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Original Article

Suicide rates across income levels: Retrospective cohort data on 1 million participants collected between 2003 and 2013 in South Korea

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ABSTRACT

Background: The relation of income and socioeconomic status with suicide rates remains unclear. Most previous studies have focused on the relationship between suicide rates and macroeconomic factors (e.g., economic growth rate). Therefore, we aimed to identify the relationship between individuals' socioeconomic position and suicide risk.

Methods: We analyzed suicide mortality rates across socioeconomic positions to identify potential trends using observational data on suicide mortality collected between January 2003 and December 2013 from 1,025,340 national health insurance enrollees. We followed the subjects for 123.5 months on average. Socioeconomic position was estimated using insurance premium levels. To examine the hazard ratios of suicide mortality in various socioeconomic positions, we used Cox proportional hazard models.

Results: We found that the hazard ratios of suicide showed an increasing trend as socioeconomic position decreased. After adjusting for gender, age, geographic location, and disability level, Medicaid recipients had the highest suicide hazard ratio (2.28; 95% CI, 1.87–2.77). Among the Medicaid recipients, men had higher hazard ratios than women (2.79; 95% CI, 2.17–3.59 vs. 1.71; 95% CI, 1.25–2.34). Hazard ratios also varied across age groups. The highest hazard ratio was found in the 40–59-year-old group (3.19; 95% CI, 2.31–4.43), whereas the lowest ratio was found in those 60 years and older (1.44; 95% CI, 1.09–1.87).

Conclusions: Our results illuminate the relationship between socioeconomic position and suicide rates and can be used to design and implement future policies on suicide prevention.

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Introduction

Suicide is a global issue important enough to have prompted the World Health Organization to announce the Mental Health Action Plan in 2013 in an effort to reduce suicide rates worldwide.¹ Addressing suicide is even more pressing in South Korea, where the national suicide rate has been the highest of all Organization for

Economic Co-operation and Development (OECD) countries in the last decade. The rate of death by suicide in Korea is at 28.5 per 100,000 people in 2013, which is as much as 5 times higher than other OECD countries (OECD on average, 12.1; Italia, 5.8; United States, 12.5; and Japan, 20.9 per 100,000 people).² The number of individuals who attempted suicide within the last year is 7.5 times the rate of actual suicide deaths during that same period, while the number of individuals who have attempted suicide more than once in their lifetime is 10.7 times that rate. These figures indicate that there is currently a high-risk population comprising about 1.2 million individuals with a history of suicide attempts.³ Consequently, a great deal of research is being conducted in South Korea on how to address this suicide problem. About 851 academic thesis

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papers on suicide, covering a wide range of subjects and causes, were published between 1966 and 2014.⁴

Suicide rates are thought to be affected by economics, an assumption rooted in the work of Durkheim.⁵ Many scholars have reported a correlation between economic factors and suicide rates in Korea,^{6–12} and researchers of various countries have also reported the impact of economic factors on suicide.^{13–24} However, it is difficult to make definite conclusions about this relation because contradictory results are continually emerging.^{25,26} Due to limited data and various other reasons, the majority of existing studies on economic factors and suicide rates have focused on the relationship in terms of macroeconomic factors, such as economic growth rate, unemployment rate, and income disparity,^{10–12,15–24} or have suggested the influence of individuals' economic circumstances on suicidal ideation and attempts.^{6–9,13,14} Therefore, we sought to identify the relationship between individuals' socioeconomic position (SEP) and suicide hazard ratios (HRs) using retrospective cohort data collected from about 1 million Koreans over 11 years. We also tried to find out the impact of SEP on suicide HRs across gender and age groups because Korea shows a different pattern of age-specific suicide rates compared to other OECD countries.⁴ Kim et al have also reported that suicidal ideation differed by gender.⁶ For these reasons, we aimed to identify HRs of suicide across SEPs and to identify trends in HRs of suicide across gender and age groups.

Methods

Ethics statement

The current study was reviewed by the institutional review board of Seoul National University Hospital. Because we utilized only secondary data, the approval process was waived. All data were encoded to protect subjects' privacy.

Data

We used the National Health Insurance Service–National Sample Cohort data, which was built using National Health Insurance claims data provided by the National Health Insurance Service. In Korea, the healthcare system consists of national health insurance and medical aid that covers almost all Koreans. The total number of registrants was approximately 51,878,000 as of June 2015, and the coverage rate of this healthcare system was about 100%.²⁷ The National Health Insurance Service–National Sample Cohort data were sampled from the 2002 database of qualified people for national health insurance and medical aid using a proportional allocation, with stratified sampling according to gender, age, and income. The dataset consists of demographic information (gender, age, and region), income quantiles, disability levels, causes of death, and date of death. We used the data established from January 2003 to December 2013, and we analyzed 1,017,468 subjects out of 1,025,340, after excluding those with missing data.

SEP measurement

The insurance premium in Korea can be considered a proxy indicator for SEP. Therefore, prior studies in Korea have used insurance premium levels as an SEP indicator.^{28,29} For this reason, the current study also used SEP criteria created using insurance premiums of the National Health Insurance System. South Korea's national health insurance is compulsory and universal, and offers three types of coverage: workplace health insurance (for employees), community insurance (for self-employed), and Medicaid (for those who do not qualify for workplace or community

insurance). As of June 2015, 69.6% of Koreans were enrolled in workplace insurance, 27.7% in community insurance, and 2.7% in Medicaid.²⁷ For workplace insurance, the premium is calculated based on the individual's monthly wage, whereas community insurance premiums are calculated according to the individual's household income (including monthly income and assets, such as property, vehicles owned, and other valuables). All calculations of premiums utilize the average income earned during the previous 12 months; the premiums for individuals without an income source (e.g., homemakers and students) depend on the income of principal enrollees (i.e., the people supporting these individuals financially), for whom the same methods of calculation apply. To calculate insurance premiums, income is divided into deciles, with the 1st to 4th deciles being low SEP, the 5th to 8th deciles being middle SEP, and the 9th and 10th deciles being high SEP; individuals with no income receive healthcare coverage through the Medicaid system. These classification criteria were based on those of the Ministry of Land.³⁰

Statistical analysis

In January 2003, the total number of subjects included in the study was 1,017,468. Monitoring began in January 2003 and ended in December 2013. During the monitoring period, we found 2791 cases of suicide mortality. The length of survival for each individual was calculated in months. Each suicide death was processed as “1” and each non-suicide as “0”. The latter includes those censored in the survival analysis. Suicide deaths were classified as X60–X84 according to the International Statistical Classification of Diseases and Related Health Problems (ICD)-10. Geographical location was classified according to administrative districts, which are divided into nine provinces and seven metropolitan cities. Thus, we classified the geographical location as “Metropolitan city” or “Province”. In order to clarify the HRs of suicide associated with age, subjects were stratified by age group (10–19, 20–39, 40–59, and ≥60 years) for the analysis. This classification of age groups was based on research by Kim et al.⁶

To examine the independent effect of SEP on suicide rates, we included age, gender, geographic location, and disability level as control variables. All variables were categorized, including age, and their relations with income were evaluated individually. And we have created stepwise models that includes related variables. To analyze suicide HRs across SEPs, we used Cox proportional hazard models. This method does not assume any particular distribution because it is impossible to presume a theoretical distribution regarding subjects' survival time. As such, the method is advantageous in the sense that the data's baseline hazard function provides a stable estimate of coefficients. However, to apply the Cox model, which measures the baseline hazard function's proportional changes dependent on the independent variable's influence, it is worthwhile to confirm the proportionality assumption — namely, that the independent variable's HR is indeed independent of time.³¹ We confirmed this assumption via a correlation analysis of the independent variable's Schoenfeld residuals and the variable representing the order of incidents. Using the Cox proportional hazard model, HRs and 95% confidence intervals (CIs) were obtained while controlling for gender, age, geographical location, and disability level. Statistical significance level was two-sided at $P < 0.05$, and all analyses were performed with SPSS version 21 (IBM SPSS Inc., Chicago, IL, USA).

Results

The demographic characteristics (age, geographical location, disability level, and SEP) of the 1,017,468 subjects are presented in

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