

ORIGINAL ARTICLE

Comparative analyses of occupational injuries among temporary agency worker and direct contract workers: Findings from the Korea Health Panel 2009–2018

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Abstract

Objectives: Several studies have reported health or safety risk of temporary agency workers (TAW). Since most of the studies are just cross-sectional studies, we intended to identify the risk of occupational injury in TAW, using longitudinal study design.

Methods: The Korea Health Panel 2009–2018 data were used in the study. For the statistical analysis of this study, we used a panel logit model to identify the risk of occupational injury in TAW compared to direct contract workers (DCW).

Results: There was no significant difference in risk of occupational injury between TAW and DCW among the overall population (adjusted OR 0.920, 95% CI 0.600–1.411). However, there was a significant increase in occupational injury in women (adjusted OR 2.134, 95% CI 1.092–4.170) and the “19–34” age group (adjusted OR 2.744, 95% CI 1.103–6.825) of TAW.

Conclusions: This study provides evidence for vulnerable groups such as women and younger age groups in the relationship between TAW and occupational injury.

KEYWORDS

longitudinal Studies, occupational injuries, outsourcing of risk, temporary agency workers

1 | INTRODUCTION

Over the past 30 years, the global labour market has undergone significant changes at an incredibly rapid pace. In many developed countries, factors such as

technological advances, globalization, neoliberal politics, and deindustrialization have contributed to the promotion of a more flexible workforce. Along with financial crises and rising unemployment rates, non-standard employment has been considered as an

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influential way to maintain economic competitiveness and cope with economic instability, and it is widespread in all industries.¹

As a particular form of non-standard employment, subcontracting has steadily increased over the last few decades. The definition of subcontracting is “Not direct, subordinate relationship with end-users” and is characterized by a triangular employment relationship including the worker, the agency (the subcontractor), and the host organization (the company).² The terms used for subcontracted workers are many, but they are mainly referred to as “temporary agency workers (TAWs)” in academia.³

From a TAW perspective, a dual relationship exists, composed of employment and management. By separating employer and management responsibilities, TAWs appear as outsiders and are underprivileged in their workplace. There are some common requirements related to occupational safety and health (OSH), which are associated with the deterioration of OSH and social benefits, along with exposure to hazardous working environments.^{4,5} Research indicates that there is a link between temporary employment status and workers’ health and safety, including poor self-assessed health, musculoskeletal symptoms, and depression.^{5–8} Studies have also shown that TAWs are more susceptible to occupational injury than other workers in the labour market.^{4,9–16}

Precarious workers have been regarded as a vulnerable working population since the late 1980s.¹ However, Koranyi et al. clearly showed the lack of well-performed research dealing with TAW’s risk of injury.¹⁷ Many comparative studies have shown that TAWs have a higher risk of injury than permanent workers in similar industries or occupations, but most of them had a cross-sectional design. This is a disadvantage because it is not possible to determine whether an individual is forced into a vulnerable employment placement because of their health, therefore causality cannot be proven. Moreover, compensation claims or insurance data have been used in many studies,^{9–11} therefore, the results might be biased due to underreporting of occupational injuries by temporary workers. Therefore, additional research on TAWs is needed using longitudinal data sources with direct outcome measurements. In this study, we sought to accurately assess the risk of occupational injury to TAWs by analyzing a large longitudinal sample representative of the Korean population. This analysis could provide information to improve precaution measures from employers, temporary employment agencies, regulators, and other stakeholders, and would result in the protection of the growing population of TAWs.

2 | METHODS

2.1 | Study participants

This study used the 1.7 beta version of the Korea Health Panel (KHP) collected by the Korea Institute for Health and Social Affairs and the National Health Insurance Service. The main purpose of the Korean Medical Panel Survey is to construct panel data that can analyze in-depth not only information on medical use, but also various factors that affect them.¹⁸ The KHP is a national survey conducted through stratified, multi-stage cluster sampling. Korea Health Panel data were released from 2008 to 2018, but information on the employment contracts were collected from 2009 onwards; therefore, the study population was based on participants from 2009, excluding new inflows, and data from 2009 to 2018 were included in this study. We excluded non-workers, employers, self-employed with employees, unpaid family workers, soldiers, and skilled agricultural, forestry, and fishery workers; workers aged <19 years and ≥65 years; and workers with missing or who refused to provide occupational information (Table 1). The number of participants was 4936 in 2009, 3407 in 2018 and 8298 in 2009–2018. Data were in the form of unbalanced data.

2.2 | Variable measurement

Occupational injury by year was the dependent variable in this study. The KHP registers the reasons for emergency room visits and the place where the injury occurred. Based on records of emergency room visits, if injury occurred at the workplace, it was defined as a case for occupational injury by year. Additionally, when the participant went to the emergency room due to an accident, the question “How did the accident happen?” have to be answered among ‘transport accident’, ‘fire accident’, ‘by hot matter’, ‘falling’, ‘fall down/slip/crash’, ‘falling object accident’, ‘poisoning’, ‘suffocation’, ‘cutting/penetration’, ‘animal/insect bite’, ‘compression’ and ‘the others’.

The independent variable, the employment contract, was defined as “direct contract worker” (DCW) if the answer to the question “What is the employment relationship with the current job (work)?” was “direct contract” and “TAW” if the answer was “indirect contract”.

Variables related to the socioeconomic status included sex, age, highest level of education attained, and occupational classification. Sex was defined as male or female; the workers were divided into three age groups at 15-year intervals from 19–64 years old; the highest level of education was categorized as ‘high school or below’ and

TABLE 1 Selection of study participants

Korea Health Panel (year)	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2009–2018
Total	19 153	17 459	16 292	14 947	13 800	12 834	12 020	11 435	11 217	10 962	19 153
Cause of exclusion											
Non-worker, employer, self-employed with employees, unpaid family workers	13 725	12 288	11 481	10 418	9568	8844	8242	7706	7361	6950	9969
Soldier and skilled agricultural, forestry and fishery workers	48	73	41	45	33	31	29	33	35	43	64
Age <19 or age ≥65	297	297	307	322	326	393	352	381	442	562	775
Missing or refuse of occupational information	147	145	0	0	1	0	11	0	0	0	47
Final participants	4936	4656	4463	4162	3872	3566	3386	3315	3379	3407	8298

‘college or above’ and occupational classification was divided according to the Korean Standard Classification of Occupations (KSCO).¹⁹ Individuals who identified as “managers, professional and related workers”, and “clerks”, were classified as white-collar workers; “service workers” and “sales workers”, as pink-collar workers, and “Craft and related trades workers”, “equipment, machine operating and assembly workers” and “elementary workers” as blue-collar workers.²⁰

2.3 | Statistical analysis

The analytical method used in this study was a panel logit model with fixed effects. The Hausman test was conducted to select a fixed effect or random effect for the adjusted model. In the result of Hausman test, the fixed-effects model was preferred with a $p < 0.05$.²¹ Panel logit model is suitable for multivariate analysis using time information by repeatedly measuring panel objects through a panel analysis. The panel model is useful by utilizing panel data that has both cross-sectional data information and longitudinal information. Specifically, the panel model has the advantage of controlling the estimation error in each data, so it can properly analyze the truth compared to only cross-sectional studies or only general longitudinal studies.²² In a general research model, it is impossible to include all the confounding variables in the model, and even if it is included, it is difficult to judge that the model is good. However, the endogenous problem of unobservable

individual effects and occupational agents is overcome by using panel data.²³ In this study, by controlling for time-invariant individual effects, we identified the relationship between occupational injuries and employment contracts. The fixed-effects model minimized the healthy worker effect by considering variations among individuals.²⁴

Age group and sex were used as the stratification variables. The effects of time-invariant variables (e.g., sex) cannot be estimated within the confines of fixed-effect regression, therefore, the effect of sex was confirmed through stratification analysis. In the sensitivity analysis, blue-collar workers with the highest risk of injury were defined as the study population, and the same analysis was performed.²⁵ In addition, the cause of the injury was investigated each time the emergency room was visited, and the distribution according to the employment contract was identified.

Data were analyzed using Stata software, version 16.0 (Stata Corp., College Station, TX) for the Hausman test and ‘proc genmod’ of SAS 9.4 software (SAS Institute Inc., Cary, NC, USA) for other analyses.

2.4 | Ethics statement

This study was carried out in accordance with the guidelines set out in the Declaration of Helsinki and exempted from deliberation by the Institutional Review Board of Seoul St. Mary's Hospital, the Catholic University of Korea (study number: KC20ZISI0773).

3 | RESULTS

3.1 | Characteristics of participants

Table 2 shows the characteristics of the TAWs from 2009–2018. In all the years, the proportion of women was higher, men and women accounted for 5–6% and 7–9% of TAWs, respectively, and the most common age group was 35–49 years. TAWs accounted for 2–3% of the “19–34” age group and 5–6% of the “35–49” group. Of those aged 50–64 years, 12–14% were TAWs from 2009 to 2016, and this decreased to 9.9%. The education level was “high school or below” and “college or above” for 9–12% and 3–4% of TAWs, respectively. The proportion of TAWs according to occupational classification was 1–2% white-collar workers, 9–13% blue-collar workers, and 9–12% pink-collar workers.

3.2 | Relationship between employment contract and occupational injury

The *p*-value for the Hausman test in the adjusted model of the overall population was 0.0345, which was suitable for the fixed-effects model. The results of the panel logit model with fixed effects are presented in Table 3. Among the study participants, 265 experienced an occupational injury at least once; 288 events of occupational injury were registered. No significant differences were found between employment contracts and occupational injuries in the overall population (adjusted OR 0.920, 95% CI 0.600–1.411). The results showed differences between the sexes. Results from the fixed effects showed that temporary agency work was associated with occupational injury in women (adjusted OR 2.134, 95% CI 1.092–4.170) but not in men (adjusted OR 0.614, 95% 0.338–1.116). The results also showed differences among the age groups. In particular, there was a significant increase in the risk of occupational injury in the “19–34” age group of TAWs (adjusted OR 2.744, 95% CI 1.103–6.825). For sensitivity analysis, we performed the same analyses using the population of blue-collar workers (Table S1), and the results were similar to those of the overall population (Table 3). Additionally, sex- and age-group-stratified analyses were conducted (Table S2). Both men and women showed an increase in risk in the 19 to 34 years age group, but a significant increase in risk was found only in the female group. Table S3 shows the causes of injury according to the employment contract. In both DCWs and TAWs, “fall/slip/crash” accounted for the majority of injuries. For DCWs the next most common injury was the “falling object agent,” and “other”; for TAWs “other” and “falling”.

4 | DISCUSSION

The results of our analyses showed that TAWs had a significantly higher risk of occupational injury, particularly among younger age groups and women. In men, the risk of occupational injury for TAWs was high at a younger age, but this was not statistically significant.

These results agree well with the findings of previous studies, which have reported that workers in precarious job situation suffer from inequalities in occupational health and safety.²⁶ Fabiano et al. (2008) reported a higher frequency and severity of occupational injuries among TAWs than that in DCWs in Italy. The authors suggested that inadequate training and short duration of work assignments are associated with increased injuries.¹⁶ Other literatures in various countries show that TAWs are at higher risk of occupational injury than other workers. A report on statistics in Belgium showed that TAWs make up about 3% of the workforce but account for 8.7% of occupational injuries.²⁷ Al-Tarawneh et al. also demonstrated that temporary workers had higher overall injury rates than permanent workers, using a large dataset of workers' compensation (WC) claims of injury in Ohio, USA.⁹ Similarly, a Korean study analyzed data of blue-collar workers from the fourth Korean Working Conditions Survey (2014) and the sixth European Working Conditions Survey (2015) and compared workplace risk factors and preventive factors for occupational injuries.¹⁵ The results showed that workplace exposure was significantly higher among TAWs in both Korea and Europe, and that TAWs lacked industrial training and support from coworkers and supervisors. Consequently, in Korea, indirectly employed blue-collar workers had a significantly higher risk of occupational injury than those directly employed (odds ratio [OR]: 1.876), whereas there was no significant difference between directly and indirectly employed workers in EU countries (OR: 1.038). In a literature review, 7 out of 13 separate studies confirmed that TAWs have an increased risk of occupational injuries, while other studies did not report an association.⁵

The underlying mechanisms explaining the poorer safety outcomes for TAWs could be categorized into hazardous working conditions, job factors and management factors. On many occasions, TAWs undertake more injury-prone work compared to regular employees because host companies attempt to transfer the risk to the subcontractor. As a result, the bulk occupational injuries have shifted from regular employees to TAWs. Several studies have shown that host companies divide tasks among workers, and TAWs are allocated simple but risky work that ordinary employees do not want to do.^{14,28} This means shifting responsibility for OSH to the socioeconomically weaker party, in other words, ‘risk outsourcing’. Therefore,

TABLE 2 Distribution of temporary agency worker by year

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total	341 (6.9)	344 (7.4)	348 (7.8)	340 (8.2)	309 (8.0)	237 (6.7)	272 (8.0)	257 (7.8)	228 (6.8)	211 (6.2)
Sex										
Male	152 (5.3)	163 (6)	171 (6.7)	163 (7)	150 (6.9)	106 (5.4)	130 (7.0)	114 (6.4)	95 (5.3)	96 (5.3)
Female	189 (9.2)	181 (9.3)	177 (9.3)	177 (9.7)	159 (9.3)	131 (8.2)	142 (9.3)	143 (9.3)	133 (8.4)	115 (7.2)
Age										
19–34	40 (2.9)	34 (2.9)	39 (3.6)	38 (3.8)	18 (1.9)	21 (2.5)	21 (2.8)	14 (1.9)	18 (2.3)	15 (1.8)
35–49	150 (6.3)	139 (6.1)	125 (5.9)	123 (6.3)	125 (7.1)	78 (4.8)	85 (5.7)	75 (5.2)	75 (5.4)	70 (5.3)
50–64	151 (12.8)	171 (14.6)	184 (14.9)	179 (14.8)	166 (14.1)	138 (12.2)	166 (14.8)	168 (14.8)	135 (11.2)	126 (9.9)
Education										
High school or below	270 (10.5)	290 (11.9)	275 (11.9)	258 (12.2)	244 (12.6)	182 (10.4)	205 (12.6)	193 (12.4)	152 (9.9)	138 (9.3)
College or above	71 (3.0)	54 (2.4)	73 (3.4)	82 (4.0)	65 (3.4)	55 (3.0)	67 (3.8)	64 (3.7)	76 (4.1)	73 (3.8)
Occupational classification										
White collar	31 (1.5)	43 (2.1)	30 (1.6)	37 (2.1)	28 (1.7)	21 (1.4)	30 (2.1)	27 (1.9)	30 (2.1)	29 (1.9)
Blue collar	207 (10.5)	227 (12.7)	237 (13.1)	219 (13.1)	196 (12.6)	145 (10.5)	167 (13.1)	160 (12.6)	124 (9.9)	113 (9.1)
Pink collar	103 (12.4)	74 (9.2)	81 (10.3)	84 (11.2)	85 (12.5)	71 (10.9)	75 (11.7)	70 (11.5)	74 (11.3)	69 (10.2)

Note: Percentage of temporary agency workers in all study participants

TABLE 3 Occupational injury risk of temporary agency worker compared to direct contract workers

	Crude OR (95% CI)	Adjusted OR ^a (95% CI)
Overall	1.219 (0.807–1.841)	0.92 (0.6–1.411)
Subgroup by sex		
Male	0.885 (0.493–1.592)	0.614 (0.338–1.116)
Female	2.605 (1.396–4.86)	2.134 (1.092–4.17)
Subgroup by age group		
19–34	3.621 (1.452–9.031)	2.744 (1.103–6.825)
35–49	1.111 (0.537–2.299)	0.957 (0.457–2.003)
50–64	0.821 (0.453–1.488)	0.739 (0.403–1.355)

^aAdjusted odds ratio was calculated using a panel logit model with fixed effects after adjusting for occupational classification and age.

occupational injury among TAWs is inevitable at the individual level but can be seen as a deformed phenomenon caused by pressure at the social level. Temporary work agencies compete by offering the lowest rates and do not require the host company to increase the level of safety for TAWs.

Regarding job factors, previous research has emphasized TAWs' unfamiliarity with their host employer's workplace, limited knowledge of physical hazards, and lower levels of job control, which creates barriers to risk mitigation.¹³ Another explanation, emphasized by Underhill and Quinlan,⁸ applies to the management's commitment to safety. TAWs were less likely to receive safety training from their agency or host company compared to permanent employees. Several earlier studies have also demonstrated that shortcomings exist in induction and training at host companies.^{12,13,28} Additionally, TAWs are less protected by regulatory authorities because the nature of temporary employment makes it difficult to enforce OSH regulations. As a result, these workers are less protected by safety management systems, such as safety equipment, sufficient training, and supervision. Other important factors for higher risk in TAWs include job insecurity, inconvenient work hours (working long hours or night shifts), and lack of clear work guidelines.

Age-stratified analysis showed that the greatest difference was in the younger age groups (Table 3). In general, younger workers are known to have a higher risk of injury than other age groups.²⁹ One of the factors that increases the risk of injury to young workers is related to precarious employment. Young workers are often part-time, seasonal or temporary workers, which can create a fragmented safety culture and training. This situation affects the occupational health awareness and vigilance of young workers. Therefore, additional protection is needed to address the social, developmental, cultural and environmental factors of young workers' vulnerability.

Meanwhile, the difference in the risk of occupational injury is higher in women than that in men. These findings may be due to differences in sex distribution by occupation. It is well known that men are employed more often than women in industries with a high risk of acute injuries, such as construction, agriculture, and excessive physical labour. In these occupations, the basal injury rate is higher independent of the employment contract; therefore, the relationship between temporary work and the causes of injury is less clear. The prevalence of fall down/slip/crash was more prevalent among TAWs compared to that in DCW in this study, while previous studies in the USA reported lower fall, slip, and trip injury rates (six or more days away from work) among TAWs.^{9,10,13} The factors that underlie the observed differences in injury rates need to be studied further to better understand and develop prevention strategies.

The core strength of the current study is the large longitudinal sample of representative data from the Korean population. Another advantage of using the KHP is that the medical records are accurate because medical care is documented in receipts, housekeeping books, year-end tax adjustment data, and self-reporting. However, the limitations of this study must be considered when interpreting the results. First, as our data were from self-reported questionnaires, there is a potential for information bias. Moreover, registry of occupational injuries was only identified by report about visit to the emergency room, so there could be cases of injuries that occur in the workplace but do not go to a medical institution. This also deteriorate the completeness and accuracy of outcome measure. Second, the selection of participants focused on the working population, which could lead to selection bias as the KHP was not established to represent the working population per se, but the general Korean population. Considering that there were few data sources representative of the working population in Korea, the KHP was deemed suitable for the current analysis. Third, the participants were restricted to South Korea, which limits the generalizability of our findings to other populations, particularly other racial or ethnic groups. Fourth, because of the lack of detailed information, we could not examine the major drivers behind this elevated risk of occupational injury in TAWs, such as risk factors in the workplace, average working hours, annual holidays, and occupational health education system.

In conclusion, the results of this study support previous evidence showing an increased risk of occupational injury in TAWs. Our study has several practical implications. First, regulators should devote more attention to TAWs as they spread into higher hazard industries, and OSH responsibilities in TAWs should be strictly regulated. Second, injury prevention among TAWs must include proper training, particularly of young workers

prior to their placement in the host workplace, and continuing safety training after placement to ensure TAWs' safety. Third, policy strategies to expand social security, regulate OSH more effectively, and reinforce host companies' joint liability to protect safety and improve working environments for TAWs may help improve the safety of TAWs. Last and most importantly, outsourcing of risk to avoid regulatory and economic pressure should be made illegal, and companies should take responsibility for their actions.

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AUTHOR CONTRIBUTIONS

M.Y.K. and J.A. conceived of and designed the study. J.A. conducted statistical analyses. M.Y.K. and J.A. drafted the manuscript. J.L., H.R.K., T.W.J., Y.M.L., D.W.L., and M.Y.K. interpreted the data and provided critical revision of the manuscript. M.Y.K. supervised the study.

DISCLOSURE

Authors declare no conflicts of interest.

APPROVAL OF THE RESEARCH PROTOCOL

This study was exempted from deliberation by the Institutional Review Board of Seoul St. Mary's Hospital, the Catholic University of Korea (study number: KC20ZISI0773).

INFORMED CONSENT

All participants signed a consent form, and anonymity and confidentiality were assured.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available in Homepage of Korea Health Panel at <https://www.khp.re.kr:444/eng/main.do>.

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REFERENCES

1. Marucci-Wellman H. Precarious employment and occupational injuries in the digital age-where should we go from here? *Scand J Work Environ Health*. 2018;44(4):335-339.
2. International Labour Organization. *Non-standard employment around the world: Understanding challenges, shaping prospects*. International Labour Office; 2016.
3. Hünefeld L, Gerstenberg S, Hüffmeier J. Job satisfaction and mental health of temporary agency workers in Europe: A systematic review and research agenda. *Work Stress*. 2020;34(1):82-110.
4. Benavides FG, Benach J, Muntaner C, et al. Associations between temporary employment and occupational injury: What are the mechanisms? *Occup Environ Med*. 2006;63(6):416-421.
5. Virtanen M, Kivimäki M, Joensuu M, et al. Temporary employment and health: A review. *Int J Epidemiol*. 2005;34(3):610-622.
6. Kang M-Y, Kang Y-J, Lee W, et al. Does long-term experience of nonstandard employment increase the incidence of depression in the elderly? *J Occup Health*. 2016;58(3):247-254.
7. Bodin J, Ha C, Sérazin C, et al. Effects of individual and work-related factors on incidence of shoulder pain in a large working population. *J Occup Health*. 2012;54(4):278-288.
8. Underhill E, Quinlan M. How precarious employment affects health and safety at work: The case of temporary agency workers. *Relat Indust*. 2011;66(3):397-421.
9. Al-Tarawneh IS, Wurzelbacher SJ, Bertke SJ. Comparative analyses of workers' compensation claims of injury among temporary and permanent employed workers in Ohio. *Am J Ind Med*. 2020;63(1):3-22.
10. Madigan D, Forst L, Friedman LS. Workers' compensation filings of temporary workers compared to direct hire workers in Illinois, 2007-2012. *Am J Ind Med*. 2017;60(1):11-19.
11. Hintikka N. Accidents at work during temporary agency work in Finland-Comparisons between certain major industries and other industries. *Saf Sci*. 2011;49(3):473-483.
12. Valluru CT, Dekker S, Rae A. How and why do subcontractors experience different safety on high-risk work sites? *Cogn Technol Work*. 2017;19(4):785-794.
13. Foley M. Factors underlying observed injury rate differences between temporary workers and permanent peers. *Am J Ind Med*. 2017;60(10):841-851.
14. Håkansson K, Isidorsson T. Between two stools: Occupational injuries and risk factors for temporary agency workers. *Int J Workplace Health Manag*. 2016;9(3):340-359.
15. Ahn J, Cho S-S, Kim H-R, et al. Comparison of work environment and occupational injury in direct and indirect employment in Korea and Europe. *Ann Occup Environ Med*. 2019;31:e24.
16. Fabiano B, Currò F, Reverberi AP, et al. A statistical study on temporary work and occupational accidents: Specific risk factors and risk management strategies. *Saf Sci*. 2008;46(3):535-544.
17. Koranyi I, Jonsson J, Rönnblad T, et al. Precarious employment and occupational accidents and injuries-A systematic review. *Scand J Work Environ Health*. 2018;44(4):341-350.
18. Jung YH, Seo NG, Go SG, et al. *A report on the Korea health panel survey of 2008*. Korea Institute for Health and Social Affairs; 2010.

19. Ok G, Ahn J, Lee W. Association between irregular menstrual cycles and occupational characteristics among female workers in Korea. *Maturitas*. 2019;129:62-67.
20. Choi SB, Yoon J-H, Lee W. The modified international standard classification of occupations defined by the clustering of occupational characteristics in the Korean Working Conditions Survey. *Ind Health*. 2020;58(2):132-141.
21. Sheytanova T. The accuracy of the Hausman Test in panel data: A Monte Carlo Study. Retrieved from <http://oru.diva-portal.org/smash/get/diva2:805823/FULLTEXT01.pdf>; 2015. Accessed November 17, 2021.
22. Baltagi BH, Baltagi BH. *Econometric analysis of panel data*. Vol 4. Springer; 2008.
23. Semykina A, Wooldridge JM. Estimating panel data models in the presence of endogeneity and selection. *J Econom*. 2010;157(2):375-380.
24. Ahn S. Working hours and depressive symptoms over 7 years: Evidence from a Korean panel study. *Int Arch Occup Environ Health*. 2018;91(3):273-283.
25. Marucci-Wellman HR, Willetts JL, Lin T-C, et al. Work in multiple jobs and the risk of injury in the US working population. *Am J Public Health*. 2013;104(1):134-142.
26. Gravel S, Dubé J. Occupational health and safety for workers in precarious job situations: combating inequalities in the workplace. *E-J Intl Comp Labour Stud*. 2016;5(3):1-30.
27. Vaes T, Vandenbrande T. *Implementing the new temporary agency work directive*. Hoger Instituut voor de Arbeid; 2009.
28. Cornes M, Manthorpe J, Moriarty JO, et al. Assessing the effectiveness of policy interventions to reduce the use of agency or temporary social workers in England. *Health Soc Care Commun*. 2013;21(3):236-244.
29. Jennifer Smith B, Purewal BP, Macpherson A, Pike I. Metrics to assess injury prevention programs for young workers in high-risk occupations: A scoping review of the literature.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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