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Family Background and Child Health

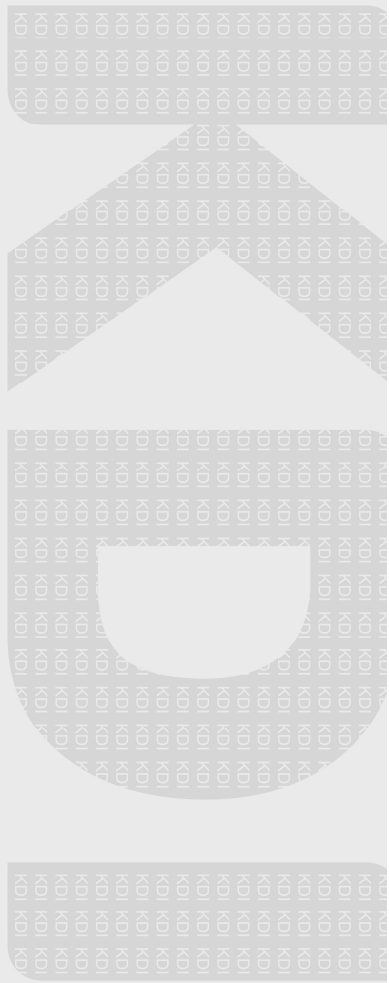
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Family Background and Child Health

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| Preface |

Socioeconomic inequity in health is of concern in many developed countries. In Korea, authorities have started to recognize the need to address this issue, as evidence on its adverse consequences grew. Health inequity in children receives particular interest because of its potential long-run effect on adult outcomes such as educational attainment and labor market success. Disadvantages occurring at this early stage may be hard to mediate and costly to reverse.

This study is an investigation into the relationship between child health and family background using nationally representative data from the Korean National Health and Nutrition Examination Survey. It confirms the existence of a socioeconomic gradient in child health, examines the role of nutrition and diet-related factors, and provides an evaluation on the income-related inequity in the distribution of health care utilization.

I believe that this research shows how family-related factors are relevant in the determination of health outcomes early in life and hope that the evidence presented here proves useful to policy-makers. The author would like to thank Dr. Hyungna Oh and Dr. Hisam Kim for valuable comments. Doug Jeong provided excellent research assistance. The views expressed herein are those of the author and should not be attributed to the Korea Development Institute.

Oh-Seok HYUN
President of KDI

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Summary

Socioeconomic inequity in health is of concern in many developed countries. To reduce inequities, one first needs to establish which factors contribute to differences in health across individuals from different socioeconomic backgrounds. The health of children receives particular interest because of its potential long-run implications on adult outcomes such as educational attainment and labor market success. Disadvantages occurring at this early stage may be hard to mediate and costly to reverse.

This study is an investigation into the relationship between child health and family background using nationally representative data from the Korean National Health and Nutrition Examination Survey. The empirical results indicate that children from low-income households have worse health on average, with diet-related lifestyle factors also playing a role. Children from high-income families with more educated parents are healthier as they are less likely to skip meals, have a more diverse and balanced diet, and their mother's are more conscious of what they put on the dinner table. Different lifestyle patterns among socioeconomic groups may result in differential risk towards various illnesses. With rising incidence of chronic illnesses, there is a consensus that more emphasis be placed on prevention and early diagnosis. One way to achieve this would be by internalizing healthy lifestyles early in childhood.

In addition, differential utilization of health care remains an issue: in an analysis on inequity in health care utilization, low-income households report to mainly seek care at the lowest (health centers) and highest (hospital) level of care, even controlling for need. Disparities also exist in

the use of preventive and diagnostic care: poor children are less likely to be immunized, to undergo diagnostic screening tests, and to receive regular check-ups.

Several existing government programs to address health inequities are reviewed and ways for improvement suggested. Policy interventions to reduce health inequities should be followed up on and their cost-effectiveness properly evaluated.

Introduction

Reducing inequities in health is one of the top priorities for authorities in many developed countries. In Korea, Shin *et al.* (2009) reported on the current state of health disparities in mortality, obesity, self-rated health, chronic diseases and the incidence of cancer among adults, noting that inequities by education, income and region had widened over the last 15 years. In accordance with such reports, authorities have started to recognize the need to address health inequities. The recently established Third National Health Promotion Plan (2011~2020) sets extended healthy lifespan and advancement of health equity as the highest aim and provides a framework for action in order to achieve these goals.

To reduce inequities, one first needs to establish what determines health and which factors contribute to differences in health across individuals from different socioeconomic backgrounds. The life-cycle approach in the formation of health is at the center of the health policy debate: critical periods exist during the life cycle and important foundations of health are laid in early childhood and even before birth (Barker, 1989). Health is the result of an accumulation of influences over a lifetime to which an individual is exposed to since conception, and of the interactions of such exposures with individual biological characteristics (Kuh and Ben-Shlomo, 2004). Physical, emotional and cognitive developmental patterns are established during early childhood, while health-related behavior appears to be malleable to some degree later on. Research across different disciplines continues to study how social and economic environments alter the functioning of human

biology, determining initial levels and subsequent developmental trajectories. Disadvantages occurring at this stage might be irreversible or costly to mediate. Thus an important research question is what influences the formation of health early in life, whether the impact of those influences remains, grows stronger or fades with time (which is also the question of whether health shocks are transitory or persistent) and whether different factors matter at different stages along the life course.

Child health is important in its own right, but economists take special interest in it because of its long-run implications on adult outcomes such as educational attainment and labor market success. Inequities in health may be related to inequities in other socioeconomic outcomes. An increasing number of research suggests that child health has an effect on educational outcomes, thereby serving as a channel for intergenerational transmission of human capital (Salm and Schunk, 2008). Poor health in childhood persists into adulthood (Case *et al.*, 2005). Health at birth or in early childhood affects cognitive ability, educational attainment, and long-term labor market outcomes (Black *et al.*, 2007; Smith, 2009; Currie *et al.*, 2010; Currie and Stabile, 2002; Richards *et al.*, 2002; see Currie and Marian, 1999; for a comprehensive review on health and labor market outcomes). Poor infant health is also found to predict welfare take-up (Oreopoulos, 2008). Some studies have gone further to argue that early-life exposure to diseases affects old-age cognitive ability (Case and Paxson, 2009).

This paper studies whether and how disparities in health start in early childhood, what the role of the child's family background is and what can be done from a policy perspective to address them, if needed. The findings are essentially threefold. First, I examine socioeconomic factors associated with child health and find that a socioeconomic status-health gradient exists not only for a measure of overall child health, but also for some more objective measures of health. Next, the implication of lifestyle-related factors (specifically, diet- and nutrition-related factors) is analyzed and their significance with respect to prevention of chronic illnesses discussed.¹ I show that children who eat a diet that is rich in

¹ Chronic diseases include cancer, diabetes, chronic respiratory disease (such as

fruits and vegetables, eat most meals at home, and do not skip main meals, and whose mothers have a sound knowledge of diet and nutrition are more likely to be healthier. Chronic diseases, the leading causes of mortality these days, often emerge as a result of long-time exposure to unhealthy lifestyle choices involving diet, physical activity and other health-related beliefs and behaviors. Preventive care and educational interventions can be more effective when started early in life. In this context, the formation of lifestyle-related behavior in childhood is emphasized and policy interventions are discussed. Thus, while this paper concentrates on the role of socioeconomic factors for child health, “family background” has a broader meaning. Considering that many lifestyle habits are established in childhood mainly through parental influence, what is termed “family background” in this paper entails such broader “family influences” as well. Last, an evaluation on equity in the distribution of health care utilization is provided. This is yet another dimension where inequality may arise and the question is whether such inequalities are systematic across groups of different socioeconomic backgrounds. This part of the analysis is motivated by the seemingly positive relationship between income and yet another measure of health, i.e., incidence of common childhood illnesses. In other words, inequity in health care utilization may be reflected in systematic differences in diagnosis rates of various childhood illnesses across income groups. Indeed, the observed illness prevalence appears to be lower for the poorest children, which is contrary to what one might expect and lets one postulate that it could be a consequence of differential utilization of the health care system. Therefore, the purpose of the latter part of the analysis lies in quantifying the degree of inequity in health care utilization by income. I present evidence that the distribution of health care utilization is pro-poor for care received at hospitals and health centers. Disparities in the receipt of preventive and diagnostic care services are subsequently discussed as differences in their utilization might lead to further inequities in health itself and illness detection rates.

Based on the empirical results, I highlight the importance of 1)

chronic obstructive pulmonary disease (COPD) and asthma), obesity, cardiovascular diseases (such as stroke), and hearing and visual impairment.

policy interventions targeted at low-income households, such as the Nutrition Plus Program, 2) policy interventions to promote healthy eating, and 3) access to and utilization of preventive and diagnostic care to reduce inequities in health.

The rest of the paper proceeds as follows. Chapter 1 provides a summary of the existing literature. Chapter 2 describes the methodology employed in each part of the analysis and outlines the data. Chapter 3, 4 and 5 each presents and discusses empirical results on the socioeconomic gradient in health, the role of nutrition and diet-related factors, and inequities in health care utilization. Chapter 6 discusses corresponding policy interventions. Chapter 7 concludes.

CHAPTER 1

Literature Review

Interest in child health generally focuses on how child health and parental socioeconomic status (SES) are linked, and how child health is related to adult outcomes such as education or income.² There is a growing list of references on the link between parental SES and child health.³

Case, Paxson and Lubotsky (2002) is an important contribution to the literature to show that children's health is strongly related to household income. Using data from the Third National Health and Nutrition Examination Survey (NHANES), they find a positive relationship between family income and the child's parent's assessment of overall health, with the relationship becoming stronger with age. In addition, with data from the National Health Interview Survey (NHIS), they show that a large part of the relationship can be explained by the arrival and impact of chronic health conditions, so that children from lower-income households with chronic conditions have worse health than do those from higher-income households. They conclude that the well-known association between health and socioeconomic status in

2 With the possibility of the causality running in both directions, from health to income and from income to health, here I can rule out the latter since it is very unlikely that children perform paid work in developed countries.

3 Currie (2009) surveys the literature to assess the status of the field in answering two questions: Is child health affected by early socioeconomic circumstances and does it affect adult education and income? See also Chen *et al.*(2002) for an exhaustive list and review of studies from different disciplines on socioeconomic status and child health.

adulthood may have its origins in childhood and that part of the intergenerational transmission of socioeconomic status may work through the impact of parental income on children's health.⁴ The former results were in contrast with the findings by West (1997), who used data from the British Census to show that for youths aged 11~19, the socioeconomic gradient in health is weak (except for severe chronic illnesses), but reappears in early adulthood. He suggested that the temporary equalization in health could be explained by effects associated with school, peer group and youth culture, but that family and neighborhood effects reemerge and dominate again in adulthood.

Subsequent studies have examined whether similar results to those of Case *et al.* (2002) could be found in other countries. Currie and Stabile (2002), using Canadian data, presented evidence that these results were not just confined to the American population and that the estimated gradient between the two populations were very similar. Further, using panel data, they show that high- and low-SES children recover from past health shocks in a similar way, but the relationship between SES and health grows stronger with age mainly because low-SES children are subject to more negative health shocks. That poor children suffer from more health insults than richer children has been widely documented, for physical as well as mental health conditions (see Newacheck (1994), for example). However, in my data, the relationship between family income and various common childhood illnesses is not necessarily consistent with the existing evidence. This partially positive association between income and childhood illness prevalence, described and investigated in more detail in Chapter 6, is the motivation into an analysis of differential utilization of health care services.

Currie, Shields and Price (2007) use data from England, a country with a national health insurance system that provides universal access to care, to explore whether there is a positive relationship between family

4 The relationship between health and socioeconomic status is well-known and has been extensively studied across different populations and times (Marmot, 1999), although the underlying channels are still debated (Deaton, 2003). Wealthier, more educated people have lower morbidity and mortality: by almost any measure taken, individuals of higher SES, whether measured by education, income, wealth or occupational class, generally enjoy better health.

income and child health. While they find consistent and robust evidence of a family income gradient in child health using the general health status measure, the slope of the gradient that they find is small. They also do not find evidence of an increasing gradient with age, nor a gradient with more objective measures of health. They instead provide evidence on the importance of lifestyle choices and nutrition in determining child health. Case, Lee and Paxson (2007) reexamined the findings of Currie *et al.* (2007) by making comparable the time period covered by the data and concluded that income and child health were as strongly related in England as in the US. Moreover, they show that the effects of chronic conditions on health are larger in England than in America. Reinhold and Jürges (2012) found similar results for German children, except that they failed to find that the income-child health gradient increases with age. Unlike Currie and Stabile (2002), their findings suggest that high-income children are better able to cope with the adverse consequences of chronic conditions. They also did not find that children from low socioeconomic background were more likely to suffer from objectively measured health problems, except for obesity.

Bhattacharya and Currie (2001) use data from the NHANES to examine the importance of the household budget and the information constraint. Their results suggest that poverty, measured as income less than 1.3 times the poverty line, is associated with food insecurity, higher blood cholesterol levels and obesity, but does not make a difference in the overall quality of the diet. Further, youths in households with more educated heads have a lower incidence of obesity, better overall diet quality as well as a reduced probability of food insecurity.

Interest in this topic has risen only relatively recently in Korea. Among the handful of studies, those that utilize data with too small a sample size are excluded from this review. Most studies on health disparities in Korea have focused on socioeconomic inequities in adults: Khang and Kim (2006) and Son *et al.* (2002) examined inequities in mortality, while others tested for differences in the incidence of diseases or self-assessed health (Son, 2002; Lee, 2005). As for studies on children, Kwon and Kuh (2010) used data from the Seoul Panel Study of Children to examine how family poverty status, defined using monthly household income, affects self-assessed health of school-age children. Chronically

poor children, compared to transitory poor or non-poor ones, were less likely to be in good health, as assessed by their parents. Yoon *et al.* (2007) examined data from an entire birth cohort and showed that childhood mortality is inversely related to parental education and paternal occupation.

A few studies examined the relationship between family socioeconomic status and child growth. Park, Lee, and Kim (2007), for example, studied anthropometric indicators and showed that family poverty status and parental education are significant factors in explaining differences in growth among children.

The list of studies exploring links between socioeconomic status and children's health using Korean data is much shorter and sometimes includes mixed conclusions, which is likely attributable to differences in the sample and methodology employed. Nationally representative data on health and nutrition is utilized in this paper to examine the role of family background characteristics for children.

CHAPTER 2

Methodology and Data

This chapter first lays out the conceptual framework and econometric methodology for the empirical analysis and then describes the data. The relationship between child health and socioeconomic status (and subsequently, nutrition and diet-related factors) is examined by means of an ordered probit model, which is used for modeling ordered response variables (in this case, ordered response on child health). Equity in health care utilization is analyzed with a concentration index which measures whether the income-related distribution of health care is pro-poor, equitable or pro-rich.

1. Methodology

(1) Family-related Factors and Child Health

The conceptual framework underlying the empirical analysis on the relationship between child health and parental socioeconomic status is a widely used application of the economic model of the household, which incorporates a health production function. The household maximizes a quasi-concave utility function which depends on the consumption of leisure, market-purchased goods and home-produced goods such as child health, subject to a budget constraint, a time constraint and a health production function. The health production function depends on market-purchased inputs (such as food and health care services),

characteristics of the household, and an endowment factor. The reduced-form demand for child health is then defined as a function of child characteristics (including age and sex), household characteristics (income, parental education), community characteristics (availability of health care services) and an idiosyncratic component (endowment). Thus I estimate a reduced-form regression of child health on household socioeconomic characteristics, controlling for other child, household and community characteristics.

Health is a multi-dimensional concept which is hard to summarize in one single measure. It can be measured in many different ways, one of which is a subjective evaluation of overall health (in most cases provided by parents). It serves as a summary measure of health and may in addition convey private information on the child's health that is unobservable to the surveyor (accumulation of observations made by parents or children's health history). The drawback of this measure however is that high-SES people may have different (stricter or not) reference levels or different expectations when evaluating health on an ordinal scale. In other words, there will be estimation bias if the reference levels vary systematically by socioeconomic status. Without further information on whether and how individuals make different judgements on different health conditions, it is difficult to examine this further.⁵ Mindful of the limitations of this measure, most of the analysis in this paper focuses on parents' assessment of the child's overall health status, measured in an ordinal, categorical scale.

Another concern is that, to the extent that socioeconomic characteristics are correlated with unobserved, unmeasured factors which also affect child health, there could be a bias. The relationship between household income and child health could at least be partially determined by some third factors that are correlated with income, such as health-related behavior or genetic factors. Poor parental health, for example, could cause both poor child health and low earnings. The presence of these factors will be explored as much as possible.

The main specification is based on an ordered probit model, for

⁵ There is a separate line of literature that examines such heterogeneity in reporting bias. See for example, Lindeboom and van Doorslaer (2004).

which justification is given by the fact that the outcome of interest, overall child health, is categorical and ordered: in the data, health status is evaluated on a scale from 1 (very good) to 5 (very bad). The response provided by the surveyed person reflects which indicator most closely represents the true underlying health. In other words, the latent regression model translates underlying, continuous health into an observable, discrete measure of health.

More formally, assume that latent health y^* is modeled as $y^* = x\beta + \varepsilon$, and let y be an ordered response taking on the values 0, 1, ..., J. Latent health y^* is observed in discrete form as follows:

$$\begin{aligned} y &= 0 \quad \text{if } y^* \leq \alpha_1, \\ y &= j \quad \text{if } \alpha_j < y^* \leq \alpha_{j+1} \\ y &= J \quad \text{if } y^* > \alpha_J \end{aligned}$$

where α_j 's are threshold parameters with $\alpha_1 < \alpha_2 < \dots < \alpha_J$. Assuming a standard normal distribution for the error term, the probability associated with each response can be expressed as follows:

$$\begin{aligned} P(y = 0 | x) &= P(y^* \leq \alpha_1 | x) = P(\varepsilon \leq \alpha_1 - x\beta | x) = \Phi(\alpha_1 - x\beta) \\ P(y = j | x) &= P(\alpha_j < y^* \leq \alpha_{j+1} | x) = \Phi(\alpha_{j+1} - x\beta) - \Phi(\alpha_j - x\beta) \\ &\quad \text{if } 0 < j < J \\ P(y = J | x) &= P(y^* > \alpha_J | x) = 1 - \Phi(\alpha_J - x\beta) \end{aligned}$$

The parameters are estimated by maximizing the log-likelihood function $l_i(\alpha, \beta) = 1[y_i = 0]\log[\Phi(\alpha_1 - x_i\beta)] + 1[y_i = 1]\log[\Phi(\alpha_2 - x_i\beta) - \Phi(\alpha_1 - x_i\beta)] + \dots + 1[y_i = J]\log[1 - \Phi(\alpha_J - x_i\beta)]$. I am not interested in $E(y^* | x) = x\beta$, since y^* is an unobserved, abstract measure of health. Instead, I am interested in the marginal change in the response probabilities as x changes a little. These marginal effects are calculated as:

$$\partial P_0(x) / \partial x_k = -\beta_k \phi(\alpha_1 - x\beta)$$

$$\partial P_j(x) / \partial x_k = \beta_k [\phi(\alpha_{j-1} - x\beta) - \phi(\alpha_j - x\beta)] \quad \text{if } 0 < j < J$$

$$\partial P_J(x) / \partial x_k = \beta_k \phi(\alpha_J - x\beta)$$

The regression does not specify a direct relationship between the covariates and the responses and as such, direct interpretation of these coefficients is not straightforward. Instead, the relationship between the covariates and the probabilities of each response is described, and interpretation is done with marginal effects. It should also be noted from the above that the sign of the effect of a covariate on the response probability can be opposite to each other. Moreover, with each set of parameter estimates, there are J different sets of marginal effects, where J is the number of possible responses. For clarity of exposition, it is indicated in each results table whether estimated coefficients or marginal effects are presented. When only parameter estimates are shown, interpretation in terms of response probabilities based on those estimates is provided in the text.

(2) Equity in Health Care Utilization

Deviations from equitable utilization are measured by means of a concentration index (Wagstaff *et al.*, 2003; van Doorslaer and Masseria, 2004). The index is very similar in spirit to the Gini index, in that it quantifies the degree of inequality across the income distribution. The concentration index is defined against a concentration curve, which plots the cumulative percentage of the outcome variable against the cumulative percentage of the population, ranked by income. The index is calculated as twice the area between the 45-degree diagonal and the concentration curve. It takes a negative (positive) value when the curve lies above (below) the diagonal, and the outcome of interest is disproportionately higher among the poor (rich). If the income-related distribution is equal, the index takes on the value zero.

Following van Doorslaer *et al.* (2004), estimates for the concentration index are conveniently obtained by running the following regression:

$$\frac{2\sigma_R}{y} y_i = \alpha + \beta R_i + \varepsilon_i$$

where σ_R is the variance of the fractional rank R_i and the estimate of β is equal to the concentration index. Estimates of this concentration index for each measure of health care are shown in the first column of Table 5-2.

Wagstaff *et al.* (2003) further demonstrate that the concentration index can be decomposed into the contribution of each determinant of the health variable to inequality. Suppose that the health variable of interest is modeled as

$$y = \alpha + \sum_k \beta_k x_k + \varepsilon$$

Then the concentration index can be written as $C = \sum_k \eta_k C_k + \frac{GC_\varepsilon}{\mu}$

where $\eta_k = \beta_k \frac{\bar{x}_k}{\mu}$, μ is the mean of y and \bar{x}_k is the mean of

x_k , C_k is the concentration index for x_k (defined analogously to C) and GC_ε is the generalized concentration index of the error term ε (the residual term).

x_k includes a list of need-related (age in linear and squared terms, sex and dummy variables for categorical health status and indicator for the presence of an activity-limiting condition, as measures of morbidity) and non-need related variables (income, mother's education, mother's activity status, region, etc).⁶

While the concentration index summarizes the distribution of actual utilization related to income, any remaining difference in need-standardized utilization is interpreted as a sign of inequity. Positive (negative) values of the concentration index indicate a pro-rich (pro-poor) distribution, after adjusting for need differences. The contribution

6 As for need-related variables, demographic variables for age and sex and indicators for morbidity are used. Lu *et al.* (2007) and van Doorslaer *et al.* (2004) also use age, sex, self-assessed health status and activity limitation variables.

of the variable x_k to income-related health inequality is given by $\eta_k C_k$ and is larger 1) the greater the elasticity of health in relation to that variable (η_k) and 2) the more unequally the variable is distributed across income (C_k).

2. Korean National Health and Nutrition Examination Survey (KNHANES)

The empirical analysis is based on nationally representative data from the Korean National Health and Nutrition Examination Survey (KNHANES), which was designed to assess the health and nutritional status of the Korean population. The survey was first performed in 1998. In general, the data is used for various purposes; to get estimates on the prevalence of chronic diseases and related risk factors and to provide evidence to develop and evaluate policies and programs with the aim of health promotion. The survey is constructed based on a multi-stage stratified cluster sampling design and consists largely of three parts: a household survey, a nutrition survey and an examination survey.⁷ The former two are conducted based on interviews, while the latter is administered through clinical examinations. The household survey contains demographic and socioeconomic information of individual household members, such as age, sex, educational attainment, as well as monthly household income, and a wide array of information on measures of health and health care utilization.⁸ The nutrition survey includes data on food consumption and nutrition knowledge. Finally, the examination component of the survey consists of physiological measurements and laboratory tests.

Cross-sectional household data from 2006, 2007, 2008 and 2009 was pooled to construct a sample of children age 18 or younger.⁹ A common

⁷ All means and estimates presented in this paper make use of the survey weights that correspond to the variables in the respective analysis.

⁸ The survey asks for total monthly household income, as the sum of income from wages, real estate, pension, interest, government transfers and other allowances.

⁹ The survey first started in 1998, but the questionnaire changed substantially with each survey round. I used data from the third (2005) and fourth (2007~2009) round

limitation of the use of cross-sectional data includes the inability to track changes of the outcome over time. With just one observation per child, it is impossible to control for unobserved, individual-specific factors using a fixed effects model.

The analysis focuses on children who co-reside with both parents, regardless of their parents' survival status. The initial sample starts out with a total of 14,689 children. Observations were dropped when there was no information collected on either parent (on age or educational attainment) or household income, setting the values of relevant variables to missing. 212 observations did not have a response on the child's overall health status. Further, households with a monthly income at the top and bottom 1% of the distribution were excluded for two reasons: to remove outliers reporting possibly implausible values of income, and also because income was top-coded at 9.98 million KRW in the 2005 survey.¹⁰ The final number of children included in the main analysis on family socioeconomic background and subjective health is 12,306. Any further variations in sample size across subsequent specifications are due to differences in the number of observations with missing values among the variables used.

Summary statistics for the final sample and variables used are shown in Table 2-1. Slightly over half of the children is male (52.4%). The average child in the sample is almost 10 years old, lives in a four-person household and has a mother who is 38 years old. Since mothers are generally the main caregivers, I am interested in the relationship between child health and the educational attainment of the mother. Maternal education was grouped into "less than high school" (11.5%), "high school graduate" (56.3%) and "college graduate and higher" (32.3%). Mean log of monthly household income is 38.436.

The primary outcome of interest is the child's health. The survey respondent, usually a parent, was asked to assess the health of the child on a five-point ordinal scale: 1 ("very good", 1906 observations), 2 ("good", 7407 observations), 3 ("average", 2540 observations), 4 ("bad",

only because data from these years are relatively comparable and contain the most information.

10 Income values were adjusted for inflation on a base year of 2005=100.

434 observations) and 5 (“very bad”, 19 observations). Given the small number of children whose health is reported as “very bad”, responses for “bad” and “very bad” are collapsed into one. Table 2-2 shows, by household income quintile and age group the percentage of children in bad/very bad or good/very good health.¹¹ Three patterns emerge from the table. First, the protective effect of household resources as measured by income on child health is apparent: across age groups, there are fewer healthy children in the bottom relative to the top income quintile group and the share of healthy children generally increases with income. The opposite is true for the share of children in bad or very bad health: the higher household income, the lower the probability that the child is unhealthy. Second, looking at children in different age groups within the same income quintile, the share of healthy (unhealthy) children decreases (increases) with age.¹² Finally, while 3.54% of children ages 0~5 in the top and 4.93% of the same children in the bottom income group are reported to be in bad health, the proportion grows to 5.74% and 7.72% respectively for children ages 12~18. There are more unhealthy children in low-income households regardless of age, but the difference between income groups grows larger over time implying that health inequalities widen with time and confirming that health is cumulative in nature.

11 Mean household income for each quintile is 840,742 (Q1), 1,527,910 (Q2), 2,164,344 (Q3), 3,010,273 (Q4) and 5,715,755 (Q5) Korean Won.

12 Since the data is cross-sectional, the second and third interpretations are conditional on the assumption that children in cohorts that make up the different age groups were not inherently different in their initial health status and were not exposed to cohort-specific shocks. The fact that the pattern in Table 2 appears similarly when the same cross-tabulation is done with data from each survey year separately lends this interpretation further support.

Table 2-1 Summary Statistics of Main Regression Variables

Variable	Mean	Std. dev.
Male	0.524	0.5
Age	9.987	5.104
Household size	4.209	0.964
Mother's age	38.436	5.526
Ln (Monthly household income)	5.444	0.76
Mother's education		
Less than high school	0.115	0.319
Completed high school	0.563	0.497
College and higher	0.323	0.468

Note: Author's calculations using KNHANES 2005, 2007, 2008, 2009.

Table 2-2 Health Status by Age Group and Income Quintile

Income quintile	Bad or very bad health			Good or very good health		
	Ages 0~5	Ages 6~11	Ages 12~18	Ages 0~5	Ages 6~11	Ages 12~18
Q1	4.92	4.81	7.72	72.7	69.96	60.92
Q2	3.29	4.11	7.06	74.31	75.32	60.86
Q3	4.54	3.25	5.33	70.38	76.54	69.1
Q4	4.06	4.28	4.24	74.73	75.52	69.71
Q5	3.54	2.85	5.74	78.7	78.32	70.76

Note: Author's calculations using KNHANES 2005, 2007, 2008, 2009. Q1~Q5 indicate the five income quintiles with Q1 being the lowest (households in the bottom 20% of the income distribution). Numbers in each cell represent the percentage of children, in each income quintile-age group, whose health was reported to be either bad/very bad (scale=4, 5) or good/very good (scale=1, 2).

CHAPTER 3

The Child Health-SES Gradient

1. The Relationship between Child Health and SES

I begin this subsection by presenting results from ordered probit estimation of the reduced-form equation that describes child health. Estimation is performed on the full sample and then on three separate age groups: ages 0~5 (pre-school age children), ages 6~11 (elementary school age children) and ages 12~18 (children in middle school and high school). In addition to income, other child and household characteristics are included that might affect child health, such as age (in dummy variables) and sex of the child, mother's age (linear and squared) and log of household size. Dummies for the 16 regions (metropolitan cities and provinces) and survey years are included to control for region- or survey year-specific factors.¹³

These estimation results are reported in Table 3-1, for the full sample in column (1) and then separately by age group in columns (2)~(4). As described before, I am interested in how the response probability is affected by a small change in SES. These are the so-called marginal effects. In other words, I am interested in how much the probability that the child's health is reported to be "very good", "good", "average", "bad

13 The geographical distribution of the sample is as follows: Seoul (18.36%), Busan (6.43%), Daegu (5.15%), Incheon (5.66%), Gwangju (3.19%), Daejeon (3.02%), Ulsan (2.8%), Gyeonggi (25.5%), Gangwon (2.77%), Chungbuk (2.85%), Chungnam (4.28%), Jeonbuk (3.15%), Jeonnam (3.26%), Kyeongbuk (5.32%), Kyeongnam (6.36%) and Jeju (1.89%).

Table 3-1 Relationship between Child Health and Parental Socioeconomic Status

	(1) All ages	(2) Ages 0~5	(3) Ages 6~11	(4) Ages 12~18
High school	-0.0773 (0.0545)	-0.1286 (0.1193)	-0.0653 (0.0772)	-0.0983 (0.0729)
College and higher	-0.0397 (0.0603)	-0.1524 (0.1284)	-0.0023 (0.0885)	-0.0195 (0.0895)
Ln (Income)	-0.0938*** (0.0301)	-0.0105 (0.0534)	-0.1358*** (0.0472)	-0.1221*** (0.0468)
Ln (Household size)	0.0063 (0.0761)	0.2638** (0.1212)	-0.0801 (0.1141)	-0.1699 (0.1245)
Sex	0.0511** (0.0255)	0.1980*** (0.0449)	0.0211 (0.0396)	-0.0286 (0.0434)
Mother's age / 100	-2.1473 (2.9836)	8.4271 (6.6369)	-4.7917 (6.4342)	5.8071 (8.5960)
(Mother's age) ² / 100	0.0150 (0.0386)	-0.1463 (0.0982)	0.0442 (0.0841)	-0.0749 (0.0999)
N	12306	3477	4515	4314

Note: This table reports coefficient estimates from an ordered probit model. Dependent variable is child health (1=very good, 2=good, 3=average, 4=bad or very bad). All regressions are weighted using sampling weights. Age and survey year dummies are included in each specification. Region dummies were included, with Seoul as the reference category. Corresponding marginal effects are presented in Table 3-2. *, ** and *** indicate significance levels at 10%, 5% and 1%, respectively. Goodness-of-fit measures are not provided by Stata when ordered probit models are estimated with complex survey data. As an alternative, I provide pseudo-R² and log-likelihoods based on ordered probit models assuming that data is sampled randomly (which yields similar estimation results across the board). The pseudo-R² (log-likelihood) are as follows corresponding to each column in the table: (1) 0.0117 (-12713.1) (2) 0.0174 (-3570.9) (3) 0.0084 (-4537.9) (4) 0.0167 (-4503.1)

or very bad” is affected by changes in each covariate. This yields four different sets of marginal effect estimates (since there are four possible health outcomes) per regression. Corresponding marginal effects are presented in Table 3-2. To conserve space, only marginal effect estimates for income (the main variable of interest) are reported, for the full sample in the first row and the three separate age groups in the

Table 3-2 | Marginal Effects of Income on Child Health

Sample	(1) (Health = very good)	(2) (Health = good)	(3) (Health = average)	(4) (Health = bad/very bad)
All ages	0.022*** (0.007)	0.009*** (0.003)	-0.022*** (0.007)	-0.008*** (0.003)
Ages 0~5	0.003 (0.017)	-0.001 (0.004)	-0.002 (0.01)	-0.000 (0.002)
Ages 6~11	0.034*** (0.012)	0.007** (0.003)	-0.031*** (0.011)	-0.01*** (0.004)
Ages 12~18	0.027*** (0.01)	0.014** (0.006)	-0.03*** (0.011)	-0.011** (0.005)

Note: This table reports marginal effect estimate of income from the ordered probit model of child health. Marginal effects in each row are calculated using the coefficient on income in the corresponding column in Table 3-1. *, ** and *** indicate significance levels at 10%, 5% and 1%, respectively.

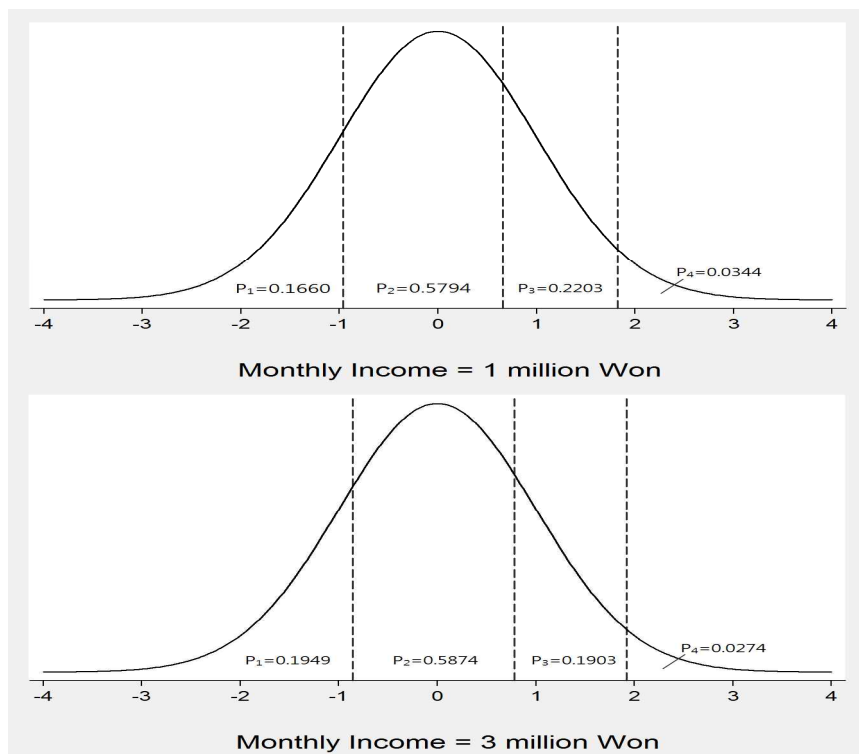
second through last row in Table 3-2.¹⁴

Several implications can be drawn from these results. First, in the full sample analysis, a 1% increase in income raises the probability that a child is in very good or good health by 2.2%p and 0.9%p, respectively. The same marginal change decreases the probability that the child is in average or bad health by a respective 2.2%p and 0.8%p.¹⁵ In order to give these results a more intuitive appeal, a graphical presentation is provided in Figure 3-1 which illustrates how the response probabilities (which are determined by model parameters) change as income changes from 1 million Won to 3 million Won, for a child with average sample

14 A Brant test was performed in order to test the parallel lines assumption which specifies that the slope vector β is the same across the J-1 models. The assumption holds for most variables (including education and income), except for a few of the age, region and year dummies. Estimation results from a generalized ordered model indicate that relaxing the parallel lines assumption for those variables for which it does not hold produces results that are otherwise very similar to the original ones presented in Table 3.

15 Measures of more permanent income (e.g., average of multi-year income) or consumption (commonly used as a proxy for permanent income) are not available because information is collected on current income only.

|| Figure 3-1 || Changes in Marginal Effects on Response Probabilities with a Change in Income for a Representative Child with Average Characteristics



Note: This figure compares the change in response probabilities for a child with average sample characteristics, when monthly household income changes from 1 million Won to 3 million Won. Specifically, marginal effects were calculated for a 10-year-old female child that lives in a four-person household in Seoul, with a 40-year-old, high-school-educated mother in 2009.

characteristics.¹⁶ The probabilities that the sample child is in very good or good health increase from 0.1660 to 0.1949 and from 0.5794 to 0.5874 as monthly income goes up, whereas the probabilities that the child is in average or bad health go down from 0.2203 to 0.1903 and 0.0344 to 0.0274, respectively.

Second, in general, variation in household resource availability is at

16 Specifically, marginal effects were calculated for a 10-year-old female child that lives in a four-person household in Seoul, with a 40-year-old, high-school-educated mother in 2009.

least partly owing to differences in education. Education generally affects health outcomes by both raising technical efficiency with which health inputs are used and by increasing allocative efficiency of input use.¹⁷ However, while having more educated parents seems to benefit child health (if anything), as indicated by the positive sign of the marginal effect of education on the probability that the child's health is at least "good", the estimates are not statistically significant. This suggests that the effect of education on child health works mainly through the effect on income in Korea.¹⁸

Third, the magnitude of the effect differs by age group. Columns (2) through (4) in Table 3-1 each shows results from ordered probit, for children of ages 0~5, 6~11 and 12~18. It is notable that the results are qualitatively similar to the ones in the full sample (shown in column (1)), with income positively associated with health, but statistically significant for school-age children only (age 6 and above). For children in the youngest age group, the marginal effect coefficient on income is much smaller and not statistically significant. One conceivable explanation for this could be that inequalities in health accumulate over time, but early disparities do not show up in the data as yet. Comparing the marginal effect of income on health in Table 3-2 shows that, except for column (1), the size of the marginal effect generally increases with age. This is consistent with the results by Case *et al.* (2002), which also finds a steeper gradient for older children.

While the health status variable may give an overall assessment of the health of the child, the downside is that the responses are subjective and there is no guarantee that they are comparable across SES-groups. Respondents may differ in their perception of good or bad health or their expectations for health. Estimating health disparities becomes problematic if there are systematic differences in reporting behavior. For example, if low-income parents are less likely to report that they are unhealthy for a given level of health, then the income-health gradient will be underestimated. To alleviate concern over reporting heterogeneity, the

17 In reduced-form, estimates reflect the influence of both.

18 Marginal effects estimates of education are statistically significant when income is not included as a regressor.

five-point scale health measure is converted into a binary one for whether the child is in “good health” or not, and run a probit regression of that indicator variable on the same set of controls. The association between income and child health remains strong and significant, even after controlling for parent's education (results not shown here).¹⁹

2. The Child Health-SES Gradient Accounting for Third Factors

The results in Table 3-1 could reflect the effect of other unobserved family background characteristics that are correlated with income. For example, poor health at birth due to deficiencies in the in utero environment could explain part of the effect. There is a good amount of evidence in the epidemiological literature suggesting that differences in health at birth are not purely genetic. Alternatively, poor health may be inherited from parents, either directly through congenital disorders or indirectly through an increased susceptibility to certain diseases. Or, parental health may affect both child health and income, leading to a spurious correlation between the two. While this justifies the inclusion of parental health in the regression, the coefficient needs to be interpreted with caution. If parental health is affected by income, then the effect of parental health might simply reflect the effect of income. Further, if parental health is affected by both current and past income, it may serve as a proxy for past income levels. Thus the effects of parental health and income are hard to separate in a clean way (Case *et al.*, 2002).

Considering these limitations, the socioeconomic gradient in child health controlling for birth health and parental health are presented in Table 3-3, with corresponding marginal effect estimates shown in Table 3-4. In 2005, the survey asked whether the child had been hospitalized in a neonatal intensive care unit (NICU). NICUs generally treat children

19 Another concern is that the survey years span the period over which the recent financial crisis hit. I repeated estimation of the model with data from the pre-crisis year 2005 only. Results are qualitatively similar to Table 2, in that the income gradient is present and statistically significant, although steeper for children aged 12~18 when estimated by age group.

Table 3-3 | Relationship between Child Health and Socioeconomic Status,
Controlling for Health at Birth and Parental Health

	(1)	(2)
High school	-0.0780 (0.0558)	-0.0228 (0.0590)
College and higher	-0.0622 (0.0657)	-0.0014 (0.0685)
Ln (Income)	-0.1360*** (0.0354)	-0.0857** (0.0357)
Ln (Household size)	0.0475 (0.0860)	0.0973 (0.0910)
Sex	-0.0053 (0.0266)	-0.0160 (0.0280)
Mother's age / 100	-1.9050 (3.3126)	-1.1075 (3.4274)
(Mother's age) ² / 100	0.0164 (0.0435)	0.0042 (0.0451)
NICU	0.3600*** (0.0819)	0.3243*** (0.0805)
Mother's health is bad		0.3849*** (0.0632)
Father's health is bad		0.2536*** (0.0635)
N	7306	6921

Note. This table reports coefficient estimates of covariates on the probability that the child's health is very good, good, average or bad/very bad, controlling for health at birth ("NICU") and parental health ("mother's health is bad", "father's health is bad"). See notes to Table 3-1 for the full list of controls. Corresponding marginal effects are presented in Table 3-4. "NICU" (Whether child had been treated in neonatal intensive care unit), "Mother's health is bad", and "Father's health is bad" are all dummy variables. *, ** and *** indicate significance levels at 10%, 5% and 1%, respectively. For reference, the pseudo-R² (log-likelihood) from random sample estimation are as follows: (1) 0.015 (-7559.4) (2) 0.0146 (-7017.8)

Table 3-4 | Marginal Effects of Income on Child Health Controlling for Birth Health and Parental Health

Table 3-3. Column (1)	(Health = very good)	(Health = good)	(Health = average)	(Health = bad/very bad)
Ln (Income)	0.029*** (0.008)	0.01*** (0.003)	-0.029*** (0.008)	-0.01*** (0.003)

Table 3-3. Column (2)	(Health = very good)	(Health = good)	(Health = average)	(Health = bad/very bad)
Ln (Income)	0.018** (0.008)	0.006** (0.002)	-0.018** (0.008)	-0.006** (0.002)

Note: This table reports marginal effect estimates of the ordered probit model of child health on socioeconomic status, controlling for birth health and parental health. The top and bottom panels report the marginal effects of income from the results in Table 3-3, column (1) and column (2), respectively. *, ** and *** indicate significance levels at 10%, 5% and 1%, respectively.

with low birth weight (infant that are too small for gestational age, generally birth weight < 2500g), those who were born pre-term or have otherwise had some birth complications, and thus may serve as an indicator of poor health at birth. Poor parental health is measured with two dummy variables that are each equal to one if the mother (father) reported herself (himself) to be in either bad or very bad health. As indicated by the sign of the marginal effects, children who had been treated in a NICU are less likely to be in good health, suggesting lasting effects of birth health. This implies that some of the income effect might start to come into play even before birth. The marginal effect of income is overall slightly reduced, but remains statistically significant. Thus, it can be inferred that health at birth does not fully account for the gradient. Unfortunately, with the data at hand, I am not able to further explore whether variation in health at birth is due to differences in prenatal care, poor nutrition in utero or other factors. Differences in prenatal care access is an unlikely candidate given the universal health insurance system and given that prenatal care includes monthly ultrasounds in Korea (which is more frequent than in the US, for example). Parental health also has a large and independent effect on child health, with mother's health having a greater effect than the father's. Again, the

income-child health gradient remains statistically significant. In all, birth health and parental health do not fully account for the relationship between income and child health.²⁰ Further, the fact that the marginal effect of income in column (2) is smaller than the one in column (1) suggests that income and parental health are also positively correlated.²¹

As a further point, having an ill child may reduce parental labor supply, leading to lower earnings. I check for this possibility by running a regression of mother's employment status on whether the child spent time in a NICU. Since mother's employment question refers to the time at the survey, the analysis is restricted to children less than 3 years old. The estimated coefficient is very small and statistically insignificant, indicating no causality running from child health to household income.

3. SES and More Objective Measures of Health

Given the limitations of the subjective health measure previously pointed out, I repeat the analysis with more objective measures of health. From the abundance of information available, I utilize measures from blood tests and physical examinations where there is little room for subjectivity to be involved. Three additional measures of health are examined: ferritin levels, blood pressure levels and indicator for whether the child is overweight (Body mass index (BMI) > 25 , where BMI is defined as the ratio of an individual's weight and square of height in meters). Iron deficiency is the most common nutritional disorder (WHO, 2001), and ferritin serves as an important biomarker of iron status. Low ferritin levels may indicate iron deficiency anemia and lead to

20 Any other omitted factor not accounted for does not matter as long as it is not correlated with the independent variable of interest.

21 This is inferred from the comparison of results from the "full model" (column (2)), which controls for both "NICU" and parents' health, and the "restricted model" (column (1)), which controls for "NICU" only. The marginal effect of income is smaller in size in the full model than in the restricted model. Given that the marginal effect on parental health is negative, this implies that income and (bad) parental health are negatively correlated.

symptoms such as headache, excessive tiredness and weakness. In the long-run, iron deficiency anemia in early childhood hinders cognitive development (Pollitt, 2001; Grantham-McGregor and Ani, 2001). High blood pressure is a major chronic disease worldwide and children may develop a predisposition to it early on.

I turn to investigate whether there is an SES-health gradient with these health measures as well. Results are shown in Table 3-5. The variables indicating low ferritin levels and high diastolic blood pressure are both dummies for whether the child's ferritin or blood pressure fell below the reference range, and thus probit models are used to analyze these outcomes. Columns (1) and (2) in Table 3-5 report estimates from probit regressions on the same set of controls as in Table 3-1, plus measures for parental health to control for possible genetic influences (marginal effects are not shown). Specifically, parents' ferritin levels (measured as a dummy equal to one if parents have ferritin levels lower than the reference level), diastolic blood pressure levels (measured as a dummy equal to one if parents' blood pressure is above the normal level) and parents' general health status are added to column (1), (2) and (3), respectively.

It is straightforward from the results that children of households with higher income are less likely to exhibit low ferritin levels: a 1% increase in household income decreases the probability that the child may suffer from iron deficiency by 4%p. The results on high blood pressure are somewhat mixed, in that being raised by a college-educated mother (relative to a mother with less than high school education) decreases the probability of high blood pressure by a statistically significant 5.6%p, but a 1% increase in household income actually raises the probability of high blood pressure by 2.2%p. While it is hard to pin down the exact mechanism causing this, one might think that a high-fat, high-cholesterol diet is more common in high-income households, especially in a country where the traditional diet is based on low-fat, fiber-rich food.

Finally, there are few indications of socioeconomic disparities in the overweight prevalence among children (column (3)). While obesity rates (BMI > 30) are still very low, they are expected to increase at a fast

Table 3-5 | Relationship between Socioeconomic Status and More Objective Measures of Health

	(1) Low ferritin	(2) High diastolic	(3) Overweight
High school	0.0928 (0.1582)	-0.0165 (0.1833)	-0.0031 (0.1048)
College and higher	0.1256 (0.2023)	-0.9586** (0.3824)	0.1268 (0.1336)
Ln (Income)	-0.2747*** (0.1036)	0.0762 (0.1615)	-0.0469 (0.0779)
Household size	0.0863 (0.3402)	-0.3231 (0.3977)	0.0132 (0.2283)
Sex	-0.8053*** (0.1110)	0.9123*** (0.1739)	0.4941*** (0.0849)
Mother's age / 100	-17.5710 (16.4816)	12.8708 (28.1643)	0.7312 (13.2792)
(Mother's age) ² / 100	0.2191 (0.1918)	-0.2250 (0.3367)	0.0107 (0.1558)
Mother's health	0.5058*** (0.1081)	0.4488 (0.3091)	0.5417*** (0.0895)
Father's health	-0.6099 (0.4972)	-0.0072 (0.2041)	0.2993*** (0.0742)
N	1574	1341	2835
Goodness-of-fit F-stat	1.78	0.00	0.00
Prob > F	0.0704	1.00	1.00

Note: This table reports estimation results from binary probit regressions of more objective health outcomes on parental socioeconomic status, controlling for parental health. “Low ferritin” and “High diastolic” are dummies of whether the child had ferritin levels of < 12 nanogram per milliliter and diastolic blood pressure levels > 80mmHg. “Overweight” indicates whether the child had BMI > 30. Controls include the log of household size, sex of child, individual child age dummies, mother’s age, mother’s age squared, survey year dummies, and 15 region dummies (with Seoul as the reference category). Mother’s (or father’s) health in column (1) and (2) is measured using their ferritin and blood pressure levels, and in column (3) with a dummy of parents’ overweightness. *, ** and *** indicate significance levels at 10%, 5% and 1%, respectively. The goodness-of-fit test statistic is obtained by comparing the observed distribution to the fitted model, with insignificant values indicating that the model is a good fit.

rate, with overweight rates ($\text{BMI} > 25$) being on the rise and already relatively high in comparison to other OECD countries (OECD, 2009; OECD, 2012). Given the socioeconomic disparity among adults and the fact that having obese parents increases the chance of children to be obese themselves (through a shared diet and common health-related behavior), as is confirmed by the coefficients on parental health in the last two rows in column (3), this trend needs to be watched closely in the next years.²² Parents' health is statistically significant in all cases, which either confirms the role of genetic factors or the presence of some third factors, such as a shared diet, that affect the ferritin level and blood pressure of both children and their parents.

22 In general, obesity rates are low among children from high-income families in developing countries and high among children from low-income countries in developed countries. When plotted against income, overweight and obesity rates exhibit a modest U-shaped curve, with incidence proportionately higher at the tails of the income distribution. These trends need to be watched closely to find out whether this pattern is just transitory, or whether low-income children are overweight because they consume a high amount of “bad calories” from processed food, whereas high-income children gain all their weight from high-calorie food such as meat.

CHAPTER 4

Child Health and Diet- and Nutrition-related Factors

1. Role of Diet- and Nutrition-related Factors

Thus far, I have demonstrated an association between household socioeconomic status and child health that cannot be attributed to third factors such as genetic influences or the prenatal environment. For the rest of the analysis in this chapter, I adhere to health status as the main outcome of interest.

In developed countries, there is an ongoing interest and debate about the role of changing lifestyle factors and dietary habits in health-related outcomes. Nutrition, diet and other lifestyle measures not only influence anthropometric indicators of health such as bodily weight and height, but scientific research has also shown the link between diet/nutrition and the incidence of non-communicable chronic diseases, such as cancer and cardiovascular diseases.²³ Children are not commonly involved in choosing and preparing their food and thus the dietary preferences and nutritional knowledge of the mother (caregiver) matters for the child's health. In addition, dietary habits form early in childhood and have a tendency to last into adulthood. I first look at whether diet-related factors indeed play a role for child health, and then proceed to summarize and discuss some popular health policy interventions in other countries in order to see how the implementation of existing

23 Nutrition is not just important for physical health. Early childhood is a critical period of brain growth and the link between nutrition and cognitive development has been extensively studied (Morley and Lucas, 1997; Gordon, 1997).

programs can be improved.²⁴

The KNHANES is well suited to examine the role of nutrition- and diet-related lifestyle choices. The nutrition part of the survey contains detailed information on food intake and dietary practices. The survey asks about the average intake frequency of 25 different fruits and vegetables.²⁵ That information is used to construct a “fruit and vegetable consumption” variable, which measures how many different fruits and vegetables the child ate at least once per week. This variable does not simply measure whether the child ate fruits and vegetables, or whether the child ate an adequate amount of them. It rather measures the level of diversity of the intake of different kinds of fruits and vegetables. Put differently, high values of this variable are an indicator that the child is receiving a balanced diet at home. An average child in the sample consumes 11.5 different fruits and vegetables per week. The second diet-related variable that is used measures whether the child skipped lunch at least once in the past couple of days. In the sample, an overall 6.1% of children skipped lunch at least once (0.9% skipped both lunches) in the last two days. As a third measure, the survey asks the mother an array of questions on dietary practices, such as “Do you avoid

24 I examined whether children’s health significantly differs depending on the mother’s employment status. Having a working mother may have two offsetting effects: there is less time to care for children, but more income available to spend on better-quality food, for example. The empirical issue arising with estimating the effect of mother’s employment status on health is that, working mothers may be inherently different from those who are not. Mothers who are working may also be the ones who provide “better quality care” for their children. I try to circumvent this endogeneity problem by exploiting an instrumental variable strategy using the maternal grandmother’s employment status as an instrument for the mother’s employment status. This would be a valid instrument if the mother’s employment status is influenced by whether the maternal grandmother’s was employed when the mother herself was a child, and if the grandmother’s past employment status does not directly affect child health. To simplify the analysis, the dependent variable is now a dummy equal to one if the child is in good or very good health. Results are not presented here but they suggest that the effect of mother’s employment status, while positive, is not significantly different from zero.

25 The list contains Korean cabbage, radish, radish leaves, sprout, spinach, cucumber, hot pepper, carrot, pumpkin, cabbage, tomato, mushroom, seaweed, laver, tangerine, persimmon, pear, watermelon, melon, strawberry, grape, peach, apple, banana and orange.

salty food” or “Do you eat a variety of food”. The number of affirmative answers to seven such questions is used to construct a variable labeled “dietary behaviour”, on a scale ranging from zero to seven.²⁶ Here I assume that the dietary behavior of the mother will directly reflect on the diet of their children, which is not a strong assumption considering that in most households the meals are prepared by the mother. The mean of this variable is at 6.3. The final measure uses a variable that reports how often (or rarely) the child eats out, or in other words, whether the child eats most of the meals at home. Measured as a dummy, the constructed variable is equal to one if the child eats out less than once a week. Only 7.8% of children in the sample reported to eat out less than once a week.

Table 4-1 shows results of an analysis that controls for each of these four nutritional/dietary variables in turn. All four diet-related variables have a statistically significant, positive effect on the probability that the child's health is either good or very good, and a negative effect on the probability that the child's health is fair or bad. Children whose mothers have a certain stock of nutrition knowledge and prepare most meals at home have a 1.4%p, 3.6%p higher probability of being in very good health and a 0.6%p, 1.4%p lower probability of being in bad/very bad health. Further, children who regularly take in a variety of fruits and vegetables and do not skip a major meal have a 0.2%p, 1.7%p higher probability of being in good health, and a 0.2%p, 1.6%p lower probability of being in bad/very bad health. Taken together, mothers' effort to provide a balanced and healthy diet, greater variety in the consumption of fruits and vegetables, not skipping a main meal, and eating home-made meals are all positively associated with better health. Whether the mother prepares most meals at home also interacts with income and at the same time has an effect on child health, as can be seen

26 The full list of questions is: 1) “Do you eat a variety of food such as grains, fruits and vegetables, fish, meat and dairy products?,” 2) “Do you avoid salty food?,” 3) “Do you maintain an adequate weight by exercising and eating appropriate amounts of food?,” 4) “Do you enjoy your meals and try not to skip breakfast?,” 5) “Do you prepare adequate amounts of food and do you prepare it in a hygienic way?,” 6) “Do you keep a traditional Korean diet?,” 7) “Do you restrain your alcohol consumption?”.

Table 4-1 Relationship between Child Health and Dietary and Nutrition-related Behavior

	(1)	(2)	(3)	(4)
High school	-0.0584 (0.0659)	-0.1323* (0.0783)	-0.0949 (0.0639)	-0.1198 (0.0768)
College and higher	0.0239 (0.0725)	-0.0054 (0.0972)	-0.0079 (0.0700)	-0.0480 (0.0813)
Ln (Income)	-0.0879** (0.0374)	-0.1256** (0.0533)	-0.0880** (0.0368)	-0.0582 (0.0400)
Dietary behavior	-0.0574*** (0.0198)			
Fruit & Vegetables consumption		-0.0126** (0.0057)		
No skipped lunch in 2 days			0.2252*** (0.0729)	
Eat most meals at home				0.1508** (0.0741)
N	6156	1906	6273	4633

Note: This table reports coefficient estimates of ordered probit models of child health, controlling for four different dietary and nutrition-related factors: 1) “Dietary behaviour”: out of seven dietary guidelines, how many the mother adheres to, 2) “Fruit and vegetable consumption”: how many, out of 25, different fruits and vegetables the child eats at least once per week, 3) “No skipped lunch in 2 days”: whether child skipped lunch at least once in the last two days, 4) “Eat most meals at home”: whether child eats out less than once a week. Dependent variable is child health status (1=very good, 2=good, 3=average, 4=bad or very bad). All regressions are weighted using sampling weights. See notes to Table 3-1 for the full list of controls. *, ** and *** indicate significance levels at 10%, 5% and 1%, respectively. For reference, the pseudo-R² (log-likelihood) from random sample estimation are as follows: (1) 0.0172 (-7561) (2) 0.0249 (-2333) (3) 0.0164 (-7289) (4) 0.0205 (-5130.6)

from the coefficient on income turning statistically insignificant and dropping from 0.022 to 0.014. Other studies have also shown how in higher-income households, the ingredients used and cooking methods are more diverse (Choi and Moon, 2008). Currie *et al.* (2007) also suggest that lifestyle choices are important for child health, and that healthy eating and active lifestyles be promoted, through the provision of a universal, high-quality free school meal for example.

While incidence of chronic illnesses is not analyzed in this paper (for reasons discussed later), it is well known that life-style factors are among the major risk-factors for chronic illnesses in adulthood. The above analysis investigates the relationship between diet and nutrition-related factors and overall child health, but it is conceivable based on existing evidence that differences in such factors across socioeconomic groups may well later contribute to inequities in the prevalence of chronic illnesses. Policy initiatives concerning diet and nutrition mainly focus on the distribution of information to support informed choices and the promotion of fruits and vegetables consumption. The emphasis here is that since dietary habits are formed early in childhood (although they can be changed later on), and because chronic illnesses, by definition, develop gradually, it is important that appropriate interventions are implemented where necessary and early if possible.

2. Sources of Nutrition Information by SES

When targeting the general population to provide health-related information, it matters to find out which group is particularly in need, where that group acquires information on nutrition, diet and health, and how the sources differ by socioeconomic background. To first look at which group currently utilizes nutrition information the most, I examine answers to a question in the KNHANES that asks whether the mother reads the nutrition label when buying processed food or does not read the label/does not know what nutrition label is. By educational achievement, 33.69% of mothers with less than high school education, 42.96% of mothers with high school and 56.52% of mothers with a college degree responded that they read the nutrition label. By income quintile, mothers in the highest income group are almost 13%p more likely to read nutrition labels compared to mothers in the lowest income group (54.22% vs. 41.43%).

Information sources by demographic, socioeconomic, geographic group could identify potential points of intervention. Table 4-2 shows the different distribution of sources of nutrition information by education and income. Administrative units are divided into urban

(“Dong”) and rural (“Eup”, “Myun”). Sources of nutrition information can be grouped into the following categories: 1) Mass media (TV/radio, newspaper/ magazines, internet), 2) group or individual counseling, 3) personal network(family, relatives, friends, neighbors), 4) other.

Observations from this table are straightforward. First, less-educated, low-income mothers living in rural areas are more likely to acquire information from unofficial sources such as friends and neighbours (12.21% vs. 3.88% for college-educated mothers). More-educated, high-income mothers living in urban areas rely on the most part (90.9%) on more official and credible sources such as the mass media or the internet. Even within the media category (columns (1)-(3)), there are notable differences by socioeconomic and geographic group. Mothers with at least a college degree are much less likely to rely on the TV/radio (44.6%) and much more likely to rely on newspapers, magazines and the internet (48.3%) compared to mothers with less than high school education (71.9% and 4.7%, respectively). The latter are sources from which information needs to be acquired “more actively”, i.e., information is searched for and identified more purposely, whereas the former are relatively passive sources in comparison.

Differential utilization of sources could be another dimension that contributes to socioeconomic health inequalities. Other countries are increasingly emphasizing behavior-related changes through the “social multiplier” effect, by promoting school- or workplace-based interventions that target peer groups. In recognition of such differences, the government could attempt to target socioeconomically disadvantaged groups to publicize and promote utilization of information from official sources, such as government-run websites.²⁷

27 For example, The National Health Information Portal (<http://health.mw.go.kr/>), was opened in January 2011 to promote health literacy and is administered by the Ministry of Health and Welfare. Despite the wealth of information on illnesses, health care service providers and much more, utilization of this website is known to be very low. In particular, as hinted on in Table 4-2, the people who may need and benefit from these sources most, are likely the ones who are also the least aware of them.

Table 4-2 Source of Nutrition Information

	(1) TV/radio	(2) Newspaper	(3) Internet	(4)=(1)+(2)+(3) Media total	(5) Counseling	(6) Personal network	(7) Other
Education level							
Less than HS	71.89	3.6	1.05	76.54	1.06	12.21	10.18
High school	63.84	19.8	4.56	88.2	0.75	6.27	4.78
College and above	44.55	35.02	13.29	92.87	0.51	3.88	2.74
Income quintile							
Q1	56.62	21.52	1.55	79.69	2.31	14.19	3.81
Q2	70	19.46	3.66	93.81	0	1.01	5.18
Q3	70.04	8.95	3.06	82.05	1.37	8.82	7.76
Q4	64.41	21.75	4.87	91.03	0	4.54	4.42
Q5	43.95	31.93	14.98	90.87	0	4.45	4.68
Administrative unit							
Urban	59.45	22.03	6.3	87.79	0.64	6.68	4.88
Rural	72.36	9.05	2.32	83.73	1.4	7.36	7.51

Note: Author's calculations using KNHANES, 2005. This table shows where mothers report to receive nutrition information, by family socioeconomic characteristic. Q1-Q5 indicate the five income quintiles with Q1 being the lowest (households in the bottom 20% of the income distribution). Numbers in cells represent percentage of individuals in each education, income and geographic group that receives information from each source. For each row, percentages in columns (4), (5), (6) and (7) sum up to 100%.

CHAPTER 5

Inequity in Health Care Utilization

The analysis in the previous section presented an array of results pointing to the presence of a socioeconomic gradient in health. I explored lifestyle choices such as diet-related factors as further channels through which health inequality is widened. In this section, I continue the discussion with a particular focus on the incidence and diagnosis of illnesses and utilization of health care, and possible inequalities arising at each stage.

1. Income and Diagnosis of Illness

In the KNHANES, the respondent is asked whether the child has ever been diagnosed of any of the following common childhood illnesses and conditions: congenital heart disease, sinusitis, chickenpox, pneumonia, tuberculosis, asthma, atopic dermatitis, diabetes, otitis media (middle ear infection) and rhinitis.

When illness prevalence is plotted against income using data from KNHANES, the resulting pattern is surprisingly counter-intuitive. Figures 5-1 and 5-2 illustrate, by income quintile, the prevalence of various illnesses(only those with a reported overall prevalence rate of >1% are shown; note the different scales in the two figures).²⁸ Except for asthma

28 Because of a change in the questionnaire, only observations from the 2007~09 surveys are used. These variables are constructed using the response to the question of whether the child has ever been diagnosed with the illness in the list. The advantage

Figure 5-1 Illness Prevalence by Income Quintile

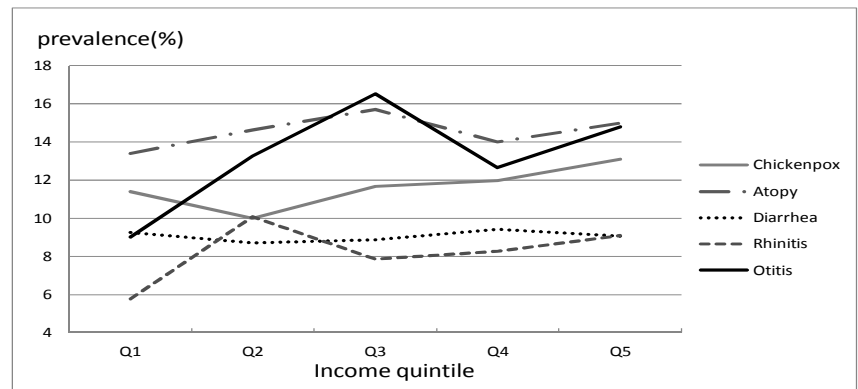
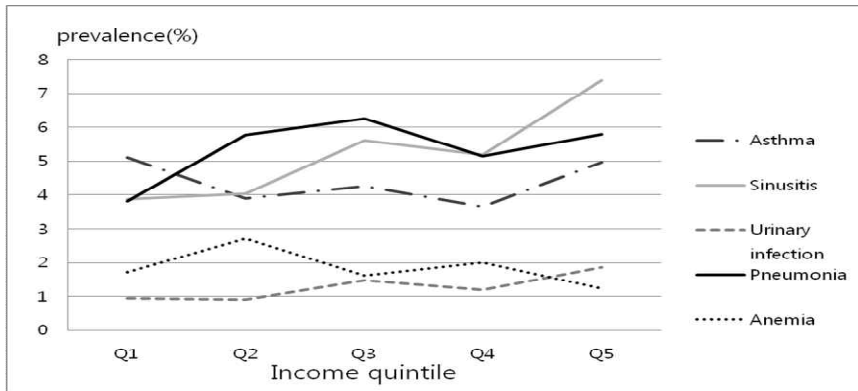


Figure 5-2 Illness Prevalence by Income Quintile



Note: This table shows the percentage of children diagnosed with each illness, by income quintile, using the Korean National Health and Nutrition Examination Survey(KNHANES), 2005, 2007, 2008, 2009. List of illnesses includes: Chickenpox, atopic dermatitis, diarrhea, rhinitis, otitis media, asthma, sinusitis, urinary infection, pneumonia and anemia. Survey weights were used to calculate means. Note the different scales in the two figures.

and diarrhea, the prevalence rates of all other illnesses are positively

of this “ever diagnosed” variable over the one that asks whether the child is currently suffering from an illness is two-fold. First, having the illness diagnosed by a doctor is a more objective measure, and second, asking whether the child has ever had a certain illness excludes possible complication concerning differences in recovery across children from different SES groups.

sloped over certain segments of the graph, albeit at varying degrees. This is especially true when comparing prevalence rates between top and bottom income quintiles, with poorer (richer) children exhibiting higher (lower) diagnosis rates. The positive slope is particularly steep for sinusitis, otitis media, pneumonia and rhinitis. It is remarkable that this pattern is not only observed for pneumonia, an illness which is easily recognizable and has been around long enough for parents to be aware of its common symptoms, but also for atopic dermatitis, for which awareness has risen relatively recently and thus prevalence could, at least in the short-run, be higher among high-SES groups that in general possess better health knowledge and are quicker to adopt new knowledge and technology (in terms of treatment).

Case *et al.* (2002) and Currie *et al.* (2007) also examine the effect of family income on childhood illnesses, but none find a positive relationship. Indeed, this rather unusual relationship is more commonly observed in a developing country context (Cameron, 2001), where exposure to the health system is overall low and higher among the better-off. Such a positive association between socioeconomic status and the probability of reporting an illness is often attributed to better information/education and better awareness, possibly because of more experience with health care providers (Strauss and Thomas, 2005). An often-cited example is the case of the Indian state of Kerala, which has the highest levels of literacy and longevity in the country, but reports the highest incidence in morbidity by a wide margin (Sen, 2002).

In the Korean context, there is a multitude of possible reasons that could drive the pattern observed in Figures 5-1 and 5-2.²⁹ In other countries, children from richer families are more likely to have had their conditions diagnosed when care is costly and insurance is not universal. Health care coverage is universal in Korea and costs remain fairly affordable to date, but the high out-of-pocket costs may decrease access to care especially for low-income households (OECD, 2011), resulting in differential utilization and diagnosis.

29 Differences across socioeconomic groups in their recall ability cannot be fully rejected. However, given that the tendency occurs across a variety of illnesses, it would seem hard to attribute it all to recall bias.

Table 5-1 Mean Age Diagnosed

Illness	Income < bottom 25% (A)	Income > top 25% (B)	Diff (A-B)
Asthma	4.14	3.9	0.24
Anemia	10.86	6.68	4.18**
Atopy	3.68	2.75	0.93**
Otitis media	4.24	4	0.24
Sinusitis	9.41	7.35	2.06**
Diarrhea	5.23	3.28	1.95*
Chickenpox	4.86	5.12	-0.26
Pneumonia	3.54	2.76	0.78

Note: This table shows the mean age children in the respective income group were diagnosed with the illnesses listed, using KNHANES, 2007, 2008, 2009. The cut-points for the bottom and top quartile (25%) of the income distribution correspond to roughly 1,500,000KRW and 3,500,000KRW each. *, ** and *** indicate significance levels at 10%, 5% and 1%, respectively.

In addition, if children from high-SES backgrounds use more health care, I would expect them to have their conditions diagnosed earlier than low-SES children. Table 5-1 shows precisely that: children from households in the top (B) and bottom (A) quartile differ in their timing when they seek medical care. This table presents for a list of childhood illnesses, the mean age children in each income group were diagnosed at. The last column in Table 5-1 indicates the difference in these mean ages between the highest and lowest income quartile, showing by how much diagnosis of each illness is delayed for low-income children. Children in poor households are diagnosed with anemia, atopy, sinusitis and diarrhea an average of 4.18, 0.93, 2.06 and 1.95 years later than children in richer households and these differences are statistically significant. A consistent pattern emerges: while not statistically significant, with the exception of chickenpox, the difference in the mean age diagnosed is positive for other illnesses as well (indicative of poor children getting diagnosed later).

A diagnosis occurs as a combination of several acts: symptoms are recognized and the child is taken to the doctor, and then the child's

condition is confirmed by the doctor. Figures 3-2, 3-3 and Table 5-1 imply at least two things: First, children from poorer families are less likely to have been diagnosed with an illness and second, even among children who have been diagnosed, there is a tendency for children from wealthier households to be diagnosed earlier. As a final note, since it is very unlikely that children from richer households are truly unhealthier, one should be careful not to take this at face-value nor view it as the true illness prevalence pattern. These should be rather taken as observed (as opposed to “true”) patterns of diagnosis rates.

It is possible that children in low-income households are in an environment where, for some reason, parents do not recognize abnormal symptoms and even when they do, they do not (or cannot) seek medical attention in a timely manner. This conjecture is in part supported by the fact that 10.6% of households in the lowest income quintile report that in the last year, there was a time that they were not able to take the child to the doctor. This share is reduced to 6.8% for children in the highest income quintile. When sorting out responses that pointed out “economic reasons” for not having been able to take the child to a doctor, the difference is even greater. There are reports that this disparity widens during times of economic hardship.³⁰

These results motivate the next part on inequities in health care utilization as this might underlie the differential diagnosis rates.

2. Estimates of Inequity in Health Care Utilization

The KNHANES contains information on whether the child had an outpatient or inpatient visit, type of health care facility (for level of care), and if it was an inpatient visit, for how many days the child was hospitalized. Using this information, health inequity is examined for several measures: the probability of any outpatient visits, number of outpatient care visits, probability of hospital admission and total number of days hospitalized. With the exception of hospital care services, all

30 Poor children were more likely to forgo treatment for chronic illnesses due to economic difficulties during the 2008 financial crisis in Korea (Mo, 2009).

Table 5-2 | Income-related Inequality in Health Care Utilization

Type and level of care	Concentration index	Contribution of need variables	Health inequality
Outpatient visits (Prob.)			
Any	0.015	-0.024	0.039
General hospital	-0.01	-0.058	0.048
Hospital	-0.061	-0.050	-0.011
Clinic	-0.051	-0.036	-0.015
Health center	-0.384	-0.050	-0.334
No. of outpatient visits			
All visits	0.016	-0.028	0.044
General hospital	-0.001	-0.057	0.056
Hospital	-0.013	-0.055	0.042
Clinic	-0.051	-0.043	-0.008
Health center	-0.38	-0.050	-0.330
Hospital services			
Hospital admission(Prob.)	-0.09	-0.031	-0.059
No. of days hospitalized	-0.12	-0.036	-0.084

Note: This table shows calculations of measures of health equity using KNHANES 2005, 2007, 2008, 2009. See the methodology section in Chapter 2 for further details.

measures are examined at the aggregated (receipt of care at any level) as well as the disaggregated level of care: general hospitals, hospitals, clinics and health centers.

Table 5-2 reports the concentration index with the actual distribution of utilization in the first column, the partial contribution of need-related variables in the second column, and the need-standardized health inequality index in the last column (which is the difference between the numbers in the first and the second column; refer to the methodology section for details on how the numbers were derived). All estimations

are done by ordinary least squares.³¹

The probability of seeing any doctor is quite equitable, when looked at aggregately (receipt of care at any level). However, the probabilities of outpatient care and number of outpatient visits are negative and statistically significant for services received at health centers. The negative value indicates a significant pro-poor distribution, i.e., a concentration of outpatient visits to health centers among the lower income groups. The distribution is also pro-poor for the probability of having a hospital admission and the number of days spent hospitalized.

But the concentration index does not control for differences in need for health care, which is why a need-standardized index is more revealing. This health inequity index is presented in the last column. While the indices move slightly towards a pro-rich direction, they remain negative and large for visits to health centers (the lowest level of care in terms of health facilities) and hospital care (probability of admission and number of days hospitalized).

In sum, the income-related distribution of health care is not equitable when examined by level of care, as indicated by the result that health care of poor children is concentrated at the lowest and highest level of care. Combined with the disproportionately high number of responses from poor households that there had been times when they were not able to seek care for the child, inequities in health care access appear to exist at the external as well as the internal margin.

Given the difference in the types and quality of services provided in the facilities at different levels, primary-level care needs to be strengthened for disadvantaged families in particular. Together with the evidence shown later in Chapter 6 section 3, this indicates a need for a better primary care system that comprises of components for well-managed preventive care as well as affordable and accessible health care coverage for diagnosis and treatment purposes.

31 Some of these measures such as incidence or days of hospitalization are better estimated using probit or count data models. However, van Doorslaer *et al.* (2000) demonstrate that the measurement of horizontal inequity is not very sensitive to specifications.

CHAPTER 6

Policy Options

This chapter discusses several relevant policy options that correspond to each set of the empirical results and can be broadly categorized into 1) policies targeted at low-income families, 2) policies that target the general population of children with the aim of improving nutritional intake and dietary behavior and 3) low-cost government interventions aimed at increasing preventive and diagnostic care. Instead of providing a mere summary of a range of interventions, I attempt to briefly describe and point out implementation issues of related programs that are already in place, and where appropriate, introduce programs that have received attention for their success in other countries and could be incorporated into existing government schemes. The aim of this chapter also lies in summarizing the types of interventions that are popular in the health policy arena these days and that have been widely adopted elsewhere.

1. Policy Interventions for Low-Income Families

The Nutrition Plus Program is an assistance program for low-income pregnant women, infants and children to resolve nutritional deficiencies and promote health through an improved diet. Pregnant women, breast-feeding women, infants and children under the age of 6 whose family income is below 200% of the poverty line and who possess at least one nutritional risk factor (anemia, underweight, stunted growth, or undernutrition) are eligible. Participants receive nutrition education and

a supplemental food package. Improved nutritional status has been reported and cited as evidence of success of the program.

While the program was very well-received by the community, it has suffered from budget problems since its inception.³² In order for the program to take full effect, ongoing budget problems need to be resolved and rigorous program evaluations be carried out to identify priority groups and improve program services.

2. Policy Interventions Related to Diet and Nutrition

Here I outline diet and nutrition-related policy interventions that are targeted at the general population. In particular, some of the more successful programs implemented in other OECD countries are introduced. Given how important food intake is for health, policy makers first need to understand why people make unhealthy choices to begin with. Research on food consumption behavior has suggested that lack of education or information is an important factor in making suboptimal choices. Then, the justification for government intervention to promote healthy lifestyles lies in the correction of possible market failures. Information failure is a common culprit: individuals may end up with an unhealthy choice because they simply did not have enough information on the contents of the food or did not know how to decide based on available information at hand. The problem is bigger with children who are less able to make a judgement about the (un) healthiness of a food item. Further, negative (positive) externalities may arise from bad (good) dietary habits of parents for their children.

Government intervention to modify food or other lifestyle choices has the potential to intrude with individual freedom of choice, which is why the government's role should be mainly confined to improving the

32 “Infant Children Nutrition Plus Program very popular” (*Chungcheong Ilbo*, 2011. 7. 5), “Dongdaemun-gu Nutrition Plus Program helping low-income pregnant women and infants” (*Munhwa Ilbo*, 2011. 2. 9), “Chungsong Nutrition Plus Program ‘popular’” (*Kyeongbuk Ilbo*, 2010. 10. 5)

environment to make it more conducive to healthy food choices, such as the provision of information through proper food and nutrition labelling and educational campaigns in collaboration with not only public health agencies (which would be the Ministry of Health & Welfare and the Center for Disease Control), but the food industry as well. Modifying the environment is particularly relevant for children as they have lesser control over their environment or choices in general. The following describes in more detail policy initiatives aimed to achieve the above.

(1) Educational Programs

These are the most popular policy measures for health promotion. The following is a brief description of programs that are targeted at young children for educational purposes.

Ireland's Food Dudes program is an often-cited success story. The UK has one of the lowest fruit and vegetable intakes in Europe and high rates of heart diseases and obesity. The Food Dudes program, started in 1992 and expanded to every primary school in 2007, is a school-based intervention to encourage and maintain healthy eating habits in children 4-11 years old. The program is based on classroom activities involving watching role models ("Food Dudes") on DVDs, eating a portion of fruit and vegetables and encouraging continued consumption through a rewards system. Evaluations reported a significant increase in the consumption of fruits and vegetables, with the effect being greatest among those children who were the least likely to consume such food at the start of the program. The budget involves 28 million Euros over 7 years. The program is part of an EU-wide initiative to promote the eating of fruit and vegetables.

In the US, MyPlate is the core educational tool which provides nutritional guidelines on the web to help people make better food choices. Sample menus and food group based recipes can be found on the web, as well as nutritional guidelines and advice on weight management and physical activity. Contents are customized to target different demographic groups, including children.

Programs with similar contents and objectives are in place in other countries as well. An important common characteristic of these

programs was to make children aware of their food choices and get them involved in the process. With the school lunch program covering most school-aged children these days, this could be a beneficial element to add into the program.

(2) Fruits and Vegetables Distribution Scheme

These types of programs are aimed at increasing the fruit and vegetable consumption of school age children through direct provision. Public funding is distributed to schools for the purchase of fruit and vegetables, to promote healthy eating (Fulponi, 2009). Examples include the US Fresh Fruit and Vegetable Program (FFVP), the School Fruit Scheme initiated by the EU Agriculture Directorate, and the Danish FruitBreak program. Health benefits have been recognized in terms of increased consumption of fruits and vegetables during school lunch, reduced consumption of less healthy food (such as unhealthy snacks) and lower rates of obesity. Again, this type of program could be incorporated relatively easily, as many Korean local governments are already implementing a free school lunch program.

(3) Food Labeling Initiatives

The Food and Nutrition Labeling Act was introduced in Korea in 1994 and has undergone several amendments since then. The law regulates nutrition labeling on certain processed foods and recommends voluntary nutrition labeling in restaurants since 2008. Further revisions to the law are being considered, such as the introduction of nutrition fact labels with traffic-light colors indicating the adequacy of the ingredients to help children make healthy food choices. In the long-run, the law would also need to cover a wider range of type of foods and restaurants, following the example in the US and Canada where all or most processed food is required to list nutrition facts.

Programs of different types from above can also be combined to achieve enhanced results. For example, while it is important to label food appropriately, it is equally important to give children sufficient guidance so they know how to actually utilize that information. A recent

survey by the Korea Food & Drug Administration found that one in four fifth graders did not know at all what nutrition labels were. Most children that did, learned about it from their parents (38%) and the mass media (29%).³³

Intervention effects could also be magnified through the involvement and active participation of the food industry. Governments could collaborate with industry to deliver specific policy messages to the public, by utilizing their generally very successful advertisement strategies (OECD, 2008).

3. The Importance of Preventive and Diagnostic Care

Health inequities arise at different stages. Interventions in the area of preventive care would not only produce improvements in public health, but also turn out to be cost-saving to the health care sector. Increasing utilization of diagnostic services would help early detection of illnesses.

Table 6-1 shows the percentage of children that received different types of preventive and diagnostic services, by mother's educational achievement (high school and less vs. college degree and above) and household income. Inequities appear across a variety of preventive and diagnostic care services, from routine annual flu shots to one-time metabolic screening tests, with children from richer and more educated families having a higher probability of receiving appropriate care. This raises further concerns about socioeconomic dimensions of health inequalities.

These disparities are important from at least two perspectives. First, this indicates notable underutilization of preventive screening services, despite high access to the health care system and the fact that they are available at low to no cost (as further detailed below). Underutilization is apparent across all income groups, but more pronounced for the poor. Second, this could be another contributing cause of health inequities for two reasons: 1) inequity in illness incidence could rise if there is a gap in the use of preventive care among socioeconomic groups, and 2) if

33 "One out of four children don't know about nutrition labels" (*Hankyoungh*, 2012. 4. 5)

Table 6-1 Socioeconomic Differences in Preventive and Diagnostic Care

	Influenza vaccination	Hearing test	Vision test	Metabolic disorder
Education level				
High school and less	35.07	54.39	37.28	79.35
College and above	45.19	60.73	36.74	86.19
Income quintile				
Q1	33.03	50.42	35.38	76.55
Q2	38.81	55.12	33.3	80.54
Q3	37.18	58.05	37.54	82.15
Q4	42.29	59.91	36.24	82.89
Q5	38.45	58.45	41.98	84.52

Note: Means calculated from KNHANES, different years (availability of variable varies across survey years). Q1~Q5 indicate the five income quintiles with Q1 being the lowest (households in the bottom 20% of the income distribution). Numbers in each cell represent the percentage of children that has received the corresponding type of service, by mother's education and income group.

uptake of a public health intervention is higher in more affluent, educated groups, one unintended consequence of public investment in that program could be to widen health inequalities. Third, differences in the utilization of diagnostic care services may lead to higher detection of illnesses in higher-income children (similar to what is observed in my data).

While further research is needed in order to precisely pin down underlying factors of such overall underutilization and differential utilization by socioeconomic background, socioeconomic constraints (time constraint because both parents have to work), insufficient communication to the public about the program, lack of knowledge (about the need and schedule of screening tests) could all have contributed. Consumers could have imperfect information about the health risk, have different health beliefs, decide not to invest in preventive activity for some other reason, or simply be unaware of the benefits.

There are several government programs that were introduced with

the aim of early detection and treatment of illnesses. Metabolic screening tests usually need to be administered within one month of birth. This test screens for inborn errors of metabolism that are due to defects of single genes that code for enzymes that break down and build chemicals in the body, which accumulate and become toxic, interfering with normal bodily function. There are many different types of metabolic disorders, some of which difficult to recognize. Early detection and treatment of metabolic disorders to prevent developmental delays Testing for the six most common metabolic disorders is provided for free by the government, but utilization rates still leave room for improvement, especially for low-SES children (Kim *et al.*, 2009). The Infants and children national health screening program was introduced in order to cope with upward trends of developmental disorders and childhood obesity. It offers regular medical check-ups for children up to 6 years old (extended to 6 year-olds starting April 2012). While adult health screening is aimed at finding and treating illnesses, screening infants and children is aimed at comprehensively evaluating their growth and development. The test includes physical-dental examinations as well as screening for developmental problems. Unfortunately, the program is facing issues with low program participation rates (50% and 17.1% for physical and dental examinations respectively in 2010) which is due to the limited number of participating clinics (likely because of low financial incentives for hospitals/clinics to participate), long waiting times, low satisfaction with examination, lack of awareness of the program. The Infants and children immunization program aims to raise immunization rates to eradication levels (95%+) and covers part of the cost of core vaccinations. Since 2012, coverage has been extended from 8 to 10 core vaccinations, cost-sharing was further reduced, and number of participating clinics increased for better accessibility. It remains to see whether these changes will improve participation in the program along with immunization rates.

CHAPTER 7

Conclusion

In this paper, I have confirmed the existence of inequities in health outcomes and health care among children from different socioeconomic backgrounds. Children from low-income households have worse health on average, with diet-related lifestyle factors also playing a role. Children from high-income families with more educated parents are less likely to skip meals, have a more diverse and balanced diet, and their mother's are more conscious of what they put on the dinner table. While improvements in nutrition and mortality rates were achieved over the last decades, lifestyles have changed dramatically such that changing diets and sedentary lifestyles led to a rise in the prevalence of chronic diseases and obesity. For instance, excessive consumption of salt (sodium) leads to higher rates of hypertension. Different lifestyle patterns among socioeconomic groups may result in increased risk towards various illnesses. For example, ramen noodles and other processed food are high in sodium. In my data, 40.6% children eat at least 2 ramen noodles per week, with 10.1% of children in the lowest income quintile reporting to consume at least 4-6 ramen noodles per week, in contrast to only 4.1% of children in the higher income quintile. With rising incidence of chronic illnesses, there is a growing consensus that more emphasis be placed on prevention and early diagnosis (rather than costly treatment). This is best achieved by internalizing healthy lifestyles adopted in early childhood.

In addition, barriers to access to care remain: in an analysis on inequity in health care utilization, low-income households report to

mainly seek care at the lowest (health centers) and highest (hospital) level of care, even controlling for need. What is more, a disproportionately high number of low-income households in the survey report to have had an experience within the last year when they had not been able to take the child to the doctor. Inequities in health care access appear to exist at the external as well as the internal margin.

Besides social equity grounds (Sen, 2002), what is the rationale from economic theory for intervention in health care?³⁴ Policy intervention is justified when health inequalities occur as a result of market failure. There is insufficient information (how to make healthier food choices, whether, when and where to present for treatment when one recognizes symptoms), people exhibit lack of self-control, or individual and social incentives do not align (suboptimal investment in health inputs such as vaccinations), which all leads to inferior choices.

Given these justifications, there is a list of policy options governments may pursue in order to promote an environment that is conducive to healthy food choices by providing the right incentives and information. As for children, school-based interventions could publicize the value of fruits and vegetables and encourage children to make healthy food choices. Programs that target families as points of interventions could involve parents as well as children, by providing nutritional information and promoting a healthy lifestyle. Alternatively, policies can exert more direct influence, as is done in the case with those who receive nutrition assistance, such as the Nutrition Plus program.

Disparities also exist in the use of preventive and diagnostic care: poor children are less likely to be immunized, to undergo diagnostic screening tests, and to receive regular check-ups. As many of these services are already offered at low to no cost by the government, this indicates problems of underutilization that should be addressed. Underutilization is prevalent across all groups, but more severe in socioeconomically disadvantaged households. These services also fall

34 Sen (2002) wrote “...In any discussion of social equity and justice, illness and health must figure as a major concern. I take that as my point of departure—the ubiquity of health as a social consideration—and begin by noting that health equity cannot but be a central feature of the justice of social arrangements in general...”

under the area of primary care, which should consist of a subset of timely first-line diagnostic and therapeutic activities.

As living standards improved, the overall health of the population has improved as well, but at the same time people from disadvantaged backgrounds have been left behind for various reasons. As such, promoting health equity is a high priority in many developed countries nowadays. The reduction of financial barriers to access to care and increased emphasis on illness prevention and health promotion initiatives were put forward by an OECD report almost 10 years ago (OECD, 2003). Since then, health equity was set as one of the primary goals in the National Health Plan 2010, but without detailed objectives or action plans (Jung-Choi, 2009).³⁵ The third national health promotion plan (2011~2020) set extended healthy lifespan and advancement of health equity as the highest aim. Promotion of a healthy lifestyle and chronic disease management are included as focus areas. It remains to see how successful the plan will be in implementing efficient measures to achieve the proclaimed goals.

Finally, there are several limitations to this study. Due to the cross-sectional nature of the data, it was impossible to find out whether it is contemporary income that adversely affects health or whether it is that children in persistently poor families are affected. Similarly, I do not know whether and how far negative health shocks last, which children recover and which do not. Further, while I have shown that socioeconomic factors matter for child health, what type of intervention could effectively mediate such inequities is another topic of research. As a last note, whether improving existing programs or designing new ones, it is important to evaluate the cost-effectiveness of them since they are funded from public sources. Policy interventions should be followed up on and their performance properly evaluated.

35 The action plan included such aims as reducing the relative difference in mortality of people in the top and bottom 20% of the income distribution, but it lacked detailed implementation strategies (Jung-Choi, 2009).

References

- Aizer, A. and L. Stroud, "Education, Knowledge and the Evolution of Disparities in Health," NBER Working Paper 15840, 2010.
- Barker, D. J. P., C. Osmond, J. Golding, D. Kuh, and M. E. J. Wadsworth, "Growth in Utero, Blood Pressure in Childhood and Adult Life, and Mortality from Cardiovascular Disease," *British Medical Journal* 298, pp.564~567.
- Bhattacharya, J. and J. Currie, "Youths at Nutrition Risk: Malnourished or Misnourished?" in Jonathan Gruber (ed.), *Risky Behavior among Youths: An Economic Analysis*, Chicago: University of Chicago Press, 2001, pp.483~522.
- Black, Sandra E., Paul J. Devereux, and Kjells G. Salvanes, "From the Cradle to the Labor Market? The Effect of Birth Weight on Adult Outcomes," *Quarterly Journal of Economics*, 2007, pp.409~439.
- Case, A. and C. Paxson, "Early Life Health and Cognitive Function in Old Age," *American Economic Review: Papers and Proceedings* 99(2), pp.104~109.
- Case, A., A. Fertig, and C. Paxson, "The Lasting Impact of Childhood Health and Circumstance," *Journal of Health Economics* 24, 2005, pp.365~389.
- Case, A., D. Lubotsky, and C. Paxson, "Economic Status and Health in Childhood: The Origins of the Gradient," *American Economic Review* 92(5), 2002, pp.1308~1334.
- Chen, Edith, Karen A. Matthews, and W. Thomas Boyce, "Socioeconomic Differences in Children's Health: How and Why do these Relationships Change with Age?" *Psychological Bulletin* 128(2), 2002, pp.295~329.
- Choi, Jihyun and Hyun-Kyung Moon, "Comparison of Dietary Patterns by Sex and Urbanization in Different Economic Status," *Korean Journal of Community Nutrition* 13(3), 2008, pp.346~358. (in Korean)
- Currie, A., M. Shields, and W. Price, "The Child Health/Family Income Gradient: Evidence from England," *Journal of Health Economics* 26, 2007, pp.213~232.
- Currie, J., M. Stabile, P. Manivong, and L. Roos, "Child Health and Young Adult Outcomes," *Journal of Human Resources* 45(3), 2010, pp.517~548.
- Currie, Janet and Brigitte C. Madrian, "Health, Health Insurance and the Labor Market," in Orley C. Ashenfelter and David Card (eds.), *Handbook of Labor Economics*,

Volume 3: North-Holland, 1999, pp.3309~3416.

- Currie, Janet and Mark Stabile, "Socioeconomic Status and Health: Why is the Relationship Stronger for Older Children?" NBER Working Paper 9098, 2002.
- Currie, Janet, "Healthy, Wealthy, and Wise: Socioeconomic Status, Poor Health in Childhood and Human Capital Development," *Journal of Economic Literature* 47(1), 2009, pp.87~122.
- Cutler, David M., Adriana Lleras-Muney, and Tom Vogl, "Socioeconomic Status and Health: Dimensions and Mechanisms," NBER Working Paper 14333, 2008.
- D'Uva, Teresa Bago, Eddy van Doorslaer, Maarten Lindeboom, and Owen O'Donnell, "Does Reporting Heterogeneity Bias the Measurement of Health Disparities?" *Health Economics* 17, 2008, pp.351~375.
- Deaton, Angus, "Health, Inequality and Economic Development," *Journal of Economic Literature* 41(1), 2003, pp.113~158.
- Fulponi, L., "Policy Initiatives Concerning Diet, Health and Nutrition," OECD Food, Agriculture and Fisheries Working Papers No. 14, OECD Publishing, 2009.
- Grantham-McGregor, Sally and Cornelius Ani, "A Review of Studies on the Effect of Iron Deficiency on Cognitive Development in Children," *The Journal of Nutrition* 131(2), pp.6495~6695.
- Jung-Choi, K., "Socioeconomic Mortality Inequalities in South Korea," *Welfare and Health Forum* 149, Korea Institute for Health and Social Affairs, 2009.
- Kang, Hani, Eun-Jung Shin, Hae-Na Kim, Kwon-Yong Eom, Kwang-Il Kwon, Seo-Young Kim, Gui-Im Moon, Baeg-Won Kang, and Jong-Wook Kim, "Food Nutrition Labeling in Korea," *Food Science and Industry* 44(1), 2011, pp.21~27.
- Khang, Young-Ho and Hye Ryun Kim, "Socioeconomic Mortality Inequality in Korea: Mortality Follow-Up of the 1998 National Health and Nutrition Examination (NHANES) Data," *Journal of Preventive Medicine and Public Health* 39(2), 2006, pp.115~122. (in Korean)
- Kim, S., Y. Kim, A. Cho, H. Kim, and S. Im, "The 2009 National Survey on Fertility, Family Health and Welfare in Korea," Korea Institute for Health and Social Affairs 2009-33, 2009
- Korenman, Sanders and Jane Miller, "Effects of Long-Term Poverty on Physical Health of Children in the National Longitudinal Survey of Youth," in Greg Duncan and Jeanne Brooks-Gunn (eds.), *Consequences of Growing Up Poor*, New York: Russell Sage Foundation, 1997, pp.70~99.
- Kuh, Diana and Yoav Ben-Shlomo, "A Life Course Approach to Chronic Disease Epidemiology: Conceptual Models, Empirical Challenges and Interdisciplinary Perspectives," *International Journal of Epidemiology* 31, 2002, pp.285~293.

- Kwon, E. and I. Kuh, "The Impact of Poverty on Child Health," *Korean Journal of Social Welfare* 62(4), 2010, pp.129~148. (in Korean).
- Lee, M., "Health Inequalities Among Korean Adults-Socioeconomic Status and Residential Area Differences," *Korean Journal of Sociology* 39(6), 2005, pp.183~209. (in Korean).
- Lindeboom, M. and Eddy van Doorslaer, "Cut-point Shift and Index Shift in Self-Reported health," *Journal of Health Economics* 28, pp.1083~1099.
- Lower, C. Fergus and Pauline J. Horne, "'Food Dudes': Increasing Children's Fruit and Vegetable Consumption," *Cases in Public Health Communication & Marketing*, 2009, pp.161~185.
- Lu, Jui-fen R., Gabriel Leung, Soonman Kwon, Keith Y.K. Tin, Eddy van Doorslaer, and Owen O'Donnell, "Horizontal Equity in Health Care Utilization Evidence from Three High-Income Asian Countries," *Social Science & Medicine* 64, 2007, pp.199~212.
- Marmot, Michael, "Multilevel Approaches to Understanding Social Determinants," in Lisa Berkman and Ichiro Kwaichi (eds.), *Social Epidemiology*, Oxford: Oxford University Press, 1999, pp.349~367.
- Ministry of Health & Welfare, "30 Years of National Health Insurance: Improvement of Health and Changes in Disease Structure," 2007.
- Morley, Ruth and Alan Lucas, "Nutrition and Cognitive Development," *British Medical Bulletin* 53(1), 1997, pp.123~134.
- Newacheck, P. W., "Poverty and Childhood Chronic Illness," *Archives of Pediatrics and Adolescent Medicine* 148(11), 1994, pp.1143~1149.
- OECD, "Reviews of Health Care Systems," 2003.
- OECD, "Policy Initiatives Concerning Diet, Health and Nutrition," 2009.
- OECD, "Health at a Glance 2011: OECD Indicators," 2011.
- OECD, "OECD Health Care Quality Review: Korea," 2012.
- Oreopoulos, Philip, Mark Stabile, Randy Walld, and Leslie L. Roos, "Short-, Medium-, and Long-Term Consequences of Poor Infant Health," *Journal of Human Resources* 43(1), 2008, pp.88~138.
- Park, Sun Young, Jong-In Lee, and Hee Kyoung Kim, "Effects of Home Environmental Characteristics on Three Year-old Childrens' Physical Growth," *Korean Child Welfare Studies* 24, 2007, pp.91~119. (in Korean)
- Pollitt, Ernesto, "Iron-Deficiency Anemia: Reexamining the Nature and Magnitude of the Public Health Problem," *The Journal of Nutrition* 131(2), 2001, pp.6695~6755.
- Reinhold, S. and H. Jürges, "Parental Income and Child Health in Germany," *Health*

Economics 21(5), 2012, pp.562~579.

- Richards, Marcus, Rebecca Hardy, Diana Kuh, and Michael Wadsworth, "Birthweight, Postnatal Growth and Cognitive Function in a National UK Birth Cohort," *International Journal of Epidemiology* 31, 2002, pp.342~348.
- Salm, Martin and Daniel Schunk, "The Role of Childhood Health for the Intergenerational Transmission of Human Capital: Evidence from Administrative Data," IZA Discussion Paper, No. 3646, 2008.
- Sassi, Franco, Marion Devaux, Michele Cecchini, and Elena Rusticelli, "The Obesity Epidemic: Analysis of Past and Projected Future Trends in Selected OECD Countries," OECD Health Working Papers, No. 45, 2009.
- Sassi, Franco, Michele Cecchini, Jeremy Lauer, and Dan Chisholm, "Improving Lifestyles, Tackling Obesity: The Health and Economic Impact of Prevention Strategies," OECD Health Working Paper, No. 48, 2008.
- Sen, Amartya, "Health: Perception versus Observation," *British Medical Journal* 324, 2002, pp.860~861.
- Shin, Y., T. Yoon, M. Kim, H. Cho, M. Kim, W. Yoo, K. Kim, Y. Kim, B. Jeon, M. Kang, J. Kim, K. Jung, Y. Ju, H. Kim, J. Lim, S. Lee, I. Kim, S. Lee, and K. Jung-Choi, "Health Promotion Strategies and Programmes Development for Health Inequalities Alleviation," Ministry of Health and Welfare, 2009. (in Korean)
- Smith, James, "The Impact of Childhood Health on Adult Labor Market Outcomes," *The Review of Economics and Statistics* 91(3), 2009, pp.478~489.
- Son, M., "The Relationship of Social Class and Health Behaviors with Morbidity in Korea," *Journal of Preventive Medicine and Public Health* 35(1), 2002, pp.57~64.
- Son, M., B. Armstrong, J-M Choi, and T-Y Yoon, "Relation of Occupational Class and Education with Mortality in Korea," *Journal of Epidemiology & Community Health* 56(10), 2002, pp.798~799. (in Korean)
- Strauss, J. and D. Thomas, "Human Resources: Empirical Modeling of Household and Family Decisions," in T. Schultz and John Strauss (eds.), *Handbook of Development Economics*, Volume 3A: North-Holland, 2005, pp.1883~2023.
- USDA, "Fresh Fruit & Vegetable Program: A Handbook for Schools," 2010.
- Van Doorslaer, E. and Christina Masseria, "Income-related Inequality in the Use of Medical Care in 21 OECD Countries," OECD Health Working Papers, 2004.
- Van Doorslaer, E., A. Wagstaff, H. van der Burg, T. Christiansen, D. De Graeve, I. Duchesne, U-G Gerdtham, M. Gerfin, J. Geurts, L. Gross, U. Häkkinen, J. John, J. Klavus, R. E. Leu, B. Nolan, O. O'Donnell, C. Propper, F. Puffer, M. Schellhorn, G. Sundberg, and O. Winkelhake, "Equity in the Delivery of Health Care in Europe and the US," *Journal of Health Economics* 19(5), 2000, pp.553~583.

- Wagstaff, A., E. van Doorslaer, and N. Watanabe, "On Decomposing the Causes of Health Sector Inequalities with an Application to Malnutrition Inequalities in Vietnam," *Journal of Econometrics* 112(1), 2003, pp.207~223.
- West, P., "Health Inequalities in the Early Years: Is there Equalisation in Youth?" *Social Science & Medicine* 44(6), 1997, pp.833~858
- WHO, "Iron Deficiency Anaemia: Assessment, Prevention and Control," 2001.
- Wooldridge, Jeffrey, "Econometric Analysis of Cross Section and Panel Data," MIT Press, 2002.
- Yoon, T., J. Kim, S. Yoo, J. Kim, Y. Lee, Y. Hong and L. Lee, "The Relationship between Parents' Socioeconomic Status and Child Mortality," *Health and Social Science* 20(1), 2007, pp.29~46. (in Korean)