



Changes in suicide inequalities in the context of an increase and a decrease in suicide mortality: The case of South Korea, 1995–2020

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ABSTRACT

South Korea experienced a sharp increase until 2010 followed by a gradual decrease in suicide mortality. This study examined changes in socioeconomic inequalities in suicide over 25 years and how suicide inequalities changed in the context of both an increase and a decrease in suicide mortality. Data with five-year intervals were extracted from the Korean death registry and census data between 1995 and 2020. Using Poisson regression, four measures of suicide inequalities were calculated for the slope of inequality index (SII), relative index of inequality, rate ratios, and ratio differences. Educational inequalities in suicide were obvious across all sub-populations, measures, and periods. The widening of suicide inequalities, particularly with absolute measures, followed an increase in suicide mortality until 2010. In contrast, a decline of suicide inequalities concurred after 2010 during the period of a decline in suicide mortality. SII among the total population decreased by 35.4%, from 62.4 per 100,000 people (95% confidence interval [CI], 59.8–64.9) in 2010 to 40.3 (95% CI, 38.3–42.4) in 2020. The pattern of widening and narrowing in suicide inequalities observed in the whole population was only concordant with the older population. However, the younger and the middle-aged population showed a gradual increase or stalemate in the inequalities throughout the period. Overall, suicide inequalities narrowed in the recent decade. This decline was largely led by the older population, and was attributed to the provision of social protection. A decline of suicide inequalities can accompany a decline in suicide mortality, when the provision of social protection favored the less educated.

1. Introduction

Suicide is widely acknowledged as a significant public health issue, contributing to approximately 703,000 deaths worldwide (WHO, 2021). Average suicide rates in recent decades have declined in most countries, including countries such as Japan, Finland, and Eastern European countries such as Hungary, Lithuania, and Estonia, which recorded alarmingly high suicide rates at one time and successfully managed to

track progress in suicide control (Supplementary Fig. 1) (OECD, 2024). Over the period, South Korea initially experienced a notable surge and stayed at the top suicide rates for 20 years among OECD countries, though a slight declining trend was seen after 2011 (Fig. 1).

Suicide inequalities refer to the uneven distribution of suicide mortality across different socioeconomic status (SES) (Lorant et al., 2005; Platt, 2016). Simultaneous monitoring of suicide mortality and suicide inequalities provides a better appreciation of the suicide situation. For

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example, if an increase in suicide mortality is accompanied by an increase in socioeconomic inequalities in suicide, this could result from a more marked increase in suicide in populations with a lower SES. Suicide mortality and inequalities are interrelated but have rarely been studied together. Most previous studies on suicide (or mortality in general) have shown that an increase in suicide or overall mortality concurred with a widening of inequalities (Allik et al., 2020; Case and Deaton, 2017), as shown in excess mortality during the recent COVID-19 pandemic (Wachtler et al., 2020).

However, in the periods of the overall decline in suicide or mortality, the direction of suicide inequalities was not obvious; most of evidence showed the worsening of suicide inequalities (Hiyoshi et al., 2018; Lorant et al., 2005; Mackenbach et al., 2016; Ordóñez-Monak et al., 2021; Page et al., 2006; Too et al., 2018), while others showed the narrowing (Borrell et al., 2017) or conflicting patterns of both directions (Leinsalu et al., 2020). A narrowing of inequalities in the context of declining suicide or mortality is important because this indicates an promising intervention that favors lower socioeconomic groups (Regidor et al., 2009). In this regard, South Korea presents a unique condition, undergoing a sharp increase in suicide until 2010, followed by a gradual decrease in the recent decade. We now examine changes in suicide inequalities in the context of both an increase and a following decrease in suicide mortality.

When examining suicide inequalities, uneven distributions regarding gender and age groups are frequently reported. In South Korea, social security measures targeting the older population such as the basic old-age pension (2008) and long-term care insurance (2008–2009), were recently introduced (Fig. 1). The expansion of social protection programs was supported as a measure to mitigate suicide or mental health, as seen in recent reviews in high- low- and middle-income countries (Basterra et al., 2023; Kim, 2018; Niedzwiedz et al., 2016). Thus, the South Korean case provides a natural experiment on the impact of particular social protection programs on the decline in suicide inequalities regarding age and gender differences.

Using death registry and census data encompassing the entire Korean population, our study aimed to examine: i) whether suicide inequalities changed in relation to suicide mortality during two distinctive periods: between 1995 and 2010 (with an increase in suicide rate) and between 2010 and 2020 (with a decrease in suicide rate); ii) whether suicide inequalities differed by age and gender and whether the differences were related to the recent introduction of the social security measures given to the older population.

2. Methods

2.1. Data sources

We employed two primary data sources representing the entire Korean population: the official Korean census data and the National Death Registry (Statistics Korea, 2022). Given the inability to link these two datasets at an individual level, we extracted the number of suicide deaths (for numerator) and population (for denominator) in the form of aggregate data and merged them by subgroup. The number of suicide deaths and population were disaggregated by gender, age groups, and educational levels in five-year intervals from 1995 to 2020, corresponding to the census years. We used the Korean Statistical Information Service to calculate the annual suicide rate (Fig. 1). Missing data related to education were noted in the death registry, ranging from 0.06% to 2.6% between 1995 and 2015, except for 6.8% in 2020, and below 0.01% for census data. Individuals with missing education data were excluded from the analysis.

2.2. Measures

Suicide deaths were identified using the International Classification of Disease, 10th Edition Revision (ICD-10), codes of X60–X84. Previously, Korea's official death statistics heavily relied on death notification cards filled out by the deceased's family, leading to potential misclassification due to a lack of autopsy verification and reporting biases. Underreporting of suicide due to cultural factors, such as Confucian values and social stigma, exacerbated this issue. Since the 2000s, the government has improved the accuracy of suicide data by increasing the proportion of medically certified deaths, revising death certificate forms, and expanding the integration of registered death statistics with various administrative datasets (e.g., Police Reports for Incidents or Injuries) (Chan et al., 2015; Ryu et al., 2024). Education level was utilized as an indicator of SES and was categorized into four groups: elementary school or below, middle school, high school, and college or above. Age was categorized as 30–44, 45–59, and 60+ years; those under 30 years of age were excluded from the analysis owing to considerable changes in educational attainment in this age group.

2.3. Analysis

Suicide mortality rates were calculated by dividing the suicide deaths by the total or sub-populations in a given year. All suicide

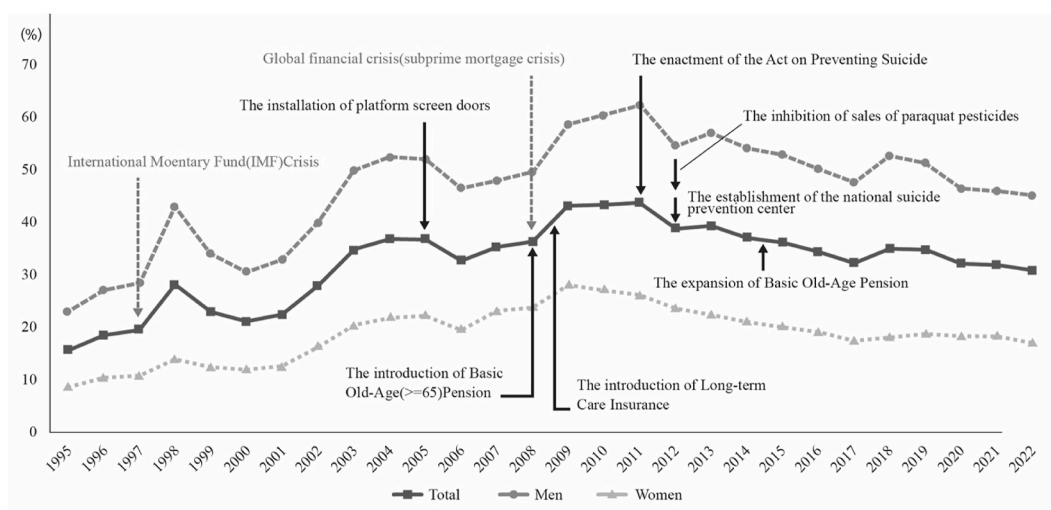


Fig. 1. Annual change in suicide rate and related policy shifts in South Korea (1995–2022).

Note. Suicide rates were calculated per 100,000 populations among the Korean population aged 30 or above using Korean Statistical information service(KOSIS) data (1995–2022).

mortality rates were expressed as the number of suicidal deaths per 100,000 individuals. We assessed the changes in suicide inequalities using four summary measures for inequalities across multiple educational levels: relative index of inequality (RII), slope index of inequality (SII), risk ratio (RR), and risk difference (RD). These measures address several aspects of inequalities: 1) relative (RII and RR) vs. absolute inequalities (SII and RD) and 2) inequalities across over all categories (RII and SII) vs. between two extreme categories (i.e., highest and lowest educational groups; RR and RD). A Poisson regression was used to derive RII and SII with an application of the logarithmic and identity link functions, respectively. RII and SII measures consider all educational level categories and the population size within each category. To consider population size, the proportions of educational level were transformed into cumulative proportions by obtaining the mid-point value, which ranges from 0 to 1 (Regidor, 2004).

Similarly, a Poisson regression was used to calculate the RR and RD, focusing on the difference between two groups with the highest and lowest educational levels. Suicide inequalities were estimated for the total population and separately for age and gender-specific sub-populations. Statistical analyses were performed using SAS software version 9.4.

3. Results

The changes in demographic and the distribution of educational levels in the Korean population based on the census data are presented in Table 1. The proportion of the older population has been increasing over time while that of the young population has been decreasing. Additionally, a significant increase in educational attainment was observed during the study period, and the share of tertiary education (i.e., a college degree or above) increased from 16.9% in 1995 to 41.6% in 2020.

The trends in suicide mortality and inequalities in the total population and by gender are presented in Fig. 1 and Table 2. The trend in overall suicide rates were changed around 2011, with an increase in suicide rates per 100,000 from 15.6 to 43.5 between 1995 and 2011, followed by a decrease to 30.6 until 2020. The peak year of suicide rate differed by gender: 2009 for women and 2011 for men (Fig. 1). The trend in suicide inequalities by educational level mirrored that of the overall suicide rate, showing an increase in inequalities until 2010 and a subsequent decrease, which was demonstrated in SII and RD. The SII increased by up to 169% from 23.2 (95% confidence interval [CI], 21.5–24.8) to 62.4 (95% CI, 59.8–64.9) between 1995 and 2010, and then decreased by 35.4%–40.3 (95% CI, 38.3–42.4) in 2020. The larger magnitude of suicide inequalities among men compared with women was observed in all inequality measures.

Further, detailed suicide inequalities by gender and age groups are presented in Fig. 2. Suicide inequalities by level of education are observed robustly regardless of time and sub-populations. These

distributional gaps indicated that individuals with lower education mainly contributed to suicide outcomes. The magnitudes of suicide inequalities were consistently larger in men than women (Supplementary Fig. 2). Additionally, the suicide inequalities remained larger in the young and middle-aged populations than in the older population; this was observed for all inequality measures except for SII. The changing patterns of suicide inequalities among the older population were similar to the patterns of inequalities and mortality rate observed in the whole population; that is, an increase until 2010 and then a decrease afterward. The similarity of the changes between suicide inequalities and suicide mortality only among the elderly population were also supported by Spearman non-parametric correlation test (data not presented). However, younger population did not follow this trend. Suicide inequalities in middle-aged men and women were steady or gradually increased, with a surge in recent years. Suicide inequalities among young women demonstrated a general increase throughout the period, as evidenced by the SII, which rose from 9.6 (95% CI, 7.4–11.8) in 1995 to 37.6 (95% CI, 31.5–43.7) in 2020. However, a gradual increase and high in suicide inequalities among young men was observed for absolute measures but not relative measures.

Though the survey years are not exactly neighboring to COVID-19 pandemic, the influence of the pandemic was partly reflected in the changes in suicide mortality and inequalities between 2015 and 2020. Though there was a general decline in suicide inequalities between 2015 and 2020, there were some exceptions, and an increase in suicide inequalities (SII) was observed among the middle-aged population and slightly among young women.

4. Discussion

The current study mainly focused that under a certain condition the reduction of suicide inequalities as well as suicide mortality can occur together. Suicide inequalities, concurrent with the suicide trend, widened until 2010 and then narrowed. This pattern was observed among the older population but not among other age and gender groups; middle-aged and young populations exhibited an increase in suicide inequalities until recent years, observed using absolute measures (i.e., SII and RD).

Suicide inequalities by educational level were robust among all gender and age groups throughout the study period. Overall, the consistent finding of strong inequalities in suicide compared with other cause-specific mortalities highlights that lower SES populations suffer the most from suicide, reminding the appropriate designation of the suicide as “deaths of despair” (Case and Deaton, 2017). Additionally, suicide inequalities in the current study were presented not simply between the lowest and highest educational levels but also across the whole population, as shown by gradient measures (RII and SII). This implies that suicide inequalities are a result of “inequality-generating structures” rather than a problem of the most disadvantaged (Platt,

Table 1
Changes in general characteristics in South Korea (aged 30 or above).

Characteristics	1995		2000		2005		2010		2015		2020	
	N	%*	N	%	N	%	N	%	N	%	N	%
Gender												
Men	10,594,297	48.4	11,851,770	48.3	13,168,975	48.1	14,360,159	48.0	15,929,409	48.4	16,781,414	48.7
Women	11,278,723	51.6	12,677,342	51.7	14,232,762	51.9	15,542,273	52.0	16,949,963	51.6	17,708,317	51.3
Age groups (years old)												
30-44	11,352,852	51.9	12,174,280	49.6	12,224,751	44.6	11,863,107	39.7	11,529,774	35.1	10,399,012	30.2
45-59	6,406,474	29.3	7,226,002	29.5	8,981,295	32.8	10,584,355	35.4	12,198,943	37.1	12,467,455	36.1
60+	4,113,694	18.8	5,128,830	20.9	6,195,691	22.6	7,454,970	24.9	9,150,655	27.8	11,623,264	33.7
Educational level												
≤Elementary	7,037,859	32.2	6,608,813	26.9	6,042,014	22.0	5,783,155	19.3	4,964,786	15.1	3,808,537	11.0
middle school	3,830,999	17.5	3,655,187	14.9	3,422,923	12.5	3,355,754	11.2	3,285,540	10.0	3,140,275	9.1
high school	7,304,179	33.4	9,110,039	37.1	10,636,584	38.8	11,328,294	37.9	12,114,752	36.8	13,186,024	38.2
≥College	3,699,983	16.9	5,155,073	21.0	7,300,216	26.6	9,435,229	31.6	12,514,294	38.1	14,354,895	41.6

Table 2
The trend in suicide mortalities, rates, and educational inequalities (RII, SII, RD, RR) by gender in South Korea (aged 30 or above).

	1995		2000		2005		2010		2015		2020	
	n	% ^c	n	% ^c	n	% ^c	n	% ^c	n	% ^c	n	% ^c
Suicide rate	3423	15.6	5236	21.3	10,291	37.6	13,331	44.6	11,824	36.0	10,567	30.6
Total population												
Educational level												
≤Elementary	1669	23.8 (22.6–24.9)	2344	35.3 (33.9–36.8)	4335	63.4 (61.3–65.6)	4639	71.8 (69.4–74.2)	3190	59.8 (57.4–62.4)	2125	59.8 (56.8–63.0)
middle school	688	17.2 (15.8–18.7)	1041	28.8 (27.0–30.7)	1789	55.8 (53.2–58.5)	2079	62.4 (59.8–65.2)	1859	55.6 (53.1–58.2)	1410	45.9 (43.6–48.5)
high school	805	10.4 (9.5–11.3)	1399	15.6 (14.7–16.7)	2959	33.9 (32.6–35.4)	4377	43.3 (41.9–44.8)	4270	36.7 (35.5–37.9)	4028	30.0 (29.1–31.0)
≥College	261	6.6 (5.8–7.6)	452	8.9 (8.1–9.9)	1208	21.1 (19.8–22.5)	2236	27.9 (26.7–29.3)	2505	21.6 (20.6–22.5)	3004	19.9 (19.1–20.8)
RII (95% CI) ^a	7.7 (2.6–23.4)		9.1 (3.0–28.0)		6.6 (1.8–24.4)		5.4 (1.9–15.1)		6.0 (2.1–16.9)		5.0 (2.0–12.6)	
SII (95% CI) ^a	23.2 (21.5–24.8)		34.6 (32.8–36.4)		56.4 (54.0–58.7)		62.4 (59.8–64.9)		53.2 (51.0–55.4)		40.3 (38.3–42.4)	
RR (95% CI) ^b	3.4 (3.0–3.8)		4.1 (3.7–4.5)		4.3 (4.1–4.6)		3.4 (3.2–3.6)		3.2 (3.1–3.4)		2.7 (2.5–2.8)	
RD (95% CI) ^b	16.7 (15.2–18.1)		26.7 (25.1–28.3)		55.2 (52.9–57.5)		56.5 (54.0–59.0)		44.2 (41.9–46.6)		34.9 (32.4–37.4)	
Men												
Educational level												
≤Elementary	1063	46.1 (43.4–49.0)	1478	70.7 (67.1–74.4)	2625	128.1 (123.0–133.5)	2752	138.6 (133.1–144.4)	1958	122.2 (116.3–128.4)	1316	116.5 (109.4–123.9)
middle school	539	28.8 (26.2–31.7)	793	47.7 (44.3–51.3)	1379	94.5 (89.7–99.7)	1577	104.1 (99.1–109.4)	1451	96.9 (92.0–102.1)	1052	75.9 (71.3–80.7)
high school	626	13.7 (12.5–15.2)	1079	21.9 (20.3–23.5)	2189	48.1 (45.8–50.4)	3106	62.2 (59.9–64.7)	3196	55.8 (53.8–57.8)	2901	45.0 (43.4–46.7)
≥College	207	7.0 (6.0–8.1)	365	10.2 (9.1–11.5)	913	24.9 (23.2–26.7)	1621	34.6 (32.8–36.5)	1833	28.2 (26.8–29.6)	2172	27.6 (26.3–28.9)
RII (95% CI) ^a	9.1 (3.3–25.1)		10.5 (3.8–28.9)		7.6 (1.8–32.4)		5.9 (2.03–17.3)		6.7 (2.7–16.6)		5.3 (2.4–11.8)	
SII (95% CI) ^a	37.9 (35.1–40.7)		55.0 (51.9–58.0)		86.4 (82.4–90.4)		94.5 (90.1–98.9)		83.9 (80.0–87.8)		61.2 (57.7–64.8)	
RR (95% CI) ^b	5.8 (5.0–6.7)		6.5 (5.8–7.3)		6.8 (6.3–7.4)		5.2 (4.9–5.5)		5.0 (4.7–5.4)		4.1 (3.9–4.4)	
RD (95% CI) ^b	38.3 (35.4–41.3)		59.5 (55.7–63.2)		119.3 (113.8–124.8)		123.9 (118.0–129.9)		105.1 (99.2–111.0)		87.3 (81.0–93.6)	
Women												
Educational level												
≤Elementary	606	12.8 (11.8–13.8)	866	18.7 (17.4–20.1)	1710	36.0 (34.0–38.1)	1887	44.6 (42.2–47.1)	1232	36.6 (34.1–39.3)	809	39.7 (36.3–43.5)
middle school	149	7.1 (5.9–8.5)	248	13.0 (11.4–14.9)	410	23.4 (21.2–25.8)	502	27.5 (25.2–30.0)	408	22.5 (20.4–24.8)	358	22.0 (19.9–24.5)
high school	179	5.5 (4.6–6.6)	320	8.1 (7.1–9.2)	770	18.1 (16.6–19.6)	1271	23.6 (22.1–25.1)	1074	17.1 (16.0–18.3)	1127	15.4 (14.5–16.4)
≥College	54	4.9 (3.7–6.5)	87	5.5 (4.4–7.0)	295	13.7 (12.1–15.6)	615	17.2 (15.7–18.9)	672	11.8 (10.7–12.9)	832	10.2 (9.4–11.1)
RII (95% CI) ^a	3.4 (1.2–9.5)		4.5 (1.3–15.2)		3.8 (0.9–15.7)		3.7 (1.3–10.1)		4.0 (1.5–10.6)		4.1 (2.2–7.6)	
SII (95% CI) ^a	9.0 (7.1–10.9)		15.3 (13.3–17.4)		27.9 (25.1–30.7)		32.5 (29.6–35.4)		24.5 (22.1–26.8)		20.7 (18.5–22.9)	
RR (95% CI) ^b	2.6 (2.0–3.5)		3.9 (3.1–4.9)		4.0 (3.5–4.5)		3.0 (2.8–3.3)		2.9 (2.6–3.2)		2.4 (2.2–2.6)	
RD (95% CI) ^b	7.9 (6.3–9.6)		14.3 (12.6–15.9)		30.7 (28.4–33.0)		31.7 (29.2–34.2)		23.3 (21.1–25.5)		17.6 (15.4–19.9)	

Note. RII=Relative Index of Inequalities; SII=Slope Index of Inequalities; RR=Rate Ratio; RD = Rate Difference; CI=Confidence Interval.

^a RIIs and SIIs are relative rates and differences across educational groups, adjusted for the size of each group of the population.

^b RRs and RDs measured the ratios and differences between two extreme categories (the lowest and highest groups) at the educational level.

^c Suicide rates were calculated per 100,000 population.

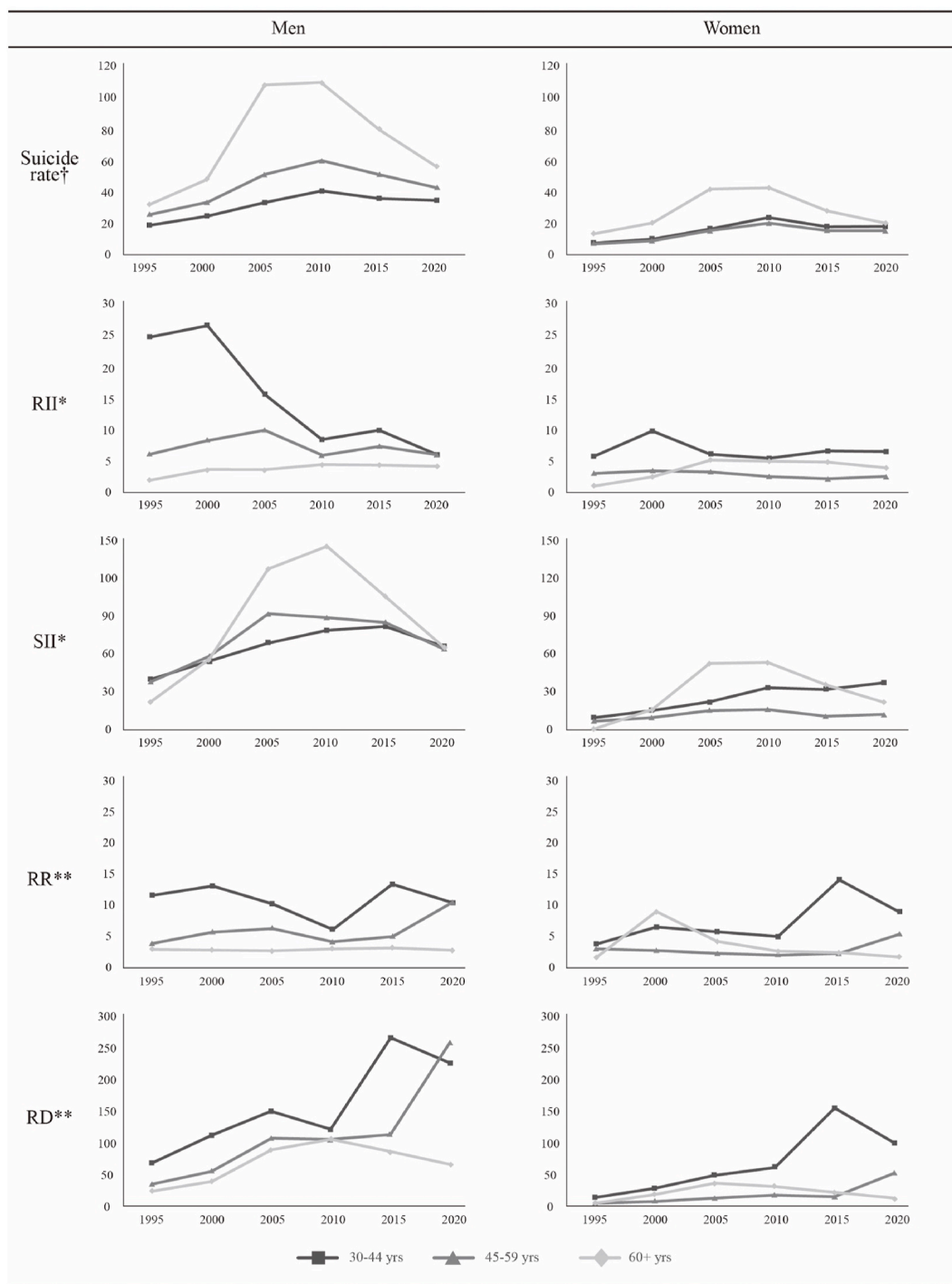


Fig. 2. Trends in suicide rate and educational inequalities by gender and age groups in South Korea, 1995–2020.

Note. RII=Relative Index of Inequalities; SII=Slope Index of Inequalities; RR=Rate Ratio; RD = Rate Difference.

* RIIs and SIIs are relative rates and differences across educational groups, adjusted for the size of each group of the population.

** RRs and RDs measured the ratios and differences between two extreme categories (the lowest and highest groups) at the educational level.

† Suicide rates were calculated per 100,000 population.

2016). The magnitudes of suicide inequalities were consistently larger in men than women. These findings were similar to those of previous studies (Hiyoshi et al., 2018; Lorant et al., 2018; Phillips and Hempstead, 2017). However, several studies have shown that the gap in suicide inequalities between men and women has narrowed in recent trends (Burrows et al., 2010; Hiyoshi et al., 2018; Phillips and Hempstead, 2017). In our study, the suicide inequalities were larger among young and middle-aged individuals than among the older population for

all summary measures of inequalities except for SII. The larger suicide inequalities among the younger population have been consistently observed in previous studies (Burrows et al., 2010; Ordóñez-Monak et al., 2021; Page et al., 2006; Pompili et al., 2013). This supports that suicides among the younger population are more motivated by socio-economic reasons such as poor provision of labor market protection and opportunities for education and training (Fleckenstein and Lee, 2024).

The current study revealed a worsening of suicide inequalities when

suicide mortality rose, but an improvement in suicide inequalities when suicide mortality fell. Most previous studies have reported an increase in inequalities because the most vulnerable in the social strata are hit first, and they slowly recover when indicated by an increase or decrease in mortality (Tobias et al., 2009). Mackenbach et al. (2016) argued that the narrowing of mortality inequalities in a situation of mortality decline, observed in the current study, is rare (Mackenbach et al., 2016). This may be explained by the fact that this trend was only observed among the older population, suggesting that they were a major driver of the change. The primary explanation for the decline of suicide inequalities during the decline of suicide mortality may be the expansion of social protection coverage. Both the basic old-age pension and long-term care launched in 2008 (Fig. 1) were provided solely to this age group and were largely lacking in the period associated with an increase in suicide mortality (Lee et al., 2018; Yun, 2018). This explanation is further supported by findings from Sweden, wherein suicide inequalities increased under the condition of suicide decline when the decline was given with the downsizing of social protection (Hiyoshi et al., 2018). The findings including ours pointed out that suicide mortality and inequalities are two separate phenomena but they are interrelated depending on situational conditions, such as social protection. It is important to point out that income inequalities turned from increase to decrease around 2010 among old population (Kim and Kim, 2024) and among entire population, which overlaps with the trend of suicide mortality. Some studies provided evidence that basic old-age pension has the impact on the reduction of income inequity among old population (Kang and Choi, 2010) and the reduction continued with the expansion of the pension in 2014 (Kim and Yeom, 2020). Subsequently, the influential role of income inequality on suicide has been noted in Korea (Pak and Choung, 2020), as shown in other countries (Iemmi et al., 2016; Inagaki, 2010). Other contributions, such as paraquat restriction, installation of platform screen doors and government efforts, were also suggested as possible reasons for the decrease in suicide mortality since 2010. The suicide decline started ahead of the paraquat restriction and government efforts (e.g., the establishment of central and regional suicide prevention centers), which were implemented in 2012. Furthermore, the fact that urban residents, as well as rural residents, showed a similar decreasing trend did not support the paraquat restriction as a main hypothesis (Jeong et al., 2022). The installation of platform screen doors helped reportedly to reduce subway suicides by 89% after being implemented between 2005 and 2009 in Seoul (Chung et al., 2016), though it is not the main driver of the suicide decline considering the scale (e.g., train-related suicides account for less than 1% of the total suicide) (National Police Agency, 2015). Notably, the older population with low education levels were most benefited during the suicide decrease, as shown in suicide inequalities trend, while a similar change was not observed among other age groups. Additionally, the changing pattern of suicide inequalities corresponded to the time sequence of social protection measures, which were largely directed at the older population (Kim, 2023; Pak, 2021). A review study found that social security programs designed to target a specific population have different consequences concerning the recipient status (Simpson et al., 2021). However, this explanation should be kept in mind with the fact that the poverty rate of Korean elderly still remains the highest among OECD countries. Declining proportion of private cash transfer from family members result in another source of poverty (Ku et al., 2021) and a future study should prioritize the contribution of changes in income composition to substantially high elderly suicide rate.

When the overall inequalities were detailed into gender and age subgroups, middle-aged and young populations notably presented increased or steady status in suicide inequalities. The increase was most apparent among young women, though suicide inequalities have decreased in this population in recent years. The increase in suicide inequalities, together with an increase in suicide mortality, suggests that young women have increasingly experienced deterioration in their psychological circumstances. Women, particularly young women, are

increasingly experienced the workplace discrimination (Hiyoshi et al., 2018) and the disadvantage in care-giver role and housework sharing relative to men (Giurge et al., 2021; Hwang and Shin, 2023; Liu et al., 2013). Additional signs which concern more about women are the negative impact of social media (Andreassen et al., 2016), the epidemic of social isolation and loneliness, and prevalent depression and anxiety disorder. In a comparison of two years between 2015 and 2020, assuming that the changes over the period reflect the impact of COVID-19, a rise in suicide mortality among young women and men was observed in the current study, consistent with findings from previous studies (Ueda et al., 2020, 2022). However, suicide inequalities decreased among these populations, contrary to our expectation that the pandemic would cause more economic damage to them. This may be because education, as a broader indicator of SES, is less able to sense the risk of imminent financial stress triggered by the COVID-19 pandemic. This explanation is hypothetical and requires further examination.

In all, findings of consistent suicide inequalities even the falling of the inequalities for old population suggest that socioeconomic conditions underlay suicide in Korea. Policy implication points to the accommodation of social determinants associated with suicide as illustrated in a recently suggested national suicide prevention strategy; a public health, whole-of-government approach (Pirkis et al., 2023). According to the approach, the efforts of Korean government to prevent suicide may be viewed as limited to 'health sector-centric interventions' such as crisis intervention, awareness raising, restriction of means to suicide, screening, and responsible media reporting. A little-noted truth is that Korea records longest hospital stay for people with mental disorders with a shortage of provision of community rehabilitation services (Heo et al., 2019). In Korea, the number of Community Mental Health Welfare Centers increased from 46 in 2001 to 244 in 2020 (Ministry of Health and Welfare, 2022), but social interventions including housing and employment supports are lacking or inadequate. This gap in resource preparedness also indicates that unmet social needs have been an obstacle to suicide prevention. It has been a complex puzzle why high suicide rate is lingering steadily in Korea. Social interventions both at individual- and population-level are an often-overlooked piece of the puzzle and need to be strengthened by ensuring to safeguard the edge of life over which many vulnerable people are being pushed.

In the current study, among the young and middle-aged population, suicide inequalities exhibited contradictory trends between measures: relative inequalities reduced, while absolute inequalities widened between 1995 and 2010. This occurred because with an increase in suicide rate, the relative increase was larger, but the absolute increase was smaller in higher-educated groups than in lower-educated groups. Suicide rates rose from 6.4 in 1995 to 23.9 in 2010 among the college or above educated young population, and from 74.2 to 144.9 among the elementary or less educated young population (Supplementary Table 1). Relative inequalities do not represent a standpoint of baseline levels or changes in population health (Harper et al., 2008). In this vein, Mackenbach et al. (2016) concluded that a decline in inequalities on the relative scale is hard to achieve when mortality rates rapidly fall. In the current study, a decline of suicide inequalities on the relative scale alone misread the situation when suicide mortality surged from initially low levels. Therefore, we valued the use of absolute measures and provided a judgment that the description of a 78–205% increase in men of absolute inequalities (an example of calculation: $95\% = (79.0 - 40.5) / 40.5$, increase of SII from 40.5 (95% CI, 37.0–43.9) in 1995 to 79.0 (95% CI, 72.2–85.7) in 2010) may better characterize the context.

5. Limitations and strengths

The current study has some strengths. The estimates in our study were derived from nationally representative data from the death registry and census, covering the entire Korean population. We assessed suicide inequalities separately for gender and age groups. This approach was instrumental when overall inequalities summed up opposing trends

across sub-populations. We used four inequality measures (i.e., RII, SII, RR, and RD), which were complementary to each other for a comprehensive interpretation. The current study explored the opportunities of natural experiment to investigate suicide inequalities in relation to the periods of increasing and decreasing suicide mortality along with the expansion of social protection. Despite these strengths, the current study has some limitations. First, we used a descriptive approach in the evaluation of changes in trends without quantification methods. This limitation occurred just because available time points in the current analysis did not reach to a minimum requirement of seven time points for trends test (e.g., joint point regression) (National Cancer Institute, 2024). Second, we only used educational level to indicate SES because other measures were not available. The application of other SES measures may present other forms of suicide inequalities and the use of multiple SES measures is recommended to warrant a comprehensive patterns of suicide inequalities. Third, we maintained the same four categories of educational level throughout the study period, though the distribution of education has substantially changed, with a far smaller share of elementary or less in later years. These upward changes in educational level may have transformed the meaning attached to each level. However, the use of the educational categories still provides a basic distinction that reflects nominal values to the categories in a given period. As such, it should be noted that educational inequalities in suicide summarized the context of simultaneous changes pertaining to both suicide and education. Fourth, since we extracted the information of education level from two separate data (Census and Death registry) and mainly because of relatively inaccurate reporting in death registry, the results are prone to numerator-denominator bias. However, in Korea, the reporting bias of education in death records has been reported to be relatively low. In a study comparing death records to self-reported survey data, the proportion of missing educational information was just 0.2% and the level of validity and reliability for education remained consistent regardless of age, the time gap between the health survey and death, or the cause of death (Khang et al., 2007).

6. Conclusion

Over the 25-year study period, the persistence of strong suicide inequalities suggests that suicide is conceived as socioeconomic phenomena. Suicide inequalities declined along with a decline in suicide mortality in the recent decade in Korea, which was mainly driven by the older population. Factors contributing to suicide inequalities such as social protection measures also contributed to the change in suicide mortality. This highlights that suicide prevention strategies need to accommodate social determinants of suicide beyond actions in health sector alone.

CRedit authorship contribution statement

Minji Hwang: Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis, Data curation, Conceptualization. **Shu-Sen Chang:** Writing – review & editing, Supervision, Methodology. **Changsu Han:** Writing – review & editing, Writing – original draft. **Seung-ah Choe:** Writing – review & editing, Writing – original draft. **Jiseun Lim:** Writing – review & editing, Validation, Methodology, Data curation. **Myung Ki:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization.

Ethical approval

This study received ethical approval from the Institutional Research Board at Korea University (KUIRB-2021-0293-01).

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.socscimed.2024.117472>.

Data availability

The authors are unable or have chosen not to specify which data has been used.

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