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Income-Related Health Inequalities in Korea

Byung Chul Ahn, PhD, Katrin Engelhardt, PhD, and Hyojee Joung, PhD

Data from the 2001 Korean National Health and Nutrition Examination Survey and the ill health concentration index (CI) were used to examine income-related health inequalities among Koreans. Participants (>19 years old) were requested to provide information regarding monthly household income, expenditures, subjective living conditions, and health status. Ill health was determined both subjectively through self-rated health (SRH) scores and objectively through the number of diseases (ND). At the individual level, the CIs for SRH and ND were –0.147 and –0.093, respectively; age–gender adjusted CIs were –0.065 and –0.071, respectively. These values remained unchanged when estimating CI for grouped data. These results indicate that ill health was more pronounced among lower income groups in Korea. However, avoidable health inequality in Korea was smaller than in the United Kingdom and the United States, larger than in Sweden, Eastern Germany, Finland, and Western Germany, and roughly equal to the Netherlands, Spain, and Switzerland.

Keywords: health inequality; self-rated health; concentration index; bootstrapping; Korea

The literature on socioeconomic inequalities in health is vast and growing rapidly. Previous studies have led to a consensus among disciplines that socioeconomic inequalities in health exist worldwide.[1-6] This issue is especially relevant in the Republic of Korea, which is one of the fastest growing economies in the Organisation for Economic Co-operation and Development (OECD), with increasingly marked income inequality among its citizens[7] in addition to rapid transition toward an aged society. The foreign currency crisis in 1997 also intensified bipolarization arguments in every aspect of social phenomena, including health disparities. Research on socioeconomic inequalities in health in Korea is an emerging field. A recent study using a relative index of inequality reported that trends in inequalities in mortality based on educational level have remained virtually unchanged over the past 10 years, whereas educational inequalities in subjective health have increased for both men and women.[8] Son et al[9] showed an inverse relationship between occupational class and education and mortality. Song and Byeon[10] found that the lowest socioeconomic group (based on monthly salary) among male Korean civil servants showed a significantly higher risk of mortality from most causes compared with the highest

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socioeconomic group. Those measures of inequalities were mainly based on a single indicator such as morbidity or mortality.

Among the various measures used to assess socioeconomic inequalities in health, the concentration index (CI) and slope index of inequality are thought to present the most accurate picture.[1,11] The CI and concentration curve have been used to describe and measure the degree of inequality in various measures of health and health care utilization,[3,12-15] health care payments,[16] mental health,[17] and obesity.[18]

Our objective was to supplement the currently available information regarding inequalities in health. We used the ill health CI, based on self-rated health and objective health status as proxies for overall health status, to estimate income-related inequality among a nationally representative sample of Korean citizens.

Methods

Data from the 2001 Korea National Health and Nutrition Examination Survey (KNHANES) were used in this study. KNHANES is a comprehensive, representative health survey of the Korean population conducted every 3 years. This survey uses household registries to collect data from a stratified, multistage probability random sample based on geographical area, administrative district, and residential type. KNHANES 2001 included 37 769 individuals from 12 183 households across the nation. Demographic, socioeconomic, and dietary information as well as medical histories were collected via personal interviews. A total of 24 781 participants were included in our analysis. All participants were ≥19 years of age and were required to complete a general questionnaire, a health examination, and provide information on household income, expenditures, subjective living conditions, and subjective health status. Monthly household income and monthly cost of living (expenditures) were adjusted for household size. To compare our findings, we assumed that US$1 ≈ 1000 Korean won.

Health was assessed based on self-rated health (SRH) and objective health. Objective health status was determined based on the total number of diseases (ND) that the subject suffered during 1 year prior to the study (chronic diseases), and acute diseases that the subject suffered 2 weeks prior to the survey. In contrast, self-rated health status provides an ordinal ranking of the individual's perception of his/her health status. Subjects were asked to rate their health based on a 5-point scale ranging from "excellent" to "very bad." It is assumed that a continuous latent variable with a standard lognormal distribution underlies the categorical self-rated health status.[1,19] An ill health score for each category was obtained by matching the cumulative sample proportion and probability of the standard lognormal distribution. To adjust for the effects of age and gender, raw scores were standardized indirectly by substituting individual scores with age–gender-wise average scores, excluding the individual's own score.[1]

Living conditions were evaluated based on a 5-point scale, ranging from "excellent" to "very bad." Because the percentage of respondents who reported their living conditions as "excellent" was negligible, the results for "excellent" and "good" were grouped into a single category.

The degree of inequality in ill health was assessed using the ill health CI.[1] The associations between the cumulative proportions of ill health scores were ranked against the cumulative proportion of the population by per capita income, beginning with the most disadvantaged populations. Graphically, this association is represented by the ill health concentration curve, denoted by $L(s)$. The ill health CI ranged from a positive to negative value depending on whether $L(s)$ fell below or above the diagonal, respectively. A negative ill health CI indicates that illness is concentrated among the lower socioeconomic groups. If

Table 1. General Characteristics of the Study Population

	Male		Female		Total	
	n	Percentage	n	Percentage	n	Percentage
Age (years)						
<40	5396	46.2	6018	45.9	11 414	46.1
40-60	4578	39.2	4685	35.7	9263	37.4
>60	1697	14.6	2407	18.4	4104	16.5
Education (years)						
<12	1673	14.3	3643	27.8	5316	21.5
≥12	9998	85.7	9467	72.2	19 465	78.5
Self-rated health (SRH)						
Good	6356	54.5	6154	46.9	12 510	50.5
Fair	3684	31.5	4392	33.5	8076	32.6
Bad	1631	14.0	2564	19.56	4195	16.9
Number of diseases (ND)						
0-1	8896	76.2	8636	65.9	17532	70.7
2-3	2296	19.7	3228	24.6	5524	22.3
≥4	479	4.1	1246	9.5	1725	7.0

$L(s)$ coincides with the diagonal (CI = 0) there is perfect equality. The ill health CI is defined as twice the area between $L(s)$ and the diagonal, as follows:

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

CI can be calculated from

$$C = \frac{2}{n\mu} \sum_{i=1}^{n} x_i R_i - 1$$

where R_i is the relative rank of the ith person and μ is the average ill health score. If CI = 0, perfect equality is observed. If CI > 1 (or <1), then ill health is concentrated within the highest (or lowest) socioeconomic groups.

Standard errors of the CI for statistical inference could be obtained under normality and serial correlation.[3] In this study, however, instead of assuming normal distribution and serial correlation, we adopted bootstrapping, distribution-free simulation-based method to estimate CI and its confidence interval. Bootstrapping was straightforwardly applicable by constructing a number of resamples by random sampling with replacement from the given data set. All estimates were obtained from bootstrapping with 1000 replicates. All analyses were conducted using SAS Version 9.0 (SAS Institute Inc., Cary, NC).

Results

The general characteristics of the study population are summarized in Table 1. The mean age was 42.8 ± 0.1 years and 43.8 ± 0.1 years for males and females, respectively, and 16.6% of the sample was older than 60 years. The majority of males (85.7%) and females (72.2%) had ≥12 years of education. Approximately half of the subjects rated their health as good or

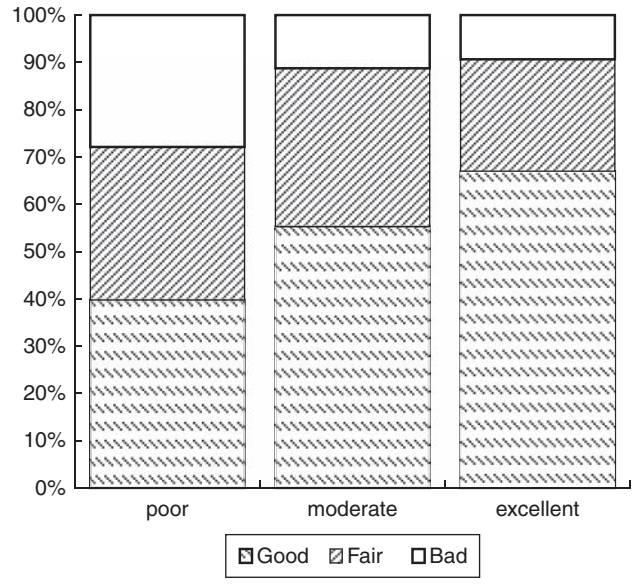

Figure 1. Self-rated health (SRH) distribution across poor, moderate, and excellent subjective living conditions.

Table 2. General Characteristics and Economic Status in Relation to Self-Rated Health[a]

	Self-Rated Health (SRH)			Number of Diseases (ND)			
	Good	Fair	Bad	0-1	2-3	≥4	Total
Income (US$ ± SE)[b]	$618.8^{1} \pm 3.8$	$545.9^{2} \pm 4.2$	$419.7^{3} \pm 4.9$	$581.3^{1} \pm 3.1$	$531.1^{2} \pm 5.3$	$455.6^{3} \pm 8.9$	561.4 ± 2.6
Expenditure (US$ ± SE)[b]	$394.0^{1} \pm 2.2$	$366.4^{2} \pm 2.6$	$316.4^{3} \pm 3.2$	$377.5^{1} \pm 1.8$	$363.0^{2} \pm 3.1$	$342.7^{3} \pm 6.0$	371.9 ± 1.5
Education (%)[c]							
<12 years	9.3	22.2	56.4	12.7	37.9	57.9	21.5
≥12 years	90.7	77.8	43.6	87.3	62.1	42.1	78.6
Gender (%)[c]							
Male	50.8	45.6	38.9	50.7	41.6	27.8	47.1
Female	49.2	54.4	61.1	49.3	58.4	72.2	52.9

[a]Data were collected in 2001. Income was reported in response to the question "What is the estimate of average monthly household income including interest, transfer payment and so on?" All those numbers were per capita and converted into US dollars (US$1.00 ≈ Korean won 1000).
[b]Different superscript numerals indicate significant differences according to Tukey's multiple comparison test.
[c]χ^2 tests reject the null hypotheses of no association between row and column variables ($P < .0001$).

excellent, compared with only 17% who rated their health as bad or very bad. Compared with males, a significantly greater proportion of females rated their health as bad ($P < .0001$) and had 3 or more diseases. In contrast, a greater proportion of males rated their health as good and reported only 1 or no diseases ($P < .0001$).

Table 2 compares SRH to the socioeconomic characteristics of our study population. The average monthly household income per person was US$561. This value was significantly higher for people who considered themselves to be in good health (US$618.80) or who reported only 1 or no disease (US$581.30), compared with those who rated their health as bad (US$419.7) or who reported 4 or more diseases (US$455.60). The mean per capita

Table 3. Regression Estimates for Ill Health Against Monthly Income and Expenditures

	Self-Rated Health Score (SRH)				Number of Diseases (ND)			
	Model 1		Model 2		Model 1a		Model 2a	
Dependent Variable	$\hat{\beta}$	SE ($\hat{\beta}$)	$\hat{\beta}$	SE ($\hat{\beta}$)	$\hat{\beta}$	SE ($\hat{\beta}$)	$\hat{\beta}$	SE ($\hat{\beta}$)
Intercept	0.08	0.03	0.00	0.03	–0.26	0.03	–0.30	0.03
Age[a]	0.41	0.01	0.42	0.01	0.37	0.01	0.38	0.01
Gender[b]	–0.16	0.02	–0.16	0.02	–0.34	0.02	–0.34	0.02
Income[c]	–0.05	0.00			–0.01	0.00		
Expenditure[c]			–0.06	0.00			–0.01	0.00
R^2	.180		.175		.188		.187	

[a]Age, 1 unit = 10 years.
[b]Gender, 1 = male, 0 = female.
[c]Income, US$100.00; expenditure, US$100.00.

income and expenditure differed significantly according to both the ill health score and ND ($P < .0001$). Subjects with good SRH and 1 or no diseases also had a higher level of education compared with subjects with bad SRH and 4 or more diseases. Finally, the ill health score was closely associated with subjective living conditions ($P < 0.0001$). In general, individuals with better living conditions reported a higher health status (Figure 1).

Table 3 presents regression estimates for ill health scores and ND against selected variables. Age and gender were significant indicators for both ill health and ND. ND and ill health scores increased with increasing age of the subjects. Males tended to suffer from fewer diseases and report a less severe ill health score. However, female gender and old age were negatively associated with health. Household income level and monthly expenditures showed positive associations with ill health scores and ND.

Figures 2 and 3 show the adjusted and unadjusted concentration curves for SRH and ND, respectively, which were expressed as the deviation of the concentration curve from the diagonal to amplify the differences. The concentration curves for unadjusted SRH and ND are located above the concentration curves adjusted for age and gender.

The concentration indices were calculated for SRH and ND at the individual level as well as the group level. In each case, the unadjusted and standardized scores were used to compute the CI. The difference between the unadjusted and adjusted CI is an estimate of the potentially avoidable inequality. At the individual level, the estimated CIs for the ill health scores were –0.147 and –0.065 for the unadjusted and adjusted data, respectively, yielding a potentially avoidable inequality of –0.082. The CIs for ND were –0.093 and –0.071 for the unadjusted and adjusted data, respectively. All values were negative and significant (Table 4), and the concentration curve was above the diagonal, indicating that health inequality existed and that ill health was more probable among individuals from lower socioeconomic groups.

In Figure 4, age–gender adjusted CI for grouped data based on SRH in Table 4 was compared with those of European countries.[3] Health inequality in Korea was smaller than in the United Kingdom and the United States, larger than in Sweden, Eastern Germany, Finland, and Western Germany, and roughly equal to the Netherlands, Spain, and Switzerland.

Discussion

Our findings contribute to the body of evidence showing a positive association between health and socioeconomic status. The socioeconomic indicators used in this study (monthly

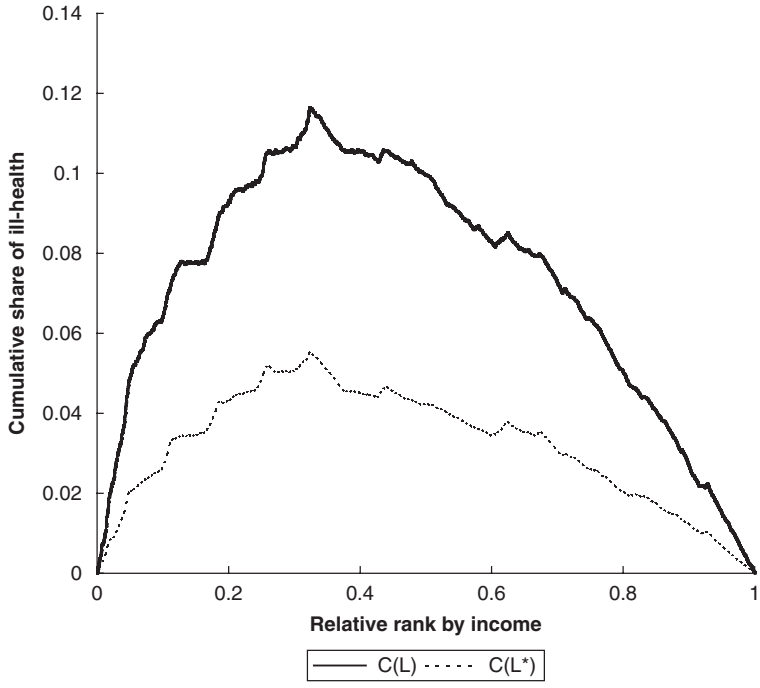

Figure 2. Concentration curve for ill health scores (self-rated health, SRH) against income-rank. C(L) and C(L^*) denote concentration curves from raw data and adjusted data, respectively.

household income, expenditures, educational level, subjective living standards) are all related to health status, which was measured both subjectively (SRH) and objectively (ND). Subjects from lower socioeconomic groups showed poorer SRH and a greater ND. Khang and Kim[20] showed that education, occupation, and income had independent effects on mortality risk, after adjusting for the remaining factors related to socioeconomic position in Korea. Khang et al.[8] explored educational inequality in association with all causes of mortality and 2 subjective morbidity indicators. Their study revealed that educational health inequalities were greater with regard to all causes of mortality in both men and women. A study in China[21] showed that people with lower educational levels were more likely to fall ill. We found that subjects who rated their living conditions as poor were significantly worse off in terms of SRH, which is consistent with previous studies investigating the link between neighborhood perception and subjective health status.[22,23]

The causal mechanisms underlying social inequalities in health are complex.[4,24] Causation could run from income to health or from health to income. We did not attempt to establish causation but to indicate significant association between income and health in Korea (Table 3). Our results for CI and the concentration curve contribute to our understanding of Korean socioeconomic inequalities in health. We estimated negative values for all CIs, indicating that socioeconomically disadvantaged groups showed a disproportionate level of ill health, even after adjusting for demographic structure. Higher inequality has been linked to SRH in numerous previous studies in North America[25,26] and Europe.[27]

It can be difficult to make international comparisons regarding socioeconomic inequality because of the many ways to interpret indicators.[28] However, the CIs calculated for Korea

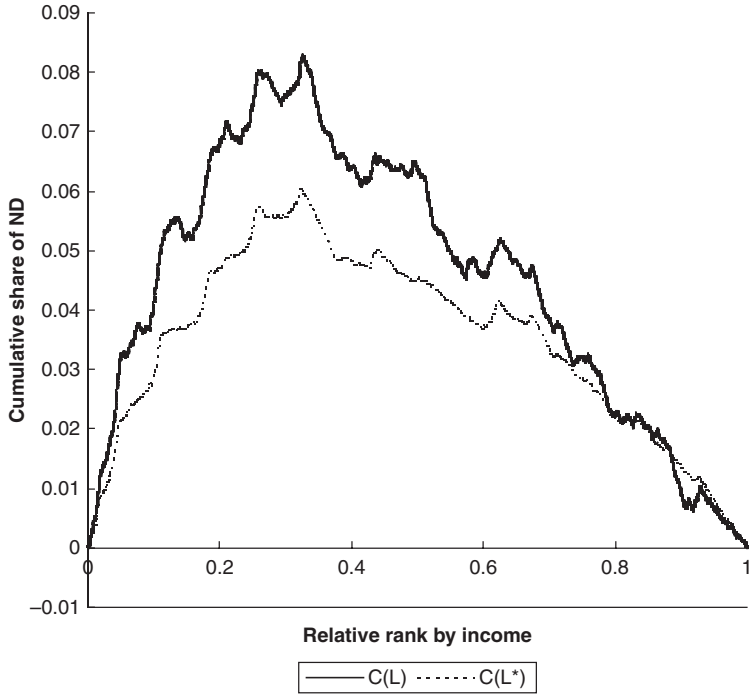

Figure 3. Concentration curve for number of diseases (ND) against income-rank.
C(*L*) and C(*L**) denote concentration curves from raw data and adjusted data, respectively.

Table 4. Bootstrapping Estimates for Concentration Indices (CIs) of Ill Health

	Individual Level			Group Level		
	Cr	Ca	I	Cr	Ca	I
Ill health score						
Mean	–0.147	–0.065	–0.082	–0.138	–0.058	–0.079
95% lower	–0.155	–0.068	–0.087	–0.145	–0.059	–0.087
95% upper	–0.139	–0.066	–0.074	–0.130	–0.057	–0.074
Min	–0.158	–0.070	–0.094	–0.150	–0.063	–0.092
Max	–0.132	–0.060	–0.066	–0.123	–0.052	–0.064
Number of diseases (ND)						
Mean	–0.093	–0.071	–0.023	–0.085	–0.063	–0.022
95% lower	–0.103	–0.072	–0.032	–0.095	–0.065	–0.030
95% upper	–0.084	–0.069	–0.015	–0.075	–0.062	–0.013
Min	–0.108	–0.078	–0.035	–0.099	–0.070	–0.034
Max	–0.078	–0.065	–0.009	–0.071	–0.057	–0.008

NOTES: Cr = concentration index for raw data (unadjusted); Ca = concentration index for standardized data (adjusted for age and gender); I = difference between Cr and Ca.

indicated only moderate income-related inequality compared with European countries (Figure 4).[3,15] There were no other Asian countries available to be compared with our results. Lu et al.[29] compared horizontal inequality in health care utilization indicating that Korea

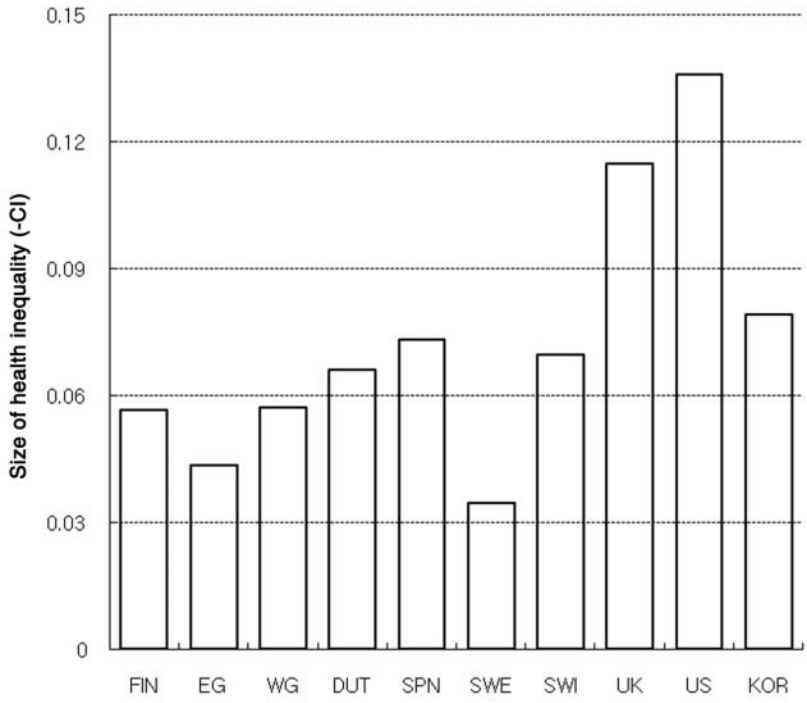

Figure 4. Health inequality in Korea compared with other nations.
Abbreviations: FIN, Finland; EG, East Germany; WG, West Germany; DUT, Dutch; SPN, Spain; SWE, Sweden; SWI, Switzerland; UK, United Kingdom; US, United States; KOR, Korea.
Source: European estimates were extracted from table 3 in van Doorslaer et al.[3]

appears to maintain ETEN (equal treatment for equal need) principles almost comprehensively compared with Hong Kong and Taiwan.

Because previous studies within Korea have not quantified inequality in the same manner, it is difficult to compare our results to those of other researchers. Kong and Lee[30] used data from the Korean Household Panel Study to show that income-related inequalities in health exist in Korea and favor the higher income groups. The estimated CIs reported here are consistent with this previous study.

We did not assess the extent of inequality in SRH and ND according to educational level or occupation. A descriptive analysis of our data shows that subjects with good SRH and one or no diseases also had a higher level of education. Previous studies have shown differences in mortality based on educational level in Korean subjects.[8,9,20] Education is an important determinant in Korea and has a stronger effect on mortality in Korea than in Western countries.[31]

Possible limitations are worth mentioning. First, our study should not be interpreted as a cause–effect relationship because of the nature of cross-sectional data. Furthermore, theoretical causation was not unidirectional. Second, international comparisons may not necessarily hold because the estimates are based on different surveys possibly under different country-specific circumstances. For better assessment of similarities and differences between countries, comparable methods and coordinated efforts such as EQUITAP (Equity in Asia-Pacific Health Systems) would be helpful.

Our study differed from other investigations into socioeconomic inequalities in health in Korea. We used the nationally representative 2001 KNHANES data, which have not yet been fully analyzed for income-related inequalities using the CI.

Conclusions

Korea is experiencing rapid transition toward becoming an aged society, which may exacerbate health problems and disparities. Although these inequalities were roughly within the moderate range when compared internationally,[3,15] further monitoring is required to correctly project the distribution of health status and possible changes in income-related inequalities. Further studies on the trend in health inequalities and the decomposition of the source of health inequalities would be necessary to set the overall direction of health policy toward reducing disparities.

Acknowledgments

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