Association between precarious employment and the onset of depressive symptoms in men and women: a 13-year longitudinal analysis in Korea (2009–2022)

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Original Article

Abstract

Aims. Increasing social concern surrounds the potential adverse health effects of precarious employment (PE). In this study, we explored the association between PE and the onset of depressive symptoms.

Methods. A total of 11,555 Korean waged workers (5700 females) contributed 62,217 observations from 2009 to 2022. PE was operationalized as a multidimensional construct, including employment insecurity, income inadequacy and lack of rights and protection. Depressive symptoms were evaluated using the Center for Epidemiological Studies-Depression Scale (11-item version). The association between PE and the onset of depressive symptoms in the subsequent year was estimated using generalized estimating equations. Effect sizes were reported as odds ratio (OR) and 95% confidence interval (CI).

Results. The overall incidence of depressive symptoms was 8.3% during the study period. In cross-sectional analysis, daily employment, disguised employment, lower monthly wages and lack of social insurance coverage were associated with concurrent depressive symptoms in both men and women. Longitudinally, fixed-term employment (OR: 1.17, 95% CI: 1.07–1.29), daily employment (OR: 1.64, 95% CI: 1.45–1.85) and disguised employment (OR: 1.36, 95% CI: 1.17–1.57) were associated with the onset of depressive symptoms among the overall sample. Among men, the lowest quartiles of wage were associated with the onset of depressive symptoms (OR: 1.34, 95% CI: 1.13–1.60), while the absence of a trade union was associated among women (OR: 1.18, 95% CI: 1.01–1.39).

Conclusions. Employment insecurity, inadequate income and lack of rights and protection may contribute to depressive symptoms. Therefore, PE serves as a significant social determinant of mental health among workers in Korea. Active policy efforts are warranted to improve the overall quality of employment in the workforce.

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Introduction

Precarious employment (PE) is acknowledged as a significant social determinant of health. Although lacking a universal definition, the existing literature recognizes PE as encompassing various employment conditions, such as employment insecurity, inadequate income and the absence of worker rights and protection (Bodin *et al.*, 2020; Kreshpaj *et al.*, 2020). PE is disproportionately distributed across socio-demographic backgrounds, including gender, age, educational level and immigrant status, thereby contributing to the exacerbation of health inequalities (Murillo-Huertas *et al.*, 2023). Recent transformations in the global labour market, such as the Fourth Industrial Revolution or the 'gig' economy, have the potential to increase the prevalence of PE among workforces.

Previous studies have associated PE with various adverse health outcomes, including poor self-rated health (Pulford *et al.*, 2022), cardiovascular diseases (Matilla-Santander *et al.*, 2022) and all-cause mortality (Matilla-Santander *et al.*, 2023). Alongside physical conditions, PE is closely associated with mental health. Systematic reviews have demonstrated that specific elements, such as temporary employment or perceived job insecurity, exhibit positive associations with depressive symptoms or psychological distress (Jaramillo *et al.*, 2022; Ronnblad *et al.*, 2019). In recent years, studies have increasingly focused on the multi-dimensionality of PE. For instance, Swedish studies have shown that those experiencing low-quality employment, characterized by insecure employment, low income and lack of rights and protection,

have an increased risk of developing common mental disorders, suicidal behaviours and substance dependence (Jonsson *et al.*, 2021b; Pollack *et al.*, 2022). Furthermore, a cross-sectional study in Korea revealed that multifaceted aspects of PE, including temporary employment, low wage and lack of trade union representation, are closely related to depressive symptoms and sleep disturbance (Baek *et al.*, 2023; Gong and Park, 2023). Regarding the mechanism linking the relationship between PE and mental health, chronic stress plays a significant role. For instance, recent studies have shown that individuals with high levels of employment precariousness experience elevated levels of stress (Julia *et al.*, 2022; Mendez-Rivero *et al.*, 2022), which may act as a trigger for the development of depression and anxiety. The heightened stress experienced by workers in PE may stem from the combination of demanding job roles and insufficient resources or control to manage them effectively (Bakker and Demerouti, 2007; Rivero *et al.*, 2021).

Despite the increasing scholarly interest in the relationship between PE and mental health, the current body of literature has limitations. First, previous studies on the impact of PE on mental health were predominantly based on European contexts, with limited representation from East Asian countries such as Korea. Considering that the manifestation of PE and its influence on mental health can be greatly influenced by regional policies (Padrosa *et al.*, 2022), its association with the onset of depressive symptoms among Korean workers can provide a meaningful contribution to the literature. Second, as highlighted in previous systematic reviews (Jaramillo *et al.*, 2022; Ronnblad *et al.*, 2019), studies examining the relationship between PE and depressive symptoms often relied on a unidimensional definition based on the contract type; the association between depressive symptoms and PE elements beyond temporary employment remains an understudied area (Jaramillo *et al.*, 2022; Ronnblad *et al.*, 2019). Third, previous Korean studies on the effects of PE on mental health have predominantly utilized a cross-sectional design (Baek *et al.*, 2023; Gong and Park, 2023), thus failing to establish a temporal association between PE and depressive symptoms. Therefore, this study aims to explore the association of PE and the onset of depressive symptoms among Korean workers by encompassing its multidimensional aspects, including employment insecurity, income adequacy and lack of rights and protection.

Methods

Study sample

The study sample was derived from the Korean Welfare Panel Study (KWPS), a longitudinal survey conducted annually since 2006 by the Seoul National University Institute of Social Welfare and Korea Institute for Health and Social Affair. In the initial wave of the KWPS, a total of 7072 households and their members, representative of the Korean population, were included through systemic sampling. Trained interviewers conducted surveys through household visits for each selected household. The sample participation rate experienced an annual decline of about 3–5%, with 5853 households surveyed in the final wave (Wave 17, 2022). An additional 1800 and 2012 households were incorporated into the study sample in 2012 and 2022, respectively to address sample attrition. After including households formed through the separation of existing households, for example, when adult offspring create a new household, a total of 11,204 households and 24,077 individuals were surveyed during the study period.

A flowchart illustrating the selection process is presented in Fig. 1. As pertinent information on PE has been collected since 2009 (Wave 4), our initial inclusion involved 24,077 adult individuals who had participated at least once from the 4th (2009) to the 17th (2022) wave of the KWPS. Subsequently, we restricted our observations to instances where each participant was a waged worker, as variables related to PE were exclusively collected for this group. After excluding observations with missing values, 11,555 individuals (representing 62,217 observations) were included in the cross-sectional analysis. For the longitudinal analysis, we first excluded observations lacking information on depressive symptoms in the subsequent year. Subsequently, we excluded observations where participants already exhibited depressive symptoms to establish a clear temporal sequence. As a result, 9385 individuals (representing 50,188 individuals) were included in the longitudinal analysis.

Variables

Precarious employment

We adopted the definition of PE proposed by Kreshpaj *et al.* in their systematic review (Kreshpaj *et al.*, 2020). PE, in this context, is a multidimensional construct comprising three primary dimensions, each further delineated into multiple themes. Table 1 provides an overview of the dimensions, themes and operationalization of PE in this study.

For the first dimension, variables such as temporary employment (permanent, fixed-term and daily employment), part-time employment (full-time and part-time employment) and employment relationship (direct, indirect and disguised employment) were selected to assess employment insecurity. The term 'disguised employment' refers to workers who operate within the grey area between self-employment and traditional employment. These individuals provide services for a business under a contract that differs from a typical employment contract, yet their working conditions and income are 'dependent' on the party with whom they have contracted. Further details on this employment type can be found at Table S1 and the report by the International Labour Organization (ILO, 2016). In the second dimension, monthly wages were categorized into four groups based on quartile values (lowest [Q1], low [Q2], high [Q3], highest [Q4]) for each year, serving as variables to gauge income inadequacy. In the third dimension, variables such as the presence of a trade union in the workplace (yes or no) and employer coverage of social insurance (yes, borderline, no) were selected to assess the absence of rights and protection in the workplace. A detailed exposition of the definition of PE is presented in Table S1.

Depressive symptoms

The assessment of depressive symptoms utilized the 11-item version of the Center for Epidemiological Studies-Depression scale (CES-D-11). The CES-D-11, an abbreviated form of the original 20-item CES-D, comprises questionnaires evaluating the respondents' emotional states and vigour over the preceding week. Responses to each question were recorded as integers ranging from 0 to 3, corresponding to the following: (i) 0: rarely or none (<1 day); (ii) 1: sometimes (2–3 days); (iii) 2: often (4–5 days) and (iv) 3: most of the time (6–7 days). In this investigation, Cronbach's alpha for the CES-D-11 ranged from 0.81 to 0.86 annually. Prior research attests to the satisfactory reliability and validity of the CES-D-11 within the general Korean population (Park *et al.*, 2022). The total score, indicative of overall depressive symptoms, spanned
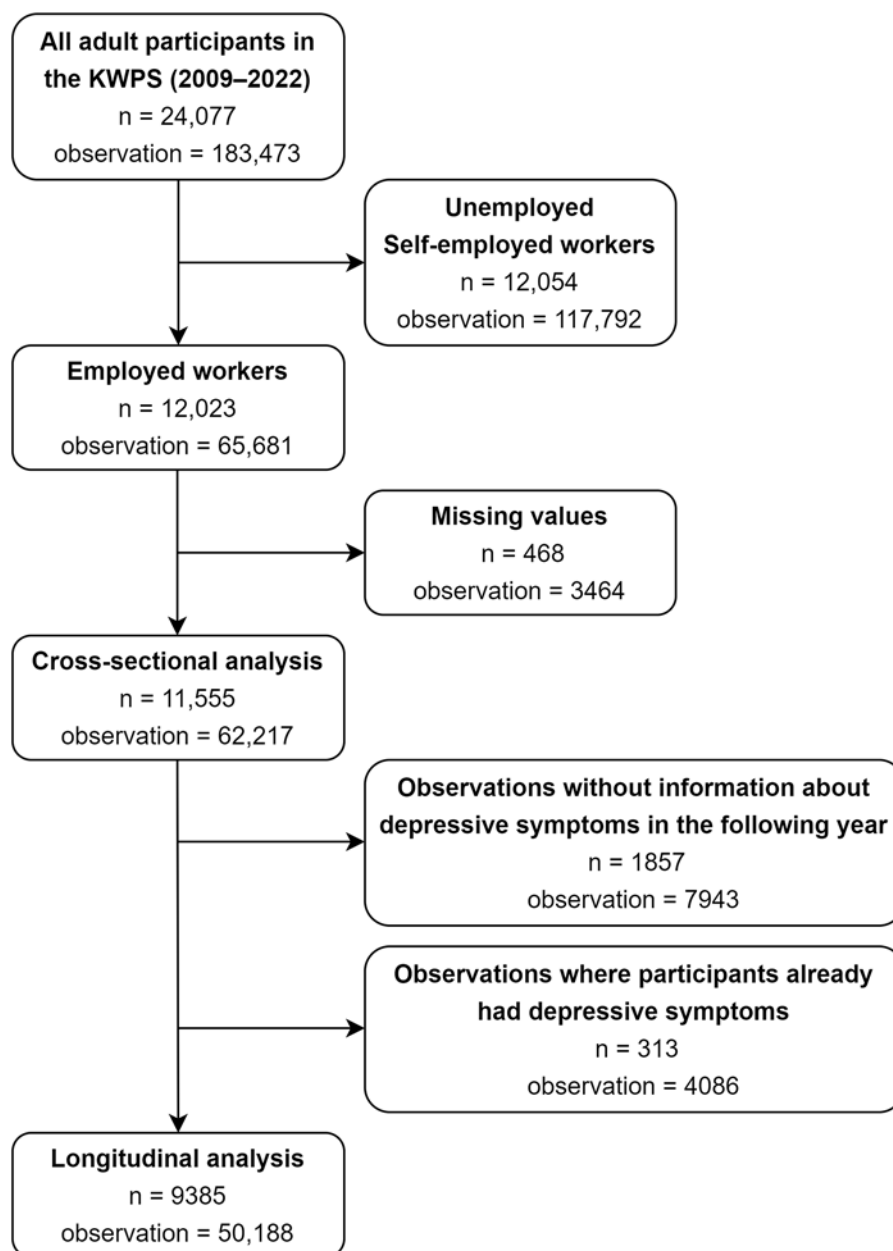
Figure 1. Flowchart of the selection process of study sample.

from 0 to 33, with a higher score signifying greater depressive symptoms. In line with established methodology from previous studies (Jeong *et al.*, 2021; Kang *et al.*, 2021; Kim *et al.*, 2023a), the total score for CES-D-11 was adjusted by multiplying it by 20 and then dividing it by 11 to align with the cut-off criteria for the 20-item version of the CES-D. Individuals with scores ≥ 16 were categorized as presenting depressive symptoms (Jeong *et al.*, 2021; Kang *et al.*, 2021; Kim *et al.*, 2023a).

Confounders

The selection of the confounders was informed by previous studies on the mental health effects of PE (Baek *et al.*, 2023; Gong and Park, 2023; Jonsson *et al.*, 2021b; Pollack *et al.*, 2022). Gender (men, women) was standardized. Age was categorized into five groups: <30, 30–39, 40–49, 50–59 and ≥ 60. Education level was classified as middle school or below, high school and college or above. Occupation was categorized according to the Korean Standard Classification of Occupation as blue collar, services or sales worker, or white collar. Marital status was classified as married, unmarried or other (separated, widowed, divorced). Unlike in Western countries, where the concept of de facto partnerships is socially and legally recognized, it remains uncommon in East Asian countries where traditional familial relationships are strong due to cultural influences; individuals in such partnerships were classified as unmarried. Chronic conditions were categorized as either present or absent, depending on whether the individual had been on medications for at least 6 months.

Statistical analysis

For the descriptive analysis, we initially examined the distribution of observations during the study periods to characterize their features. Subsequently, we investigated the incidence of depressive symptoms based on study variables.

Table 1. Definitions of precarious employment

Dimension	Theme	Proxy indicator (variables)	Categorization	Operationalization
Employment insecurity				
	Contractual temporariness	Temporary employment[a]	a. Permanent employment b. Fixed-term employment c. Daily employment	a. Duration of contract: $\geq$1 year b. Duration of contract: 1 month−1 year c. Duration of contract: <1 month
	Contractual underemployment	Part-time employment	a. No b. Yes	a. Full-time employment b. Part-time employment
	Contractual relation insecurity	Employment relationship	a. Direct employment b. Indirect employment c. Disguised employment	a. Direct employment b. Dispatch company; service company c. Dependent contractor
Income inadequacy				
	Income level	Monthly wage	a. Q4 b. Q3 c. Q2 d. Q1	Categorized into four groups according to quartile values of monthly wage for each year
Lack of rights and protection				
	Lack of unionization	Existence of trade union	a. Yes b. No	
	Lack of regulatory support	Coverage of social insurance[b]	a. Yes b. Borderline c. No	a. Coverage of all social insurances b. Coverage of one or two social insurances c. Coverage of none of the social insurances

Detailed information on the operationalization is presented in Table S1.
[a]This criterion corresponds to the official classification of Statistics Korea.
[b]National pension plan, employment insurance, industrial accidence insurance.

In the regression analysis, we employed generalized estimating equations (GEEs) with an exchangeable working correlation matrix to account for repeated measurements for each participant given that our primary research focus was to explore the population-averaged effects of PE on depressive symptoms. The cross-sectional association between PE elements and concurrent depressive symptoms was explored. Specifically, for each year t, we explored how exposure to PE elements in year t is associated with having depressive symptoms in year t. Furthermore, the longitudinal association between PE and the onset of depressive symptoms in the subsequent year was examined, assessing how exposure to PE elements in year t was linked to the onset of depressive symptoms in year $t + 1$. To ensure temporal sequence clarity, observations in which participants already had depressive symptoms in year t were excluded.

Several additional analyses were conducted. First, considering the significant impact of the COVID-19 pandemic on employment conditions and mental health in the Korean population, a sensitivity analysis excluding waves conducted from 2020 to 2022 was performed. Second, an additional analysis was conducted, treating

CES-D-11 as a continuous variable, to further assess the robustness of our findings. Third, based on the operationalization of PE used in this study, we developed a scale to represent the overall level of employment precariousness for workers (Table S2). Subsequently, we investigated the relationship between the overall PE score and the onset of depressive symptoms.

Acknowledging previous evidence suggesting gender differences in the mental health effects of PE (Mendez-Rivero *et al.*, 2022; Padrosa *et al.*, 2022), analyses were conducted for the overall sample and separately for men and women. GEE models with a logit link function were employed to estimate the odds ratio (OR) and 95% confidence intervals (CIs). All statistical analyses and visualizations were performed using R software (version 4.2.3; R Foundation for Statistical Computing, Vienna, Austria). The R package '*geepack*' was utilized for GEE analyses.

Results

Table 2 displays the distribution of observations during the study period. The prevalence of temporary employment at 32.2% for

Table 2. Distribution of characteristics of observations throughout the study periods

	Total	Men	Women
	N = 62,217	N = 33,176	N = 29,041
Age			
<30	9635 (15.5)	3940 (11.9)	5695 (19.6)
30–39	14,421 (23.2)	8542 (25.7)	5879 (20.2)
40–49	17,072 (27.4)	9612 (29.0)	7460 (25.7)
50–59	12,136 (19.5)	6551 (19.7)	5585 (19.2)
≥60	8953 (14.4)	4531 (13.7)	4422 (15.2)
Education			
Middle school or below	10,760 (17.3)	4387 (13.2)	6373 (21.9)
High school	29,973 (48.2)	17,006 (51.3)	12,967 (44.7)
College or above	21,483 (34.5)	11,783 (35.5)	9701 (33.4)
Occupation			
Blue collar	26,697 (42.9)	17,297 (52.1)	9401 (32.4)
Service/sales worker	11,014 (17.7)	3842 (11.6)	7172 (24.7)
White collar	24,505 (39.4)	12,037 (36.3)	12,468 (42.9)
Marital status			
Married	40,694 (65.4)	23,395 (70.5)	17,299 (59.6)
Unmarried	14,515 (23.3)	7474 (22.5)	7042 (24.2)
Others	7007 (11.3)	2307 (7.0)	4700 (16.2)
Chronic condition			
No	44,320 (71.2)	23,927 (72.1)	20,394 (70.2)
Yes	17,896 (28.8)	9249 (27.9)	8647 (29.8)
Temporary employment			
Permanent employment	32,985 (53.0)	20,854 (62.9)	12,131 (41.8)
Fixed-term employment	20,008 (32.2)	7786 (23.5)	12,223 (42.1)
Daily employment	9223 (14.8)	4536 (13.7)	4687 (16.1)
Part-time employment			
No	55,455 (89.1)	31,644 (95.4)	23,812 (82.0)
Yes	6761 (10.9)	1532 (4.6)	5229 (18.0)
Employment relationship			
Direct employment	55,551 (89.3)	30,017 (90.5)	25,535 (87.9)
Indirect employment	3914 (6.3)	1971 (5.9)	1943 (6.7)
Disguised employment	2751 (4.4)	1188 (3.6)	1563 (5.4)
Monthly wage			
Q4	15,340 (24.7)	12,701 (38.3)	2639 (9.1)

(Continued)

Table 2. *(Continued.)*

	Total	Men	Women
	N = 62,217	N = 33,176	N = 29,041
Q3	15,487 (24.9)	10,069 (30.3)	5419 (18.7)
Q2	15,669 (25.2)	5864 (17.7)	9805 (33.8)
Q1	15,720 (25.3)	4542 (13.7)	11,178 (38.5)
Existence of trade union			
Yes	13,072 (21.0)	8365 (25.2)	4707 (16.2)
No	49,144 (79.0)	24,811 (74.8)	24,334 (83.8)
Coverage of social insurance			
Yes	35,295 (56.7)	20,573 (62.0)	14,722 (50.7)
Borderline	17,935 (28.8)	10,368 (31.3)	7567 (26.1)
No	8986 (14.4)	2235 (6.7)	6752 (23.2)

Values are presented as *N* (%).

fixed-term and 14.8% for daily employment. Additionally, 10.9% of participants had part-time employment, 6.3% were engaged in indirect employment and 4.4% were involved in disguised employment. About 79.0% had no trade union presence in their workplace, and 14.4% lacked social insurance coverage provided by the employer. The proportion of temporary, part-time, indirect or disguised employment was higher among women than men. Furthermore, women exhibited a tendency for lower income levels, the absence of a trade union in their workplace and a lack of coverage by social insurance.

Table 3 illustrates the incidence of depressive symptoms based on study characteristics. The overall incidence of depressive symptoms was 8.3% during the study period, with a higher incidence observed among individuals engaged in temporary, part-time and indirect or disguised employment. Additionally, individuals with lower wages, without trade union in their workplace and lacking social insurance coverage displayed a higher incidence of depressive symptoms.

Table 4 presents the cross-sectional association between temporary employment and concurrent depressive symptoms. Daily employment (OR: 1.67, 95% CI: 1.48–1.89), the lowest monthly wages (OR: 1.93, 95% CI: 1.66–2.23) and the absence of social insurance coverage (OR: 1.28, 95% CI: 1.15–1.43) were associated with an increased likelihood of having depressive symptoms in the overall sample, as well as in both men and women. Additionally, men with disguised employment were more likely to have depressive symptoms compared to those with direct employment (OR: 1.47, 95% CI: 1.18–1.84).

Figure 2 shows the longitudinal association between temporary employment and the onset of depressive symptoms in the following year. In men, fixed-term (OR: 1.24, 95% CI: 1.09–1.42) or daily employment (OR: 1.84, 95% CI: 1.56–2.18), disguised employment (OR: 1.47, 95% CI: 1.19–1.83) and the lowest wages (OR: 1.34, 95% CI: 1.13–1.60) were positively associated with depressive symptom onset in the following year. In women, daily employment (OR: 1.42, 95% CI: 1.19–1.70), disguised employment (OR: 1.27, 95% CI: 1.03–1.56) and the absence of trade union (OR: 1.18, 95% CI: 1.01–1.39) were positively associated with depressive symptom onset. Detailed results of the longitudinal analyses are provided in Table S3.

Table 3. Incidence of depressive symptoms according to study variables

	Total		Men		Women	
	Cases	Non-cases	Cases	Non-cases	Cases	Non-cases
Age						
<30	789 (10.6)	6687 (89.4)	347 (11.3)	2721 (88.7)	442 (10.0)	3966 (90)
30–39	837 (6.9)	11,248 (93.1)	506 (6.9)	6788 (93.1)	331 (6.9)	4460 (93.1)
40–49	978 (6.9)	13,158 (93.1)	585 (7.3)	7481 (92.7)	393 (6.5)	5677 (93.5)
50–59	792 (8.2)	8892 (91.8)	411 (7.6)	4970 (92.4)	381 (8.9)	3922 (91.1)
≥60	767 (11.3)	6040 (88.7)	333 (9.2)	3279 (90.8)	434 (13.6)	2761 (86.4)
Education						
Middle school or below	982 (11.7)	7442 (88.3)	358 (10.0)	3236 (90.0)	624 (12.9)	4206 (87.1)
High school	1720 (7.1)	22,562 (92.9)	957 (6.8)	13,085 (93.2)	763 (7.5)	9477 (92.5)
College or above	1461 (8.4)	16,021 (91.6)	867 (8.9)	8918 (91.1)	594 (7.7)	7103 (92.3)
Occupation						
Blue collar	2084 (9.7)	19,332 (90.3)	1288 (9.1)	12,872 (90.9)	796 (11.0)	6459 (89.0)
Service/sales worker	758 (8.7)	7979 (91.3)	262 (8.3)	2888 (91.7)	496 (8.9)	5091 (91.1)
White collar	1321 (6.6)	18,714 (93.4)	632 (6.3)	9478 (93.7)	689 (6.9)	9236 (93.1)
Marital status						
Married	2222 (6.6)	31,634 (93.4)	1279 (6.4)	18,561 (93.6)	943 (6.7)	13,073 (93.3)
Unmarried	1275 (11.4)	9923 (88.6)	696 (12.0)	5115 (88.0)	579 (10.7)	4808 (89.3)
Others	666 (13.0)	4468 (87.0)	207 (11.7)	1563 (88.3)	459 (13.6)	2905 (86.4)
Chronic condition						
No	2773 (7.6)	33,643 (92.4)	1541 (7.7)	18,482 (92.3)	1232 (7.5)	15,161 (92.5)
Yes	1390 (10.1)	12,382 (89.9)	641 (8.7)	6757 (91.3)	749 (11.8)	5625 (88.2)
Temporary employment						
Permanent	1704 (6.2)	25,673 (93.8)	1049 (6.0)	16,568 (94.0)	655 (6.7)	9105 (93.3)
Fixed-term	1471 (9.3)	14,350 (90.7)	620 (9.8)	5685 (90.2)	851 (8.9)	8665 (91.1)
Daily	988 (14.1)	6002 (85.9)	513 (14.7)	2986 (85.3)	475 (13.6)	3016 (86.4)
Part-time employment						
No	3600 (8.0)	41,539 (92.0)	2015 (7.7)	24,263 (92.3)	1585 (8.4)	17,276 (91.6)
Yes	563 (11.2)	4486 (88.8)	167 (14.6)	976 (85.4)	396 (10.1)	3510 (89.9)
Employment relationship						
Direct employment	3600 (8.0)	41,321 (92.0)	1892 (7.6)	22,984 (92.4)	1708 (8.5)	18,337 (91.5)
Indirect employment	309 (9.9)	2820 (90.1)	162 (10.0)	1452 (90.0)	147 (9.7)	1368 (90.3)
Disguised employment	254 (11.9)	1884 (88.1)	128 (13.7)	803 (86.3)	126 (10.4)	1081 (89.6)
Monthly wage						
Q4	714 (5.5)	12,284 (94.5)	606 (5.6)	10,253 (94.4)	108 (5.0)	2031 (95.0)
Q3	899 (7.0)	11,863 (93.0)	609 (7.3)	7791 (92.7)	290 (6.6)	4072 (93.4)
Q2	1135 (9.1)	11,345 (90.9)	491 (10.4)	4245 (89.6)	644 (8.3)	7100 (91.7)
Q1	1415 (11.8)	10,533 (88.2)	476 (13.9)	2950 (86.1)	939 (11)	7583 (89.0)
Existence of trade union						
Yes	650 (6.1)	10,076 (93.9)	426 (6.1)	6567 (93.9)	224 (6.0)	3509 (94.0)
No	3513 (8.9)	35,949 (91.1)	1756 (8.6)	18,672 (91.4)	1757 (9.2)	17,277 (90.8)

(Continued)

Table 3. (*Continued.*)

	Total		Men		Women	
	Cases	Non-cases	Cases	Non-cases	Cases	Non-cases
Coverage of social insurance						
Yes	2054 (7.1)	26,835 (92.9)	1177 (6.8)	16,055 (93.2)	877 (7.5)	10,780 (92.5)
Borderline	1250 (8.7)	13,080 (91.3)	751 (8.8)	7776 (91.2)	499 (8.6)	5304 (91.4)
No	859 (12.3)	6110 (87.7)	254 (15.3)	1408 (84.7)	605 (11.4)	4702 (88.6)

Values are presented as *N* (%).

Table 4. Cross-sectional association between precarious employment and concurrent depressive symptoms

	Total	Men	Women
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Temporary employment			
Permanent employment	1.00 (1.00–1.00)	1.00 (1.00–1.00)	1.00 (1.00–1.00)
Fixed-term employment	1.09 (0.98–1.20)	1.06 (0.90–1.25)	1.12 (0.99–1.28)
Daily employment	1.67 (1.48–1.89)	1.60 (1.32–1.94)	1.72 (1.46–2.02)
Part-time employment			
No	1.00 (1.00–1.00)	1.00 (1.00–1.00)	1.00 (1.00–1.00)
Yes	0.92 (0.83–1.01)	0.84 (0.68–1.03)	0.96 (0.86–1.07)
Employment relationship			
Direct employment	1.00 (1.00–1.00)	1.00 (1.00–1.00)	1.00 (1.00–1.00)
Indirect employment	1.00 (0.89–1.13)	1.07 (0.88–1.29)	0.96 (0.82–1.12)
Disguised employment	1.26 (1.08–1.46)	1.47 (1.18–1.84)	1.10 (0.90–1.35)
Monthly wage			
Q4	1.00 (1.00–1.00)	1.00 (1.00–1.00)	1.00 (1.00–1.00)
Q3	1.25 (1.10–1.43)	1.34 (1.14–1.57)	1.12 (0.89–1.43)
Q2	1.59 (1.39–1.83)	1.72 (1.43–2.09)	1.37 (1.08–1.72)
Q1	1.93 (1.66–2.23)	2.63 (2.15–3.22)	1.48 (1.16–1.89)
Trade union			
Yes	1.00 (1.00–1.00)	1.00 (1.00–1.00)	1.00 (1.00–1.00)
No	1.03 (0.93–1.14)	1.04 (0.89–1.21)	1.02 (0.89–1.18)
Coverage of social insurance			
Yes	1.00 (1.00–1.00)	1.00 (1.00–1.00)	1.00 (1.00–1.00)
Borderline	1.08 (0.99–1.18)	1.09 (0.95–1.25)	1.06 (0.94–1.20)
No	1.28 (1.15–1.43)	1.42 (1.16–1.72)	1.24 (1.08–1.41)
N of observations	62,217	33,176	29,041

(*Continued*)

Table 4. (*Continued.*)

	Total	Men	Women
	OR (95% CI)	OR (95% CI)	OR (95% CI)
N of individuals	15,555	5855	5700

OR, odds ratio; CI, confidence interval.
Models adjusted for gender, age, educational level, occupation, marital status and chronic condition.

Sensitivity analyses excluding waves conducted from 2020 to 2022 yielded comparable findings to the main analyses (Table S4). Additional analyses treating CES-D-11 as continuous variable produced findings that were consistent with the main analyses (Table S5). In the analysis considering overall PE level, we observed a dose–response relationship between the overall level of employment precariousness and the onset of depressive symptoms. Specifically, individuals exposed to the highest level of PE exhibited 2.3- and 1.6-fold increased odds of developing depressive symptoms in men and women, respectively (Table S6).

Discussion

In this study, we observed that the experience of PE is associated not only with concurrent depressive symptoms but also with the onset of depressive symptoms in both male and female individuals. The overall incidence of depressive symptoms observed in this sample was comparable to that observed in the general population in Korea. Factors such as employment insecurity, insufficient income and a lack of rights and protection were identified as contributors to an increased likelihood of the onset of depressive symptoms. Consequently, proactive policy measures are warranted to improve the overall quality of employment for workers (Kang, 2023).

Our findings are consistent with prior research demonstrating the link between PE and compromised mental health among workers. As indicated in systematic reviews (Jaramillo *et al.*, 2022; Ronnblad *et al.*, 2019), previous evidence has predominantly concentrated on the type of contract. Similarly, earlier Korean studies defined PE primarily based on contract types, revealing associations between insecure employment and depressive symptoms (Han *et al.*, 2017; Jang *et al.*, 2015; Oh *et al.*, 2021). However, recent studies have emphasized that various dimensions of PE, including not only employment insecurity but also income inadequacy, as well as a lack of rights and protection, are closely linked to poor mental health (Jonsson *et al.*, 2021a, 2021b; Pollack *et al.*, 2022; Vives *et al.*, 2020). A recent cross-sectional study
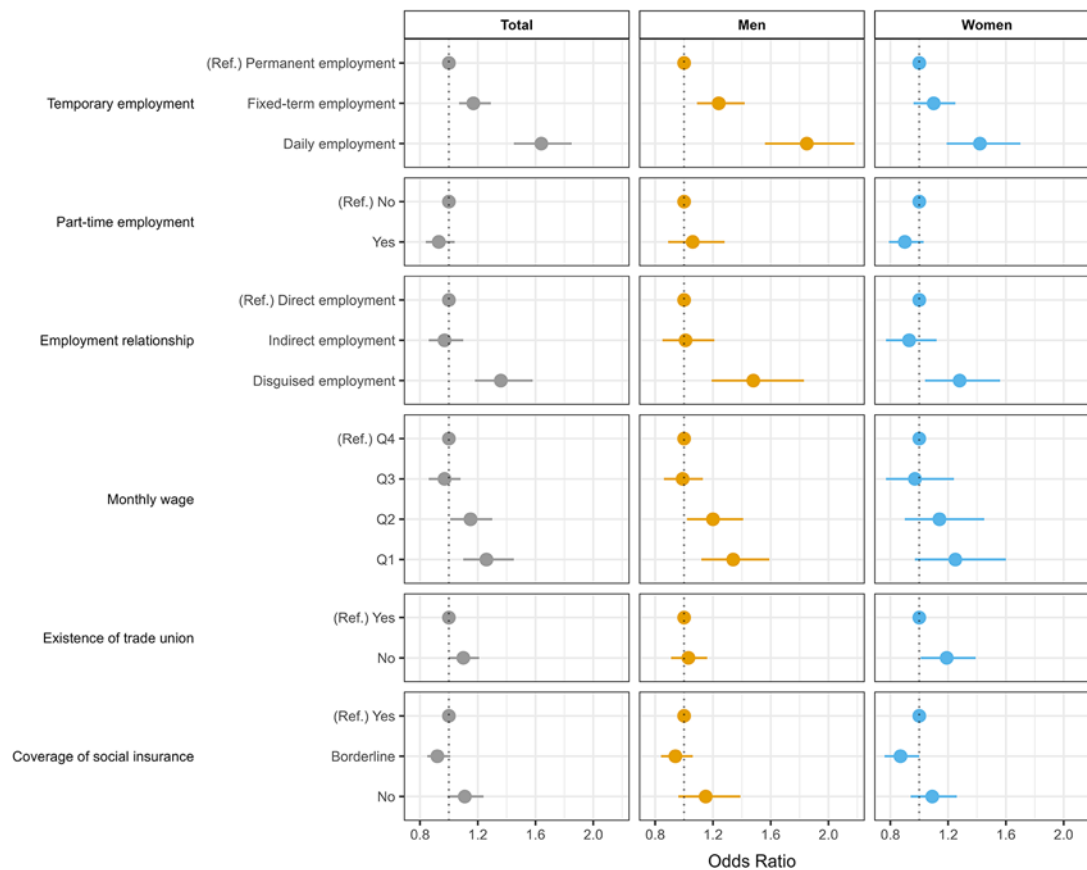
Figure 2. Longitudinal association between precarious employment and onset of depressive symptoms in the following year. Models adjusted for gender, age, educational level, occupation, marital status and chronic condition (OR, odds ratio; CI, confidence interval; Ref, reference).

in Korea uncovered that workers in employment typologies with high precariousness – characterized by elevated employment insecurity, low wages with high volatility and a lack of rights and protection – were more prone to experiencing poor mental well-being (Baek *et al.*, 2023). Therefore, in alignment with this evolving perspective, our findings make a substantial contribution to the literature by demonstrating that the multidimensional aspects of PE among Korean workers are not only associated with concurrent depressive symptoms but also with their onset.

One intriguing finding in this study concerns the association between disguised employment and depressive symptoms. This employment type, alternatively termed a 'dependent contractor' or 'dependent self-employed', exists in the ambiguous realm between self-employment and waged work (Cherry and Aloisi, 2016; International Labour Office, 2017). In Korea, individuals in this employment category are required to autonomously seek and engage with clients to provide goods or services, thereby receiving income based on actual performance rather than a fixed salary. This form of employment is experiencing rapid growth, especially in conjunction with the rise of the 'gig' economy (Hendrickx, 2023; International Labour Office, 2017). In Korea, ongoing legal and social debates revolve around the classification of these workers as either self-employed or wage workers. Disguised employment often circumvents the application of labour laws, exposing workers to various physical and psychological workplace hazards (Kim, 2020). As observed in previous cross-sectional studies in Korea, disguised employment demonstrated a positive association with

depressive and anxiety symptoms (Baek *et al.*, 2022; Won *et al.*, 2019), a correlation further affirmed in our longitudinal study.

Exposure to PE can contribute to the onset of depressive symptoms through intricate mechanisms. Initially, factors such as employment insecurity, low wages and a lack of rights and protection may heighten workers' perceived insecurity, uncertainty and instability, consequently leading to psychological anxiety and stress (Bodin *et al.*, 2020). This observation is in line with recent studies that associate PE with elevated levels of biomarkers indicative of the stress response (Julia *et al.*, 2022; Mendez-Rivero *et al.*, 2022). Secondly, PE can subject workers to various physical, ergonomic or psychosocial workplace hazards, all of which are significant risk factors for the development of depressive symptoms (Rivero *et al.*, 2021). Thirdly, factors such as low wages and a lack of social insurances can result in material deprivation, a well-documented risk factor for the onset of depressive symptoms (Guan *et al.*, 2022; Ridley *et al.*, 2020).

In this study, the association between PE and the onset of depressive symptoms was ubiquitously observed in both men and women. However, the prevalence of PE was observed to be higher among Korean women, aligning with prior research (Baek *et al.*, 2023; Ervin *et al.*, 2023). Particularly, in East Asian countries strongly influenced by Confucian culture, a cultural perception prevails that assigns women the role of 'caregiver' and men the role of 'breadwinner'. Consequently, despite possessing high educational backgrounds, women are often discouraged from pursuing professional career development, leading to their concentration

in more precarious job positions (Choi, 2018). This underscores the need for the development of gender-sensitive policies aimed at improving employment quality among Korean workers.

Our findings are subject to several limitations. Firstly, the observational nature of our study prevents the establishment of a causal relationship between PE and depressive symptoms. Potential unmeasured confounders, such as prior psychiatric history, parental socio-economic position and the number of children in the household, could introduce bias into our estimations. We could not include these factors in our analyses due to a lack of information. Secondly, reliance on self-reported questionnaires for depressive symptoms introduces the possibility of measurement errors, including recall bias. While the CES-D-11 is commonly used in epidemiological studies, it was originally developed for screening purposes. Therefore, further research is warranted to confirm whether PE is associated with the onset of clinically diagnosed depressive disorders. Thirdly, limitations in the assessment of PE should be acknowledged. Specifically, in interpreting null findings between part-time employment and depressive symptoms, we were unable to distinguish between involuntary and voluntary part-time work due to lack of information. Additionally, our assessment of PE exposure did not account for other important elements, such as income volatility or vulnerability in the workplace, due to a lack of available information. Fifth, self-employed workers were excluded from our study, and detailed information on their employment conditions was not collected. Future studies should investigate employment precariousness among self-employed workers and its potential impact on their mental health in Korea (Kim *et al.*, 2023b). Sixth, information on ethnicity and migration status was not collected. South Korea is ethnically homogeneous due to its geographical isolation and unique language, with approximately 96% of the total population being native Koreans, while immigrants comprise about 3.5% of the population. However, similar to other countries, immigrants, despite constituting a relatively small proportion of the population, tend to disproportionately experience PE in Korea. Consequently, further research is necessary to investigate the current status of PE among Korean migrant workers and its mental health effects (Pollack *et al.*, 2022). Seventh, concerning the operationalization of income level, categorizing income levels based on quartile values of monthly wages may not fully reflect the ability to cover basic needs. Eighth, the potential for selection bias stemming from attrition and loss to follow-up may have impacted the estimates derived from our analysis. For instance, individuals with missing values on the onset of depressive symptoms or lacking follow-up data could exhibit high levels of employment precariousness at baseline and subsequently more prone to developing depressive symptoms (Kachi *et al.*, 2014). Consequently, such loss to follow-up could lead to an underestimation of the association between PE and the onset of depressive symptoms.

Nevertheless, the study exhibits several strengths. Firstly, a nationwide sample was employed, encompassing diverse demographics and occupations, thereby augmenting the generalizability of the findings. Secondly, prior Korean studies have focused solely on contract type or relied on cross-sectional analyses to explore the association between PE and depressive symptoms. In contrast, we contend that our investigation makes a meaningful contribution to the literature by uncovering the longitudinal association between the various facets of PE and the onset of depressive symptoms.

Conclusion

This study elucidates the impact of various elements of PE, including employment insecurity, logarithmic wages and the lack of worker rights and protection, on the development of depressive symptoms among Korean wageworkers. The findings underscore PE as a noteworthy social determinant affecting the mental health. Consequently, proactive policy interventions are imperative to alleviate the detrimental effects of PE on mental health and to improve employment quality for Korean workers.

References

Baek SU, Lim SS, Yun S, Lee WT, Kim MS, Yoon JH and Won JU (2022) Mental health symptoms among dependent contractors in Korea: A cross-sectional study based on the Fifth Korean Working Condition Survey. *Annals of Occupational & Environmental Medicine* **34**, e1.

Baek SU, Won JU and Yoon JH (2023) Multidimensional typologies of precarious employment and their relationships with mental well-being in Korean wageworkers: A latent class analysis based on the Korean Working Conditions Survey (2020-2021). *Preventive Medicine* **177**, 107787.

Bakker AB and Demerouti E (2007) The Job Demands-Resources model: State of the art. *Journal of Managerial Psychology* **22**(3), 309–328.

Bodin T, Caglayan C, Garde AH, Gnesi M, Jonsson J, Kiran S, Kreshpaj B, Leinonen T, Mehlum IS, Nena E, Orellana C, Peckham T, Seixas N, Vanroelen C and Julia M (2020) Precarious employment in occupational health – An OMEGA-NET working group position paper. *Scandinavian Journal of Work, Environment & Health* **46**(3), 321–329.

Cherry MA and Aloisi A (2016) Dependent contractors in the gig economy: A comparative approach. *American University Law Review* **66**, 635.

Choi SE (2018) What makes it difficult for highly educated Korean women to participate in the labor market? *The Journal of the Korean Welfare State and Social Policy* **2**(1), 58–86.

Ervin J, Taouk Y, Hewitt B and King T (2023) The gendered associations between precarious employment and mental health in working-age Australians: A longitudinal analysis using 16 waves of the HILDA survey. *Social Science & Medicine* **339**, 116382.

Gong SC and Park S (2023) Increased risk of sleep problems according to employment precariousness among paid employees in Korea. *American Journal of Industrial Medicine* **66**(10), 876–883.

Guan N, Guariglia A, Moore P, Xu F and Al-Janabi H (2022) Financial stress and depression in adults: A systematic review. *PLoS One* **17**(2), e0264041.

Han KM, Chang J, Won E, Lee MS and Ham BJ (2017) Precarious employment associated with depressive symptoms and suicidal ideation in adult wage workers. *Journal of Affective Disorders* **218**, 201–209.

Hendrickx F (2023) Platform work and beyond. *European Labour Law Journal* **14**(4), 465–473.

ILO (2016) Disguised employment and dependent self-employment. In Philippe M (ed) *Non-standard Employment Around the World: Understanding Challenges, Shaping Prospects.* Geneva: International Labour Organization, 98–102.

International Labour Office (2017) Dependent self-employment: Trends, challenges and policy responses in the EU. Geneva: International Labour Organization, 5–6.

Jang SY, Jang SI, Bae HC, Shin J and Park EC (2015) Precarious employment and new-onset severe depressive symptoms: A population-based prospective study in South Korea. *Scandinavian Journal of Work, Environment & Health* **41**(4), 329–337.

Jaramillo NR, Trillos CE and Julia M (2022) The measure of precarious employment and its impact on the mental health of workers: A systematic review 2007-2020. *Work* **73**(2), 639–650.

Jeong SH, Lee DW, Kang SH, Kim SH, Park EC and Shin J (2021) Association between changes in depressive symptoms and hazardous drinking: Findings from the Korea Welfare Panel Study (2013-2018). *Frontiers in Public Health* **9**, 809043.

Jonsson J, Matilla-Santander N, Kreshpaj B, Johansson G, Kjellberg K, Burstrom B, Ostergren PO, Nilsson K, Stromdahl S, Orellana C and Bodin T (2021a) Precarious employment and general, mental and physical health in Stockholm, Sweden: A cross-sectional study. *Scandinavian Journal of Public Health* **49**(2), 228–236.

Jonsson J, Muntaner C, Bodin T, Alderling M, Rebeka R, Burstrom B, Davis L, Gunn V, Hemmingsson T, Julia M, Kjellberg K, Kreshpaj B, Orellana C, Padrosa E, Wegman DH and Matilla-Santander N (2021b) Low-quality employment trajectories and risk of common mental disorders, substance use disorders and suicide attempt: A longitudinal study of the Swedish workforce. *Scandinavian Journal of Work, Environment & Health* **47**(7), 509–520.

Julia M, Mendez-Rivero F, Gomez-Gomez A, Pozo OJ and Bolibar M (2022) Association between precarious employment and chronic stress: Effect of gender, stress measurement and precariousness dimensions—A cross-sectional study. *International Journal of Environmental Research & Public Health* **19**(15), 9099.

Kachi Y, Otsuka T and Kawada T (2014) Precarious employment and the risk of serious psychological distress: A population-based cohort study in Japan. *Scandinavian Journal of Work, Environment & Health* **40**(5), 465–472.

Kang D (2023) Problems and suggested improvement plans for occupational health service in Korea. *Annals of Occupational & Environmental Medicine* **35**, e10.

Kang SH, Jeong W, Jang SI and Park EC (2021) The effect of depression status change on daily cigarette smoking amount according to sex: An eleven-year follow up study of the Korea Welfare Panel Study. *BMC Public Health* **21**(1), 1304.

Kim SH (2020) The labor legal issue and task on the protection of gig worker by digital platform. *Hannam Journal of Law & Technology* **26**(2), 59–96.

Kim KM, Kim JH, Rhee HS and Youn BY (2023a) Development of a prediction model for the depression level of the elderly in low-income households: Using decision trees, logistic regression, neural networks, and random forest. *Scientific Reports* **13**(1), 11473.

Kim MS, Oh J, Sim J, Yun BY and Yoon JH (2023b) Association between exposure to violence, job stress and depressive symptoms among gig economy workers in Korea. *Annals of Occupational & Environmental Medicine* **35**, e43.

Kreshpaj B, Orellana C, Burstrom B, Davis L, Hemmingsson T, Johansson G, Kjellberg K, Jonsson J, Wegman DH and Bodin T (2020) What is precarious employment? A systematic review of definitions and operationalizations

from quantitative and qualitative studies. *Scandinavian Journal of Work, Environment & Health* **46**(3), 235–247.

Matilla-Santander N, Matthews AA, Gunn V, Muntaner C, Kreshpaj B, Wegman DH, Sanchez-Martinez N, Hernando-Rodriguez JC, Albin M, Balogh R, Davis L and Bodin T (2023) Causal effect of shifting from precarious to standard employment on all-cause mortality in Sweden: An emulation of a target trial. *Journal of Epidemiology & Community Health* **77**(11), 736–743.

Matilla-Santander N, Muntaner C, Kreshpaj B, Gunn V, Jonsson J, Kokkinen L, Selander J, Baron SL, Orellana C, Ostergren PO, Hemmingsson T, Wegman DH and Bodin T (2022) Trajectories of precarious employment and the risk of myocardial infarction and stroke among middle-aged workers in Sweden: A register-based cohort study. *The Lancet Regional Health – Europe* **15**, 100314.

Mendez-Rivero F, Pozo OJ and Julia M (2022) Gender differences in the indirect effect of psychosocial work environment in the association of precarious employment and chronic stress: A cross-sectional mediation analysis. *International Journal of Environmental Research & Public Health* **19**(23), 16073.

Murillo-Huertas IP, Ramos R, Simón H and Simón-Albert R (2023) Is multidimensional precarious employment higher for women? *Journal of Industrial Relations* **65**(1), 44–71.

Oh JW, Park JY and Lee S (2021) Association between exercise variations and depressive symptoms among precarious employees in South Korea. *Scientific Reports* **11**(1), 15952.

Padrosa E, Vanroelen C, Muntaner C, Benach J and Julia M (2022) Precarious employment and mental health across European welfare states: A gender perspective. *International Archives of Occupational and Environmental Health* **95**(7), 1463–1480.

Park B-S, Lee K, Shin C, Choi K and Bae S-W (2022) Longitudinal measurement invariance of the Korean version of the CES-D-11 scale. *Sage Open* **12**(3), 21582440221117799.

Pollack R, Kreshpaj B, Jonsson J, Bodin T, Gunn V, Orellana C, Ostergren PO, Muntaner C and Matilla-Santander N (2022) Low-quality employment trajectories and the risk of common mental health disorders among individuals with Swedish and foreign background – a register-based cohort study. *Scandinavian Journal of Work, Environment & Health* **48**(5), 351–360.

Pulford A, Thapa A, Thomson RM, Guilding A, Green MJ, Leyland A, Popham F and Katikireddi SV (2022) Does persistent precarious employment affect health outcomes among working age adults? A systematic review and meta-analysis. *Journal of Epidemiology & Community Health* **76**(11), 909–917.

Ridley M, Rao G, Schilbach F and Patel V (2020) Poverty, depression, and anxiety: Causal evidence and mechanisms. *Science* **370**(6522), eaay0214.

Rivero FM, Padrosa E, Utzet M, Benach J and Julià M (2021) Precarious employment, psychosocial risk factors and poor mental health: A cross-sectional mediation analysis. *Safety Science* **143**, 105439.

Ronnblad T, Gronholm E, Jonsson J, Koranyi I, Orellana C, Kreshpaj B, Chen L, Stockfelt L and Bodin T (2019) Precarious employment and mental health: A systematic review and meta-analysis of longitudinal studies. *Scandinavian Journal of Work, Environment & Health* **45**(5), 429–443.

Vives A, Benmarhnia T, Gonzalez F and Benach J (2020) The importance of using a multi-dimensional scale to capture the various impacts of precarious employment on health: Results from a national survey of Chilean workers. *PLoS One* **15**(9), e0238401.

Won G, Park JB, Lee KJ, Ha R, Lee S and Jeong I (2019) The association between dependent self-employment and self-reported depression/anxiety and sleep disorder in South Korea. *Annals of Occupational & Environmental Medicine* **31**, e13.