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Is suicidal ideation linked to working hours and shift work in Korea?

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Abstract: Is suicidal ideation linked to working hours and shift work in Korea? : Chang-Gyo YOON, *et al*. Department of Preventive Medicine, Armed Forces Medical Command, Republic of Korea—Objective: This study attempted to use the community health survey (CHS) to identify the effect of long working hours (long WHs) and night/shift work on suicidal ideation among the employed population of Korea. **Methods:** This study used data from 67,471 subjects who were administered the 2008 CHS which obtained information regarding sociodemographic characteristics, health behaviors and working environment, using structured questionnaires and personal interviews. We adopted multiple logistic regression models for gender and employment stratification. **Results:** Among male employees, suicidal ideation was significantly associated with only moderately long WHs (51−60 hours), after controlling covariates (adjusted odds ratio [aOR], 1.30; 95% confidence interval [95%CI], 1.07 to 1.57). Self-employed/male employer populations had higher suicidal ideation when they had moderately long WHs (aOR, 1.23; 95%CI, 1.01 to 1.50) and very long WHs (over 60 hours) (aOR, 1.31; 95%CI, 1.08 to 1.59). Among the female population, suicidal ideation was significantly association with moderately long WHs in the employee group (aOR, 1.31; 95%CI, 1.08 to 1.58) and moderately (aOR, 1.35; 95%CI, 1.08 to 1.69) and very (aOR, 1.33; 95%CI, 1.07 to 1.65) long WHs in the self-employed/employer group. Shift work was a significant predictor only in the female population in the employee groups (aOR, 1.45; 95%CI, 1.23 to 1.70). **Conclusions:** Long WHs and shift work were associated with suicidal ideation when taking into account gender and employment differences. The harmful effects of exceptionally long WHs in Korea, among other Organization for Economic Co-operation and Development (OECD) countries, raise concerns about public and occupational health. To address the issue of long WHs, labor policies that reduce maximum working hours and facilitate job stability are needed.
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Key words: Community health survey, Long working hours, Shift work, Suicidal ideation

Suicide is a global, pervasive social and public health issue. In South Korea, suicide was the fourth leading cause of death in 2012; it was the most frequent cause of death for individuals in their twenties and thirties and the second most frequent cause of death in those in their forties[1)]. Since these age groups reflect the most economically active population, suicide is regarded as a serious social problem.

Some investigations on suicide in occupational settings have identified high-risk groups and suggested specific causes and interventions in certain occupations[2,3)]. Poor social support, low income and social separation could affect the mental health of manual workers, farmers and miners[4)]. Easy access to lethal instruments is a well-known risk factor of suicide among health-care workers[5)]. Furthermore, severe job stress increases the risk of depression, which in turn, is linked to suicidal ideation and attempted suicide[6,7)].

Among severe job stressors, long working hours (WHs) are prevalent in rapidly developing Asian countries[8–12)]. According to Organization for Economic Co-operation and Development (OECD) statistics for 2012, the average work hours per year in South Korea was 2,163 hours, the second highest among 34

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countries[13]. Long WHs aggravate fatigue, anxiety and burnout and inhibit workers' abilities to revive their mental and physical health outside of work[11]. Thus, long WHs can potentially increase the risk of depression[14]. In Japan, suicides due to excessive work have been reported in a case series study[15]. Some studies have also reported the association between long WHs and suicidal ideation[12], but none of them examined the impact of gender and employment stratification due to relatively small sample sizes. Moreover, both night and shift work can negatively impact social networks and family relationships[16]. Although a growing body of evidence supports the relationship between long WHs and shift work and suicide, empirical studies conducted in Asian countries are limited.

In the current study, we used Community Health Survey (CHS) data to investigate the impact of long WHs and shift work on the prevalence of suicidal ideation among the economically active population. To elucidate this association more precisely, gender-stratified analyses were undertaken, adjusting for conventional suicidal risk factors including sociodemographic characteristics. Further, we examined differences according to type of employment. We expect that our investigation—using a relatively large sample size—could provide evidence for the effect of long WHs and shift work on suicidal ideation.

Methods

Data collection

This study used data from the CHS conducted by the Korea Center for Disease Control and Prevention (KCDC) in 2008[17]. Since 2008, the KCDC has carried out the CHS annually to produce community-based comparable health statistics for adults (≥19 years old) at the city (*si*), county (*gun*) and district (*gu*) levels through personal interviews. Among the CHSs for 2008 to 2012, which are released publicly, only the 2008 survey questionnaire adopted items related to work conditions, and so we chose it for the study. A complex, stratified, multistage, probability-cluster sampling method was adopted that made use of each subject's resident registration information. Approximately 90 primary sampling units—with 5–8 households selected from each primary sampling unit—were randomly selected from the total sampling units in each community for an average of 900 participants from each community. Data were collected in September–November, 2008 and included information regarding sociodemographic characteristics, health behaviors, chronic illness/injury, quality of life/health services and working environments. For the present analyses, we limited the study population to the economically active population, which was defined as those who were employed in the year prior to the investigation period. Thus, 67,471 subjects were identified as eligible.

Measures

To examine the relationship between long WHs, shift work and suicidal ideation, we selected relevant measures based on prior studies[12]. As explanatory variables, we selected working hours (35–40, 41–50, 51–60, 60< hours) and working conditions (day work, night/shift work); as covariates, we selected gender, age, marital status, educational level (lower than elementary school, middle–high school, college or higher), annual family income (less than 1,000,000 Korean Won (KRW), 1,010,000–2,000,000 KRW, 2,010,000–3,000,000 KRW, 3,010,000–4,000,000 KRW, more than 4,010,000 KRW), history of smoking (nonsmoker, ex-smoker/current smoker), alcohol intake (nondrinker/social drinker, problematic drinker, alcoholic, based on the Alcohol Use Disorders Identification Test [AUDIT]), regular exercise, comorbidities (no disease, 1–2 diseases, 3–5 diseases, 6 or more diseases), self-rated health (good, fair/bad), occupation (professional, clerical work, service industry, agricultural, technical, manual labor) and employment status (employee, self-employed/employer); and as the result variable, we selected suicidal ideation, measured by responses (yes/ no) to the question, "Have you ever been willing to die during the past year?"

Statistical analysis

We analyzed data using the chi square and multivariate logistic regression with the SAS statistical package (SAS 9.3, SAS Institute, Cary, NC, USA). A descriptive analysis of relevant variables by gender was performed using the chi-square test. We adopted a multivariate logistic regression to identify work-related variables according to gender and employment stratification. Statistical significance was set at $p<0.05$ and a 95% confidence interval (CI) was reported as appropriate.

Ethics statement

The protocol of the community health survey was reviewed and approved by the Institutional Review Board of Armed Forces Medical Command (AFMC-14-IRB-069). Written informed consent was obtained from all participants in the community health survey.

Results

From the 220,258 respondents of the 2008 CHS, 67,471 subjects were eligible (Fig. 1). Table 1 shows the demographic differences in subjects with suicidal ideation according to gender. The results showed that 1,899 male (4.3% of 43,498 eligible male subjects) and 2,218 female subjects (9.25% of 23,973 eligible

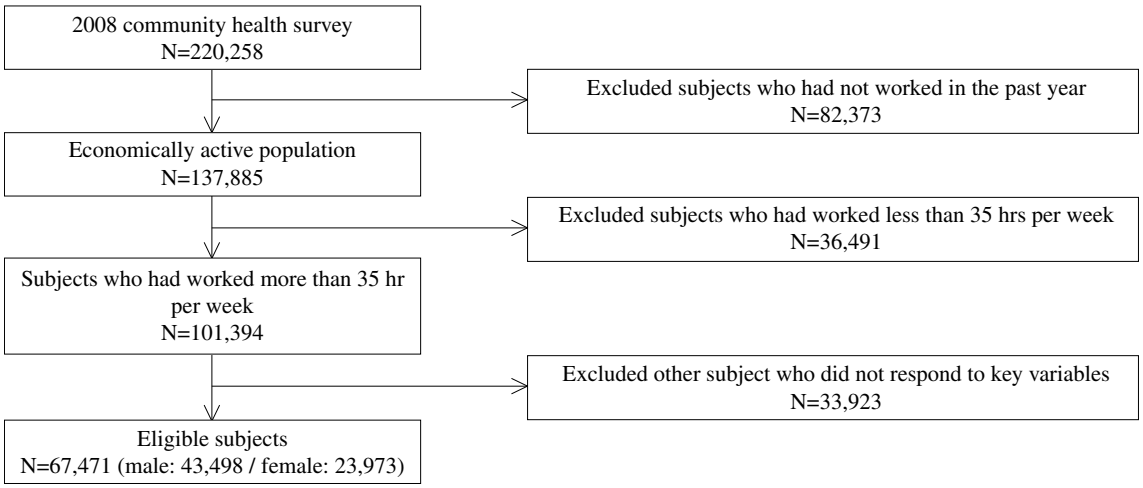

Fig. 1. Schematic diagram depicting the study population.

female subjects) responded affirmatively, stating that they had suicidal ideations during the past 1 year. There was a U shape relationship between the proportion of suicidal ideation and sleep hours, with the lowest proportion observed in the 6 to 9 hours sleep group in both genders (3.84% in men, 8.18% in women, all p values were <0.001). In terms of work duration, the proportion of individuals with suicidal ideation increased significantly as working hours increased among both male and female subjects. Further, compared with subjects with regular work, a significantly greater number of subjects with night or shift work responded that they had experienced suicidal ideation.

Using a multivariate logistic model, we proposed two models to identify the association between the variables accounting for gender and employment stratification; one (model I) was adjusted for age and occupation and the other (model II) was adjusted for age, occupation, socioeconomic status (SES), health behaviors and work-related variables. Among the male population, while it was revealed that moderately long WHs (odds ratio [OR], 1.21; 95%CI, 1.01 to 1.44) and very long WHs (OR, 1.51; 95%CI, 1.26 to 1.83) were associated with suicidal ideation in the employee group, the association was found only for very long WHs in the self-employed/employer group (OR, 1.33; 95%CI, 1.10 to 1.61) in the analysis with model I. With regard to working conditions, only night/shift work in the self-employed/employer group was significantly associated with suicidal ideation (OR, 1.29; 95%CI, 1.07 to 1.55). When we adjusted for other covariates, the result was quite different. For the male employee group, very long WHs were significantly associated with suicidal ideation (adjusted odds ratio [aOR], 1.30; 95%CI, 1.07 to 1.57), whereas moderately (aOR, 1.23; 95%CI, 1.01 to 1.50) and very long WHs (aOR, 1.31; 95%CI, 1.08 to 1.59) were associated with suicidal ideation in the self-employed/employer group. Night and shift work did not have any significance in the adjusted model.

Among the female population, only very long WHs were significantly associated with suicidal ideation in the employee group in models I (OR, 1.61; 95%CI, 1.34 to 1.92) and II (aOR, 1.31; 95%CI, 1.08 to 1.58). However, in the self-employed/employer group after adjusting for potential confounding variables, moderately (aOR, 1.35; 95%CI, 1.08 to 1.69) and very long WHs (aOR, 1.33; 95%CI, 1.07 to 1.65) were associated with suicidal ideation. In terms of working conditions, while night/shift work in the employee group was significant even after adjustment (aOR, 1.45; 95%CI, 1.23 to 1.70), it was not significant in the self-employed/employer group after adjustment.

Discussion

In this study, we identified an association between both long WHs and night/shift work and suicidal ideation. Our results are supported by prior research and provide an analytic model that explains how long WHs and night and shift work are linked to mental health problems[11,12,18,19]. Furthermore, the association was still significant when taking into account gender and employment stratification while controlling age, marital status, education level, household income, smoking history, alcohol consumption, physical activity, comorbidities, subjective quality of life and occupation.

It was found that 4.3 and 9.2% of working men and women, respectively, had expressed suicidal ideation in the year prior to data collection. In 2012, the suicide rate in South Korea was 28.1 people per 100,000 among the total population, with 38.2 per 100,000 men and 18.0 per 100,000 women, indicat-

Table 1. General characteristics of the study population

Characteristics	Proportion of Suicidal Ideation					
	Male			Female		
	N	%	*p*	N	%	*p*
Demographics						
Age						
19–29	112/3,806	2.94	<0.0001	238/4,285	5.55	<0.0001
30–39	406/10,962	3.70		429/5,432	7.90	
40–49	527/12,136	4.34		591/6,491	9.10	
50–59	398/9,109	4.37		475/4,429	10.72	
60–69	298/5,327	5.59		302/2,377	12.71	
70<	159/2,158	7.37		183/959	19.08	
Socioeconomic status						
Marriage						
Married	1,381/34,999	3.95	<0.0001	1,281/14,825	8.64	<0.0001
Divorced/separated	283/2,709	10.45		673/4,556	14.77	
Single	236/5,790	4.08		264/4,592	5.75	
Educational level						
Lower than elementary school	454/6,423	7.07	<0.0001	746/5,415	13.78	<0.0001
Middle–high school	1,021/21,522	4.74		1,047/10,975	9.54	
College or higher	425/15,553	2.73		425/7,583	5.60	
Income level (KRW)						
Less than 1,000,000	581/7,517	7.73	<0.0001	774/5,633	13.74	<0.0001
1,010,000–2,000,000	582/12,009	4.85		582/5,801	10.03	
2,010,000–3,000,000	363/10,734	3.38		380/5,194	7.32	
3,010,000–4,000,000	153/5,245	2.92		218/2,967	7.35	
More than 4,010,000	221/7,993	2.76		264/4,378	6.03	
Health behaviors						
History of smoking						
Nonsmoker	378/11,363	3.33	<0.0001	1,992/22,997	8.66	<0.0001
Ex-smoker/current smoker	1,522/32,135	4.74		226/976	23.16	
Alcohol intake (AUDIT)						
Never/social	751/21,348	3.52	<0.0001	1,761/20,960	8.40	<0.0001
Problematic	520/14,694	3.54		322/2,507	12.84	
Alcoholic	629/7,456	8.44		135/506	26.68	
Regular moderate exercise						
No	1,645/38,188	4.31	0.099	2,009/22,079	9.10	0.005
Yes	255/5,310	4.80		209/1,894	11.03	
Duration of sleep						
≤5	383/4,712	8.13	<0.0001	493/2,920	16.88	<0.0001
6–9	1,468/38,249	3.84		1,701/20,795	8.18	
9<	49/537	9.12		24/258	9.30	
Comorbidities						
No disease	833/26,515	3.14	<0.0001	776/13,668	5.68	<0.0001
1–2 diseases	811/14,582	5.56		918/7,917	11.60	
3–5 diseases	236/2,299	10.27		452/2,159	20.94	
6 or more diseases	20/102	19.61		72/229	31.44	
Self-rated health						
Good	574/22,939	2.50	<0.0001	567/11,664	4.86	<0.0001
Fair, Bad	1,326/20,559	6.45		1,651/12,309	13.41	

Table 1. General characteristics of the study population (continued)

Characteristics	Proportion of Suicidal Ideation					
	Male			Female		
	N	%	*p*	N	%	*p*
Work-related measures						
Job						
Professional	234/8,022	2.92	<0.0001	278/4,799	5.79	<0.0001
Clerk	187/6,860	2.73		299/4,537	6.59	
Service industry	294/6,353	4.63		683/6,656	10.26	
Agricultural	480/7,901	6.08		397/2,986	13.3	
Technical	452/10,545	4.29		167/1,722	9.70	
Manual labor	253/3,817	6.63		394/3,273	12.04	
Working conditions						
Day work	1,513/35,893	4.22	<0.0001	1,736/19,985	8.69	0.0007
Night/shift work	387/7,605	5.09		482/3,988	12.09	
Working time per week (hours)						
35–40	463/12,733	3.64	<0.0001	643/8,209	7.83	<0.0001
41–50	390/10,638	3.67		535/6,326	8.46	
51–60	494/10,498	4.71		466/4,846	9.62	
60<	553/9,629	5.74		574/4,592	12.5	
Employment status						
Employee	946/25,793	3.67	<0.0001	1,333/16,140	8.26	<0.0001
Self-employed / employer	954/17,705	5.39		885/7,833	11.30	
Total	1,900/43,498	4.37		2,218/23,973	9.25	

Table 2. Results for the multivariate logistic model of the study population (N=67,471)

		Employee		Self-employed / employer	
		Model I	Model II	Model I	Model II
Long working hours					
Male	Normal (<41 hours, n=463)	Reference	Reference	Reference	Reference
	Mildly (41–50, n=390)	0.89 (0.74–1.08)	0.90 (0.74–1.09)	1.04 (0.84–1.27)	1.06 (0.86–1.31)
	Moderately (51–60, n=494)	1.21 (1.01–1.44)†	1.12 (0.93–1.34)	1.21 (0.99–1.46)	1.23 (1.01–1.50)†
	Very (60<, n=553)	1.51 (1.26–1.83)†	1.30 (1.07–1.57)†	1.33 (1.10–1.61)†	1.31 (1.08–1.59)†
Female	Normal (<41 hours, n=8,209)	Reference	Reference	Reference	Reference
	Mildly (41–50, n=6,326)	1.06 (0.92–1.23)	1.04 (0.89–1.20)	1.06 (0.84–1.34)	1.11 (0.88–1.41)
	Moderately (51–60, n=4,846)	1.07 (0.91–1.25)	1.00 (0.85–1.18)	1.33 (1.07–1.66)†	1.35 (1.08–1.69)†
	Very (60<, n=4,592)	1.61 (1.34–1.92)†	1.31 (1.08–1.58)†	1.40 (1.14–1.72)†	1.33 (1.07–1.65)†
Working conditions					
Male	Day work (n=35,893)	Reference	Reference	Reference	Reference
	Night or shift work (n=7,605)	1.16 (0.99–1.36)	1.08 (0.92–1.28)	1.29 (1.07–1.55)†	1.14 (0.94–1.38)
Female	Day work (n=19,985)	Reference	Reference	Reference	Reference
	Night or shift work (n=3,988)	1.70 (1.47–1.98)†	1.45 (1.23–1.70)†	1.30 (1.08–1.55)†	1.11 (0.91–1.34)

† $p<0.05$. Model I: adjusted for age and occupation. Model II: model I + adjusted for marital status, education level, household income, smoking history, alcohol intake, physical activity, comorbidities, self-rated health.

ing a 2.1-fold higher suicide rate among men[1]. It is widely accepted that suicidal ideation generally occurs more frequently among women, reflecting biological and psychological differences between men and women. While we examined the prevalence of suicidal ideation only among employed individuals, a previous study showed that lifetime prevalence of suicidal ideation was 9.2% of the adult population across 17 countries[20].

It is noteworthy that long WHs and shift work remained as significant associates with suicidal ideation after controlling possible confounders. Although long WHs more than 60 hours per week were well identified as a risk factor for suicidal ideation and other mental illnesses, as well, in prior research[11,12,21,22], the association of shift work with suicidal ideation was identified in specific jobs such as police officers only[23]. Because the 2008 CHS was implemented nationwide, our analysis elucidated how shift work linked with suicidal ideation in all occupations. Regarding the spectrum of suicidal ideation, suicidal attempt, suicide and mental illness, the result of the USA National Comorbidity Survey[24] showed that 34% of the instances of suicidal ideation transited to suicidal planning and that and 72% of the instances of suicidal planning became suicide attempts. Furthermore, 26% of the instances of suicidal ideation became suicide attempts without suicidal planning. Hence, almost 50% of instances of suicidal ideation might become suicide attempts.

Several models can explain the mechanisms through which long WHs affect suicidal ideation. Long WHs imply excessive time spent daily at work, making it difficult to revive mental and physical health after work. Overwork leads to physical and emotional exhaustion, requiring more time to recover. Because long WHs generally accompany overwork, the vicious cycle of worker health deterioration begins with long WHs. A systemic review reported that long WHs were linked to various stress responses including physical and psychological problems, such as cardiovascular disease and mental illnesses[25]. Meijman and Mulder proposed the Effort-Recovery model to explain this mechanism, suggesting that one's work efforts depend on his/her circumstances, causing physiological and psychological changes, thus straining the body's capacity to accommodate and recover from excessive demands[26]. Hence, incomplete physical and psychological recovery induced by long WHs is an important contributor to chronic physical and psychological impairment[27].

Long WHs also aggravates the negative impact of poor lifestyles. For example, those working at least ten hours a day exercise less regularly, pay less attention to nutritional balance and consume caffeine more frequently; they also smoke and drink (alcohol) more and have higher rates of related diseases. Long WHs lead to poor quality of life[28], which also includes sleep disturbances[29]. They not only lead to insufficient sleep but also affect the quality of sleep, further leading to mental health deterioration and even suicidal ideation. In the current study, by analyzing the relationship between long WHs and sleep duration, we found that those who worked over 60 hours per week had less than 5 hours of sleep daily, 1.8 times lower than those working 35–40 hours per week (data not shown). There is a meta-analysis study that concluded that sleep problem are related to mental health[11]. Furthermore, a prospective study showed that sleep disturbances are strong predictors of future depression[30]. Sleep hours were linked to long WHs as well as suicidal thoughts; hence, sleep hours were a confounding factor. In the current study, the association between long WHs and suicidal thoughts was not attenuated even after controlling for sleep. Therefore, suicidal thoughts are directly associated with long WHs, rather than just indirectly through hours of sleep. Strategies for preventing suicidal thoughts due to long WHs are needed.

Among our subjects, it was shown that less educated people have more thoughts on suicide. Nock *et al.* reported that a lower level of education is one of the risk factors of suicidal ideation[20]. Though a consistent finding was observed, we controlled this variable for the effect of working hours and shift work on suicidal ideation only.

Long working hours, night work and shift work also disrupt basic social life that helps maintain health and psychological well-being. For example, a well-designed cohort study that followed more than 13,000 men and women found that separation or divorce rates among night workers were six times higher than those of day workers[31]. The present study demonstrated that poor quality of life is linked to poor mental health.

Furthermore, long WHs imply overwork that tends to increase all kinds of job stress, resulting in depressive symptoms and suicidal ideation. Some studies suggest that work stress continuously stimulates the hypothalamic-pituitary-adrenal axis, causing uncontrolled moods that result in a vulnerability to depression[18].

Night and shift workers are exposed to light even at night, disrupting normal melatonin secretion[32]. Melatonin acts as an anticarcinogen for breast and intestinal cancer[33]. Recently, a meta-analysis—using five prospective case-control studies—reported that low urinary melatonin metabolite levels were related to risk of breast cancer[34], suggesting that irregular work schedules caused clinical illnesses. Night and

shift work were found to disrupt the circadian rhythm and melatonin levels in the central and peripheral nervous system[35]. Circadian rhythms and melatonin levels were also linked to mental health and melatonin-based therapies showed psychopharmacological effects similar to anti-depressant drugs[36]. Our study found an increased likelihood of mental illness among night and shift workers, suggesting a plausible link between night/shift work and mental health.

Traditionally, women in Asian countries have a greater responsibility for homemaking and childcare than men. Hence, women may have experienced higher stress levels due to having less time to spend at home during the day. Since our study found a stronger influence of night and shift work on suicidal ideation among women than among men, policy makers and employers must pay careful attention to the health effects of irregular work schedules in order to prevent mental illnesses in women.

Generally, the employee has less job control compared with the employer. Job demand–control models explain how job strain affects psychological and physical health[37]. While high job demands such as overwork, increases job strain, high job control can reduce job strain as well as its adverse health effects. Hence, adverse health effect of long WHs may increase among workers who have less job control and may decrease with higher job control. However, in the current study, no difference in the magnitude of the relationship between long WHs and suicidal ideation was found for employees and employers.

The present study has several limitations. First, the CHS is cross-sectional study that cannot establish causal associations between explanatory and outcome variables. Further, this population was sampled in order to develop comparable health data of local districts and was therefore not representative of the economically active population in South Korea. Second, the survey questionnaire included various physical health variables like smoking, alcohol consumption and comorbidities, but contained only a single question on suicidal ideation and a depression-screening test. Although we did not use the result of the depression-screening test in the analysis due to multicollinearity, other mental illnesses—which were not examined in the CHS—could be mediating factors. It is also possible that seasonal conditions can affect the working hours per week. For example, the working hours of agricultural workers reach their peak in the harvest season, and those of manual production workers can fluctuate due to marker demands. However, our current study did not have any information about various factors that might affect the working hours per week. This is also a limitation of the current study. Hence, further studies to overcome these limitations are needed to clarify the association between long WHs and suicidal ideation.

The analysis revealed that long WHs and night/shift work affect suicidal ideation, taking into account differences in gender and employment. This finding is supported by prior studies performed in other Asian countries[11,12]. As the CHS was developed to follow various health outcome trends in local districts, we constructed an analytic model with various explanatory variables that were not used in prior studies, such as comorbidities, alcohol intake, SES and sleep duration[12]. High suicide incidence is widely recognized as a serious public health issue in South Korea. The attention focused on the harmful effects of exceptionally long WHs in Korea among OECD countries reflects concern from the public health and occupational medicine perspectives. Considering that suicide is a result of various aspects including individual factors, mental illness, social support, physical illness, occupation and societal and environmental influences, labor policies that reduce working hours and facilitate job stability are needed.

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