



Job strain, long work hours, and suicidal ideation in US workers: a longitudinal study

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Abstract

Purpose To investigate whether chronic psychosocial work stressors (low job control, high job demands, job strain, low supervisor and coworker support, job insecurity, and long work hours) are longitudinally associated with suicidal ideation in a working population.

Methods Five-hundred seventy-eight workers (aged 34–69) were chosen for this analysis from those who participated in both project 1 (2004–2006 at baseline) and project 4 (2004–2009 at follow-up) of the Midlife Development in the United States II study. The median time interval between the two projects was 26 months (range 2–62 months).

Results About 11% of the workers reported suicidal ideation at follow-up, while 3% of them reported moderate/severe suicidal ideation at follow-up. After controlling for age, marital status, race, family history of suicide, and suicidal ideation at baseline, low skill discretion and job strain (a combination of low job control and high job demands) were associated with total suicidal ideation. After excluding those with suicidal ideation at baseline from analysis and further controlling for other work stressors, job strain was strongly associated with moderate/severe suicidal ideation: ORs, 4.29 (1.30–14.15) for quartile-based job strain and 3.77 (1.21–11.70) for median-based job strain. Long work hours (> 40 h/week vs. ≤ 40 h/week) also increased the likelihood for moderate/severe suicidal ideation: OR 4.06 (1.08–15.19).

Conclusions Job strain and long work hours were longitudinally associated with moderate/severe suicidal ideation. Increasing job control and ensuring optimal level of work demands, including 40 h or less of work per week may be an important strategy for the prevention of suicide in working populations.

Keywords MIDUS II study · Job strain · Skill discretion · Work demands · Work hours

Introduction

Suicide is a serious public health concern across the globe, including the United States (US) (Rockett et al. 2012; World Health Organization 2014). About 800,000 people died due to suicide globally in 2012, which is equivalent to one suicide death every 40 s (World Health Organization 2014, 2017). In the US, the population suicide mortality

rate increased by 24% from 1999 (10.5 per 100,000) to 2014 (13.0 per 100,000) (Curtin et al. 2016), particularly among middle-aged adults (Centers for Disease Control and Prevention, 2013; Phillips and Nugent 2014). And the suicide mortality rate in US working populations has been also on the rise (Tiesman et al. 2015).

For the primary prevention of suicide in working populations, it is essential to identify the important work-related risk factors for suicidal ideation that is a strong predictor for suicide attempt within 1 or 2 years (Nock et al. 2008; Simon et al. 2013; Ten Have et al. 2009). Several chronic psychosocial work stressors such as low job control, high psychological job demands, job strain (as a combination of low job control and high job demands), low social support at work, job insecurity, and long work hours have been implied as important risk factors for suicide mortality case studies (Amagasa et al. 2005; Lee et al. 2016) or for suicidal

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ideation in many cross-sectional studies (Loerbroks et al. 2016; Milner et al. 2016, 2017).

However, only a handful of longitudinal studies (Baumert et al. 2014; Ostry et al. 2007; Tsutsumi et al. 2007) have been undertaken to examine chronic psychosocial work stressors in relation to suicidal attempt or mortality in working populations. With regard to suicide ideation, only one study (Kim et al. 2017) has examined and reported job insecurity as a significant risk factor. However, in the study, neither other chronic psychosocial work stressors nor a family history of suicide (Wang et al. 2017) was considered in analysis. Thus, there is still a possibility of residual confounding by unmeasured occupational and individual risk factors for suicidal ideation. In addition, no studies have examined the longitudinal associations of job strain and its components, supervisor and coworker support, and long work hours with suicidal ideation in working populations.

The purpose of this study is to investigate whether chronic psychosocial work stressors (job strain and its components, supervisor and coworker support, job insecurity, and work hours) are longitudinally associated with suicidal ideation in a middle-aged US working population particularly after controlling for family history of suicide.

Methods

MIDUS II study data

Psychosocial work stressors were assessed in Project 1 (2004–2006) of the National Survey of Midlife Development in the United States (MIDUS) II study. Suicidal ideation was measured in both Project 1 and Project 4 (2004–2009) of the MIDUS II study (Fig. 1).

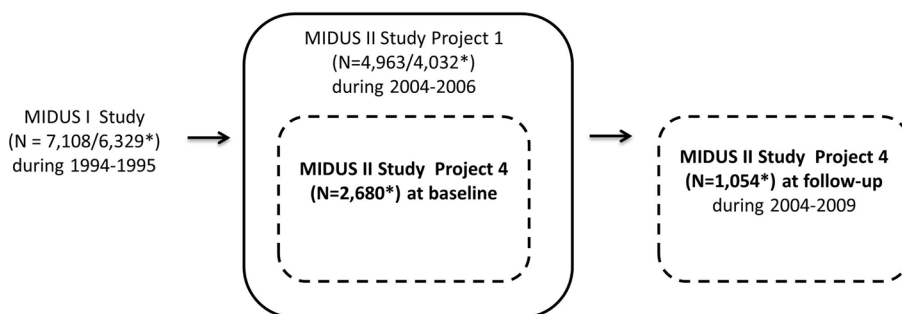
Project 1 of the MIDUS II study was conducted in 2004–2006 as a follow-up study of the MIDUS I study (1994–1995) that had been originally designed to investigate the roles of behavioral, psychological, and social factors in understanding age-related differences in physical and mental health (Ryff et al. 2007). Initially, 7108 persons (males, 48% and females, 52%) participated in the baseline phone interview of the MIDUS I study. 6329 participants additionally

completed a self-administered questionnaire. All of the participants were non-institutionalized, English-speaking adults, aged 25–74 in the US. They were drawn from four subsamples: (a) a main national random-digit-dial (RDD) sample ($N=3034$); (b) oversamples from five metropolitan areas ($N=658$); (c) siblings of individuals from the RDD sample ($N=869$); and (d) a national RDD sample of twin pairs ($N=1764$). The response rates of the four subsamples ranged from 60 to 70%. The socio-demographic characteristics of the main RDD subsample were comparable to those of a US population representative sample, the October 1995 Current Population Survey (<http://www.census.gov/cps>). However, the main RDD subsample relatively underrepresented those who were black, young (e.g., aged 25–34), or had less formal education (i.e., 12 or less than 12 years of formal education) (Choi et al. 2010a; Ryff et al. 2007).

In total, 4963 persons (males 47% and females 53%) participated in the follow-up phone interview of the MIDUS I study. The longitudinal retention rates among the four subsamples ranged from 65 to 78% (on average 70%). There were no significant ($p < 0.01$) differences in age and gender between the follow-up participants and non-participants. However, during the follow-up, less-educated persons and non-whites were relatively more likely to have dropped out of the study (Choi et al. 2010a).

Among the phone interview participants of the MIDUS II study, 4032 persons additionally completed a self-administered questionnaire (i.e., Project 1 of the MIDUS II study), including the items about psychosocial work stressors: (a) the main national RDD sample ($N=1805$); (b) the city oversamples ($N=386$); (c) the sibling sample ($N=637$); and (d) the twin national RDD sample ($N=1204$). All the main and twin RDD participants of the Project 1 of the MIDUS II study, along with a small subgroup of the sibling sample, were eligible for participation in the Project 4 of the MIDUS II study if their existing health information indicated an ability to travel to clinics for comprehensive bioindicator and physical examinations ($N=2680$) (Dienberg Love et al. 2010). Among the eligible participants ($N=2680$), 1054 persons (response rate, 39.2%, and 43.1% after adjusting for those who could not be located or contacted) were additionally recruited to a

Fig. 1 Description of the MIDUS II study as the basis of this study. *Participated in a phone interview and a self-administered questionnaire survey



subsequent project, called the Biomarker project (Project 4) of the MIDUS II study in 2004–2009 (Fig. 1). For the recruitment for the Project 4, a study invitation letter was sent to all eligible participants and then follow-up calls were made by the research staff. The participants of the Project 4 were given \$200 as a stipend for their 2-day visit to the medical clinic. The purpose of Project 4 was to add a subsample of MIDUS participants including information on comprehensive biological assessments (Ryff et al. 2013). There were no significant ($p > 0.01$) differences between the participants and non-participants of Project 4 in terms of gender, marital status, household income, working conditions (e.g., job strain, work hours, and job insecurity), and suicidal ideation at T1 (see below) in the MIDUS II study. But, the participants of Project 4 were younger (mean ages, 55.3 vs. 56.6 years), more whites (93 vs. 90%) and less less-educated persons (24% for 12 or less years of formal education vs. 35%), compared to the non-participants of Project 4. And the participants of Project 4 were mostly from the main RDD and twin RDD subsamples.

Study subjects: 582 workers

For the current study, among those ($N = 1054$) who participated in both Project 1 (called hereafter T1) and Project 4 (called hereafter T2) of the MIDUS II study, study subjects were first restricted to those ($N = 582$) who were aged less than 70 years at T1, had a full-time or part-time job in 2003 and were working (at least 1 h per week at a main job) at T1, and had valid information on the exposure and outcome variables at both T1 and T2 for analysis. The median time interval between the two projects was 26 months (range 2–62 months) in the study subjects of the current study. Then, study subjects were further restricted to those ($N = 552$) who did not reported suicidal ideation at T1. Suicidal ideation at T1 was only approximately assessed with the following two items for screening major depression in the World Health Organization Composite International Diagnostic Interview Short-Form (CIDI-SF) (Kessler et al. 1998): “During the past 12 months, was there ever time when you felt sad, blue, or depressed for 2 weeks or more in a row? (Yes/No)”; and “Did you think a lot about death—either your own, someone else’s, or death in general—during those 2 weeks? (Yes/No)”. Suicidal ideation cases at T₁ were defined as those ($N = 30$) who agreed to the above two items. Several previous studies (Crandall et al. 2010; Ten Have et al. 2009) based on the suicidal process perspective from early stage (death ideation) to later stages (e.g., suicidal ideation and suicide attempt) (Neeleman et al. 2004) have used the above more inclusive CIDI-SF items as a proxy measure of suicidal ideation or for suicidality research.

Suicidal ideation at T2

Suicidal ideation at T2 was measured with one question of the anhedonia depression scale in the Mood and Anxiety Symptoms Questionnaire (MASQ) (Watson et al. 1995): “During the past week, how much you have felt or experienced thought about death or suicide?” Total suicidal ideation cases in the current study were defined as those who responded to the above question with one of the following four response options (a little bit, moderately, quite a bit, or extremely) vs. not at all (i.e., non-suicidal ideation cases). In addition, in consideration of a strong dose–response relationship between the degree of suicidal ideation and future suicidal attempt (Walker et al. 2010), moderate or severe suicide ideation cases were also defined with those who responded to the above question with one of the following three response options (moderately, quite a bit, or extremely). A similar single questionnaire item [item 9 of the Patient Health Questionnaire (Kroenke et al. 2001)] has been commonly used for research on work and suicidal ideation (Loerbroks et al. 2016). Its validity was demonstrated against cross-sectional clinical assessment (Walker et al. 2010) and subsequent suicide attempt or death (Simon et al. 2013).

Psychosocial working conditions at T1

Several psychosocial working conditions (job control, psychological job demands, supervisor and coworker support at work, job insecurity, working hours, and serious on-going stress at work) were measured with a self-administered questionnaire at T1. The items for job control (five items: two skill discretion items about variety of work and learning opportunities on the job and three decision authority items about on-the-job decision-making opportunities), psychological job demands (three items; time pressure and workload), and immediate supervisor (two items) and coworker support (two items) were similar to the ones of the Job Content Questionnaire (JCQ) (Karasek et al. 1985). Cronbach alphas of job control and psychological job demands were 0.81 and 0.68, respectively (Choi et al. 2010b). More detailed information about the items is available elsewhere (Choi et al. 2010a). The items had a five-point Likert type of response set: all of the time to never, and were summed up for scaling-scoring. The scores of the aforementioned scales were dichotomized at their medians in those who participated in Project 1 of MIDUS II study for analyses. There was one additional response option for the immediate supervisor and coworker support items: does not apply. Thus, those who responded with the option were categorized into no immediate supervisor and no coworker groups, respectively.

Job strain, a combination of low job control and high job demands based on the Karasek’s demand-control model

(Karasek 1979), was operationalized in the following two ways: (a) median-based dichotomous job strain (vs. non-job strain) using the medians of job control and psychological job demands, and (b) quartile-based dichotomous job strain, using the quartiles of job control and psychological job demands (the 3 bottom right corner cells for job strain vs. the other 13 cells for non-job strain) (Karasek et al. 2007) for avoiding potential misclassification of job strain around the medians of job control and psychological job demands.

Job insecurity was measured with one item (“If you wanted to stay in your present job, what are the chances that you could keep it for the next 2 years?”). Those with the response options (fair or poor vs. good, very good, or excellent) were considered to be the high-job-insecurity group. Work hours per week at a main job and other paid jobs were added up for analysis.

Covariates

Several potential confounders (Table 1) were considered in analysis: data sources, socio-demographic measures (age, sex, marital status, race, annual household income, and education), number of chronic diseases, alcohol consumption, and family history of suicide. Race was categorized into three groups: White, Black, and the remaining group. In the last remaining group ($N=26$), there were Native Americans/Alaska native islanders/Eskimo ($N=9$), Asians ($N=1$), and others ($N=16$). The number of chronic diseases (those who have experienced or been treated for any of the following during the past 12 months: arthritis, sciatica, recurring stomach trouble or diarrhea, persistent foot troubles, trouble with varicose veins, multiple sclerosis, stroke, and hernia; or those who have ever had heart problems or ever had cancer) was counted. Alcohol consumption was categorized into heavy, moderate, and non-drinking. Moderate drinking was defined as up to two drinks per day for men and one drink per day for women during the past month and heavy drinking was defined as more than moderate drinking. Family history of suicide was measured with one question: “Has any one in your immediate family (father, mother, and siblings), or maternal/paternal family (grandparents and uncle/aunt) had suicide?” (Yes/No).

Statistical analyses

Descriptive statistics of total and moderate/severe suicidal ideation are presented in Table 1. The univariate associations of each of the study variables with total and moderate/severe suicidal ideation were examined by χ^2 or Fisher’s exact test. When a psychosocial working condition was at least marginally ($p < 0.20$) associated with suicidal ideation in the univariate analysis, it was further investigated through a series of multivariate logistic regression models after controlling

for socio-demographic variables (Model 1); controlling for socio-demographic variables, health behaviors and conditions, and suicidal ideation at T1 (Model 2); and if necessary, controlling for socio-demographic variables, health behaviors and conditions, suicidal ideation at T1, and other psychosocial work stressors (Model 3). In addition, the above multivariate analyses were replicated without those who reported suicidal ideation at T1. Statistical significance testing was based on a two-sided test.

Results

Total and moderate/severe suicidal ideation at T2

Sixty-six (11.3%) of the 582 workers in this study reported suicidal ideation at T2 and most of them (47 workers) thought of suicide a little bit. Nineteen (3.3%) of the 582 workers reported that they thought of suicide moderately (14 workers), quite a bit (4 workers), or extremely (1 worker). Among the 552 workers without suicidal ideation at T1, 52 workers (9.4%) newly reported suicidal ideation at T2. Most of the 52 workers (38 workers) thought of suicide a little bit, while 14 workers (2.5%) thought of suicide moderately (13 workers) or quite a bit (1 worker).

Univariate associations between psychosocial working conditions and total suicidal ideation at T2

Low skill discretion and job strain (quartile based) were positively and significantly ($p < 0.05$) associated with suicidal ideation in univariate analyses (Table 1). High psychological job demands and job strain (median based) were marginally ($p < 0.20$) associated with suicidal ideation. Low decision authority, low job control, no coworkers, job insecurity, and long work hours were all positively associated with suicidal ideation; however, their associations with suicidal ideation did not reach the marginal statistical significance ($p = 0.20$). Immediate supervisor support was not associated with suicidal ideation.

Age, marital status, race, and family suicide history were at least marginally associated with suicidal ideation. Suicide ideation was greatest in the Native Americans/Alaska native islanders/Eskimo (four out of nine, 44.4%). Suicide ideation was relatively greater in the younger (< 40 years old), the windowed or never married, non-white and non-black people (i.e., native Americans/Alaska native islanders/Eskimo/Asians/ Others), and those with family history of suicide. Data source, sex, education, household income, number of chronic disease, alcohol consumption, and the time interval between Time 1 and Time 2 were not significantly associated with suicidal ideation in univariate analyses. As expected,

Table 1 Suicidal ideation in relation to study variables in 582 US workers

Major category	Minor category	Subcategory	Frequency (%)	Total suicidal ideation (%)	Moderate or severe suicidal ideation (%)
Data source	Subsamples	Main RDD	57.9	13.4	3.3
		City or Siblings	2.7	6.3	0.0
		Twin	39.3	8.7	3.3
Socio-demographic variables	Sex	Men	50.0	12.4	3.1
		Women	50.0	10.3	3.4
	Age (years)	< 40	11.2	18.5 [‡]	6.2 [†]
		40–49	35.7	12.5 [‡]	2.4 [†]
		50–59	36.1	11.9 [‡]	4.8 [†]
		60–69	17.0	3.0 [‡]	0.0 [†]
	Marital status	Married	73.5	10.3 [†]	3.0*
		Separated	1.9	9.1 [†]	0.0*
		Divorced	11.9	7.2 [†]	4.3*
		Windowed	2.1	33.3 [†]	16.7*
		Never married	10.7	19.4 [†]	1.6*
	Race	White	92.6	10.2 [‡]	2.8*
		Black	2.9	11.8 [‡]	5.9*
		Native Americans/Alaska native islanders/Eskimo/Asian/Others	4.5	34.6 [‡]	11.5*
	Education	High school or less	20.7	15.0	4.2
		Some college	26.2	10.5	2.0
		University or more	53.2	10.4	3.6
	Annual household income (\$)	< 60,000	31.1	9.4	3.3
		60,000–99,999	33.2	13.5	3.6
≥ 100,000		35.7	11.1	2.9	
Psychosocial working conditions	Skill discretion	Low	35.7	15.4 [†]	5.3 [†]
		High	64.3	9.1 [†]	2.1 [†]
	Decision authority	Low	41.2	12.9	4.6*
		High	58.8	10.2	2.3*
	Job control	Low	45.4	12.9	4.9 [†]
		High	54.6	10.1	1.9 [†]
	Psychological job demands	Low	43.1	9.2*	1.6 [†]
		High	56.9	13.0*	4.5 [†]
	Job strain (median based)	No	74.4	10.2*	2.1 [‡]
		Yes	25.6	14.8*	6.7 [‡]
	Job strain (quartile based)	No	84.7	10.1 [†]	2.2 [‡]
		Yes	15.3	18.0 [†]	9.0 [‡]
	Supervisor support	Low	42.4	10.5	3.2
		High	41.6	12.4	3.3
		No immediate supervisors	16.0	10.8	3.2
	Coworker support	Low	46.7	11.8	3.3
		High	44.5	9.7	3.5
		No coworkers	8.8	17.6	2.0
	Job insecurity	No	95.5	11.2	3.1
		Yes	4.5	15.4	7.7
Hours of work per week	≤ 40	49.6	11.5	2.1*	
	41 or more	50.4	11.3	4.4*	
Hours of work per week	≤ 40	49.6	11.5	2.1*	

Table 1 (continued)

Major category	Minor category	Subcategory	Frequency (%)	Total suicidal ideation (%)	Moderate or severe suicidal ideation (%)
Health behaviors and conditions	Number of chronic diseases	41–48	18.4	9.3	2.8*
		49–56	21.2	11.4	4.9*
		≥ 57	10.8	14.3	6.3*
		0	26.8	10.3	3.2*
		1–2	44.3	10.5	1.9*
		≥ 3	28.9	13.7	5.4*
	Family history of suicide	No	90.0	10.7*	3.6
		Yes	10.0	17.2*	0.0
	Alcohol consumption	No	29.7	12.1	5.2*
		Moderate	67.4	10.5	2.3*
		Heavy	2.9	23.5	5.9*
	Suicidal ideation at T1	No	94.8	9.4 [‡]	2.5 [‡]
Yes		5.2	46.7 [‡]	16.7 [‡]	

* $p < 0.20$, [†] $p < 0.05$, and [‡] $p < 0.01$ at χ^2 test or Fisher's exact test

Table 2 Odds ratios and their 95% confidence intervals of psychosocial working conditions at T1 for total suicidal ideation at T2 in US workers ($N = 582$)

Variables	Model 1	<i>P</i> value	Model 2	<i>P</i> value
Low skill discretion	1.84 (1.07–3.17)	0.027	1.95 (1.11–3.43)	0.020
High psychological job demands	1.45 (0.83–2.53)	0.197	1.25 (0.70–2.23)	0.454
Job strain (median based)	1.46 (0.82–2.58)	0.196	1.40 (0.78–2.55)	0.263
Job strain (quartile based)	2.03 (1.08–3.85)	0.029	1.95 (1.00–3.80)	0.050

Model 1 was controlled for age, marital status, race, and family suicide history. Model 2 was controlled for age, marital status, race, family suicide history, and suicidal ideation at T1

suicidal ideation at T1 was strongly associated with suicidal ideation at T2.

Multivariate associations between psychosocial working conditions and total suicidal ideation at T2

After controlling for age, marital status, race, and family suicide history in multivariate logistic regression analysis (Model 1), the odds ratios (ORs) for suicidal ideation were significantly higher in the workers with low skill discretion and job strain (quartile based) (Table 2): 1.84 (95% CI: 1.07, 3.17, $p = 0.027$) and 2.03 (1.08, 3.85, $p = 0.029$), respectively. On the other hand, high psychological job demand and job strain (median based) were not significantly associated with suicidal death after controlling for age, marital status, race, and family suicide history. The ORs of low skill discretion and job strain (quartile based) only slightly changed after additionally controlled for suicidal ideation at T1 (Model 2): 1.95 (1.11–3.43) and 1.95 (1.00–3.80), respectively. When the above multivariate analyses were replicated in those without suicidal ideation at T1 ($N = 552$), the results were very similar (Table 3).

Table 3 Odds ratios and their 95% confidence intervals of psychosocial working conditions at T1 for total suicidal ideation at T2 in US workers who did not report suicidal ideation at T1 ($N = 552$)

Variables	Model 1	<i>P</i> value
Low skill discretion	1.87 (1.03–3.39)	0.040
High psychological job demands	1.24 (0.67–2.27)	0.498
Job strain (median based)	1.44 (0.76–2.73)	0.260
Job strain (quartile based)	1.96 (0.96–4.01)	0.065

Model 1 was controlled for data source, age, marital status, race, and family history of suicide

Univariate associations between psychosocial work stressors and moderate/severe suicidal ideation at T2

Generally, the distribution patterns of moderate or severe suicide ideation by the study variables were similar to those of total suicide ideation (Table 1). However, in univariate analyses, job strain (both quartile and median based) and its components (skill discretion, decision authority, job control and psychological job demands), job insecurity, and work hours per week were all more strongly associated with

moderate/severe suicidal ideation than total suicidal ideation. In particular, there was a linear association ($p=0.043$) between work hours per week and moderate/severe suicidal ideation. However, supervisor and coworker support at work were not associated with moderate/severe suicidal ideation. Also, there was no moderate or severe suicidal ideation case at T2 among those with family history of suicide ($N=58$).

Multivariate associations between psychosocial work stressors and moderate/severe suicidal ideation at T2

Table 4 shows the results of the multivariate associations between psychosocial work stressors with moderate/severe suicidal ideation after controlling for age, marital status, race, family history, and suicidal ideation at T1. The ORs for moderate/severe suicidal ideation were 4.18 (1.57–11.16) for job strain (quartile-based) and 3.14 (1.22–8.10) for job (median based). These results were similar after additionally controlling for job insecurity and long work hours (Model 3, Table 4). Low skill discretion, low decision authority, low job control, and psychological job demands were at least at the marginal significance level associated with moderate/severe suicidal ideation. Job insecurity was positively, but not significantly associated with moderate/severe suicidal ideation. Work hours per week were associated with moderate/severe suicidal ideation. In particular, there was a significant linear increase in moderate/severe suicidal ideation as hours of work per week increased in all multivariate models in Table 4. The above multivariate associations were similar, but stronger in those without suicidal ideation at T1

(Table 5). Low skill discretion, low decision authority, low job control were significantly associated with moderate/severe suicidal ideation. The ORs for moderate/severe suicidal ideation after controlling for age, marital status, race, family history of suicide, and other work stressors (Model 3 in Table 5) were 4.29 (1.30–14.15) for job strain (quartile-based) and 3.77 (1.21–11.70) for job (median based) in the 552 workers without suicidal ideation at T1. Long work hours per week (>40 h vs. ≤ 40 h per week) also increased the risk for moderate/severe suicidal ideation: OR, 4.06 (1.08–15.40). In particular, the OR for moderate/severe suicidal ideation was significantly higher in those who reported 49–56 h of work per week (vs. ≤ 40 h per week): 6.34 (1.48–27.26).

Discussion

This is the first longitudinal study that clearly demonstrated significantly positive associations of job strain and long work hours with moderate/severe suicidal ideation in a working population after controlling for other chronic work stressors and also family history of suicide. Job control and its components were strongly associated with moderate/severe suicidal ideation. While both high psychological job demands and job insecurity increased the likelihood of total or moderate/severe suicidal ideation, their associations were not statistically significant. This study indicates that improving psychosocial working conditions may be an important strategy for the prevention of suicide in working populations.

Table 4 Odds ratios and their 95% confidence intervals of psychosocial working conditions at T1 for moderate/severe suicidal ideation at T2 in US workers ($N=582$)

Variables	Model 1	<i>P</i> value	Model 2	<i>P</i> value	Model 3	<i>P</i> value
Low skill discretion	2.38 (0.93–6.10)	0.070	2.49 (0.94–6.58)	0.065	2.54 (0.94–6.92)	0.067
Low decision authority	2.15 (0.83–5.51)	0.113	2.10 (0.81–5.45)	0.126	2.38 (0.88–6.40)	0.086
Low job control	2.61 (0.97–7.04)	0.059	2.68 (0.98–7.35)	0.055	2.94 (1.03–8.35)	0.044
High psychological job demands	2.99 (0.97–9.17)	0.056	2.51(0.81–7.83)	0.113	1.99 (0.61–6.43)	0.253
Job strain (median based)	3.46 (1.36–8.77)	0.009	3.14 (1.22–8.10)	0.018	2.99 (1.13–7.95)	0.028
Job strain (quartile based)	4.56 (1.75–11.87)	0.002	4.18 (1.57–11.16)	0.004	4.08 (1.47–11.34)	0.007
Job insecurity	2.79 (0.60–13.06)	0.192	3.05 (0.63–14.81)	0.167	2.36 (0.41–13.72)	0.339
Hours of work per week (≥ 41 vs. ≤ 40)	2.30 (0.85–6.20)	0.100	2.43 (0.88–6.66)	0.085	2.60 (0.91–7.37)	0.073
Hours of work per week (41–48 vs. ≤ 40)	1.40* (0.34–5.79)	0.641	1.50 [†] (0.36–6.32)	0.581	1.82 [‡] (0.42–7.93)	0.425
(49–56 vs. ≤ 40)	2.63* (0.82–8.44)	0.104	2.61 [†] (0.79–8.60)	0.115	2.90 [‡] (0.85–9.87)	0.088
(≥ 57 vs. ≤ 40)	3.21* (0.86–12.06)	0.084	3.74 [†] (0.97–14.39)	0.055	3.10 [‡] (0.75–12.81)	0.118

Model 1 was controlled for age, marital status, race, and family suicide history. Model 2 was controlled for age, marital status, race, family suicide history, and suicidal ideation at T1. Model 3 for job strain or its components was controlled for the covariates in Model 2 plus job insecurity and work hours per week. Model 3 for job insecurity was controlled for the covariates in Model 2 plus job strain (quartile based) and work hours per week. Model 3 for work hours per week was controlled for the covariates in Model 2 plus job strain (quartile based), and job insecurity

* P for linear trend=0.019. [†] P for linear trend=0.013. [‡] P for linear trend=0.028

Table 5 Odds ratios and their 95% confidence intervals of psychosocial working conditions at T1 for moderate/severe suicidal ideation at T2 in US workers who did not report suicidal ideation at T1 ($N=552$)

Variables	Model 1	<i>P</i> value	Model 2	<i>P</i> value
Low skill discretion	3.04 (0.99–9.31)	0.052	3.48 (1.11–10.94)	0.033
Low decision authority	2.46 (0.80–7.59)	0.117	3.41 (1.05–11.05)	0.041
Low job control	3.33 (1.01–10.99)	0.048	4.09 (1.20–13.98)	0.025
High psychological job demands	2.09 (0.64–6.84)	0.222	1.56 (0.46–5.32)	0.481
Job strain (median based)	3.62 (1.20–10.62)	0.022	3.77 (1.21–11.70)	0.022
Job strain (quartile based)	4.03 (1.26–12.92)	0.019	4.29 (1.30–14.15)	0.017
Job insecurity	1.59 (0.19–13.20)	0.668	1.72 (0.19–15.82)	0.630
Hours of work per week (≥ 41 vs. ≤ 40)	3.91 (1.06–14.41)	0.040	4.06 (1.08–15.19)	0.038
Hours of work per week (41–56 vs. ≤ 40)	1.88 (0.30–11.75)	0.499	1.90 (0.29–12.40)	0.502
(49–56 vs. ≤ 40)	5.92 (1.40–25.16)	0.016	6.34 (1.48–27.26)	0.013
(≥ 57 vs. ≤ 40)	4.08 (0.77–21.62)	0.098	3.89 (0.73–20.87)	0.113

Model 1 was controlled for age, marital status, race, and family suicide history. Model 2 for job strain or its components was controlled for the covariates in Model 1 plus job insecurity and work hours per week. Model 2 for job insecurity was controlled for the covariates in Model 1 plus job strain (quartile based) and work hours per week. Model 2 for work hours per week was controlled for the covariates in Model 1 plus job strain (quartile based), and job insecurity

Comparison with the previous studies

None of the previous longitudinal studies on chronic psychosocial work stressors and suicidal mortality or suicidal ideation have considered a family history of suicide in their analysis. The current study newly showed that chronic psychosocial work stressors can increase the risk for suicidal ideation in working populations, independently of a family history of suicide. A family history of suicide was only marginally associated with total suicidal ideation, but not moderate/severe suicidal ideation in the current study.

Low job control, its components (low skill discretion and low decision authority), and long work hours increased the risk for moderate/severe suicidal ideation in the current study. This is consistent with the previous longitudinal study in a Japanese working population (Tsutsumi et al. 2007) in which job control was inversely associated with suicidal mortality, although there was no separate analysis for the components of job control in the Japanese study. Also it is similar to the previous longitudinal study in a German working population (Baumert et al. 2014) in which a very crude composite measure of several work stressors (i.e., overtime, shift work, night shifts, taskwork, and assembly-line work) was positively associated with suicidal mortality. However, the current study has a merit over the German study in demonstrating clearly long work hours per week as a risk factor for suicidal ideation.

On the other hand, as opposed to the previous longitudinal studies (Baumert et al. 2014; Ostry et al. 2007; Tsutsumi et al. 2007), both job strain and high psychological job demands (albeit not statistically significant) were positively associated with suicidal ideation in the current study. In the previous longitudinal studies (Baumert et al. 2014; Ostry et al. 2007; Tsutsumi et al. 2007), job strain and high

psychological job demands unexpectedly appeared to be protective against suicidal mortality or suicidal attempt. There is no clear answer for the discrepancy between the current study and the previous studies. And they are not completely comparable to each other due to the difference in the main outcome of interest (suicidal ideation vs. suicidal mortality or suicide attempt). Nonetheless, two methodological differences between the studies deserve some discussion here for future studies. In the previous longitudinal studies (Ostry et al. 2007; Tsutsumi et al. 2007), psychological job demands were assessed with the standard JCQ or JCQ-like five-item scale. And study subjects were mostly manual workers (sawmills workers and a rural community sample). But in the current study, psychological job demands were measured with time pressure-focused three items without the two items, “work fast” and “work hard”, of the standard JCQ demand scale. In addition, study subjects were mostly non-manual workers (Choi et al. 2010a), although they had a wide range of occupations. The construct validity of the standard JCQ job demand scale has been reported to be weak particularly in physically demanding occupations (Choi et al. 2008, 2012). Also, an alternative three-item JCQ demand scale without the “work fast” and “work hard” items was stronger in terms of predictive validity for mental health indicators and cardiovascular disease risk factors than the standard five-item JCQ demand scale (Choi et al. 2008; Garcia-Rojas et al. 2015).

The current study demonstrated that quartile-based dichotomous job strain is a better predictor for total or moderate/severe suicidal ideation than the typical median-based dichotomous job strain. This is consistent with the previous cross-sectional study (Choi et al. 2010b) on job strain and leisure-time physical activity; however, the current study newly demonstrated that the differential operationalization

of job strain could also make a difference in longitudinal research (Choi et al. 2015; Karasek et al. 2007).

Job insecurity was positively associated with moderate/severe suicidal ideation in the current study as in the previous longitudinal study (Kim et al. 2017). However, the associations were not statistically significant in the current study. But, the non-significant associations in the current study should be cautiously interpreted due to the following two reasons. First, only 4.5% of the study subjects in the current study reported job insecurity. It should be reminded that the majority of the study subjects in the MIDUS II study (2004–2009) were recruited during non-economic downturns (e.g., before the Great Recession, 2008–2012). Second, the sample size of the current study was relatively small. Thus, job insecurity should be further tested in future studies in a larger sample of working populations.

Supervisor support and coworker support were not associated with suicidal ideation in the current study. In a case–control study in a German working population (Schneider et al. 2011), dissatisfaction with supervisors or colleagues was not associated with suicidal mortality, while psychic strain due to contact with clients was associated with suicidal mortality. In a cross-sectional study in an Australian working population (Milner et al. 2016), supervisor support was only marginally associated with suicidal ideation, while bullying or harassment at work was significantly associated with suicidal ideation. In one previous longitudinal study (Ostry et al. 2007), coworker support was inversely associated with suicide attempt, but not suicidal mortality. However, the measure for coworker support in the previous study (e.g., “The worker could interact with co-workers while they worked”) was different from those (general emotional and informational support from immediate supervisor and coworkers) in the current study. Experiences of bullying or harassment at work, and a lack of social interactions with coworkers may be better predictors for suicidal behaviors than general low social support at work from immediate supervisor and coworkers.

Implications for the prevention of suicide in working populations

This study indicates that job strain and long work hours may be important occupational risk factors for suicidal ideation in working populations. However, contemporary suicide prevention programs at the workplace are mostly focused on training and education for detecting those at high risk of suicide and connecting them with mental health services (Milner et al. 2015). Those programs are necessary as the secondary or tertiary prevention approaches, but insufficient for addressing the sources of suicide ideation in working populations. The current study suggests that creating and maintaining healthy work organization should be another

important strategy for the prevention of suicide in working populations. Several workplace intervention studies targeting low job control (Bond and Bunce 2001) including monotonous tasks (Orpen 1979), high workload (Evans et al. 1999), and long work hours (Schiller et al. 2017) have demonstrated that changing adverse psychosocial working conditions are possible and it is also beneficial for workers’ mental health and job satisfaction. The World Health Organization (World Health Organization 2006) has also recommended promoting a healthy workforce by eliminating or reducing job-related stressors for the prevention of suicide in working populations.

Limitations

This study has four limitations. First, the information on psychosocial work stressors was available only at baseline. Repeated assessments of psychosocial work stressors were more strongly associated with exhaustion and coronary heart disease than one-time assessment (Kivimaki et al. 2006). Thus, it is likely that the associations between psychosocial work stressors and suicidal ideation in the current study were underestimated to some extent. Second, no identical measure for suicidal ideation was administered twice (at T1 and at T2) in the MIDUS II project. Thus, the two different measures for suicidal ideation at T1 and at T2 were used in the current study. However, it is unlikely that the main findings of the current study were significantly affected by the different measures for suicidal ideation due to the following reasons. The more inclusive (death ideation), proxy measure of suicidal ideation at T1 (Crandall et al. 2010; Ten Have et al. 2009) in the current study would have captured most, if not all, suicidal ideation cases at T1. In addition, there was a very high correlation (0.76) between death ideation and suicidal ideation based on a single item each (Milos et al. 2004). Furthermore, the results in those with and without suicidal ideation at T1 in the current study were very similar to each other. On the other hand, the wording of the measure for suicidal ideation at T2 was suicide specific, although it included death (i.e., thought about death or suicide). Despite some possible overestimation of the proportion of suicidal ideation at T2 in the current study, it is unlikely that the overestimation was differential according to exposures at T1, including job strain and long work hours. Third, the findings of the current study should be carefully interpreted because of the underrepresentation of the following groups in the MIDUS study: younger workers, racial minority workers, and workers with less formal education. A more representative sample of US workers will be needed for testing and confirming the findings of the current study. Nonetheless, in the current study, workers with the racial background of Native Americans, Alaska Native Islanders, or Eskimo

were at a higher risk for suicidal ideation than black workers, which is generally in line with the existing literature (Olson and Wahab 2006; Tiesman et al. 2015). Fourth, the sample size of the current study is relatively small. Some of chronic psychosocial work stressors (job insecurity) in the current study remain to be further tested and confirmed in relation to suicidal ideation in future larger samples of working populations. However, it should be balanced against the fact that the current study is the first study that examined the longitudinal associations between multiple chronic psychosocial work stressors and suicidal ideation in a working population.

Compliance with ethical standards

Conflict of interest The author declares that he has no conflict of interest.

Ethical approval For this type of study formal consent is not required.

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