the elderly, which means that the high and equal education distribution can improve the inequality in HEI among the elderly. Third, Food stamp participation has also improved the equality via the change in estimated elasticity, which indicates the Food Stamp Program has played a part in reducing inequality of HEI among the elderly. In addition, doing more exercise and being on diet also appear to have improved the equality of the elderly dietary condition. However, the rural-urban gap is found to have contributed to the inequality in HEI. Ethnicity, geographical regions, cigarette smoking, and gender do not seem to have contributions to the inequality in HEI.

As for fruit consumption, income inequality has contributed to the unequal distribution of fruit consumption among the elderly. Education, exercise frequency, being a meal planner, and being on a diet all have favored the poor and improved the equality in fruit consumption. Similarly, ethnicity, geographical regions, cigarette smoking, and gender do not seem to have effects on the inequality in fruit consumption. The results in the restricted regression model are similar to those in

the unrestricted regression model.

Policy implications can be drawn from the decomposition results. The ameliorating effects of income suggest that income growth may help to reduce health inequality among the elderly. Although welfare programs exist in the United States, it is useful to apply the CI methodology to investigate whether the these programs have achieved their goals in reducing health inequality and improving health and nutritional well-being of the poor.

Compared with the CI values with those in other studies (Wagstaff et al., 2003), the CIs for the HEI and its components found in this study are relatively low because most people meet the basic nutritional needs and the HEI for CSFII94–96 does not account for the over-nutrition problem and other things. The HEI is calculated from foods intakes rather than nutrients, and is designed to measure diet quality as compared with U.S. national guidelines. Therefore, the HEI is useful in providing a composite measure of dietary intake, but does not discern the need for nutrients such as vitamin and mineral supplements. Since inequalities in HEI do exist among the elderly in the United Sates, the government might consider reducing inequality in HEI and its components as its policy goals.

REFERENCES

REFERENCES

Asada,Y., and Y. Ohkusa. 2004. "Analysis of Health-Related Quality of Life (HRQL), Its Distribution, and Its Distribution by Income in Japan, 1989 and 1998." Soc*ial Science & Medicine* 59(7):1423–1433.

Bowman, S.A., M. Lino, S. Gerrior, and P. P. Basiotis. 1998. *The Healthy Eating Index: 1994–96.* Washington DC: U.S. Department of Agriculture, Center for Nutrition Policy and Promotion. CNPP-5.

Bremberg, S. 2003. "Does an Increase of Low Income Families Affect Child Health Inequalities?" *Journal of Epidemiology and Community Health* 57(8):584–588.

Carlson, A., and B. Senauer. 2003. "The Impact of the Special Supplemental Nutrition Program for Women, Infants, and Children on Child Health." *American Journal of Agriculture Economics* 85(2):479–491.

Carlson, A., M. Lino, S. Gerrior, and P. P. Basiotis. 2003. "Report Card on the Diet Quality of Children Ages 2 to 9." Family Economics and Nutrition Review 15(2):52–54.

Dwyer J., C. Cosentino, D. Li, H. Feldman, A. Garceau, M. Stevens, C. Perry, D. Hoelscher, L. S. Webber, and M. Zive. 2002. "Evaluating School-Based Interventions Using the Healthy Eating Index." *Journal of the American Dietetic Association* 102(2):257–259.

Fotso, J., and B. Kuate-Defo. 2005. "Socioeconomic Inequalities in Early Childhood Malnutrition and Morbidity: Modification of the Head-level Effects by the Community SES." *Journal of Health and Place* 11(3):205–225.

Gujarati, D.N. 2003. Basic Econometrics. New York: McGraw Hill.

Gravelle, H., and M. Sutton. 2003. "Income Related Inequalities in Self Assessed Health in Britain: 1979–1995." *Journal of Epidemiology and Community Health* 57(2):125–129.

Jones, A. M., and A. L. Nicolás. 2004. "Measurement and Explanation of Socioeconomic Inequality in Health with Longitudinal Data." *Health Economics* 13(10):1015–1030.

Joshipura K. J., A. Ascherio, J. E. Manson, M. J. Stampfer, E. B. Rimm, F. E. Speizer , C. H. Hennekens, D. Spiegelman, and W. C. Willett. 1999. "Fruit and Vegetable Intake in Relation to Risk of Ischemic Stroke." *Journal of the American Medical Association* 282(13):1233–1239.

Kakwani, N., A.Wagstaff, and E. van Doorslaer. 1997. "Socioeconomic Inequalities in Health: Measurement, Computation and Statistical Inference." *Journal of Econometrics* 77(1):87–103.

Key T. J., N. E. Allen , E. A. Spencer , and R. C. Travis. 2002. "The Effect of Diet on Risk of Cancer." *Lancet* 360(9336):861–868.

Kunstae, G. J., G. J. Vandenber. 1995. "International Variation in Socio-Economic Inequalities in Self-reported Health." *Journal of Epidemiology and Community Health* 49(2):117–123

Kushi L. H., E. B. Lenart, and W. C. Willett. 1995. "Health Implications of Mediterranean Diets in Light of Contemporary Knowledge: Plant Foods and Dairy Products." *American Journal of Clinical Nutrition* 61:1407–1415.

Le Grand, J. 1989. "Inequalities in Health Some International Comparisons." *European Economic Review* 31(1):182–191.

Lin, B. 2005. *Nutrition and Health Characteristics of Low-income Populations: Healthy Eating Index*. Washington, DC: U.S. Department of Agriculture. Economic Research Service. Agriculture Information Bull. No. AIB796-1.

Craig, N. 2005. "Exploring the Generalisability of the Association between Income and Inequality and Self-assessed Health." *Social Science & Medicine* 60(11):2477–2488.

Podder, N. 1993. "The Disaggregation of the Gini Coefficient by Factor Components and its Applications to Australia." *The Review of Income and Wealth* 1:51–61

Roland S., and G. C. Roan. 2002. "Relations of Income Inequality and Family Income to Chronic Medical Conditions and Mental Health Disorders: National Survey." *British Medical Journal* 324:20–23

Sehili S., E. H. Elbasha, D. G. Moriarty, and M. M. Zack. 2005. "Inequalities in Self-reported Physical Health in the United States, 1993–1999." *Health Economics* 14(4):377–389.

U.S Department of Agriculture. 1999. *Food and Nutrition Intakes by Children 1994–96, 1998*. Agriculture Research Service, Available at: http://www.barc.usda.gov/bhnrc/foodsurvey/pdf/scs_all.pdf

U.S. Department of Agriculture. 1992. *The Food Guide Pyramids*. Human Nutrition Information Service. Home and Garden Bull. No. 252.

U.S. Department of Agriculture. 1995. *The Healthy Eating Index*. Center for Nutrition Policy, and Promotion. CNPP-1.

U.S. Department of Agriculture. 1998. *1994–96 Continuing Survey of Food Intakes by Individuals and 1994–96 Diet and Health Knowledge Survey*. Springfield VA: National Technical Information Service.

U.S. Department of Agriculture. 2000. *Dietary Guidelines for Americans, 5th ed.* U.S. Department of Health and Human Services, Editors. Home and Garden. Bull. No. 232.

U.S. Department of Agriculture. 2005. *Dietary Guidelines for Americans.* Department of Health and Human Services, May. Available at: http://www.healthierus.gov/dietaryguidelines/.

U.S. Department of Health and Human Services. 2000. *Healthy People 2010: Understanding and improving Heath* (2nd edition). Washington, DC.

Variyam, J. N., J. Blaylock, D. Smallwood, and P. P. Basiotis. 1998. *USDA's Healthy Eating Index and Nutrition Information.* U.S. Department of Agriculture, Economic Research. Service, TB-1866, April.

Wagstaff, A. 2002. "Inequality Aversion, Health Inequalities and Health Achievement." *Journal of Health Economics* 21(4):627–641.

Wagstaff, A. 2005. "The Bounds of the Concentration Index When the Variable of Interest is Binary, with an Application to Immunization Inequality." *Journal of Health economics* 14(4):429–432.

Wagstaff, A., and N. Watanabe. 2000. "Socioeconomic Inequalities in Child Malnutrition in the Developing World." Working paper, World Bank, Health, Nutrition, and Population Team.

Wagstaff, A., E. van Doorslaer, and N. Wantanable. 2003. "On Decomposing the Cause of Health Sector Inequalities with an Application to MalnutritionInequalities in Vietnam." *Journal of Econometrics* 112(1):207–223.

Wagstaff, A., E. van Doorslaer, H. Bleichrodt, S. Calonge, U. G. Gerdtham, M. Gerfin, J. Geurts, L. Gross, U. Hakkinen, R. E. Leu, O. ODonnell, C.

Propper, F. Puffer, M. Rodriguez, G. Sundberg, and O. Winkelhake. 1997. "Income-related Inequalities in Health: Some International Comparisons." *Journal of Health Economics* 16(1):93–112.

Wagstaff, A., P. Paci, and E. van Doorslaer. 1991. "On the Measurement of Inequalities in Health." *Social of Science and Medicine* 33(5):545–557.

Wagstaff, A., P. Paci, and E. van Doorslaer. 1989. Equality in the Finance and Delivery of Health Care: Some Tentative Cross-country Comparisons. *Oxford Review of Economic Policy* 5(1):89–112.

Zhang, Q., and Y. Wang. 2004. "Socioeconomic Inequality of Obesity in the United States: Do Gender, Age, and Ethnicity Matter?" *Social Science & Medicine* 58(6):1171–1180.

VITA

Yuling Lin was born in Taiwan, Taipei on February 6th, 1982. She was raised in Taiwan, Taipei and went to elementary, high school in Hsin-Chuang City. She graduated from Gin-Ling Girls High School in 2000. From there, she went to the National Taiwan University, Taipei and received a B.S. in Agricultural Economics in 2004. From there, she went to the University of Tennessee, Knoxville and received a M.S. in agricultural economics with a minor in Statistics in 2006.

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