Safety and Health at Work 17 (2026) 262–269

Contents lists available at ScienceDirect

Safety and Health at Work

journal homepage: www.e-shaw.net

Original article

Adverse Impact of Nonstandard Working Hours on Mental Health: An Analysis Using Two-way Fixed Effects Model

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ARTICLE INFO

Article history:
Received 16 May 2025
Received in revised form
10 December 2025
Accepted 22 February 2026
Available online 7 March 2026

Keywords:
Employment
Longitudinal studies
Mental health
Work schedule tolerance

ABSTRACT

Background: Although several studies have demonstrated the adverse impacts of both longer and shorter working hours on workers' mental health, findings remain inconsistent. This study aimed to analyze the impacts of working hours on mental health and investigate how this relationship varies across subgroups.

Methods: Using the 12th to 18th waves of the Republic of Korea Welfare Panel Study, we analyzed 29,025 observations from 7,415 individuals. Working hours were categorized as "<35 hours," "35–40 hours (standard)," "41–52 hours," and ">52 hours." Mental health outcomes included depressive symptoms, self-esteem, and subjective well-being. Two-way fixed effects models were used to analyze the causal associations between working hours, with subgroup analyses by gender, age, and employment type.

Results: Compared to standard working hours, both reduced (<35 hours) and extended working hours (41–52 hours and >52 hours) were associated with adverse mental health outcomes. Depressive symptoms increased with reduced (estimate = 0.301) and extended hours (41–52 hours: estimate = 0.238; >52 hours: estimate = 0.283). Self-esteem decreased across all nonstandard categories (<35 hours: estimate = -0.266; 41–52 hours: estimate = -0.200; >52 hours: estimate = -0.214). Subjective well-being decreased with extended hours (41–52 hours: estimate = -0.054; >52 hours: estimate = -0.125). Extended hours were associated with adverse mental health across all groups, with stronger associations among women and younger adults. Women, older adults, and casual or fixed-term workers exhibited high vulnerability to the effects of reduced working hours.

Conclusion: Our findings indicate a nonlinear relationship between working hours and mental health, with standard working hours demonstrating the most favorable outcomes. Differential impacts across demographic groups underscore the necessity for tailored policies.

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1. Introduction

The Republic of Korea is widely recognized for its longer working hours. In 2023, the average annual working hours per employed person in the Republic of Korea were 1,872 hours—considerably greater than the Organization for Economic Cooperation and Development average of 1,742 hours [1]. Excessive working hours constitute a significant social concern in the Republic of Korea [2–4].

The relationship between working hours and mental health is complex. While numerous studies have identified the negative impacts of longer working hours on workers' mental health and

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https://doi.org/10.1016/j.shaw.2026.02.006

depression [5–8], meta-analyses have found insufficient evidence to substantiate the hypothesis that longer working hours increase depression risk [9,10]. Moreover, shorter working hours have been linked to adverse mental health including elevated stress levels [7,11], indicating a potential nonlinear relationship (U-shaped or inverted U-shaped) between working hours and mental health.

Demographic factors may influence this relationship. Studies indicate that women, young employees, and workers with low income levels show stronger associations between longer working hours and depressive symptoms [6,12]. Understanding this heterogeneity can help develop tailored interventions for vulnerable populations.

While prior studies have examined depression and subjective well-being, self-esteem—an important indicator and protective factor for mental health—has received less attention, particularly within the context of the Republic of Korea's dual labor market structure. Therefore, this study aimed to examine the nonlinear relationships between working hours and mental health, and variations by gender, age, and employment type by analyzing South Korean longitudinal data. A two-way fixed effects (TWFE) model was employed to overcome the limitations of cross-sectional designs commonly used in previous research, guided by the conceptual framework of this study (Fig. 1).

2. Materials and methods

2.1. Data sources

This study utilized the Korea Welfare Panel Study (KWPS) data, conducted annually by the Korea Institute for Health and Social Affairs. The KWPS is a nationally representative survey collecting information regarding health, economic activity, and satisfaction via face-to-face interviews with household members over a period of 15 years [13].

The initial sampling employed stratified double sampling based on the primary survey of 30,000 households nationwide to resemble each region's household distribution. Beginning with 7,072 households and 14,496 individuals in 2006, additional households were added in the 7th and 17th waves in 2012 (1,800) and 2022 (2,012), respectively, to address sample distribution and attrition concerns [13].

We utilized data from the 12th–18th waves (2017–2023) because the subjective well-being measurement was first introduced in the 12th wave.

2.2. Study participants

Of the 119,878 total observations, we selected 37,900 observations with no missing values. As the KWPS measures working hours differently for those who work regularly versus irregularly, we included only wage workers aged 20–64 years having regular work patterns to avoid measurement errors.

The final sample included 29,025 observations from 7,415 individuals, resulting in an unbalanced panel. Panel data can be classified into balanced (all individuals observed at all times) and unbalanced (some individuals are missing at certain times) panels. We employed an unbalanced panel to maximize the sample size and enhance the generalizability of the findings.

2.3. Variables

2.3.1. Exposure variables

Average weekly working hours were categorized as "<35 hours," "35–40 hours (standard)," "41–52 hours," and ">52 hours." We considered 35–40 hours as the reference group. This classification follows the standard working hours set by the Labor Standards Act in the Republic of Korea, which stipulates a 40-hour workweek, and since 2018, the weekly working hours have been limited to less than 52 hours, except for five specific industries [14].

2.3.2. Outcome variables

1) Depressive symptoms

Depressive symptoms were measured using the Center for Epidemiologic Studies Depression Scale-11 [15]. This scale comprises 11 items and collects information regarding respondents'

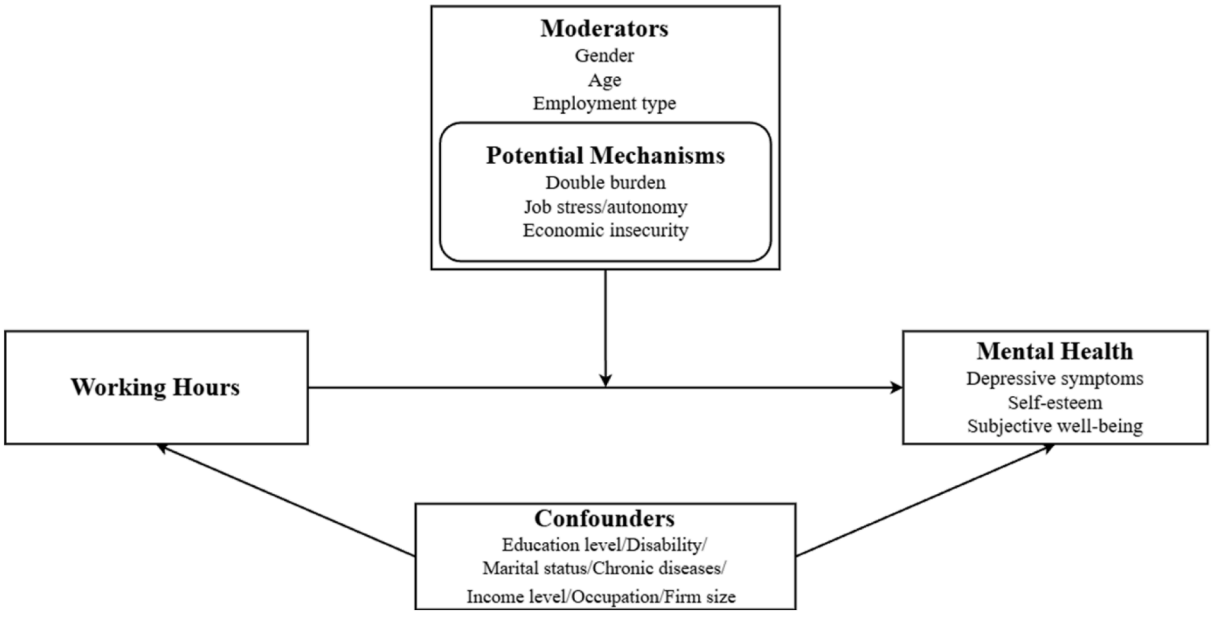


Fig. 1. Conceptual framework of the study.

psychological states over the past week, with higher scores indicating higher depressive symptoms.

2) Self-esteem

Beyond depression [7,8] and subjective well-being [16,17], we specifically examined self-esteem to capture the evaluative aspect of mental health. Low self-esteem is associated with several mental health issues, such as depression, anxiety, and suicidal ideation [18]. Understanding the impact of working hours on self-esteem offers important implications for developing policies to enhance workers' mental health.

Self-esteem was measured using the Rosenberg Self-Esteem Scales [19]. This scale consists of 10 items and asks how respondents feel about themselves on the current day of the survey. Higher scores indicate higher self-esteem.

3) Subjective well-being

Subjective well-being was measured on an 11-point scale using the Cantril Ladder, which has been included as a subjective well-being measurement indicator in various studies [20,21]. Respondents indicate which rung of the ladder they feel they are currently on, from the bottom (0: the worst possible state in life) to the top (10: the best possible state in life).

2.3.3. Covariates

Age was classified into "younger adults (<35 years)" and "older adults (≥35 years)." Disability status and chronic disease status were categorized into "present" and "absent." Marital status was categorized into "married," "not married," and "others (divorced, widowed, and separated)." Educational level was categorized into "high school or less" and "college or more." Household equivalized income was adjusted by dividing the annual disposable income by the square root of the number of household members, and the natural logarithm of this value was used. Occupation was classified into "white collar," "service and sales," and "blue collar" and employment type into "permanent employees," "casual or fixed-term workers," "employers," and "self-employed." Permanent employees have contracts of one year or more or a fixed contract period whereby they can continue working for as long as they wish. Further, casual or fixed-term workers include temporary workers, day laborers, and workers in a government-funded employment program. Employers operate a business with one or more employees, whereas the self-employed run a business independently, either alone or with unpaid family workers. Establishment size was categorized into "<5," "5–29," "30–299," and "≥300."

2.4. Statistical methods

The TWFE models were employed to determine the impact of working hours on mental health. The Hausman test was significant ($p < 0.001$) across all models for the three dependent variables, supporting the appropriateness of the fixed effects models. We estimated TWFE models to account for within-individual variation. The TWFE models incorporated individual- and time-fixed effects, controlling for unobserved time-invariant individual characteristics such as temperament and personality; and time-specific factors such as economic conditions and policy changes, that affect mental health.

The main analytical model was as follows:

$$Y_{it} = \beta_0 + \beta_1 WorkingHour_{it} + \beta_2 X_{it} + \alpha_i + \lambda_t + \varepsilon_{it}$$

where Y_{it} denotes the dependent variable for individual i at time t. $WorkingHour_{it}$ indicates weekly working hours. The term α_i, λ_t, and ε_{it} represent time-invariant individual characteristics, time-fixed effects, and the error term, respectively. X_{it} is a vector of time-varying covariates. The model did not incorporate age as a separate variable because age is controlled by including time dummies.

We employed cluster-robust standard errors to prevent the underestimation of standard errors because of repeated measures within the same individuals.

We conducted subgroup analyses based on gender, age, and employment type using the same TWFE model. For the analysis by employment type, we excluded employers and self-employed individuals owing to small sample sizes. We restricted analysis by employment type to individuals who maintained consistent employment type throughout the study to prevent confounding attributable to changes in employment type.

All statistical analyses were performed using R software version 4.4.2. Statistical significance was assessed at a p value<0.05.

3. Results

Table 1 lists the study population's characteristics at initial inclusion. Notably, 43.5% worked standard hours, while 40.6% worked longer. The proportion of men increased with an increase in weekly working hours. Participants working <35 hours were predominantly casual or fixed-term workers (83.2%), whereas those working 35–40 and 41–52 hours were more likely to be permanent employees. Those working 35–40 hours exhibited the best mental health outcomes. Depressive symptoms were the highest among those working <35 hours, while subjective well-being was the lowest among those working >52 hours.

Table 2 presents the mental health outcomes according to weekly working hours across demographic characteristics and employment types. Participants working standard hours generally reported better mental health than those working shorter or longer hours. Women exhibited higher depressive symptoms and lower self-esteem than men across all working-hour categories, with women working >52 hours reporting the worst outcomes. Among those working >52 hours, older adults exhibited the lowest self-esteem and subjective well-being. Casual or fixed-term workers primarily reported poorer mental health than those with other employment types. Notably, the fixed effects model estimates within-individual variation over time, while Table 2 shows a pooled cross-sectional analysis reflecting both within- and between-individual variation.

Table 3 reveals the association between working hours and mental health. Compared to working standard hours, working either shorter or longer hours was significantly associated with worsened mental health. Working <35 hours was associated with increased depressive symptoms and decreased self-esteem, while both working 41–52 hours and >52 hours were significantly associated with worsened mental health across all measures, with stronger associations for those working >52 hours.

Tables 4–6 present the association between working hours and mental health outcomes according to subgroups. Among men, compared to working standard hours, working <35 hours showed no significant associations with mental health, while working 41–52 hours significantly increased depressive symptoms and decreased self-esteem. These relationships were even stronger for working >52 hours, with increased depressive symptoms and decreased subjective well-being. Women experienced adverse effects across all nonstandard hours compared to standard. Working <35 hours significantly increased depressive symptoms and decreased self-esteem compared to standard hours. Working

Table 1
Characteristics of study subjects at baseline wave N(%)

	Weekly working hours				
	<35	35-40	40-52	>52	Total
Total	1178 (15.9)	3227 (43.5)	1833 (24.7)	1177 (15.9)	7415 (100)
Age					
<35	384 (32.6)	1140 (35.3)	551 (30.1)	278 (23.6)	2353 (31.7)
≥35	794 (67.4)	2087 (64.7)	1282 (69.9)	899 (76.4)	5062 (68.3)
Gender					
Men	325 (27.6)	1623 (50.3)	1131 (61.7)	823 (69.9)	3902 (52.6)
Women	853 (72.4)	1604 (49.7)	702 (38.3)	354 (30.1)	3513 (47.4)
Education					
Highschool or below	542 (46.0)	1072 (33.2)	871 (47.5)	690 (58.6)	3175 (42.8)
College or above	636 (54.0)	2155 (66.8)	962 (52.5)	487 (41.4)	4240 (57.2)
Income (log) (mean (SD))	7.94 (0.53)	8.15 (0.47)	8.10 (0.45)	8.04 (0.47)	8.09 (0.48)
Employment type					
Permanent employees	68 (5.8)	2009 (62.3)	1013 (55.3)	422 (35.9)	3512 (47.4)
Casual or fixed-term workers	980 (83.2)	1054 (32.7)	563 (30.7)	364 (30.9)	2961 (39.9)
Employers	12 (1.0)	53 (1.6)	75 (4.1)	112 (9.5)	252 (3.4)
Self-employed	118 (10.0)	111 (3.4)	182 (9.9)	279 (23.7)	690 (9.3)
Occupation					
Blue collar	430 (36.5)	915 (28.4)	774 (42.2)	528 (44.9)	2647 (35.7)
Service and sales workers	368 (31.2)	470 (14.6)	364 (19.9)	438 (37.2)	1640 (22.1)
White collar	380 (32.3)	1842 (57.1)	695 (37.9)	211 (17.9)	3128 (42.2)
Firm size					
0-4	501 (42.5)	436 (13.5)	504 (27.5)	558 (47.4)	1999 (27.0)
5-49	487 (41.3)	1271 (39.4)	715 (39.0)	363 (30.8)	2836 (38.2)
50-299	137 (11.6)	663 (20.5)	312 (17.0)	160 (13.6)	1272 (17.2)
≥300	53 (4.5)	857 (26.6)	302 (16.5)	96 (8.2)	1308 (17.6)
Weekly working hours (mean (SD))	20.19 (7.99)	39.71 (1.12)	47.12 (2.62)	62.20 (8.46)	42.01 (13.15)
Marital status					
Married	660 (56.0)	1944 (60.2)	1147 (62.6)	777 (66.0)	4528 (61.1)
Not married	390 (33.1)	1055 (32.7)	535 (29.2)	268 (22.8)	2248 (30.3)
Others	128 (10.9)	228 (7.1)	151 (8.2)	132 (11.2)	639 (8.6)
Disability					
No	1126 (95.6)	3142 (97.4)	1775 (96.8)	1124 (95.5)	7167 (96.7)
Yes	52 (4.4)	85 (2.6)	58 (3.2)	53 (4.5)	248 (3.3)
Chronic diseases					
No	732 (62.1)	2254 (69.8)	1224 (66.8)	751 (63.8)	4961 (66.9)
Yes	446 (37.9)	973 (30.2)	609 (33.2)	426 (36.2)	2454 (33.1)
Depressive symptoms (mean (SD))	2.84 (4.07)	1.91 (3.15)	2.15 (3.32)	2.35 (3.43)	2.19 (3.41)
Self-esteem (mean (SD))	31.70 (4.00)	32.48 (3.41)	31.94 (3.38)	31.76 (3.29)	32.11 (3.50)
Subjective well-being (mean (SD))	6.62 (1.69)	6.92 (1.51)	6.59 (1.59)	6.40 (1.61)	6.71 (1.59)

41–52 hours showed broader effects including increased depressive symptoms, decreased self-esteem, and reduced subjective well-being, while >52 hours was associated with increased depressive symptoms and decreased self-esteem.

Younger adults transitioning from standard to <35 hours showed no significant effects, whereas shifting to 41–52 hours significantly increased depressive symptoms and decreased self-esteem. Working >52 hours exhibited stronger associations, with increased depressive symptoms and decreased subjective well-being. Among older adults, working either reduced or extended hours showed poorer mental health. All mental health indicators deteriorated with extended hours, with stronger associations for >52 hours.

Permanent employees showed adverse effects only with extended hours; working 41–52 hours was significantly associated with increased depressive symptoms and decreased self-esteem; further, working >52 hours exhibited significant associations with increased depressive symptoms, decreased self-esteem, and reduced subjective well-being. Casual or fixed-term workers exhibited a contrasting pattern: working <35 hours significantly increased depressive symptoms and decreased self-esteem compared to standard hours, while extended hours showed no significant associations. Fig. 2 illustrates these different patterns across subgroups.

4. Discussion

This study found that, compared with working standard hours, either reduced or extended working hours were associated with adverse mental health outcomes. Working longer hours affected all groups; however, women and younger adults were the most strongly impacted. Working shorter hours particularly affected women, older adults, and casual or fixed-term workers.

Our findings substantiate a U-shaped relationship between working hours and mental health, noting optimal mental health at standard hours. Studies conducted across different countries have demonstrated this pattern with varying thresholds: an Australian study observed that mental health peaks at 39 weekly hours (38 for women, 43.5 for men) [22]. A Chinese study suggested that depressive symptoms are minimized at approximately 48 hours per week (48.58 for women, 47.60 for men) [23]. Meanwhile, Wang employed the Korean Labor and Income Panel Survey from 1998 to 2012, revealing that life satisfaction is maximized at 47.6 hours

Table 2
Mental health outcomes by weekly working hours across gender, age, and employment type

	Weekly working hours	Depressive symptoms (mean (SD))	Self-esteem (mean (SD))	Subjective well-being (mean (SD))	Total (*n*(%))
Gender					
Men	<35	2.67 (3.83)	31.44 (4.20)	6.47 (1.82)	841 (5.3)
	35-40	1.61 (2.80)	32.69 (3.31)	7.14 (1.46)	7607 (48.4)
	41-52	2.01 (3.12)	32.22 (3.35)	6.89 (1.51)	4491 (28.6)
	>52	2.31 (3.48)	31.88 (3.42)	6.59 (1.60)	2790 (17.7)
Women	<35	2.82 (4.07)	31.92 (3.78)	6.78 (1.71)	2673 (20.1)
	35-40	2.22 (3.45)	32.59 (3.47)	7.01 (1.50)	6922 (52.1)
	41-52	2.83 (3.95)	32.01 (3.47)	6.77 (1.59)	2557 (19.2)
	>52	2.91 (3.69)	31.70 (3.46)	6.55 (1.63)	1144 (8.6)
Age					
<35 y	<35	2.64 (4.09)	32.04 (4.22)	6.69 (1.65)	758 (11.0)
	35-40	2.08 (3.37)	32.62 (3.65)	7.02 (1.47)	3806 (55.4)
	41-52	2.28 (3.49)	32.30 (3.54)	6.87 (1.51)	1615 (23.5)
	>52	2.25 (3.53)	32.37 (3.49)	6.64 (1.63)	689 (10.0)
≥35 y	<35	2.82 (3.99)	31.74 (3.79)	6.71 (1.76)	2756 (12.4)
	35-40	1.84 (3.06)	32.65 (3.29)	7.10 (1.48)	10723 (48.4)
	41-52	2.31 (3.46)	32.09 (3.35)	6.84 (1.55)	5433 (24.5)
	>52	2.53 (3.56)	31.72 (3.41)	6.56 (1.60)	3245 (14.6)
Employment type					
Permanent employees	<35	2.20 (3.52)	32.85 (3.44)	7.11 (1.48)	322 (2.0)
	35-40	1.66 (2.87)	32.96 (3.29)	7.25 (1.38)	10266 (63.7)
	41-52	2.04 (3.16)	32.46 (3.24)	7.03 (1.44)	4082 (25.3)
	>52	2.26 (3.33)	31.89 (3.51)	6.68 (1.55)	1438 (8.9)
Casual or fixed-term workers	<35	2.87 (4.10)	31.62 (3.91)	6.63 (1.76)	2800 (30.1)
	35-40	2.49 (3.77)	31.80 (3.54)	6.58 (1.62)	3546 (38.2)
	41-52	2.79 (4.03)	31.50 (3.60)	6.47 (1.64)	1913 (20.6)
	>52	2.58 (3.68)	31.47 (3.46)	6.32 (1.66)	1035 (11.1)
Employers	<35	1.95 (3.12)	31.87 (3.57)	7.00 (1.14)	38 (3.8)
	35-40	2.13 (2.94)	32.96 (3.09)	7.26 (1.31)	216 (21.3)
	41-52	2.32 (3.45)	32.41 (3.31)	7.05 (1.42)	287 (28.3)
	>52	2.79 (3.99)	32.22 (3.45)	6.83 (1.54)	472 (46.6)
Self-employed	<35	2.70 (3.77)	32.24 (3.91)	6.92 (1.74)	354 (13.6)
	35-40	2.40 (3.21)	31.88 (3.26)	6.85 (1.53)	501 (19.2)
	41-52	2.50 (3.38)	31.95 (3.48)	6.76 (1.68)	766 (29.3)
	>52	2.55 (3.50)	31.94 (3.24)	6.57 (1.62)	989 (37.9)

SD, standard deviation.
Pooled cross-sectional analysis of all observations. Individuals may contribute multiple observations if measured in multiple years.

[17]. The discrepancy between Wang's findings and ours likely reflects the transition from a 44-hour to a 40-hour statutory workweek in the Republic of Korea between 2001 and 2011. Our utilization of categorized working hours limited the identification of optimal working hours. Future research should address this limitation by estimating optimal working hours.

Several mechanisms may explain why women and younger adults were disproportionately affected by extended working hours. Women's greater vulnerability to longer working hours reflects role conflict arising from their double burden of paid employment and unpaid domestic responsibilities [24]. In 2019, South Korean women spent over three hours daily on housework, whereas men spent only 48 minutes [25]. This gender inequality in domestic labor likely exacerbates the adverse impacts of extended working hours among women.

Distinct mechanisms underlie the vulnerability of younger adults. First, younger adults may experience heightened job stress due to their lower positions in organizational hierarchies [26]. Second, age-related differences in stress resilience suggest that older adults have developed superior coping strategies [27,28]. Third, younger adults tend to prioritize work-life balance more than older generations [29,30], making extended hours more psychologically distressing for this demographic.

The association between shorter working hours and adverse mental health outcomes was particularly evident among women, older adults, and casual or fixed-term workers. A common feature of shorter working hours across these groups is that they are typically involuntary. These groups are more likely to desire longer working hours but are constrained by labor market conditions [31–35], leading to economic insecurity and psychosocial stress.

Table 3
Association between working hours and mental health: Fixed effects model (estimate [95% CI])

Weekly working hours	Depressive symptoms	Self-esteem	Subjective well-being
Crude model			
<35	0.349 [0.146, 0.551]	-0.344 [-0.533, -0.154]	-0.095 [-0.177, -0.013]
35-40	Reference	Reference	Reference
41-52	0.244 [0.132, 0.355]	-0.203 [-0.313, -0.094]	-0.052 [-0.098, -0.005]
>52	0.291 [0.127, 0.455]	-0.218 [-0.379, -0.056]	-0.115 [-0.186, -0.044]
Adjusted model*			
<35	0.301 [0.097, 0.505]	-0.266 [-0.457, -0.074]	-0.060 [-0.143, 0.023]
35-40	Reference	Reference	Reference
41-52	0.238 [0.127, 0.350]	-0.200 [-0.310, -0.091]	-0.054 [-0.100, -0.008]
>52	0.283 [0.118, 0.448]	-0.214 [-0.376, -0.051]	-0.125 [-0.195, -0.054]

CI, confidence interval.
* Education level, disability, marital status, chronic diseases, income, occupation, firm size, employment type adjusted.

Table 4
Association between working hours and mental health by gender: Fixed effects model (estimate [95% CI])

	Weekly working hours	Depressive symptoms	Self-esteem	Subjective well-being
Gender*				
Men	<35	0.311 [-0.038, 0.660]	-0.191 [-0.549, 0.167]	-0.149 [-0.299, 0.001]
	35-40	Reference	Reference	Reference
	41-52	0.140 [0.008, 0.272]	-0.143 [-0.281, -0.004]	-0.027 [-0.087, 0.032]
	>52	0.196 [0.005, 0.388]	-0.161 [-0.358, 0.036]	-0.130 [-0.215, -0.044]
Women	<35	0.323 [0.070, 0.576]	-0.317 [-0.544, -0.090]	-0.024 [-0.124, 0.076]
	35-40	Reference	Reference	Reference
	41-52	0.386 [0.189, 0.584]	-0.293 [-0.473, -0.113]	-0.100 [-0.173, -0.027]
	>52	0.418 [0.100, 0.736]	-0.351 [-0.637, -0.065]	-0.094 [-0.221, 0.033]

CI, confidence interval.
* Education level, disability, marital status, chronic diseases, income, occupation, firm size, employment type adjusted.

Studies have indicated that involuntary shorter working hours adversely affect mental health, elevate depression risk [36], and increase psychological distress. Socially marginalized groups are highly likely to experience underemployment [37].

This study has several limitations. First, exposure and outcome variables were based on self-reported data, which might have introduced common method bias, potentially inflating our estimates. While TWFE mitigates bias by controlling for time-invariant individual characteristics, it cannot fully address this methodological concern. Second, selection bias owing to attrition during follow-up or the healthy worker effect might have influenced the estimates. Third, changes in mental health status or structural shifts in the labor market because of the COVID-19 pandemic during the analysis period might have influenced the results. Nevertheless, we attempted to mitigate this concern by incorporating time-fixed effects. Fourth, we did not assess whether working hour arrangements were voluntary or involuntary, which may introduce bias to our estimates for shorter hours. This is particularly important because women, older adults, and casual workers—the groups showing vulnerability to reduced hours—are also the most likely to experience involuntary part-time employment.

Despite these limitations, this study offered evidence approaching causality by employing TWFE models. Moreover, our findings indicate that employment security moderates the working-hours–mental-health relationship, reflecting the Republic of Korea's dual labor market. Extended hours signify overwork for permanent employees, while reduced hours indicate involuntary underemployment for casual workers. Furthermore, the inclusion of self-esteem highlights distinct psychological vulnerabilities often overlooked in previous studies.

This study found that, compared to standard working hours, both reduced and extended working hours were associated with poorer mental health, revealing a nonlinear relationship whereby optimal mental health aligns with standard working hours. Extended hours were associated with adverse mental health across all groups, with stronger associations observed among women and younger adults. Shorter hours were associated with adverse mental health, particularly among women, older adults, and casual or fixed-term workers.

This study provides empirical support for the Republic of Korea's 52-hour maximum workweek policy, particularly for mitigating overwork among primary labor market workers.

Table 5
Association between working hours and mental health by age: Fixed effects model (estimate [95% CI])

	Weekly working hours	Depressive symptoms	Self-esteem	Subjective well-being
Age*				
<35 y	<35	0.190 [-0.272, 0.651]	-0.287 [-0.707, 0.133]	-0.095 [-0.274, 0.084]
	35-40	Reference	Reference	Reference
	41-52	0.345 [0.092, 0.598]	-0.286 [-0.531, -0.040]	-0.059 [-0.157, 0.039]
	>52	0.394 [0.051, 0.737]	-0.227 [-0.600, 0.147]	-0.181 [-0.336, -0.025]
≥35 y	<35	0.337 [0.108, 0.566]	-0.285 [-0.504, -0.065]	-0.060 [-0.155, 0.036]
	35-40	Reference	Reference	Reference
	41-52	0.218 [0.093, 0.342]	-0.180 [-0.304, -0.056]	-0.055 [-0.108, -0.002]
	>52	0.259 [0.070, 0.447]	-0.216 [-0.398, -0.035]	-0.109 [-0.189, -0.028]

CI, confidence interval.
* Education level, disability, marital status, chronic diseases, income, occupation, firm size, employment type adjusted.

Table 6
Association between working hours and mental health by employment type: Fixed effects model (estimate [95% CI])

	Weekly working hours	Depressive symptoms	Self-esteem	Subjective well-being
Employment type*				
Permanent employees	<35	-0.014 [-0.465, 0.438]	0.313 [-0.247, 0.872]	-0.048 [-0.259, 0.164]
	35-40	Reference	Reference	Reference
	41-52	0.287 [0.136, 0.439]	-0.231 [-0.388, -0.073]	-0.049 [-0.111, 0.013]
	>52	0.398 [0.140, 0.656]	-0.463 [-0.747, -0.178]	-0.179 [-0.291, -0.066]
Casual or fixed-term workers	<35	0.397 [0.041, 0.752]	-0.477 [-0.797, -0.157]	-0.141 [-0.287, 0.004]
	35-40	Reference	Reference	Reference
	41-52	0.360 [-0.012, 0.731]	-0.253 [-0.559, 0.054]	-0.044 [-0.177, 0.088]
	>52	0.340 [-0.178, 0.859]	-0.156 [-0.591, 0.279]	-0.095 [-0.291, 0.100]

CI, confidence interval.
* Education level, disability, marital status, chronic diseases, income, occupation, firm size adjusted.

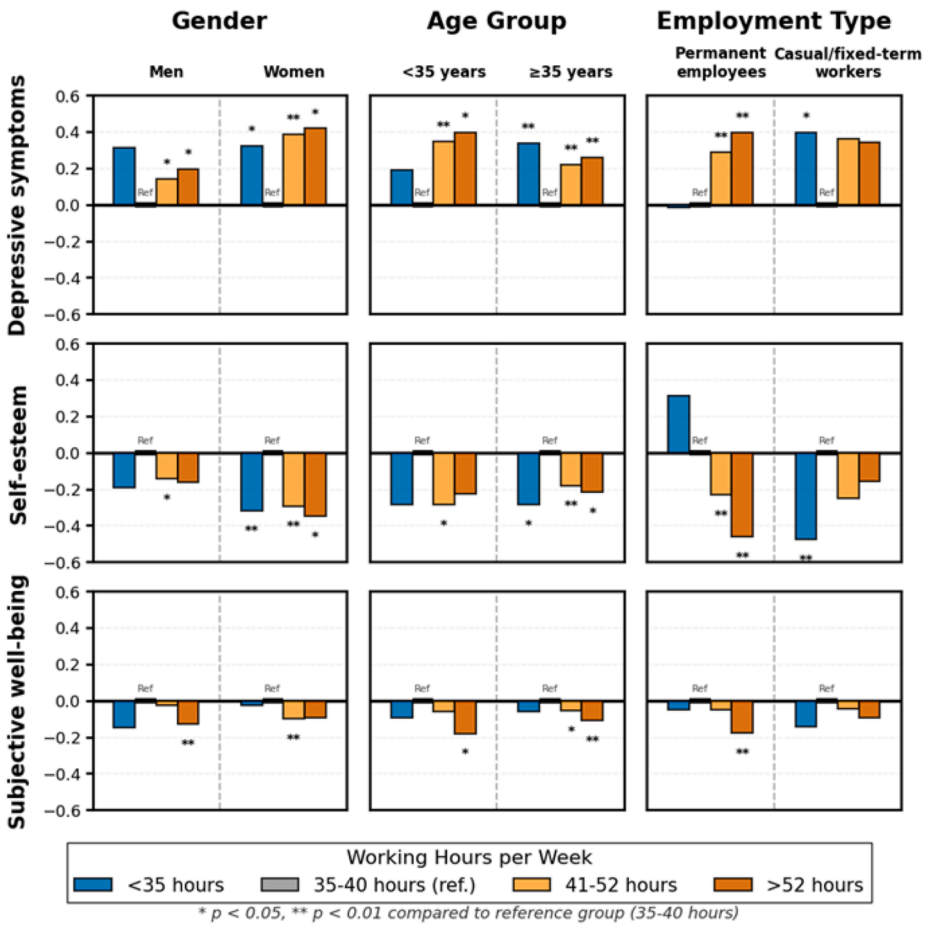


Fig. 2. Association between nonstandard working hours and mental health outcomes by subgroups. Estimates from TWFE models comparing <35 hours (dark blue), 41–52 hours (light blue), and >52 hours (orange) to standard working hours (35–40 hours, reference). *$p < 0.05$; **$p < 0.01$. TWFE, two-way fixed effects.

However, within the Republic of Korea's dual labor market structure, restrictions on maximum hours alone are insufficient. Our findings regarding the adverse effects of reduced hours highlight the necessity for complementary policies that address involuntary underemployment among casual workers. Therefore, a comprehensive approach is required—one that not only enforces the 52-hour limit to prevent burnout but also ensures a minimum level of employment stability for vulnerable groups.

CRediT authorship contribution statement

Nahyun Kim: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Woo Chul Jeong:** Writing – review & editing. **Hyunjoo Kim:** Writing – review & editing. **Rangkyoung Ha:** Writing – review & editing, Methodology. **Kyunghee Jung-Choi:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Formal analysis, Conceptualization.

Statement on the Use of AI Tools

During the preparation of this work, the authors used ChatGPT to assist with language editing and grammar checking. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

Conflicts of interest

All authors have no conflicts of interest to declare.

Acknowledgments

The authors would like to thank the Korea Institute for Health and Social Affairs for conducting and sharing the KWPS. This research received no external funding.

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