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The Relationship Between Economic Status and Mortality of South Koreans, as It Relates to Average Life Expectancy

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Abstract

This study investigates the relationship between economic status and mortality of Korean men and women who were under and over the average national life expectancy using Cox's proportional hazard model to adjust for health status, past medical history, and age. The study subjects come from local applicants of Korean National Health Insurance who had a health examination in 2005. They were enrolled into a follow-up investigation from 2005 to 2011. In individuals younger than the average life expectancy, the mortality of the lowest economic status was 2.48 times higher in men and 2.02 times higher in women than that in the highest economic status. Economic status–mortality association in males older than the average life expectancy was attenuated but not eliminated. However, there is no significant relationship between economic status and mortality for females above the average life expectancy.

Keywords

economic status, average life expectancy, mortality, socioeconomic inequality, Korea

Introduction

Economic status is closely related to health.[1] Economic status reflects well-being better than educational level or occupation and is also a good indicator of material status or class; therefore, it can be a good measure of health inequality.[2] Prior reports show that the proportion of unhealthy versus healthy people decreases as economic status increases.[3] In one US study, subjects divided into 12 economic status levels had mortality rates inversely proportional to economic status.[4] In another US study, mortality rate differed by economic level, especially for socioeconomic characteristics.[5] In a UK study, individuals of lower economic class had a higher

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prevalence of acute disease, chronic disease, arthritis/rheumatism, and heart disease, as compared with those of higher economic class.[6] According to the cohort study conducted in North America and Europe for approximately 40 years, the mortality and morbidity is higher as the economic status is lower.[7]

Past research has focused on the relationship between mortality rate and social or economic class for a variety of reasons.[8] First, despite a decline in mortality rate across several decades, socioeconomic inequality in mortality rate continues to persist. Second, socioeconomic inequality in mortality can be potentially reduced through political intervention that promotes health-related activities and medical care services. Finally, socioeconomic inequality in mortality can alter income redistribution by affecting income security systems such as pensions.

Higher economic status increases access to health resources; thus, it can directly and indirectly influence health levels and mortality. Previous studies point out that the degree of correlation between income and mortality differs among age and gender groups. Most socioeconomic factors are related to average life expectancy. According to socioeconomic indicators, the differences between average life expectancy of men and women were detected.[9] Studies conducted in the United States and Europe have reported that an imbalance between income and mortality is higher in men than women and is apparent during the economically active period rather than old age.[8,10] Although the gap between income and life expectancy decreases as age increases, the life expectancy of those in the high-income bracket was higher than those with the lower income levels, and the gap was somewhat large among men.[11]

Rapid economic growth in South Korea has improved medical accessibility and has provided a medical security system for the entire population. In 1998, however, the Asian financial crisis intensified income disparity, which is now a significant social problem. Several studies regarding socioeconomic inequality in mortality have been undertaken; however, these were limited to investigations on the differentials by occupation, income, and age.[12] In addition, many had incomplete follow-up, either because of attrition or because deaths were only tracked for 1 year, which made it difficult to generalize the relationship between socioeconomic characteristics and mortality. There is a paucity of studies reporting associations between economic status and mortality among elderly Asian population. There are limited studies investigating behavioral and biological pathway by which socioeconomic status and mortality are associated for the elderly. Moreover, most studies focused on Western countries and the evidence relating socioeconomic satus to mortality among elders is far from consistent.

The purpose of this study was to investigate the association of economic status and mortality in both Korean men and women, below and above average life expectancy. We also examined how the economic status–mortality associations were accounted for by economic status differences in health behaviors and past morbidity.

Methods

Data Sources

This study uses health examination data collected by the National Health Insurance Corporation (South Korea's public health insurance), which includes almost all of South Korea's population. Subscribers may be classified as employee-insured or self-employed insured. Health insurance premiums for the employee-insured are based on monthly income. Health insurance premiums for the self-employed are based on income, property value, living standards, and economic activity rate. Coverage under both plans includes dependent family members (spouses, direct ascendants, and descendants of both the subscriber and spouse). For most others, the National Basic Living Security Act, as part of the Medical Care Assistance Act, provides medical fee assistance to those who qualify, including persons of National

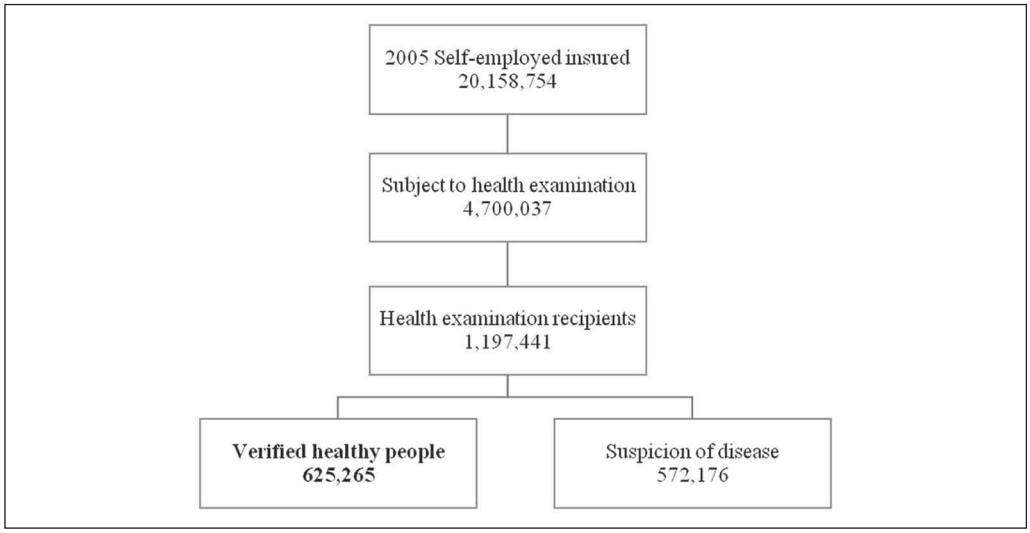

Figure 1. Flowchart of subject selection

Merit. By the end of 2005, 47.39 million people were enrolled in the National Health Insurance Corporation, which is 96.4% of the 49.2 million who are eligible for medical security.[13] Of those insured, 55.4% (27.23 million) were covered by employee-insured benefits, 41.0% (20.16 million) were covered by self-employed benefits, and 3.6% (1.76 million) were incorporated into the medical fee assistance program.[13]

National Health Insurance Corporation data used in this study include health examination follow-up data from January 2005 to July 2011. Health examinations of office workers and their dependent families take place every 2 years (every year for nonoffice workers) to promote early disease detection and subsequently cover the resulting medical care expenses at that stage.

Study Subjects

This study used data on self-employed subscribers only because their health insurance premiums are probably the most accurate indicators of economic status. From the total number of self-employed insured in 2005 (20 158 754), 4 700 037 were subject to health examination. Of those, 1 197 441 received health examinations. We excluded 572,176 who had possible disease, resulting in 625 265 final study subjects who were considered as healthy (Figure 1). Final subjects were neither obese, nor did they have tuberculosis, other chest diseases, high blood pressure, high cholesterol, liver disease, intestinal disease, kidney disease, poor health perception and habits, or poor oral diagnosis (eg, dental caries, missing teeth, periodontal disease). Of the people who received health examinations, those who were suspected of any one of the diseases in the results of the interview, eyesight, hearing, obesity, tuberculosis and other chest diseases, high blood pressure related diseases, hyperlipidemia, liver and bowel diseases, diabetes, kidney disease, anemia, health perception, everyday habits, and oral checkup (dental cavities, loss of teeth, periodontal disease) were excluded from the population of the final subjects. The final subject population selected for this study possessed a normal health state according to the results of the health examination.

Because the premiums of self-employed subjects consider gender, age, cars, business income, asset income, property (including houses and cars), living standards, and economic activity rate, they are a good indicator of economic status in Korea.[14] The health insurance premium

of self-employed subscribers was used as a proxy indicator of economic status in this study. The economic status of the subjects was categorized into 10 levels according to their health insurance premiums.

Mortality

When a death occurs, a family member must directly report to the Health Insurance Corporation within 14 days of the death so that the Corporation can disqualify the individual. Death and date of death are recorded by the Corporation. In this study, we calculated the death rate of the final study subjects from January 2005 to July 2011.

Factors Influencing Risk of Death

Mortality rate varied by area of residency (recorded during health examinations). We divided subjects by place of residence: Seoul, metropolitan cities, other cities, and regional counties.

Apart from economic status, we have included in the analysis factors such as smoking, alcohol intake, and exercise level. Smoking habit was categorized into "nonsmoker," "past smoker, but currently nonsmoker," and "current smoker." Alcohol intake was measured as the number of drinking incidences per week plus alcohol intake per incident and then divided into 4 levels. Exercise level was measured according to the number of times, per week when the subject exercised until the body was soaked with sweat.

Past medical history can also influence mortality and was, therefore, included in the analysis. Past medical history categories included tuberculosis, hepatitis, liver disease, high blood pressure, heart disease, stroke, diabetes, cancer, and other diseases. Past medical history was categorized by disease, year of occurrence, and current status (full recovery or under treatment).

Statistical Analysis

Chi-square tests were used to test for differences in the study subjects. For each male and female group, calibrations for age, smoking, drinking, exercise, past medical history, and residency were made prior to testing the association between economic status and risk of death. In addition, data were divided into "below" and "above" average life expectancy to test this effect. Finally, we fit mortality by economic status to Cox's proportional hazards models using hazard ratios with 95% confidence intervals. SAS (version 9.2) was used for all procedures.

Results

Table 1 presents the general characteristics of the study subjects. From the 625 265 study subjects who were verified to be healthy in 2005, 9496 males and 6045 females died.

Relationship Between Economic Status and Risk of Death

Age, smoking, drinking, exercise, past medical history, and residency adjustments were calculated (Table 2) and applied before testing the relationship between economic status and risk of death. For men, the risk of death for subjects in the lowest economic status was 2.32 times higher than that of subjects in the highest economic status (hazard ratio [HR] = 2.32, 95% confidence interval [CI] = 2.11-2.55). For women, the risk of death for subjects in the lowest economic status was 1.85 times higher than that of subjects in the highest economic status (HR = 1.85, 95% CI = 1.64-2.09). In both men and women, the risk of death was highest in subjects older than 40 years and in those with a past medical history.

Table 1. Baseline Characteristics of the Study Population

	Males						Females					
		Dead		Alive				Dead		Alive		
		n	%	n	%	*P*		n	%	n	%	*P*
Total	255 275	9496	3.7	245 779	96.3		369 990	6045	1.6	363 945	98.4	
Economic status (2005)						<.0001						<.0001
Class I (high)	27 065	598	2.2	26 467	97.8		40 321	364	0.9	39 957	99.1	
Class II	25 854	557	2.2	25 297	97.8		36 970	316	0.9	36 654	99.1	
Class III	25 321	531	2.1	24 790	97.9		34 233	317	0.9	33 916	99.1	
Class IV	26 034	547	2.1	25 487	97.9		40 537	429	1.1	40 108	98.9	
Class V	24 941	580	2.3	24 361	97.7		33 268	380	1.1	32 888	98.9	
Class VI	25 838	737	2.9	25 101	97.1		37 030	461	1.2	36 569	98.8	
Class VII	25 754	825	3.2	24 929	96.8		37 309	531	1.4	36 778	98.6	
Class VIII	23 769	997	4.2	22 772	95.8		36 603	773	2.1	35 830	97.9	
Class IX	25 294	1641	6.5	23 653	93.5		41 898	942	2.2	40 956	97.8	
Class X (low)	25 405	2483	9.8	22 922	90.2		31 821	1532	4.8	30 289	95.2	
Age (years)						<.0001						<.0001
<30	2598	13	0.5	2585	99.5		2169	4	0.2	2165	99.8	
30-39	22 630	109	0.5	22 521	99.5		10 739	38	0.4	10 701	99.6	
40-49	85 937	791	0.9	85 146	99.1		17 101	762	4.5	16 339	95.5	
50-59	74 172	1531	2.1	72 641	97.9		105 223	873	0.8	104 350	99.2	
60-69	47 895	2799	5.8	45 096	94.2		59 856	1435	2.4	58 421	97.6	
70-79	19 147	3173	16.6	15 974	83.4		24 538	2034	8.3	22 504	91.7	
≥80	2896	1080	37.3	1816	62.7		3364	899	26.7	2465	73.3	
Year of death												
2005		289						171				
2006		1075						669				
2007		1465						861				
2008		1647						995				
2009		1791						1209				
2010		2015						1292				
2011		1214						848				
Residence						<.0001						<.0001
Seoul	41 808	951	2.3	40 857	97.7		65 149	652	1.0	64 497	99.0	
Metropolitan cities (6)	66 336	1868	2.8	64 468	97.2		97 587	1252	1.3	96 335	98.7	
City	103 621	3645	3.5	99 976	96.5		145 454	2328	1.6	143 126	98.4	
County	43 510	3032	7.0	40 478	93.0		61 800	1813	2.9	59 987	97.1	
History of liver disease						.001						.0359
No	249 296	9226	3.7	240 070	96.3		365 504	5954	1.6	359 550	98.4	
Yes	5979	270	4.5	5709	95.5		4486	91	2.0	4395	98.0	
History of high blood pressure						<.0001						<.0001
No	233 636	7936	3.4	225 700	96.6		336 133	4680	1.4	331 453	98.6	
Yes	21 639	1560	7.2	20 079	92.8		33 857	1365	4.0	32 492	96.0	
History of stroke						<.0001						<.0001
No	253 111	9231	3.6	243 880	96.4		368 352	5961	1.6	362 391	98.4	
Yes	2164	265	12.2	1899	87.8		1638	84	5.1	1554	94.9	
History of heart disease						<.0001						<.0001
No	251 640	9144	3.6	242 496	96.4		365 102	5754	1.6	359 348	98.4	
Yes	3635	352	9.7	3283	90.3		4888	291	6.0	4597	94.0	

(continued)

Table 1. (continued)

	Males						Females					
		Dead		Alive				Dead		Alive		
		n	%	n	%	*P*		n	%	n	%	*P*
History of diabetes						<.0001						<.0001
No	248 952	8988	3.6	239 964	96.4		362 740	5725	1.6	357 015	98.4	
Yes	6323	508	8.0	5815	92.0		7250	320	4.4	6930	95.6	
History of cancer						<.0001						<.0001
No	253 771	9258	3.6	244 513	96.4		367 063	5903	1.6	361 160	98.4	
Yes	1504	238	15.8	1266	84.2		2927	142	4.9	2785	95.1	
History of other diseases						<.0001						<.0001
No	225 677	7886	3.5	217 791	96.5		325 537	5111	1.6	320 426	98.4	
Yes	29 598	1610	5.4	27 988	94.6		44 453	934	2.1	43 519	97.9	
Smoking						<.0001						<.0001
Nonsmoker	119 731	4375	3.7	115 356	96.3		340 163	5314	1.6	334 849	98.4	
Past smoker but currently nonsmoker	42 680	1457	3.4	41 223	96.6		5438	122	2.2	5316	97.8	
Current smoker	89 144	3500	3.9	85 644	96.1		14 238	417	2.9	13 821	97.1	
Nonresponse	3616	159	4.4	3457	95.6		10 005	188	1.9	9817	98.1	
Missing	104						146					
Daily alcohol intake (g)						<.0001						<.0001
0	115 804	5614	4.8	110 190	95.2		295 739	5326	1.8	290 413	98.2	
1-11	52 459	1388	2.6	51 071	97.4		56 902	532	0.9	56 370	99.1	
12-47	65 472	1755	2.7	63 717	97.3		15 312	163	1.1	15 149	98.9	
48-84	16,716	538	3.2	16 178	96.8		1522	15	1.0	1507	99.0	
≥85	4720	196	4.2	4 524	95.8		369	5	1.4	364	98.6	
Missing	104						146					
Exercise (times per week)						<.0001						<.0001
None	133 716	6155	4.6	127 561	95.4		213 715	4279	2.0	209 436	98.0	
1-2	61 144	1250	2.0	59 894	98.0		68 500	666	1.0	67 834	99.0	
3-4	25 631	554	2.2	25 077	97.8		38 112	316	0.8	37 796	99.2	
5-6	7523	202	2.7	7321	97.3		11 521	91	0.8	11 430	99.2	
Everyday	21 402	1007	4.7	20 395	95.3		28 550	442	1.5	28 108	98.5	
Nonresponse	5755	323	5.6	5432	94.4		9446	247	2.6	9199	97.4	
Missing	104						146					

When we examined factors that could influence mortality, we found that smokers had a high risk of death. Those who did regular exercise had 10% to 20% lower risk of death.

Risk of Death Below and Above the Average Life Expectancy

The average life expectancy of South Koreans in 2005 was 75 years for men and 82 years for women.[15] Both men and women had greater differences in risk of death by economic status below the average life expectancy as compared with above average life expectancy (Tables 3 and 4). In subjects younger than the average life expectancy, those with a lower economic status had a significantly higher risk of death than those with a higher economic status, suggesting economic status is significantly related to risk of death. In contrast, subjects older than the average life

Table 2. Adjusted Hazard Ratios for All Variables

	Males		Females	
	HR	95% CI	HR	95% CI
Economic status (2005)				
Class I (high)	1.00		1.00	
Class II	1.20	1.07-1.35	1.13	0.97-1.31
Class III	1.27	1.13-1.43	1.27	1.09-1.47
Class IV	1.31	1.17-1.48	1.44	1.25-1.65
Class V	1.43	1.28-1.61	1.42	1.23-1.64
Class VI	1.73	1.55-1.93	1.48	1.29-1.70
Class VII	1.74	1.57-1.94	1.47	1.29-1.69
Class VIII	1.87	1.68-2.07	1.63	1.43-1.85
Class IX	2.16	1.96-2.38	1.69	1.49-1.91
Class X (low)	2.32	2.11-2.55	1.85	1.64-2.09
Age (years)				
<30	1.00		1.00	
30-39	1.14	0.64-2.03	2.08	0.74-5.82
40-49	2.27	1.31-3.93	3.19	1.19-8.51
50-59	5.27	3.06-9.10	5.60	2.10-14.98
60-69	13.64	7.91-23.52	14.28	5.35-38.13
70-79	34.47	20.00-59.43	44.45	16.65-118.67
≥80	83.83	48.52-144.84	155.26	58.09-414.96
Residence				
Seoul	1.00		1.00	
Metropolitan cities (6)	1.17	1.09-1.27	1.13	1.03-1.25
City	1.20	1.11-1.29	1.10	1.01-1.21
County	1.33	1.23-1.44	1.15	1.05-1.27
Smoking				
Nonsmoker	1.00		1.00	
Past smoker but currently nonsmoker	1.02	0.96-1.08	1.65	1.38-1.98
Current smoker	1.44	1.38-1.51	1.73	1.56-1.91
Daily alcohol intake (g)				
0	1.00		1.00	
1-11	0.77	0.73-0.82	0.93	0.85-1.02
12-47	0.83	0.78-0.88	1.15	0.98-1.34
48-84	0.89	0.81-0.97	1.14	0.69-1.90
≥85	0.99	0.86-1.14	1.50	0.62-3.60
Exercise (times per week)				
None	1.00		1.00	
1-2	0.76	0.71-0.80	0.81	0.75-0.88
3-4	0.73	0.67-0.80	0.75	0.67-0.84
5-6	0.78	0.68-0.90	0.71	0.57-0.87
Nearly everyday	0.85	0.79-0.91	0.82	0.74-0.90
History of liver disease				
No	1.00		1.00	
Yes	1.53	1.35-1.73	1.47	1.20-1.81

(continued)

Table 2. (continued)

	Males		Females	
	HR	95% CI	HR	95% CI
History of high blood pressure				
No	1.00		1.00	
Yes	1.07	1.01-1.13	1.16	1.09-1.24
History of stroke				
No	1.00		1.00	
Yes	1.69	1.49-1.91	1.35	1.09-1.68
History of heart disease				
No	1.00		1.00	
Yes	1.36	1.23-1.52	1.51	1.34-1.70
History of diabetes				
No	1.00		1.00	
Yes	1.42	1.30-1.56	1.29	1.15-1.44
History of cancer				
No	1.00		1.00	
Yes	2.39	2.10-2.72	2.63	2.23-3.11
History of other diseases				
No	1.00		1.00	
Yes	1.26	1.19-1.33	1.14	1.06-1.22

Abbreviations: HR, hazard ratio; 95% CI, 95% confidence interval.

expectancy had different risks of death by economic status depending on gender: Men had a higher risk of death with lower economic status ($P = .0113$; Table 3), but women had no difference in risk by economic status ($P = .4281$; Table 4). The relation between economic status and mortality associations in subjects younger than the average life expectancy were attenuated but not eliminated after adjustment for health behaviors and past medical history, and this is true for both sexes. However, the relations were not significant in women above average life expectancy both before and after adjustments for these confounders.

Discussion

Our analysis of data from the National Health Insurance Corporation shows that risk of death is higher for individuals with lower economic status, which is similar to study results in North America[4,5] and Europe.[7] Adjustment for residence, health behaviors, and past medical history reduced, but did not eliminate, the economic status–mortality relations. Economic status inequality in mortality still persisted in both males and females, even after simultaneous adjustment for health behaviors and past health status. It is likely that unhealthy behaviors and poor health status in the past constitute steps in the causal pathway between low economic status and high mortality. Since the relation between economic status and mortality appears to be attenuated by adjusting health behaviors, health policies for the population with low economic status below the life expectancy should consider health education.[16] Our study results show that risk of death decreases more in men than in women as economic status improves. Other studies also report socioeconomic inequality in mortality to be less pronounced in women than in men partly because of a difference in the main cause of death or partly because of the influence of marital status.[8,10] A previous study in Europe found that the imbalance in

Table 3. The Relationship Between Economic Status and Risk of Death by Average Life Expectancy: Males

	Model 1[a]				Model 2[b]				Model 3[c]			
	<75 Years		≥75 Years		<75 Years		≥75 Years		<75 Years		≥75 Years	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
Economic status (2005)												
Class I (high)	1.00		1.00		1.00		1.00		1.00		1.00	
Class II	1.26	1.11-1.42	1.16	0.87-1.56	1.20	1.06-1.37	1.11	0.83-1.49	1.23	1.08-1.39	1.14	0.85-1.52
Class III	1.30	1.15-1.48	1.59	1.21-2.11	1.20	1.06-1.37	1.49	1.12-1.97	1.24	1.09-1.41	1.53	1.16-2.03
Class IV	1.40	1.23-1.59	1.48	1.12-1.96	1.25	1.10-1.42	1.35	1.02-1.79	1.30	1.14-1.48	1.40	1.05-1.86
Class V	1.64	1.44-1.85	1.16	0.86-1.57	1.43	1.26-1.62	1.05	0.77-1.42	1.49	1.32-1.69	1.08	0.79-1.46
Class VI	1.95	1.73-2.19	1.71	1.31-2.22	1.67	1.48-1.88	1.50	1.15-1.96	1.75	1.55-1.97	1.54	1.18-2.01
Class VII	2.00	1.78-2.24	1.77	1.38-2.27	1.66	1.48-1.87	1.54	1.20-1.99	1.77	1.57-1.99	1.59	1.23-2.05
Class VIII	2.18	1.95-2.44	1.86	1.47-2.35	1.77	1.57-1.98	1.60	1.26-2.03	1.89	1.68-2.12	1.68	1.32-2.13
Class IX	2.68	2.42-2.98	1.81	1.47-2.24	2.14	1.92-2.39	1.54	1.24-1.92	2.30	2.06-2.56	1.61	1.30-2.01
Class X (low)	2.95	2.66-3.27	1.93	1.59-2.36	2.34	2.10-2.61	1.62	1.32-2.00	2.48	2.23-2.76	1.71	1.39-2.10
P for mortality ratio trend	<.0001		.0020		<.0001		.0110		<.0001		.0113	
Residence												
Seoul					1.00		1.00		1.00		1.00	
Metropolitan cities (6)					1.15	1.06-1.26	1.19	0.99-1.44	1.17	1.07-1.27	1.20	1.00-1.45
City					1.16	1.07-1.26	1.11	0.93-1.32	1.21	1.11-1.31	1.15	0.97-1.37
Country					1.29	1.18-1.40	1.20	1.00-1.43	1.37	1.26-1.49	1.24	1.04-1.49
Smoking												
Nonsmoker					1.00		1.00		1.00		1.00	
Past smoker but currently nonsmoker					1.08	1.01-1.17	1.01	0.90-1.14	1.04	0.97-1.11	0.98	0.87-1.10
Current smoker					1.49	1.42-1.57	1.25	1.12-1.38	1.50	1.42-1.58	1.26	1.13-1.40
Daily alcohol intake (g)												
0					1.00		1.00		1.00		1.00	
1-11					0.79	0.74-0.84	0.77	0.68-0.89	0.78	0.73-0.84	0.78	0.68-0.90
12-47					0.94	0.79-0.89	0.76	0.67-0.87	0.84	0.79-0.89	0.78	0.68-0.89
48-84					0.90	0.82-0.99	0.74	0.58-0.95	0.92	0.83-1.01	0.76	0.59-0.97
≥85					0.98	0.84-1.14	0.94	0.64-1.36	1.00	0.86-1.17	0.97	0.66-1.40
Exercise (times per week)												
None					1.00		1.00		1.00		1.00	
1-2					0.78	0.73-0.83	0.76	0.65-0.89	0.76	0.71-0.82	0.76	0.65-0.89
3-4					0.77	0.70-0.85	0.74	0.59-0.94	0.74	0.67-0.81	0.73	0.58-0.92
5-6					0.87	0.74-1.01	0.68	0.46-0.99	0.83	0.71-0.97	0.64	0.44-0.94
Nearly everyday					0.95	0.88-1.03	0.66	0.57-0.76	0.92	0.85-0.99	0.64	0.55-0.75
History of liver disease												
No									1.00		1.00	
Yes									1.63	1.44-1.85	0.91	0.59-1.41
History of high blood pressure												
No									1.00		1.00	
Yes									1.11	1.04-1.19	0.94	0.85-1.04

(continued)

Table 3. (continued)

	Model 1[a]				Model 2[b]				Model 3[c]			
	<75 Years		≥75 Years		<75 Years		≥75 Years		<75 Years		≥75 Years	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
History of stroke												
No									1.00		1.00	
Yes									1.70	1.46-1.97	1.68	1.35-2.10
History of heart disease												
No									1.00		1.00	
Yes									1.40	1.23-1.59	1.21	1.00-1.47
History of diabetes												
No									1.00		1.00	
Yes									1.47	1.32-1.63	1.30	1.07-1.57
History of cancer												
No									1.00		1.00	
Yes									2.67	2.31-3.09	1.67	1.26-2.22
History of other diseases												
No									1.00		1.00	
Yes									1.27	1.19-1.35	1.20	1.08-1.34

Abbreviations: HR, hazard ratio; 95% CI, 95% confidence interval.
[a]Model 1: Adjusted for age.
[b]Model 2: Adjusted for age, residency, smoking, drinking, and exercise.
[c]Model 3: Adjusted for age, residency, smoking, drinking, exercise, and past medical history.

the level of women's social or economic death rate is not very pronounced during their younger years.[17]

Male mortality is higher than female mortality in South Korea because of many reasons. Men are usually economically responsible for their family, so they may have more social and psychological stress than women. Men also have a higher rate of smoking, which is correlated with higher rates of lung cancer and chronic obstructive pulmonary disease.[18]

Smoking rate is higher among the lower economic classes. These individuals tend to absorb more nicotine per cigarette and find it harder to quit smoking than those in higher economic classes.[19] In contrast, the relationship of drinking to socioeconomic factors is less clear. In the United States and the United Kingdom, poor smoking and exercise habits tend to have unfavorable effects on lower economic class individuals; however, the relationship between drinking and social class is not as clear and can even be more common in higher social classes.[20]

Regarding the rise of inequality in risk of death increasing with age, a previous study explained that the difference in exposure to health risk factors according to the socioeconomic situation accumulates to appear as inequalities in health status.[21] The difference in exposure to health risk factors is not evident when young, but accumulates with age and thus, the gap regarding one's health status increases with age.

In contrast, our study showed that the inequality gap was not significant above the average life expectancy for women ($P = .4281$). At senescence, human bodies become similarly frail and the effectiveness of medicine may weaken regardless of socioeconomic class.[22] An earlier study in the United States found that the health gap, depending on social or economic status, declines as people reach old age. The narrowing of the health gap occurs because government support for the

Table 4. The Relationship Between Economic Status and Risk of Death by Average Life Expectancy: Females

	Model 1[a]				Model 2[b]				Model 3[c]			
	<82 Years		≥82 Years		<82 Years		≥82 Years		<82 Years		≥82 Years	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
Economic status (2005)												
Class I (high)	1.00		1.00		1.00		1.00		1.00		1.00	
Class II	1.14	0.97-1.33	1.03	0.64-1.64	1.11	0.95-1.31	1.01	0.63-1.62	1.14	0.97-1.34	1.01	0.63-1.63
Class III	1.28	1.09-1.50	1.26	0.78-2.03	1.23	1.05-1.44	1.28	0.79-2.07	1.28	1.09-1.50	1.28	0.79-2.06
Class IV	1.51	1.30-1.75	1.00	0.62-1.62	1.42	1.22-1.65	0.94	0.58-1.54	1.49	1.29-1.73	1.00	0.61-1.63
Class V	1.50	1.29-1.75	1.14	0.71-1.83	1.39	1.20-1.62	1.10	0.69-1.77	1.46	1.25-1.70	1.16	0.72-1.86
Class VI	1.62	1.40-1.87	0.82	0.51-1.32	1.49	1.29-1.73	0.82	0.51-1.33	1.56	1.34-1.80	0.84	0.52-1.36
Class VII	1.59	1.38-1.83	1.22	0.81-1.85	1.44	1.25-1.66	1.22	0.80-1.86	1.52	1.32-1.76	1.24	0.82-1.89
Class VIII	1.85	1.62-2.12	0.96	0.64-1.43	1.67	1.46-1.91	0.92	0.61-1.38	1.76	1.53-2.01	0.96	0.63-1.44
Class IX	1.90	1.67-2.16	1.00	0.69-1.46	1.70	1.49-1.94	1.97	0.66-1.43	1.82	1.59-2.07	1.02	0.70-1.50
Class X (low)	2.10	1.85-2.38	1.04	0.75-1.43	1.86	1.63-2.12	1.02	0.72-1.43	2.02	1.78-2.30	1.05	0.75-1.47
P for mortality ratio trend	<.0001		.9043		<.0001		.9294		<.0001		.4281	
Residence												
Seoul					1.00		1.00		1.00		1.00	
Metropolitan cities (6)					1.13	1.03-1.25	1.09	0.79-1.51	1.14	1.04-1.26	1.11	0.80-1.54
City					1.10	1.00-1.21	0.94	0.70-1.28	1.14	1.03-1.25	0.96	0.71-1.30
Country					1.18	1.07-1.31	0.97	0.71-1.33	1.21	1.09-1.34	1.00	0.73-1.37
Smoking												
Nonsmoker					1.00		1.00		1.00		1.00	
Past smoker but currently nonsmoker					1.64	1.34-1.99	1.60	1.00-2.57	1.65	1.36-2.01	1.56	0.98-2.48
Current smoker					1.75	1.57-1.95	1.00	0.73-1.37	1.84	1.65-2.05	1.05	0.77-1.43
Daily alcohol intake (g)												
0					1.00		1.00		1.00		1.00	
1-11					0.89	0.81-0.97	0.87	0.60-1.26	0.93	0.85-1.02	0.88	0.61-1.28
12-47					1.06	0.90-1.25	0.59	0.28-1.26	1.14	0.97-1.35	0.64	0.30-1.35
48-84					1.01	0.60-1.71	0.91	0.13-6.49	1.10	0.65-1.86	0.94	0.13-6.75
≥85					1.35	0.56-3.25	—	—	1.52	0.63-3.65	—	—
Exercise (times per week)												
None					1.00		1.00		1.00		1.00	
1-2					0.83	0.76-0.91	0.72	0.50-1.30	0.83	0.76-0.91	0.71	0.49-1.02
3-4					0.80	0.71-0.90	0.30	0.11-0.81	0.78	0.69-0.87	0.31	0.12-0.84
5-6					0.71	0.57-0.88	1.14	0.46-2.82	0.71	0.57-0.88	1.19	0.49-2.90
Nearly everyday					0.88	0.80-0.98	0.97	0.65-1.46	0.85	0.76-0.94	0.96	0.64-1.43
History of liver disease												
No									1.00		1.00	
Yes									1.52	1.23-1.87	0.86	0.21-3.44
History of high blood pressure												
No									1.00		1.00	
Yes									1.19	1.11-1.27	1.09	0.91-1.30
History of stroke												
No									1.00		1.00	
Yes									1.43	1.14-1.79	1.12	0.50-2.51
History of heart disease												
No									1.00		1.00	
Yes									1.57	1.38-1.78	1.11	0.78-1.60

(continued)

Table 4. (continued)

	Model 1[a]				Model 2[b]				Model 3[c]			
	<82 Years		≥82 Years		<82 Years		≥82 Years		<82 Years		≥82 Years	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
History of diabetes												
No									1.00		1.00	
Yes									1.33	1.18-1.50	1.10	0.74-1.62
History of cancer												
No									1.00		1.00	
Yes									2.66	2.23-3.16	2.42	1.29-4.52
History of other diseases												
No									1.00		1.00	
Yes									1.16	1.08-1.25	1.03	0.80-1.32

Abbreviations: HR, hazard ratio; 95% CI, 95% confidence interval.
[a]Model 1: Adjusted for age.
[b]Model 2: Adjusted for age, residency, smoking, drinking, and exercise.
[c]Model 3: Adjusted for age, residency, smoking, drinking, exercise, and past medical history.

elderly (eg, Social Security or Medicare) narrows the gap in resources that are associated with their social or economic status and in their risk factors.[21] However, unlike in the United States, the Korean insurance system covers the entire population. Therefore, there is a possibility that any other causes exist. The previous studies indicate that the higher mortality associated with lower socioeconomic status is mediated by factors in 3 key domains: behavioral, biological, and psychosocial.[23] Our findings showed that economic status inequality in mortality is still persistent after adjustment health behaviors and past medical history. Although there is potential for residual confounding despite adjustment, we suggest that the psychosocial factors (depression, hopelessness, and reduced social support) should be considered as the contributors on this association between economic status and mortality.

The psychological health of the lower economic class is often relatively poor, and social support often reflects low standards. When there is a large amount of social stress, people may smoke, drink, and not exercise. Furthermore, stress can affect the hormone and immune systems to directly and indirectly cause disease.[24] This suggests that, although all our subjects were initially healthy, it is more likely subjects with lower economic status changed to a poorer health status during the follow up period than those with higher economic status.

When economic status is low, socioeconomic factors, such as education and income, can also affect an individual's ability to manage his or her health. Their social support for regular exercise, preventive health examination, and a healthy occupational and family life may be limited. Early detection of disease, such as cancer, can be less common in people with low economic status.[25] Lower socioeconomic status is associated with a higher prevalence of overweight/obesity.[26] Finally, those with low economic status may have less and/or passive interest in a productive and healthy life.

Those with high economic status tend to participate more in healthy activities, have better access and greater use of medical information, and often enjoy the resources that are helpful for their health.[27] Patients with lower economic status may not receive the necessary medical management after major procedures, such as cancer surgery. These services may be neither economically nor geographically accessible. The quality of accessible medical institutes and medical staff may be lower in some areas. Unequal treatment after diagnosis of cancer has been shown to occur,[28] and patients are sometimes unable to appropriately use quality medical services.[29]

This study has several advantages. First, the number of subjects in this study (n = 625 265) was large enough to represent the national population over time. Data in previous studies included only a limited range of regions and occupations. This study, however, encompasses a wide range of social classes and regions. Second, we analyzed study subjects who were verified to be considered healthy people at the beginning of the study period. Third, age, smoking, drinking, regular exercise, past medical history, and residency were adjusted. This study adjusted for 3 types of variables: health behavior variables (smoking, drinking, and regular exercise); demographic variables (gender, age, and residency); and past medical history, an objective clinical indicator that shows a subject's health level. Fourth, this study accurately analyzed subjects' economic status as it used health insurance premiums as a proxy indicator of economic status. Most studies that involve income tend to consider gross income or income in kind.[27] Health insurance premiums in Korea are determined by taking into account income, gender, age, properties, cars, standard of living, and economic activity rates. Therefore, using health insurance premiums can improve one of the weaknesses of previous studies, that is, an economic indicator as a socioeconomic variable.[30] Fifth, we used the National Health Insurance data, which are representative data in Korea. With the aforementioned advantages, this study more accurately analyzed the relationship between economic status and mortality of South Korean men and women who were under and over the average national life expectancy.

In this study, we limited our data to an initially healthy group of individuals in order to objectively test the effects of social class; however, one must be careful when generalizing the results. First, our follow-up period for new deaths was short (January 2005 to July 2011); therefore, we could not examine long-term risk of death similar to US and European studies that follow cohort data for several decades. Second, we were unable to incorporate socioeconomic indicators such as educational level, occupation, and marital status, in our analysis. Education level and marital status are more stable attributes than economic status and occupation: Educational level is generally completed during youth and maintained as a stable attribute throughout life, whereas economic status and occupation can have relatively large fluctuations. We suggest that future studies include such stable attributes because they can directly and indirectly influence less stable attributes. Third, we did not categorize causes of death. To clearly prove the causality of economic status and risk of death, one must research not only the detailed causes of death but also information on social health, psychological health, and change in economic status. Overall, we suggest that future studies consider all of the above adjustments to provide more informative results.

Studies that examine the relationship between economic status and risk of death help clarify political intervention points that can reduce inequality in death. When direct and indirect causes of inequality in death can be identified, detailed plans and strategies for changing social environments that promote better health and medical resources, and reduce economic inequality in death, can be developed. The findings of this study suggest that it is necessary to consider not only health-related factors but also psychosocial factors that mediate the pathways by which economic status and mortality are associated.

Conclusions

In this study, we tracked an initially healthy South Korean population for 6 years and found that, below average life expectancy, economic status was related to risk of death in both men and women. However, the pattern of results is different by gender and by age. For those above the average life expectancy, however, economic status was related to risk of death in men but not in women. This result suggests health status, health behavior, and/or use of medical services by those above the average expectancy may differ between men and women.

Since economic status–mortality associations were attenuated after adjustment for health behaviors, it is necessary to consider public health interventions among low economic status groups that have poor health behaviors. However, economic status–mortality associations were not eliminated after adjustment for health behaviors and past medical history. Our findings also suggest that social and psychological conditions seem to influence the mortality of individuals below the life expectancy.

To better identify those causes, future studies should include measures of health status, health behavior, psychosocial factors, accessibility to medical services/information, and quality of medical care.

Authors' Note

Ji Man Kim and Yong-Sim Jo are co–first authors.

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