

Social Capital and Suicide Rates: Panel Data Analysis in South Korea

Sehee Han

Institute of Social Sciences, Kookmin University, South Korea

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Abstract Suicide is a significant public health issue in South Korea. An increasing number of researchers have begun to consider social capital as a protective element against suicide. The major aim of the research was to scrutinize the impact of social capital on suicide rates using panel data in South Korea. All data used in this research, except for the social capital variable, were obtained from the Korean Statistical Information Service. The social capital variable was acquired from the website of the Ministry of the Interior and Safety. Panel data were constructed using administrative-district level data from South Korea spanning from 2009 to 2018. The fixed-effect Poisson quasi-maximum likelihood estimator was applied. The findings showed that higher levels of social capital were related to lower suicide rates ($B = -.046, p < .001$). Thus, a one-unit increase in nonprofit organizations was related to an approximately 4.5% decrease in suicide mortality. However, community center was not statistically associated with suicide rates. The current research provides further evidence that the implementation of a public intervention that can formulate civic society, encourage citizens to articulate and share their concerns, and promote interactions among members of the society for advancing a public interest may have a protective effect on suicide.

Keywords Social Capital, Suicide, Suicide Rates, South Korea, Panel Data Analysis

1. Introduction

Suicide mortality constitutes a significant and pervasive global public health concern with more than 700,000

people dying via suicide each year [1]. Suicide is an important public health problem in South Korea as well; in 2020, the South Korean suicide rate was 25.7 per 100,000 population and suicide was the fifth leading cause of death [2]. South Korea holds the highest suicide rate among the member countries of the Organization for Economic Cooperation and Development [3]. Considerable efforts have been made to reduce and prevent suicide deaths by both researchers and practitioners.

Following Durkheim [4], many researchers have systematically investigated factors associated with suicide to better understand mechanisms behind suicide [5]. Various factors, such as income, employment rate, population size, divorce rate, social expenditure, and economic rate have been suggested to be related to suicide [6, 7]. Among the many variables, an increasing number of researchers have begun to consider social capital as a protective element against suicide [8-13].

Social capital, which refers to the available social resources for people or groups via their social relationships [14], is reported to be associated with various health outcomes [15-17]. While social capital encompasses multiple facets, it is often characterized by two distinct components: structural and cognitive [18]. The structural form of social capital is related to observable behavioral manifestations of social interactions, whereas cognitive social capital entails the attitudinal manifestations of social relationships that are subjectively perceived. While a cognitive component of social capital has an important theoretical implication, a structural form of social capital is better suited for public health interventions [19]. This research concentrated on the structural component of social capital.

Several theoretical pathways have been suggested connecting social capital to various health outcomes. For instance, social capital can improve health by facilitating dissemination of health knowledge and information. Social capital may additionally serve as a protective buffer against the negative effects of stress, life events, limited access to community services, and tangible resources, including job opportunities [20]. Moreover, social capital can foster healthy behaviors, such as physical activity and deter unhealthy behaviors, such alcohol or substance abuse [21]. These mechanisms can be applied to explain the linkage between social capital and suicide.

It is also argued that social capital works both horizontally and vertically [22, 23]. Horizontal social capital encompasses cooperative social relationships among network members who possess equivalent or comparable social status and power. This horizontal manifestation of social capital can have a pivotal impact on fostering social cohesion and integration between people and various groups, which are important protective factors against suicide [12]. Vertical social capital refers to mutually respectful and trusting relationships between people of different levels of hierarchy and unequal political power. In general, vertical social capital links citizens to institutionalized or formal authorities, including politicians and civil servants. Accordingly, vertical social capital can facilitate citizens to communicate with decision makers, which enables them to engage on public health issues, including interventions for suicide prevention [12].

To date, only a limited body of research has been performed to explore the relationship between various dimensions of social capital and suicide rates. Prior studies were conducted at multiple levels, including the national level [8], European country level [9], state level in the U.S. [13], county level in the U.S. [12, 24], and city level in Japan [11]. In general, these studies reported that some forms of social capital were related to decreased suicide rates. One shortcoming of previous studies is that they primarily relied on the cross-sectional data analysis. One such research [24] explored the impact of social capital on suicide rate using panel data. Its results were based on the random effects estimator that posits no correlation between social capital and time-invariant factors. This is a strong assumption that needs further investigation and therefore more research is needed.

Given this information, the major objective of the research was to estimate the impact of social capital on suicide rates using panel data from 2009 to 2018 in South Korea.

2. Materials and Methods

2.1. Data

Other than the social capital variable, all the data for this research were gained from the Korean Statistical Information Service (KOSIS), which are publicly available

(<http://kosis.kr/index/index.do>). Social capital variable was gained from the Ministry of the Interior and Safety website that is also publicly available (<https://www.mois.go.kr/frt/a01/frtMain.do>). Panel data were constructed using administrative-district-level data from South Korea spanning from 2009 to 2018. Descriptive statistics for the variables utilized in this research are shown in Table 1. The mean of suicide rate per 100,000 for the study period was 33.75.

Table 1. Descriptive statistics, 2009-2018.

	Mean	SD	Min	Max
Suicide rate per 100,000 population	33.75	11.36	2.1	128.7
NPOs per 100,000 population	2.43	2.56	0	36.55
Community center per 100,000 population	9.39	8.45	0.6	74.9
Health expenditure per capita (1,000 KRW)	7.25	6.57	0.944	73.11
Population density	3762.61	6085.46	19.45	29290.29
GRDP per capita (1 million KRW)	30.76	43.54	0.79	1069.98
Social expenditure per capita (1,000 KRW)	77.00	32.95	15.70	183.65
Population aged 65 or above (%)	16.94	7.65	04.90	37.14
Fiscal autonomy (%)	61.07	10.98	28.3	91.8
Female population (%)	49.87	1.15	43.30	52.50
Disabled population (%)	6.48	2.22	1.69	14.42
University degree and above (%)	23.52	11.88	4.92	72.19
Public servant per 1,000 residents	7.11	5.17	1.10	37.55

2.2. Suicide Deaths

Suicide mortality was defined by referencing the International Classification of Diseases-10 codes X60-X84. As a robustness check, further investigation was performed to assess the impact of incorporating undetermined deaths as suicide mortality on the findings [25]. The results showed that there were no notable changes in the effect of social capital, indicating that the incorporation of undetermined deaths did not have a significant impact on the obtained results.

2.3. Social Capital

Two structural dimensions of social capital were measured. Firstly, the number of nonprofit organizations

(NPOs) per 100,000 population, which was used in the previous study [26] was utilized. This measure is commonly recognized as Putnam-type associations, which are characterized by horizontally structured groups [14]. Compared to Olson-type associations that tend to collaborate in rent seeking, Putnam-type associations tend to collaborate to provide public goods, thereby fostering positive externalities for society as a whole [27]. Given that one of the major goals of NPOs is pursuing a public purpose [28], they can be considered as Putnam-type associations.

It needs to be noted that NPOs are often deemed as a crucial source of social capital [29]. Essentially, the endeavors of NPOs foster public values, shared norms, and the fulfillment of unmet community services, thereby generating societal or community benefits. Moreover, NPOs promote social interactions among people with various backgrounds and interests, facilitating their pursuit of common goals and participation in collective action [28]. This pivotal role of NPOs exemplifies an important function of social capital [14]. Thus, NPOs are recognized as social capital [28].

Secondly, community center was measured by utilizing the number of cultural, literary, exhibition, and art centers per 100,000 population. Community center may increase chances for informal social relationships, which can mitigate the detrimental influence of life experiences and increase social integration [14, 30].

2.4. Confounders

To reduce residual confounding, a wide range of confounders was considered by referencing previous studies [10-13, 24, 31]. Included confounders were health expenditure per capita, social expenditure per capita, population density, gross regional domestic product (GRDP) per capita, the percentage population aged above 65, the percentage of female population, the percentage of disabled population, the proportion of public servants per 1,000 residents, and local fiscal autonomy.

2.5. Statistical Analysis

By utilizing panel data, the current study estimates the impact of social capital on suicide rates. To account for the panel data structure, a random-effect model could be applied. It needs to be noted that the random-effect estimator assumes that there is no correlation between explanatory variables and an unobserved time-invariant error [32]. Thus, estimated coefficients of social capital variables on suicide rates from random-effect estimator are inconsistent, if there is a correlation between social capital and unmeasured time-invariant factors.

The current study adopted the fixed-effect estimator that allows a correlation between social capital and unmeasured time-invariant factors. Since the outcome variable for this study is count in its nature, Poisson regression was applied.

Specifically, the fixed-effect Poisson quasi-maximum likelihood estimator (QMLE) was applied to adjust for overdispersion. It should be noted that the Poisson QMLE does not assume count outcomes to be equidispersed [32]. Moreover, unlike the negative binomial fixed-effect estimator, the fixed-effect Poisson QMLE does not suffer from the incidental-parameters problem [33]. In the Poisson regression model, the log of the total number of population was included as the offset variable in the model to adjust for the different numbers of population at risk. In all models, year fixed effects are included to adjust for temporal trends in suicide rates across the study regions.

Stata 15.1 (StataCorp., College Station, TX) was utilized to analyze the data. Cluster-robust standard errors at the administrative-district level were applied to adjust for the arbitrary within-administrative district correlation. For comparison, the results based on the random effects estimator are also presented.

3. Results

Table 2. Estimates of the effects of social capital on suicide rates from 2009 to 2018 in South Korea using the Poisson QMLE.

	Model A	Model B
NPOs	-.001 (.661)	-.046 (.011)***
Community center	-.002 (.006)	-.008 (.005)
Health expenditure per capita	-.001 (.002)	-.009 (.003)**
Population density (ln)	-.023(.013)	.030 (.024)
GRDP per capita (ln)	-.022 (.010)*	-.073 (.013)***
Social expenditure per capita	.0005 (.007)	.001 (.001)
Population aged 65 or above	.012 (.004)*	.056(.021)**
Fiscal autonomy	-.002 (.001)*	-.038 (.008)***
Female population	-.025 (.013)	.044 (.036)
Disabled population	.016 (.010)	-.003 (.010)
University degree and above	-.006(.001)***	-.010 (.004)*
Public servant per 1,000 residents (ln)	.051 (.030)	.026 (.041)
District fixed effects	No	Yes
Year fixed effects	Yes	Yes
Observations	2,131	2,131
Districts	220	220

Notes: cluster-robust standard errors are in parentheses.
* $p < .05$; ** $p < .01$; *** $p < .001$.

Table 2 shows estimates of the effects of social capital on suicide rates. In Model A, the results based on the random-effect estimator that does not control for unobserved time-invariant variables are shown. The results revealed that both NPOs and community center were not statistically associated with suicide rates. In Model B, the results based on the fixed-effect estimator that controls for

time-invariant factors are presented. The results showed a negative relationship between NPOs and suicide rates ($B = -.046, p < .001$). Thus, a one-unit increase in NPOs was related to an approximately 4.5% decrease in suicide mortality. Again, community center was not statistically associated with suicide rates.

3.1. Robustness Checks

Additional analyses were performed to assess the robustness of the conclusions. Foremost, the year fixed effects were considered using different specifications. For instance, instead of considering dummy year fixed effects, either linear or both linear and quadratic years fixed effects were considered. No appreciable changes could be found. Secondly, more confounders were considered to further reduce residual confounding. Included confounders were marriage rate, government total revenues per capita, the number of people for livelihood protection per 1,000 population, and the number of beds at hospital per 1,000 population [34, 35]. No significant changes in the effects on the social capital variables could be observed. Thirdly, the natural log transformation on the social capital variables was applied, and the analysis has been re-conducted. The results indicated a negative relationship between NPOs and suicide rates, whereas community center did not show a statistically significant relationship with suicide rates. Finally, linear fixed-effect estimator was applied using the natural log of suicide rate per 100,000 population as an outcome variable. The results indicated that there was a negative relationship between NPOs and suicide rates ($B = -.064, p < .01$), which were similar to the results based on the fixed-effects Poisson QMLE estimator. The results are reported in Table 3.

Table 3. Estimates of the effects of social capital on suicide rates from 2009 to 2018 in South Korea using the linear fixed-effect estimator.

	Coefficients (SE) ^a
NPOs	-.064 (.023)**
Community center	.007 (.010)
District fixed effects	Yes
Year fixed effects	Yes
Observations	2,131
Districts	220

a. cluster-robust standard errors are in parentheses.

The same confounders are included as Table 2.

* $p < .05$; ** $p < .01$; *** $p < .001$.

4. Discussion

Suicide mortality represents a substantial global public health issue, and social capital has been identified as a crucial protective factor against suicide [8, 13]. By

fostering community engagement that aims to produce benefits for broader members of the society, social capital may, in turn, help prevent suicide [36]. However, empirical studies estimating the effect of social capital on suicide in the entire region of South Korea are scarce. Utilizing panel data between 2009 and 2018 in South Korea, the present research aimed to address research gaps in the field of social capital and suicide through the examination of the association between NPOs and community centers, which represent the structural dimension of social capital, and suicide rates. To control for unobserved time-invariant variables, this research used the fixed-effect Poisson QMLE estimator.

The findings of the current research indicated a negative relationship between NPOs and suicide rates. For instance, an increase in NPOs was related to a reduction in suicide rates. However, community facility was not statistically related to suicide rates. The results, which showed a negative relationship between the structural component of social capital and suicide, were in line with the previous research relying on cross-sectional data analysis [12] and panel data analysis [24] in the USA. The present research further provided evidence that presence of organizations that encourages group activities aiming to achieve public goals can possibly protect against suicide in South Korea.

Theoretically, organizations that are characterized by a horizontal structure can encourage and provide chances for citizens to have positive views and to socially interact with not only their own group members but also other members of the society [37]. This horizontally structured organization, in turn, can facilitate access to both tangible and intangible resources [30], exert control over deviant health behaviors and encourage healthy behaviors [38], and increase the likelihood of participating in collective action related to addressing broader public issues that is beneficial for the whole society [37], such as preventing suicide. Through these mechanisms NPOs may lower suicide mortality.

The findings of this research have an important policy implication. The results suggest that public policy interventions, such as subsidies or other programs aimed at promoting associational life and social integration, can be beneficial for preventing and mitigating suicide mortality. As it was emphasized by some researchers [14, 27], it is important for decision makers to differentiate types of organizations. The results of this study provide evidence that facilitating horizontally structured organizations can be associated with reduction suicide rates and this provides important information for policy makers. Those who consider social capital as a suicide preventive intervention should carefully distinguish dimensions of social capital, as different forms of social capital may not have similar influences on health-related outcomes [39], including suicide rates.

This research has several limitations to be noted. Foremost, this study included various time-varying factors to reduce residual confounding due to unobserved time-

varying heterogeneity. However, it still needs to be noted that there may be other unobserved time-varying characteristics that could have affected the estimated impacts of the social capital variables on suicide rates. Second, while the current research posited that social capital influences suicide rates, it is also likely that social capital is a reaction to suicide rates in regions. In general, NPOs have been considered as entities that aim to promote social integration and values while fulfilling public needs [40]. In South Korea, the South Korean nonprofit sector has continuously evolved since the early 1900s. During the period preceding the mid-1980s, NPO sector in South Korea flourished with organizations that had a close affiliation with the government because the country was operating under an authoritarian developmental state [41]. The number and scope of NPOs have been rapidly proliferated since the 1990s due to the process of democratization, and they are now widely considered as critical actors facilitating the well-being of humans and providing various social services and goods in reaction to social needs [41].

Thus, it is conceivable that NPO activities could be a response to depressed communities or unsatisfactorily operating governments that fail to address public health problems, including suicide. If this premise holds true, reverse causality could have biased the effect of NPOs on suicide.

Third, this research employed a district-level analysis to estimate the impact of social capital on suicide rates. It was reported that the effect of social capital on health measures may differ depending on the specific contexts under investigation [42]. It is also argued that collective social capital is better captured at smaller geographic areas, such as neighborhood and community, as they can provide a more precise representation of daily social interactions [43]. Thus, further effort that investigates the impact of social capital on suicide rates at different levels of context needs to be taken. Finally, this research only utilized the structural form of social capital and did not consider cognitive social capital. Although structural social capital is considered as a more policy relevant variable, cognitive social capital can also provide information about a theoretical mechanism linkage from social capital to suicide [9, 11]. However, the current research was unable to use the cognitive component of social capital because of limited data accessibility.

5. Conclusions

In conclusion, the current research investigated the effect of social capital on suicide rates by employing panel data spanning the years 2009 and 2018 in South Korea, with a focus on the district level. This research found that a dimension of social capital, captured by NPOs was inversely related to suicide rates. This research further provides evidence that the implementation of a public intervention can formulate civic society, which encourages

citizens to articulate and share their concerns and to interact with other members of the society for advancing a public interest which may in turn have a protective effect on suicide. Nevertheless, it should also be noted that since NPOs, in general, are not specifically established and designed to prevent suicide, the findings of the current research may be a preventive unintended result of associational life.

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Conflict of Interest

The author claims that there are no competing interest.

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