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Single and combined effects of marital status, education attainment, and employment status on suicide among working-age population: A case-control study in South Korea

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ABSTRACT

Background: Suicide in the working-age population is an important public health issue. This group is heterogeneous regarding marital status, education level, and employment status, which are generally important socioeconomic factors for suicide, and has a wide age range. This study aims to explore the individual and combined effect of these socioeconomic factors on suicide in different age groups among the working-age population.
Methods: This study utilized a population-based case-control design for the working-age population in South Korea. Suicide cases were identified in Korean Governmental Death Registry from 2008 to 2017, and eight controls from Korea Community Health Survey were matched to each case by gender, age group, and year of suicide. Conditional logistic regression models estimated the relationship between marital status and socioeconomic status (SES) including educational attainment and employment status and suicide and examined the combined effect of the SES indicators and marital status on suicide.
Results: Low education, single status, and unemployment or economically inactive status were associated with suicide, but their magnitude varied across SES indicators. The association between SES and suicide was more pronounced in younger adults. The suicide risk was highest among divorced women aged 25–34 years (OR = 7.93; 95% CI: 7.21–8.72). Individuals experiencing two social adversities among SES or marital status had a significantly increased suicide risk. Those who are divorced and unemployed or economically inactive have the highest suicide risk, specifically among men aged 24–35 years (OR = 17.53; 95% CI: 14.96–20.55).
Conclusions: Marital status, education attainment, and employment status have a separate and combined impact on suicide among the working-age population. Specifically, the divorced and unemployed or economically inactive status amplified suicide risk, predominantly among young adults. Monitoring and intervention for those young adults should be considered for suicide prevention.

1. Introduction

Suicide is one of the top 20 leading causes of death worldwide and the World Health Organization (WHO) reported over 700,000 people annually die of suicide across the world (WHO, 2021). This is an important public health issue because of its relationship with human and socioeconomic losses. Moreover, suicide is the leading cause of death in the working-age population (IHME, 2022), suggesting that attention is needed to reduce suicide mortality.

Although mental health is one of the main risk factors on suicide, a study of systematic review also suggests that the population attributable risk regarding socioeconomic factor for suicide were similar in psychiatric disorders (Li et al., 2011), indicating that social factor is also similarly important for improving public health. Various studies including a review study showed that marital status, education, income, and occupation are associated with suicide (Agerbo et al., 2002; Chen et al., 2006; Li et al., 2011; Yamauchi et al., 2013). Several population-based studies have been conducted, but most regarding the association between SES and marital status and suicide focused on independent effects of SES, namely, on education (Bálint et al., 2016;

Øien-Ødegaard et al., 2021), marital status (Bálint et al., 2016; Kposowa, 2000; Qin et al., 2003; Yamauchi et al., 2013), and employment status (Qin et al., 2003; Yamauchi et al., 2013) without considering the combined effect of social adversities. Few studies investigated the combined effects of socioeconomic adversities and marital status on suicide (Næss et al., 2021; Yamauchi et al., 2013; Øien-Ødegaard et al., 2021). Notably, one study demonstrated that individuals with unemployed and divorced status were at an increased suicide risk than employed and married people (Yamauchi et al., 2013). Other study showed that the suicide risk was higher for people with low education and all forms of single status (Næss et al., 2021). Despite these advances, these studies have not investigated the socioeconomic association of suicide for the age-specific population with the exception for a Norwegian study focusing on individuals aged 35–54 years (Øien-Ødegaard et al., 2021).

The magnitude of association between SES and suicide may vary depending on age (Masocco et al., 2008). Several population-based case-control studies focused on age-specific groups such as those comprising adolescents (Agerbo et al., 2002), young adults (Page et al., 2014), and older-age individuals (Rubenowitz et al., 2001). Specifically, the working-age population is most exposed to socioeconomic factors, highlighting that the socioeconomic impact of suicide might be higher than in other age groups (Reeves et al., 2014), but only a few studies examined the association between SES and suicide for this population. Furthermore, it remains unclear to what extent to these associations might be different in different age groups within the working-age population. Although the working-age population experience the same social adversities, the impact on suicide may vary by age group as it includes young-aged and middle-aged adults who have different social and cultural characteristics (Humphrey & Palmer, 1991; Wiktorsson et al., 2022). Thus, it is necessary to investigate the age difference in the association between SES and marital status and suicide.

In South Korea, the suicide rate has been the highest among Organization for Economic Co-operation and Development (OECD) countries in the past decade and it was at 24.6 per 100,000 people in 2019, which is two times higher than the OECD average of 11.0 (OECD, 2021). Although Korea achieved one of the highest levels in education attainments among OECD countries, paradoxically employment rate of 25–54 years was lower than the OECD average. Moreover, the divorce rate was also higher than the OECD average (OECD, 2022), indicating that it is necessary to understand suicide in South Korea through socioeconomic contexts. This study used data from the total national sample of suicide cases in South Korea over a 10-year period to 1) investigate the association between marital status, education attainment, and employment status and suicide, 2) whether suicide risk increases when individuals have the combined social adversities across two SES indicators and marital status, and 3) to explore age-specific aspect of this relationship among working-age population in South Korea.

2. Methods

2.1. Study design, setting, and subjects

This study is a population-based case-control study, based on data from the death registry and Korean Community Health Survey (KCHS). The national death registry comprises the dates and causes of all deaths and sociodemographic information including marital status, education level, and occupation, which enables the inclusions of all suicide deaths of the working-age population. KCHS is the nationwide and representative survey, conducted by Korea Centers for Disease Control and Prevention and has the largest samples (approximately over 200,000 samples each year) in South Korea (Kang et al., 2015). It also collects marital status, education attainment, and employment status, which are almost identical categories to the death registry (Supplementary Table 1). Considering these advantages, the KCHS may be appropriate data for the selection of controls to compare with suicide cases. Since the

KCHS was initiated in 2008, the study period is from 2008 to 2017.

In the death registry data, we defined suicide cases as X60-X84 in ICD-10 codes and study cases were individuals aged 25–64 because the SES and marital status variables used in the study (marital status, educational attainment, unemployment) could be less relevant in people who are younger than 25 – they are mostly students – and in older people aged 65+ as many of them already retired. Of 94,156 suicide cases, we excluded cases with missing information on variables of interest from the analyses. Therefore, we identified 89,647 suicide deaths from 2008 to 2017 among people 25–64 years and there was no difference in distributions of age and gender between study cases and included missing cases (Supplementary Table 2). Since increasing the case-control ratio in matched case-control studies may increase statistical power (Hennessy et al., 1999), we matched each suicide case to a representative random subsample of a maximum of eight people of the same gender and age who were alive at the time of the suicide from KCHS to maximize statistical power. This yielded 717,176 control subjects.

2.2. Measures

The main exposure variables included marital status, education attainment, and employment status. Since the aspiration for higher education is culturally intense and education levels tend to be dichotomously classified in Korean society (Kim, 2010), we grouped education attainment into two levels: less than high school refers to a low education level while community college or more refers to a high level based on the highest level of completed education. Employment status was categorized into employed or self-employed and unemployed or economically inactive including student and housewife. The marital status categories were married, unmarried, divorced, and widowed. To control for the confounding effect of suicide, we selected a place of residence based on data availability. Residential codes were used to categorize the place of residence into three geographical areas: metropolitan, urban, and rural. Individuals with missing information on variables of interest were excluded from the analyses.

2.3. Statistical analysis

Descriptive analyses were initially conducted to show the distribution of sociodemographic characteristics of death by suicide. To investigate the socioeconomic association of suicide, we analyzed data by conditional logistic regression model with PhReg procedure in SAS, estimating odds ratios (ORs) and 95% confidence intervals (CIs). Crude ORs were estimated from analyses adjusted for matched variables including gender, age, and suicide year. In contrast, fully adjusted ORs were derived from the complete model which included matching variables, education attainment, employment status, marital status, and place of residence. The combined effects of SES and marital status on suicide were assessed with a model that included a variable that combined SES and marital status. We used likelihood ratio tests for heterogeneity of association between SES and marital status and suicide by gender and age groups; where these were statistically significant, the analyses were performed after stratification by gender and age groups (25–34, 35–44, 45–54, and 55–64 years) to identify which certain groups were particularly vulnerable to suicide (McEachan et al., 2016; Rencher & Schaalje, 2008). All statistical analysis was two-sided and p < 0.05 was considered statistically significant and performed using SAS 9.4. The exemption of ethical approval of this study was granted by the Institutional Research Board at Ajou University Hospital (AJIRB-S-BR-EXP-22-054) as it used secondary data without personal identifiers.

3. Results

Table 1 shows the distribution of the sociodemographic characteristics of the men and women who died by suicide and their control

Table 1

Distribution of socio-demographic variables among suicide deaths pooled over 10 years (2008–2017) and population live controls matched for age, gender, and year of suicide for men and women aged 25–64 years.

	Total		Men		Women	
	Suicide N(%)	Control N(%)	Suicide N(%)	Control N(%)	Suicide N(%)	Control N(%)
Gender						
Men	62,821(70.1)	502,568(70.1)				
Women	26,826(29.9)	214,608(29.9)				
Age group						
25–34	17,966(20.0)	143,728(20.0)	10,661(16.9)	85,288(16.9)	7,305(27.2)	58,440(27.2)
35–44	23,562(26.3)	188,496(26.3)	15,914(25.3)	127,312(25.3)	7,648(28.5)	61,184(28.5)
45–54	27,389(30.6)	219,112(30.6)	20,289(32.3)	162,312(32.3)	7,100(26.5)	56,800(26.5)
55–64	20,730(23.1)	165,840(23.1)	15,957(25.4)	127,656(25.4)	4,773(17.8)	38,184(17.8)
Education attainment						
College or more	23,934(26.7)	282,776(39.4)	16,669(26.5)	201,533(40.1)	7,265(27.1)	81,243(37.9)
Less high school	65,713(73.3)	434,400(60.6)	46,152(73.5)	301,035(59.9)	19,561(72.9)	133,365(62.1)
Marital status						
Married	41,823(46.6)	560,613(78.2)	28,846(45.9)	391,945(78.0)	12,977(48.4)	168,668(78.6)
Unmarried	28,469(31.8)	113,847(15.9)	20,885(33.3)	85,522(17.0)	7,584(28.3)	28,325(13.2)
Divorced	16,744(18.7)	28,880(4.0)	11,885(18.9)	20,605(4.1)	4,859(18.1)	8,275(3.9)
Widowed	2,611(2.9)	13,836(2.0)	1,205(1.9)	4,496(0.9)	1,406(5.2)	9,340(4.3)
Employment status						
Employed	43,236(48.2)	579,048(80.7)	35,106(55.9)	449,965(89.5)	8,130(30.3)	129,083(60.2)
Unemployed or inactive	46,411(51.8)	138,128(19.3)	27,715(44.1)	52,603(10.5)	18,696(69.7)	85,525(39.8)
Region						
Metropolitan	38,600(43.1)	215,790(30.1)	26,438(42.1)	147,729(29.4)	12,162(45.4)	68,061(31.7)
Urban	42,403(47.3)	311,239(43.4)	29,869(47.5)	217,713(43.3)	12,534(46.7)	93,526(43.6)
Rural	8,644(9.6)	190,147(26.5)	6,514(10.4)	137,126(27.3)	2,130(7.9)	53,021(24.7)
Year						
2008	7,901(8.8)	63,208(8.8)	5,218(8.3)	41,744(8.3)	2,683(10.0)	21,464(10.0)
2009	9,812(11.0)	78,496(11.0)	6,528(10.4)	52,224(10.4)	3,284(12.2)	26,272(12.2)
2010	9,850(11.0)	78,800(11.0)	6,707(10.7)	53,656(10.7)	3,143(11.7)	25,144(11.7)
2011	10,093(11.3)	80,744(11.3)	7,055(11.2)	56,440(11.2)	3,038(11.3)	24,304(11.3)
2012	8,954(10.0)	71,632(10.0)	6,313(10.1)	50,504(10.1)	2,641(9.8)	21,128(9.8)
2013	9,452(10.5)	75,616(10.5)	6,760(10.8)	54,080(10.8)	2,692(10.0)	21,536(10.0)
2014	9,214(10.3)	73,712(10.3)	6,659(10.6)	53,272(10.6)	2,555(9.5)	20,440(9.5)
2015	8,587(9.6)	68,696(9.6)	6,207(9.9)	49,656(9.9)	2,380(8.9)	19,040(8.9)
2016	8,204(9.2)	65,632(9.2)	5,887(9.4)	47,096(9.4)	2,317(8.6)	18,536(8.6)
2017	7,580(8.5)	60,640(8.5)	5,487(8.7)	43,896(8.7)	2,093(7.8)	16,744(7.8)
Total	89,647(100)	717,176(100)	62,821(100)	502,568(100)	26,826(100)	214,608(100)

subjects. For both, a higher proportion of suicide cases were seen in individuals with an education level less than high school (n = 65,713, 73.3%), single status including unmarried, divorced, and widowed (n = 47,824, 53.4%), and unemployment or economically inactive status (n = 46,411, 51.8%).

Table 2 presents the suicide risk associated with marital status, education attainment, and employment status derived from the conditional logistic regression analyses. Generally, poor SES or single status is highly associated with suicide. Specifically, compared to married people, suicide risk was highest for divorce men and women (total OR = 3.81; 95% CI:3.74–3.88). The suicide risk among unmarried or widowed people was also significantly higher than that of married counterparts (OR = 2.54; 95% CI:2.51–2.58 for unmarried, OR = 1.66; 95% CI:1.60–1.73 for widowed). For education attainment, individuals who were less educated were more likely to die from suicide (OR = 1.62; 95% CI:1.60–1.65). People who were unemployed or economically inactive status have higher odds of death by suicide than employed people (OR = 2.78; 95% CI:2.74–2.82).

In Table 3, the socioeconomic association with suicide remained significant, but age differences significantly were observed. After

Table 2

Risk of suicide associated with socioeconomic and marital status for men and women aged 25–64 years.

	Total		Men		Women		P-value[c]
	Crude OR[a] (95% CI)	Adjusted OR[b] (95% CI)	Crude OR[a] (95% CI)	Adjusted OR[b] (95% CI)	Crude OR[a] (95% CI)	Adjusted OR[b] (95% CI)	
Education							
College or more	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	0.58
Less high school	1.68(1.66–1.71)	1.62(1.60–1.65)	1.74(1.71–1.77)	1.57(1.54–1.60)	1.56(1.52–1.60)	1.74(1.69–1.79)	
Marital status							
Married	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	<0.001
Unmarried	2.88(2.84–2.93)	2.54(2.51–2.58)	2.86(2.81–2.92)	2.03(1.99–2.07)	2.96(2.87–3.04)	3.77(3.66–3.88)	
Divorced	5.29(5.19–5.38)	3.81(3.74–3.88)	5.34(5.22–5.45)	3.30(3.23–3.38)	5.18(5.01–5.35)	4.48(4.33–4.63)	
Widowed	2.29(2.20–2.38)	1.66(1.60–1.73)	3.08(2.91–3.27)	2.05(1.93–2.17)	1.83(1.73–1.94)	1.71(1.61–1.80)	
Employment status							
Employed	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	0.315
Unemployed or inactive	3.62(3.57–3.67)	2.78(2.74–2.82)	4.77(4.70–4.85)	3.11(3.06–3.16)	3.03(2.95–3.11)	3.14(3.06–3.22)	

[a] Odds ratio adjusted for age and year of suicide through matching.

[b] Odds ratio adjusted for age, year of suicide, place of residence, and all other variables shown in the table.

[c] P-value was calculated from the likelihood ratio test to test the heterogeneity of ORs.

Table 3
Single effect of marital status, education attainment, and employment status for men and women by age group.

	25–34 years		35–44 years		45–54 years		55–64 years		P-value[c]
	Crude OR[a] (95% CI)	Adjusted OR[b] (95% CI)	Crude OR[a] (95% CI)	Adjusted OR[b] (95% CI)	Crude OR[a] (95% CI)	Adjusted OR[b] (95% CI)	Crude OR[a] (95% CI)	Adjusted OR[b] (95% CI)	
Men									
Education									
College or more	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	<0.001
Less high school	2.07	1.62	2.16	1.53	1.66	1.33	1.37	1.38	
	(1.99–2.15)	(1.56–1.69)	(2.09–2.23)	(1.48–1.58)	(1.60–1.71)	(1.29–1.38)	(1.31–1.44)	(1.32–1.44)	
Marital status									
Married	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	<0.001
Unmarried	3.29	2.10	4.26	2.51	4.05	2.31	4.08	2.71	
	(3.12–3.48)	(1.97–2.21)	(4.12–4.41)	(2.42–2.61)	(3.90–4.20)	(2.22–2.41)	(3.84–4.33)	(2.55–2.88)	
Divorced	9.89	5.88	6.51	3.66	4.93	2.98	4.62	3.19	
	(8.87–11.03)	(5.26–6.57)	(6.21–6.82)	(3.48–3.85)	(4.77–5.10)	(2.88–3.09)	(4.45–4.80)	(3.07–3.31)	
Widowed	9.91	5.62	6.66	4.12	3.26	2.31	2.19	1.76	
	(6.78–14.50)	(3.84–8.23)	(5.65–7.85)	(3.49–4.86)	(2.95–3.60)	(2.09–2.56)	(2.02–2.37)	(1.62–1.90)	
Employment status									
Employed	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	<0.001
Unemployed or inactive	4.34	3.10	7.11	3.75	5.80	3.40	3.59	2.52	
	(4.18–4.51)	(3.00–3.21)	(6.89–7.34)	(3.62–3.89)	(5.64–2.37)	(3.29–3.51)	(3.48–3.70)	(2.44–2.61)	
Women									
Education									
College or more	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	<0.001
Less high school	2.31	2.11	1.78	1.60	1.12	1.17	0.83	1.03	
	(2.21–2.42)	(2.01–2.21)	(1.70–1.87)	(1.52–1.69)	(1.05–1.18)	(1.10–1.25)	(0.75–0.92)	(0.93–1.14)	
Marital status									
Married	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	<0.001
Unmarried	3.58	4.75	4.74	4.94	4.35	3.73	3.96	3.25	
	(3.39–3.78)	(4.49–5.03)	(4.49–5.01)	(4.67–5.22)	(4.00–4.74)	(3.42–4.06)	(3.43–4.56)	(2.81–3.74)	
Divorced	9.56	7.93	6.03	5.43	4.01	3.54	4.04	3.32	
	(8.70–10.50)	(7.21–8.72)	(5.69–6.38)	(5.12–5.75)	(3.79–4.24)	(3.35–3.75)	(3.74–4.37)	(3.08–3.59)	
Widowed	7.31	6.38	2.63	2.89	1.67	1.81	1.35	1.37	
	(5.34–10.00)	(4.66–8.73)	(2.22–3.11)	(2.44–3.41)	(1.51–1.85)	(1.64–2.01)	(1.25–1.46)	(1.27–1.48)	
Employment status									
Employed	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	<0.001
Unemployed or inactive	2.06	2.73	2.96	3.05	4.30	3.87	3.76	3.10	
	(1.96–2.16)	(2.60–2.87)	(2.82–3.11)	(2.91–3.21)	(4.08–4.53)	(3.67–4.08)	(3.50–4.03)	(2.89–3.33)	

[a] Odds ratio adjusted for year of suicide through matching.
[b] Odds ratio adjusted for year of suicide, place of residence, and all other variables shown in the table.
[c] P-value was calculated from the likelihood ratio test to test the heterogeneity of ORs.

adjusting for covariates and SES factors, divorced individuals have the highest magnitude of socioeconomic association with suicide and the magnitude gradually decreased as age increased (e.g., OR = 5.88; 95% CI:5.26–6.57 for men aged 25–34, OR = 3.19; 95% CI:3.07–3.31 for men aged 55–64 years). Specifically, among women aged 25–34 years, divorce is highly associated with suicide (OR = 7.93; 95% CI:7.21–8.72). A similar magnitude of association of suicide was observed among the widowed aged 25–34 years (e.g., OR = 6.38; 95% CI:4.66–8.73 for women aged 25–34 years). Its magnitude between education attainment and suicide reduced as age increased. For women aged 55–64 years, low education was not significantly associated with suicide (OR = 1.03; 95% CI:0.93–1.14). The employment status was significantly associated with suicide across all age groups but with small age differences.

Table 4 shows the results of the combined effect of marital status, education attainment, and employment status on suicide. Among all combined factors, any pair with single status significantly showed a higher increased suicide risk among younger adults. Notably, the highest risk of suicide was 17.53 (95% CI: 14.96–20.55) among those who were unemployed or economically inactive and divorced, compared to employed and married among men aged 25–34 years. The suicide risk associated with being married was substantially less increased for men and women who were unemployed or economically inactive rather than those who were with divorced (OR = 7.97; 95% CI:7.07–8.98 for men aged 25–34 years). Although those with single status (unmarried, divorced, and widowed) and low education attainment have high suicide risk, little differences between those with low and high education attainment were observed (e.g., divorced OR = 14.31; 95%

CI:12.72–16.08 for women aged 35–44 years with low education attainment vs divorced OR = 14.47; 95% CI:12.08–17.33 for women aged 35–44 years with high education attainment).

4. Discussion

4.1. Main findings and their interpretations

This population-based case-control study examined the association between education status, marital status, and employment status and suicide among working age adults in South Korea. We found that increased suicide risk is associated with all forms of the single status, low education attainment, and unemployed or economically inactive status for both sexes and in all age groups. Divorced status has the strongest suicide risk, with younger people showing the highest magnitude of suicide association. Furthermore, the combined effect of divorce and unemployment or economically inactive status on suicide was observed.

This study demonstrated the protective effect of marriage on suicide which is consistent with previous studies (Kposowa, 2000; Yeh et al., 2008). Durkheim explained that suicide is related to social integration, which indicates that marriage, a significant type of social integration, reduced the chances of suicide within the social structure (Durkheim, 2005). Similarly, it brings to social happiness and a sense of security through social, economic, and emotional support based on social interaction between the married couple (Yeh et al., 2008). Taken together, marriage provides a range of support and cohesiveness that is not available to unmarried, divorced, and widowed people (Kposowa,

Table 4
Combined effect of marital status, education attainment, and employment status for men and women by age group.

Combined SES variables	Men						Women				
	25–64 years	25–34 years	35–44 years	45–54 years	55–64 years	P-value[d]	25–64 years	25–34 years	35–44 years	45–54 years	55–64 years	P-value[d]
Education and Marital status[a]												
College or more and married	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	<0.001	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	<0.001
College or more and unmarried	2.09 (2.02–2.16)	2.72 (2.50–2.96)	3.21 (3.02–3.40)	2.68 (2.46–2.93)	3.17 (2.58–3.90)		3.72 (3.54–3.91)	4.49 (4.13–4.88)	6.27 (5.72–6.87)	3.99 (3.40–4.67)	2.89 (2.08–4.02)	
College or more and divorced	5.09 (4.84–5.35)	10.33 (8.38–12.74)	5.54 (5.03–6.09)	3.95 (3.66–4.25)	4.62 (4.16–5.13)		7.96 (7.34–8.60)	14.47 (12.08–17.33)	8.91 (7.89–10.05)	4.29 (3.73–4.94)	4.10 (3.15–5.34)	
College or more and widowed	2.62 (2.21–3.10)	7.23 (3.00–17.42)	6.02 (4.22–8.57)	2.53 (1.95–3.28)	1.50 (1.10–2.04)		3.47 (2.86–4.22)	11.62 (6.57–20.56)	3.50 (2.32–5.29)	2.37 (1.70–3.31)	1.57 (1.09–2.25)	
Less high school and married	1.70 (1.65–1.74)	2.52 (2.28–2.79)	1.94 (1.84–2.04)	1.47 (1.41–1.54)	1.50 (1.42–1.58)		1.86 (1.79–1.94)	2.04 (1.86–2.24)	1.97 (1.84–2.11)	1.25 (1.16–1.35)	1.06 (0.94–1.20)	
Less high school and unmarried	3.42 (3.32–3.52)	4.14 (3.80–4.51)	4.19 (3.98–4.42)	3.26 (3.10–3.44)	3.98 (3.67–4.30)		7.27 (6.94–7.61)	10.16 (9.37–11.01)	8.54 (7.87–9.27)	4.57 (4.06–5.14)	3.58 (2.94–4.34)	
Less high school and divorced	5.15 (5.00–5.32)	10.98 (9.57–12.59)	6.00 (5.64–6.39)	4.10 (3.90–4.30)	4.55 (4.28–4.84)		7.58 (7.23–7.95)	14.31 (12.72–16.08)	9.32 (8.63–10.07)	4.27 (3.92–4.65)	3.47 (3.02–3.99)	
Less high school and widowed	3.33 (3.12–3.55)	11.49 (7.52–17.56)	6.79 (5.63–8.21)	3.30 (2.95–3.69)	2.65 (2.41–2.91)		3.01 (2.82–3.21)	11.03 (7.56–16.08)	5.27 (4.37–6.37)	2.20 (1.95–2.48)	1.44 (1.26–1.66)	
Employment and Marital status[b]												
Employed and married	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	<0.001	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	<0.001
Employed and unmarried	2.38 (2.32–2.44)	2.53 (2.37–2.70)	3.13 (2.99–3.27)	3.42 (3.24–3.60)	4.02 (3.62–4.46)		3.55 (3.38–3.73)	3.03 (2.75–3.34)	5.08 (4.61–5.59)	4.79 (4.06–5.65)	3.91 (2.81–5.42)	
Employed and divorced	4.66 (4.53–4.80)	8.13 (7.06–9.35)	5.38 (5.06–5.71)	4.25 (4.07–4.45)	4.41 (4.17–4.66)		4.80 (4.51–5.10)	7.21 (6.17–8.44)	5.95 (5.39–6.57)	4.00 (3.60–4.44)	3.31 (2.78–3.94)	
Employed and widowed	2.66 (2.44–2.89)	8.56 (5.14–14.25)	5.81 (4.69–7.20)	2.83 (2.47–3.25)	1.92 (1.69–2.19)		1.21 (1.21–1.53)	5.01 (2.68–9.37)	2.50 (1.88–3.33)	1.41 (1.15–1.72)	1.08 (0.90–1.29)	
Unemployed or inactive and married	4.31 (4.21–4.42)	7.97 (7.07–8.98)	8.08 (7.60–8.59)	5.56 (5.33–5.80)	3.02 (2.90–3.14)		3.06 (2.94–3.18)	1.72 (1.56–1.91)	3.17 (2.97–3.40)	4.05 (3.79–4.33)	2.97 (2.72–3.25)	
Unemployed or inactive and unmarried	6.62 (6.47–6.78)	7.27 (6.82–7.76)	9.93 (9.51–10.38)	7.57 (7.22–7.94)	6.52 (6.05–7.03)		11.90 (11.38–12.44)	9.88 (8.99–10.86)	15.49 (14.26–16.82)	13.92 (12.47–15.53)	9.31 (7.84–11.07)	
Unemployed or inactive and divorced	9.34 (9.08–9.62)	17.53 (14.96–20.55)	12.13 (11.34–12.97)	9.44 (9.03–9.88)	7.50 (7.14–7.88)		13.30 (12.67–13.96)	13.43 (11.71–15.41)	16.47 (15.13–17.92)	13.68 (12.61–14.83)	9.90 (8.86–11.06)	
Unemployed or inactive and widowed	6.23 (5.77–6.74)	15.64 (8.86–27.64)	13.86 (10.74–17.88)	8.14 (7.06–9.40)	4.74 (4.28–5.25)		5.62 (5.25–6.02)	11.97 (8.28–17.30)	10.04 (8.12–12.41)	8.15 (7.19–9.24)	4.32 (3.87–4.83)	
Education and Employment[c]												
College or more and employed	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	<0.001	1(reference)	1(reference)	1(reference)	1(reference)	1(reference)	<0.001
College or more and unemployed or inactive	4.02 (3.89–4.15)	4.18 (3.94–4.44)	5.53 (5.20–5.88)	4.60 (4.32–4.90)	2.28 (2.09–2.48)		3.31 (3.16–3.47)	3.42 (3.19–3.67)	2.93 (2.70–3.19)	3.37 (3.00–3.78)	2.41 (1.91–3.04)	
Less high school and employed	1.78 (1.74–1.82)	2.11 (2.00–2.22)	1.82 (1.74–1.90)	1.50 (1.44–1.56)	1.31 (1.23–1.39)		1.83 (1.75–1.92)	2.73 (2.53–2.94)	1.54 (1.42–1.68)	1.04 (0.93–1.16)	0.82 (0.66–1.02)	
Less high school and unemployed or inactive	5.09 (4.97–5.21)	5.15 (4.88–5.44)	5.93 (5.65–6.23)	4.73 (4.52–4.95)	3.35 (3.15–3.57)		5.61 (5.37–5.85)	6.08 (5.70–6.49)	4.80 (4.45–5.17)	4.16 (3.76–4.60)	2.61 (2.12–3.22)	

[a] Odds ratio adjusted for year of suicide through matching, place of residence, and employment status.
[b] Odds ratio adjusted for year of suicide through matching, place of residence, and education attainment.
[c] Odds ratio adjusted for year of suicide through matching, place of residence, and marital status.
[d] P-value was calculated from the likelihood ratio test to test the heterogeneity of ORs.

2000). Contrary to the protective effect of marriage, marital dissolution (divorce, widow, and unmarried) is a risk factor for suicide and there were differentials in suicide risk by marital dissolution. In line with previous studies (Corcoran & Nagar, 2010; Kposowa, 2000; Park et al., 2018; Yeh et al., 2008), our findings demonstrated that divorce has the strongest suicide risk among other forms of single status. A possible explanation is that breaking strong social ties may lead to loss of the social, economic, and emotional support, which is given in the past, causing severe psychological distress and suicide (Yip et al., 2015). Another explanation is that the cultural perceptions and expectations of marriage might influence the suicide risk (Andrés et al., 2010). Particularly, divorce is a greater risk factor of suicide in Asian than in western countries (Yip et al., 2012) because divorced people in Asian society where cultural conservatism including preserving family and religious traditions exists (Yeh et al., 2008) are more likely to be thought of as inferior, leading to more psychological stress than married people (Yamauchi et al., 2013).

We also confirmed that low education and unemployed or economic inactive status were associated suicide, consistent with previous studies (Bálint et al., 2016; Kposowa, 2000; Yamauchi et al., 2013; Øien-Ødegaard et al., 2021). In particular, we found that unemployed or economically inactive status is associated with a greater burden of suicide risk. Since social activities among working-aged adults are the most active along with economic activities, wherein the workplace offers opportunities for the development of the social relationship, those who are unemployed or economically inactive may experience a decrease in social integration and an increase in economic stress, especially among young adults (Lantz et al., 2010).

In this study, our findings showed that individuals who have two socioeconomic adversities simultaneously have a higher suicide risk among both men and women. Importantly, the combined effect of co-occurrence of divorce and unemployment or economically inactive status on suicide was pronounced. Yamauchi et al. (2013) found that individuals who are divorced and unemployed are at a higher suicide risk, which is consistent with our findings. Divorce and unemployment are significant life events that experience both unexpected relationship and economic losses (Yamauchi et al., 2013). According to the interpersonal theory of suicide, thwarted belongingness (e.g., divorce and widow), perceived burdensomeness (e.g., unemployment and financial hardship), and acquired capabilities for suicide resulting from the greater number of co-occurring risk factors are prerequisites of suicide (Joiner, 2005). When individuals face multiple negative life-events simultaneously, the negative effects are amplified because these factors can be attributed to similarities with mental illness distress (Assari, 2018). Moreover, these co-occurring risk factors may worsen social and community integration, which abruptly increases social isolation (Kyung-Sook et al., 2018). Another possible explanation is that breaking strong social ties and economic participation poses an amplified threat to those who occupy a relatively less advantaged social position. Specifically, in Korea, the culture of social comparison presumably is more prominent. Hence, individuals experiencing these losses are more likely to be stigmatized as failures regarding social, family, and self-imposed expectations, leading to more severe significant psychological distress, or sharply lowering self-esteem, thus making them more vulnerable to suicide behavior (Pak & Choung, 2020). Furthermore, our findings imply that socioeconomic inequalities were lower among married people and suggest marriage may be of greater benefit to those at a low SES level. Although individuals experienced socioeconomic adversity, the effect of this economic difficulty on suicide may be protected by strong social ties (Yamauchi et al., 2013).

In particular, the co-occurrence of divorce and unemployment or economically inactive status was associated with 17.53 times increase in the odds of suicide among men aged 24–35 years. This is an alarming figure considering that young adulthood is a significant period wherein they intensively invest in their work and relationships. Although these investments may carry a specific set of protections for their mental

health, if they are abruptly ruined and the social ties start breaking, people may feel a sense of frustration and hopelessness because of loss and deem suicide as a viable escape (Shiner et al., 2009). Furthermore, it can be seen that, there were downward trends in the effects of some variables with increasing age, e.g., low education and being widowed, indicating lower pressure that may result from these statuses in older people or older cohorts. Likewise, young adults are more likely to delayed adaptation. Prior studies partly support our findings by demonstrating that younger cohorts have higher stress levels and anxiety symptoms compared with older groups because of the lack of an economic and social safety network (Shierholz et al., 2013). Since younger people may have a less understanding of the coping strategies that mitigate the impact of socioeconomic adversities on suicide, they are less likely to manage psychological stability when confronted with socioeconomic difficulties (Folkman et al., 1987; Mirowsky & Ross, 2001; Thoits, 1995).

4.2. Strengths and limitations

The strength of our study is that we used the systematic approach to the case-control design rigorously to ensure that extracted data is reliable: the population controls were randomly selected from a nationally representative survey in South Korea. Moreover, data pooling with matched case-control data from 2008 to 2017 offers on opportunity to produce precise and reliable findings for a rare case and enable a detailed understanding of the influence of different socioeconomic factors on suicide risk. Specifically, to the best of our knowledge, this study is the first to analyze the combined effect of SES on the increased suicide risk in several range of age groups to observe heterogeneity of suicide risk across life course.

There are some limitations, suggesting caution in interpretation. First, the selection of variables that can be included in the analysis is largely dependent on the availability of the death registry, making some variables of interest absent but the use of this case-control data from different sources may reduce the risk of differential misclassification bias (Qin et al., 2003). Although potential confounding factors such as social network and participation, and mental illness were significant protective and risk factors for suicide (Agerbo et al., 2002; Duberstein et al., 2004; Qin et al., 2003), we lacked data for quantifying the effect of these variables. Second, although area-level SES measures, including deprivation index and GINI coefficient, are associated with suicide, our measures of SES cover only individual characteristics. Third, we could not examine how different time period after separation and unemployment or economically inactive status have different effects on suicide risk. Since previous studies reported recent changes in marital and socioeconomic statuses have more adverse effects on suicide than distant ones (Næss et al., 2021), it may be important to understand this association. Fourth, this study does not completely cover the entire range of marital statuses such as cohabitation and separation because four categories of marital status were based on categories of death registry data. These categories, particularly unmarried status, may contribute to the underestimation of suicide risk. Fifth, the association between suicide and marital status could be because of a matrimonial selection meaning that individuals with better health status would be more likely to be married (Joung et al., 1998). Although previous studies reported that the protective effect of marriage remains after controlling for past health conditions (Murray, 2000), we cannot rule out the possibility of such a selection effect. Last, we test the interaction between age and social factors using the likelihood ratio test. Stratified analysis were conducted if interaction was statistically significant. Although these stratified analysis method is frequently used and intuitive, the interaction effect estimates in the pooled model would be also advisable (Knol et al., 2009). Since we matched each suicide case to a representative random subsample of eight people of the same gender and age group people, we could not include the interaction terms of matching variables in the pooled models.

5. Conclusion

In this study, all forms of single status and low SES were associated with suicide. Furthermore, the combined effect of socioeconomic adversities on suicide is higher than individual social factors. Specifically, individuals aged 24–34 years who are divorced and unemployed or economically inactive are far more likely to die by suicide. Thus, young adults experiencing these socioeconomic adversities are important targets for the suicide prevention and should be provided social and economic supports.

Author contribution

Minjae Choi and Yo Han Lee designed the study. Minjae Choi, Joshua Kirabo Sempungu and Yo Han Lee were involved in reviewing the literature, data collection, statistical analyses and drafted the manuscript. Minjae Choi, Joshua Kirabo Sempungu and Eun Hae Lee interpreted the data and Minjae Choi and Joshua Kirabo Sempungu contributed to the writing. Eun Hae Lee and Yo Han Lee revised the manuscript. Shu-Sen Chang and Yo Han Lee read and commented on the manuscript. All authors approved the final manuscript.

Role of funding sources

The authors declare no competing interests. The funding body played no role in the design, data collection, analysis, and interpretation of the data.

Ethical statement

This study was exempted from ethical approval by the Institutional Research Board at Ajou University Hospital (AJIRB-SBR-EXP-21-555).

Declaration of competing interest

The authors declare no competing interests. The funding body played no role in the design, data collection, analysis, and interpretation of the data.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ssmph.2022.101246.

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