

MORTALITY

## Relationship of education, occupation, and income with mortality in a representative longitudinal study of South Korea

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**Abstract.** To examine relationship of education, occupation, and income with mortality risk, the 1998 National Health and Nutrition Survey data were linked to data on mortality. Education, occupation, and income had independent effects on mortality risk

after adjustment for the remaining two socioeconomic position indicators. Educational, occupational, and financial approaches would be equally important to reduce socioeconomic mortality inequalities in South Korea.

**Key words:** Education, Income, Mortality, Occupation, South Korea

Socioeconomic inequality in mortality has been documented in South Korea according to education [1–3], occupation [1], and income [4]. Prior studies have reported greater educational differences in mortality than in the west [1–3] and relatively small mortality differentials according to occupational class (manual vs. non-manual) [1]. Occupational mortality differentials measured by relative risks were significantly reduced after adjustment for education (1.65–0.94 in males, 1.48–1.17 in females) [1]. However, these studies [1–3] were limited by the use of unlinked data for the numerator and denominator. A previous UK study examined the independent effect of education and occupation on mortality [4]. The independent effect of education, occupation, and income on mortality, after simultaneous adjustment for these three socioeconomic position indicators, has not been explored in South Korea. We examined the relationship of education, occupation, and income with mortality risk using representative longitudinal data of South Korea.

We used the 1998 National Health and Nutrition Examination Survey data conducted by the Korea Institute for Health and Social Affairs on a cross-sectional probability sample of South Korean households representing the civilian, non-institutionalized population. The response rate of this survey was 86.5% for adults aged 30+ (N = 6468). This survey contains unique 13-digit personal identification numbers (PIN) which were linked to data on mortality from the National Statistical Office of Korea (NSO) through December 2002. By law, all deaths of Koreans must be reported to the NSO. A total of 1.4% (N = 93) did not have a 13-digit PIN. The validity of the 13-digit PINs was checked with a validation program, by which 11.9% (768) were ascertained to be

invalid. Of the remaining 5607 males and females aged 30+, 197 died between 1999 and 2002. Levels of education, determined by the highest level completed, were categorized as No education, Elementary, Middle, High school or over. High school and College education were combined together because of unstable number (N = 3) of death among college graduates. Occupation was divided into three categories: Manual, Non-manual, and Others. Others included housewife, the unemployed and the retired. Monthly household income was adjusted for household size [equivalent household income = total household income ÷ (household size)<sup>0.5</sup>] and then categorized into four levels at the nearest quartile points. Cox's regression was used to estimate relative risks and their 95% confidence intervals (CI) of mortality. Data on men and women were combined as the interactions between gender and socioeconomic position indicators were not significant ( $p = 0.48, 0.54, \text{ and } 0.36$  for interaction of gender with education, occupation, and income respectively).

As shown in Table 1, graded socioeconomic differentials in mortality were observed after adjustment for sex and age. Among those aged 30+, those without any formal education had 2.49 time (95% CI: 1.40–4.43) greater mortality risk than those with high school or over education. Greater mortality risks were also found among those having elementary school education. Relative risk of manual workers was 3.09 (95% CI: 1.45–6.58) compared with non-manual workers among those aged 30+. Others group being not in labor market (e.g., housewife, the unemployed, and the retired) had greater relative risk of dying than manual workers. The others group had 1.75 time (95% CI: 1.25–2.45) greater mortality risk than

**Table 1.** Relationships of education, occupation, household income with mortality in the National Health & Nutrition Survey of South Korea

	Men and women aged 30+			Men and women aged 30-64			Men and women aged 65+			
	No. of subjects (deaths)	Age-adjusted	Education and occupational class adjusted	Fully adjusted model	No. of subjects (deaths)	Fully adjusted model	No. of subjects (deaths)	Fully adjusted model	No. of subjects (deaths)	Fully adjusted model
Educational level										
High school +	2610 (29)	1.00 (reference)	1.00 (reference)	1.00 (reference)	2531 (22)	1.00 (reference)	1.00 (reference)	79 (7)	1.00 (reference)	1.00 (reference)
Middle school	934 (24)	1.75 (1.00-3.06)	1.61 (0.92-2.84)	1.55 (0.88-2.72)	876 (17)	1.44 (0.74-2.78)	1.44 (0.74-2.78)	58 (7)	1.31 (0.46-3.78)	1.31 (0.46-3.78)
Elementary school	1298 (56)	1.84 (1.10-3.09)	1.72 (1.02-2.89)	1.54 (0.91-2.59)	1035 (27)	1.49 (0.78-2.86)	1.49 (0.78-2.86)	263 (29)	1.36 (0.58-3.19)	1.36 (0.58-3.19)
No formal education	765 (88)	2.49 (1.40-4.43)	2.43 (1.36-4.31)	2.10 (1.17-3.78)	290 (12)	2.63 (1.11-6.25)	2.63 (1.11-6.25)	475 (76)	1.67 (0.70-3.97)	1.67 (0.70-3.97)
Occupational class										
Non-manual	1557 (8)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1528 (5)	1.00 (reference)	1.00 (reference)	29 (3)	1.00 (reference)	1.00 (reference)
Manual	2088 (64)	3.09 (1.45-6.58)	2.57 (1.19-5.57)	2.26 (1.04-4.90)	1789 (44)	3.49 (1.33-9.17)	3.49 (1.33-9.17)	299 (20)	0.44 (0.13-1.51)	0.44 (0.13-1.51)
Others <sup>a</sup>	1962 (125)	5.40 (2.52-11.58)	4.96 (2.29-10.73)	4.33 (2.00-9.41)	1415 (29)	5.35 (1.98-14.48)	5.35 (1.98-14.48)	547 (96)	1.11 (0.34-3.64)	1.11 (0.34-3.64)
Household Income quartile <sup>b</sup>										
I (highest)	1395 (16)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1237 (5)	1.00 (reference)	1.00 (reference)	225 (26)	1.00 (reference)	1.00 (reference)
II	1387 (26)	1.48 (0.80-2.77)	1.38 (0.78-2.45)	1.27 (0.68-2.38)	1099 (10)	1.69 (0.57-4.97)	1.69 (0.57-4.97)	211 (30)	1.34 (0.79-2.28)	1.34 (0.79-2.28)
III	1480 (58)	2.37 (1.36-4.14)	2.12 (1.12-3.65)	1.96 (1.12-3.45)	1231 (24)	3.00 (1.13-7.99)	3.00 (1.13-7.99)	225 (29)	1.25 (0.73-2.15)	1.25 (0.73-2.15)
IV (lowest)	1345 (97)	2.44 (1.42-4.22)	2.12 (1.12-3.65)	1.83 (1.05-3.19)	1165 (39)	3.40 (1.29-8.98)	3.40 (1.29-8.98)	214 (34)	1.29 (0.77-2.18)	1.29 (0.77-2.18)

Relative risks of mortality and their 95% confidence intervals in 5607 males and females.

<sup>a</sup>Others included housewife, the unemployed, and the retired.

<sup>b</sup>Monthly household income was adjusted for household size [equivalent household income = total household income ÷ (household size)<sup>0.5</sup>] and then categorised into four levels at the nearest quartile points.

manual workers when mortality risk between manual workers and others group was compared after adjustment for sex and age among those aged 30+. Low income quartiles were also associated with the excess risk of mortality. The lowest and the second lowest income quartiles had about 2.4 time excess risk of mortality than the highest. As expected, the magnitude of socioeconomic mortality inequalities in those aged 30–64 was greater than that of 30 or older age groups. This pattern was true in education, occupation, and income (data not shown). In the fully adjusted models where education, occupation, and income were adjusted simultaneously, each socioeconomic position was significantly associated with mortality risk. These patterns were true among whole study samples (those aged 30+) and sub-samples (those aged 30–64). However, among those aged 65+, each socioeconomic position indicator did not have statistically significant association with mortality risk.

A previous UK study found that occupational class was a better discriminator of socioeconomic differentials in mortality than was education [5]. On the contrary, a recent South Korean study reported that occupational mortality differentials (manual vs. non-manual) were relatively small and further reduced after adjustment for education [1]. The mortality risk of male manual workers was 6% lower than that of non-manual workers if those workers were of the same age and educational level [1]. Our study, which used longitudinal data and presented significant occupational differences (manual vs. non-manual) in mortality after adjustment of education, indicated that the previous finding was likely due to numerator–denominator bias. This study further showed that those who were not in the labor market (housewives, the unemployed, and the retired) had a greater mortality risk than their counterparts. According to an additional investigation using decedents' information of this study [6], the reliability level of occupation between survey data and death certificate data was relatively low (Kappa index: 0.40). The Kappa indices were 0.60 for five educational levels (same as this study and previous study) [2] and 0.75 for three educational levels (same as previous study) [3]. In addition, the number of subjects in the no education category in death certificate data was smaller than in the survey data [6], which implied that educational mortality differentials between no education and college education in the previous study [2] were not overestimated. This study adds evidence from longitudinal data that subjects within the no education category had a considerably higher relative risk of dying as compared with those with higher education in South Korea.

As shown in a previous longitudinal study [4], low income quartiles were associated with the excess mortality risk. However, the difference in mortality risk between the highest and lowest quartiles was greater in this study than the previous one. In those

aged 30–64, this study showed a relative risk of 6.14 (95% CI: 2.39–15.80) in the lowest income quartile compared to the highest (data not shown), while the relative risk of mortality in lowest quartile was 2.07 (95% CI: 1.97–2.17) in the previous study [4]. Mortality differences in a more diverse population would be greater than in less diverse study subjects (civil servants and private school teachers in the previous study) [4].

This study showed that socioeconomic mortality differentials measured by relative risk were greater among those aged 30–64 compared with those aged 65+. A previous South Korean study also showed decreasing educational mortality inequalities (measured by relative index of inequality) with age [2]. Huisman et al. [7] showed that relative socioeconomic mortality inequalities generally decreased with age, although the pattern varied with place, gender, and socioeconomic position indicators. Use of different socioeconomic position indicators (e.g., housing tenure) and/or larger sample size may produce significant relationships between socioeconomic position and mortality risk among South Korean elderly.

As an individual measure of socioeconomic position, each of education, occupation, and income has peculiar meanings different from the remaining two indicators in promoting or damaging the individual's health [8]. This study showed that in South Korea, education, occupation, and income had independent effects on mortality risk after adjustment for the remaining two socioeconomic position indicators. This result suggests that educational, occupational, and financial approaches would be equally important to reduce socioeconomic mortality inequalities in South Korea.

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