

BMJ Open Influence of combined exposure to perceived risk at work and unstable employment on self-rated health: a comparison of two cross-sectional surveys in Europe and Korea

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ABSTRACT

Objectives The purpose of this study was to investigate the combined effect of exposure to perceived risk at work and unstable employment on self-rated health in both Korea and the European Union.

Design Cross-sectional study.

Setting We conducted the analyses using employees data from the third Korean Working Conditions Survey (KWCS) conducted in 2011 and the fifth European Working Conditions Survey (EWCS) conducted in 2010.

Participants Employees of the third KWCS and the fifth EWCS from 35 European countries were the participants of the study.

Primary outcome measures Employment status was divided into two categories: stable and unstable employment. Perceived risk regarding safety and health at work were assessed. Primary health outcomes were poor or moderate self-rated health. Exposures and health status were assessed via a questionnaire.

Results Among Korean employees, the OR of poor self-rated health was 2.00 (95% CI: 1.80 to 2.22) for those with perceived risk at work, 1.18 (95% CI: 1.09 to 1.28) for those with unstable employment and 3.22 (95% CI: 2.72 to 3.81) for those with both perceived risk at work and unstable employment. Relative excess risk due to interaction (RERI) was 1.03 (95% CI: 0.48 to 1.58). Among European employees, the OR for poor self-rated health was 3.20 (95% CI: 2.93 to 3.49) for those with perceived risk at work, 1.04 (95% CI: 0.97 to 1.13) for those with unstable employment and 3.41 (95% CI: 2.93 to 3.98) for those with both perceived risk at work and unstable employment. The RERI was 0.18 (95% CI: -0.36 to 0.71).

Conclusions Among Korean employees, a supra-additive interaction between perceived risk at work and unstable employment on poor self-rated health was observed. Conversely, a supra-additive interaction was not observed among European employees.

INTRODUCTION

Today, Korea still suffers from traditional industrial accidents and acute industrial intoxication. Although Korea has legal provisions prohibiting subcontracting and outsourcing of hazardous work, dangerous

Strengths and limitations of this study

- Our sample included a large number of workers from the general working population, allowing us to study a non-selective population, which has been shown to be crucial.
- As we compared representative data from Korea and European Union (EU) countries, surveyed using almost identical methodologies and survey questionnaires, it was possible to present result of Korea in parallel with that of the EU.
- Owing to its cross-sectional nature, the study could not establish a causal relationship between exposure and health outcome.
- The measurement of risk at work and health status was subjective and could be due to information bias.

and harmful jobs are increasingly being carried out by temporary workers. According to a report on fatal industrial accidents in the shipbuilding industry, the majority of fatal accidents occurred among workers with unstable employment.¹ Despite limited systematic research on the difference in hazard exposure between employees with different employment status,² short reports in newspapers on fatal injury occurrence among at-risk workers might reflect the inequalities across occupations and employment status.

Differences in exposure to hazardous conditions between regular workers and temporary workers in the same occupation highlight an important ethical issue. This deviates from the principle of equity and requires social efforts such as strict legal regulations on subcontracting or outsourcing hazardous work. Previous studies have reported the harmful effects of precarious or unstable employment on workers' health.³⁻⁵ Moreover, existing literature identifies a variety of potential moderators⁶ including occupational type

(manual or non-manual), gender, personal characteristics, psychosocial work characteristics, social support, length of time spent in a precarious labour market position and union membership. In addition, it is well known that social factors such as employment protection laws, availability and amount of unemployment benefits, availability of jobs and active labour market policies can also influence the health-related consequences of job insecurity.⁷ However, the combined effects of unstable employment and perceived risk at work have rarely been studied. If working under unstable employment and dangerous working conditions simultaneously is more harmful due to the interaction between the two concurrent exposures, greater social efforts should be made to improve conditions surrounding these workers. It is also necessary to examine whether this interaction unique to Korea, where workers have been unfairly treated, or if a similar interaction exists in other industrialised countries.

A comparative study on health equality across countries provides insights into this question.^{8 9} Improved social structure including the welfare system in each country, as well as the relationship between employers and employees, can change the negative perception of hazardous working conditions.^{10 11}

Therefore, the aim of this study is to examine whether there is a difference in the combined effect of unstable employment and perceived risk at work on self-rated health between Korea and European countries.

METHOD

Study subjects

We used data from the third Korean Working Conditions Survey (KWCS) conducted in 2011, and the fifth European Working Conditions Survey (EWCS) conducted in 2010. These were nationally representative interview surveys which included questions relating to workers' socioeconomic data, workplace environment and social and occupational health. The fifth EWCS comprises data from 35 European countries with 43 816 participants. The third Korean Working Conditions Survey (KWCS), which was based on the EWCS, was conducted by the Korea Occupational Safety and Health Agency. Total sample size of the KWCS was 50 033 participants (unweighted sample size=50 032), and the sample size of employees was 35 904 (unweighted sample size=29 711). Total sample size of the EWCS was 43 816 (unweighted sample size=43 816), and the sample size of employees was 35 078 (unweighted sample size=35 181). Self-employed people with or without employees and other types of employment were excluded from the analysis. The EWCS and KWCS assess the distribution of work-related risk factors to establish occupational safety policies. All study variables were assessed with the questionnaire. The surveys were conducted by trained interviewers through face-to-face interviews. To ensure comparability, the KWCS questionnaire was developed based on a translation of the questionnaire of the EWCS. The KWCS used a representative sample, only including

the economically active population aged over 15 years in South Korea.¹² Informed consent was obtained from all participants in both surveys, and detailed information about these surveys was made available on the following websites: <http://www.eurofound.europa.eu/working/surveys/> for the EWCS and <http://www.kosha.or.kr/jsp/kwcs/> for the KWCS.

Sampling and survey weighting

The KWCS sample was taken from the Population and Housing Census conducted in 2010. To ensure the sample was representative of the economically active population, we excluded students, housewives, the unemployed and the retired. The sampling method employed a multistage stratified approach using sampling with probability proportional to size. Census districts were selected using probability proportional to size of systematic sampling which reflected the number of households in each census district. Then, 10 households were randomly chosen within the selected census district. Finally, one eligible person was interviewed in the selected household.

The survey weighting was calculated using the information on distribution by region, locality, size, gender, age and occupation. Additionally, the response rate of the interviewees was considered to calculate the weighting of survey data.

Patient and public involvement

Both in the KWCS and EWCS, participants and the public were not involved in the development of the study design or planning. Participation was voluntary and could be terminated at any time. Study results were not distributed to the participants after the study by the study team. All data were used strictly confidentially and anonymously.

Study variables

Sociodemographic and behavioural characteristics

Information on age, sex, educational level, income, smoking habits and alcohol drinking was collected through questionnaires. Age was categorised as 15–29, 30–39, 40–49, 50–59 and 60 or more years of age. Educational level was categorised as middle school (lower secondary) or less, high school (higher secondary), college and university or more (post-graduate education, tertiary education or above). Monthly income was divided into four groups by quartiles. Alcohol consumption was categorised as none, moderate or risky. Risky alcohol consumption was defined as drinking more than seven units of alcohol at one time (binge drinking) or drinking more than 14 units of alcohol per week. Smoking was categorised as non-smokers, ex-smokers or current smokers.

Health was assessed based on the response to the subjective question, How is your health in general? Very poor, Poor or Fair were regarded as self-rated

poor health, while Very good or Good were regarded as good health.

Occupation and employment

The question on occupation in the original questionnaire included eight categories which were professional, management, office, sales, service, skilled, semi-skilled, non-skilled, fishery and farming. For analysis, the eight categories were combined into four categories which were management and professional, office worker, sales and service or manual (skilled, semi-skilled, non-skilled and farming and fishery). Employment status was classified by indefinite, fixed-term and temporary in EWCS. However, employment status was classified by regular, temporary and daily contract in KWCS. In the interaction analysis, employment status was combined into two categories (stable employment vs unstable employment). In European Union (EU) countries, indefinite employment was regarded as stable employment, and fixed-term and temporary employment were regard as unstable employment. Similarly, in Korea, regular employment was regarded as stable employment and temporary employment and employment based on daily contract were regard as unstable employment. Perceived risk at work was assessed by the question ‘Do you think your health or safety is at risk because of your work?’. ‘Yes’ was regarded as a perceived risk, and ‘No’ was regarded as no perceived risk to safety or health.

Statistical analysis

We analysed the EWCS and KWCS data separately to compare European and Korean participants. General characteristics are presented as means and SD for continuous variables and numbers and prevalence (%) for categorical variables. Proportions were calculated by occupation and employment status with survey weighting. The prevalence of perceived risk at work and variables regarding safety and health at work were summarised by occupational categories, as they differed by occupation (online supplementary table 1). To estimate the OR, multiple survey logistic analysis was employed. In the model, age, sex, educational level, income, occupation, smoking and alcohol consumption were included as potential confounders.

Relative excess risk due to interaction (RERI) and the ORs

For the interaction analysis, we initially employed multiple survey logistic analysis including all potentially confounding variables, and the product term between perceived risk at work and employment status in the model. We then estimated the combined effect of perceived risk of safety or health at work and employment status using the linear combination (lincom) command. Finally, we conducted an interaction analysis between perceived risk at work and employment status using ‘linear combination of coefficients’ (lincom) and ‘non-linear combination of coefficients’ (nlcom). RERI and CIs were estimated using the non-linear combination of

coefficients, and the ORs and CIs were estimated using the linear combination of coefficients. The commands ‘lincom’ and ‘nlcom’ are postestimation commands for estimating the combined effects of multiple variables after regression-based models. These commands can perform interaction analysis based on both additive and multiplicative scales and can estimate CIs. All statistical analyses were conducted using Stata V.13.1 (StataCorp, College Station, Texas, USA).¹³

The RERI is calculated to estimate the interaction between joint exposures based on additive scales.

$$\text{RERI} = \text{OR}_{\text{combined exposure to perceived risk at work and unstable employment}} - \text{OR}_{\text{exposure to only perceived risk at work}} - \text{OR}_{\text{exposure to only unstable employment}} + 1$$

An RERI larger than 0 indicates supra-additivity.

Ratios of ORs estimate the interaction between two combined exposures based on a multiplicative scale and are calculated using the following formula:

$$\frac{\text{OR}_{\text{combined exposure to perceived risk at work and unstable employment}}}{(\text{OR}_{\text{exposure to only perceived risk at work}} \times \text{OR}_{\text{exposure to only unstable employment}})}$$

Ratios larger than 1 indicate that the joint effect of two exposures is larger than the product of effects of the two separate exposures.

RESULTS

Characteristics of the study population

Table 1 shows the general characteristics of employees in Korea and EU countries. In Korea, the percentage of female employees was 41%. About 60% of participants were in their 30s and 40s, 34% were current smokers and 28% were risky alcohol consumers. More than half of the participants had finished college and university. Proportion of sales and service workers was 27%, and the proportion of manual workers was 34%. Regarding employment status, 20% of the employees were temporary and daily workers.

In the EU survey, the proportion of female employees was 46%. More than half (53%) of the participants of the study population were in their 30s and 40s. The EWCS did not investigate smoking and alcohol consumption. More than one-third (36%) of the study population had finished postsecondary education or tertiary education. Proportion of sales and service workers was 17%, and the proportion of manual workers was 33%. Regarding employment status, 22% of the employees had fixed-term or temporary employment.

There was a difference in the survey questionnaire between the KWCS and the EWCS regarding the type of employment. This difference might reflect the different labour contract systems in Korea and EU countries. Employment status of the EWCS was categorised by regular, fixed-term or temporary. In contrast, employment

Table 1 Characteristics of study populations (survey-weighted analysis)

	Korea		EU	
	n	Proportion	n	Proportion
Gender				
Female	14 618	0.41	16 234	0.46
Male	21 286	0.59	18 844	0.54
Age				
15–29	5 589	0.16	8 086	0.23
30–39	10 972	0.31	9 361	0.27
40–49	10 488	0.29	9 054	0.26
50–59	6 058	0.17	7 053	0.20
60+	2 796	0.08	1 524	0.04
Smoking				
No	19 614	0.55		
Ex	4 037	0.11		
Current	12 252	0.34		
Alcohol consumption				
No	8 216	0.23		
Moderate	17 526	0.49		
Risky	10 162	0.28		
Education				
Lower secondary or less	2 643	0.08	7 872	0.22
Upper secondary	13 155	0.38	14 400	0.41
Postsecondary but not tertiary	6 352	0.18	1 541	0.04
Tertiary education or more	12 497	0.36	11 176	0.32
Occupational				
Management and professional	3 095	0.09	8 028	0.23
Office or clerical	10 682	0.30	9 238	0.27
Sales and service	9 846	0.27	5 977	0.17
Manual	12 281	0.34	11 540	0.33
Employment				
Regular/Indefinite	28 543	0.80	26 873	0.78
Fixed-term	–	–	4 032	0.12
Temporary	5 078	0.14	3 466	0.10
Daily	2 283	0.06	–	–
Income				
Lowest	7 944	0.23	5 821	0.24
Low middle	9 223	0.26	6 281	0.25
High middle	9 164	0.26	6 557	0.27
Highest	8 844	0.25	6 023	0.24

status of the KWCS was classified by regular, temporary or daily. Notably, 6% of employment in Korea is on a daily contract basis.

Interaction between the perceived risk at work and employment status on self-rated health in Korea and EU countries

In Korea, perceived risk at work (OR: 2.00; 95% CI: 1.80 to 2.20) and unstable employment (OR: 1.18; 95% CI: 1.09

to 1.28) both increased the risk of poor self-rated health, with the other factors being constant (table 2). Furthermore, there was a supra-additive interaction between both perceived risk at work and employment status (RERI: 1.03; 95% CI: 0.48 to 1.58) and supra-multiplicative interaction (ORs: 1.36; 95% CI: 1.11 to 1.66).

In EU countries, only the perceived risk at work (OR: 3.20; 95% CI: 2.93 to 3.49) was linked to an increase in

Table 2 Effect of the perceived risk at work and employment status on self-rated health among Korean employees*

	No perceived risk at work	Perceive risk at work	OR for perceived risk versus no perceived risk within strata of employment
	OR (95% CI): p value	OR (95% CI): p value	OR (95% CI): p value
Stable employment†	Reference	2.00 (1.80 to 2.22): p<0.001	2.00 (1.80 to 2.20): p<0.001
Unstable employment‡	1.18 (1.09 to 1.28): p<0.001	3.22 (2.72 to 3.81): p<0.001	2.72 (2.29 to 3.24): p<0.001
OR for unstable employment versus stable employment within strata of long perceived risk at work	1.18 (1.09 to 1.28): p<0.001	1.60 (1.33 to 1.93): p<0.001	
Measure of interaction on additive scale: RERI	1.03 (0.48 to 1.58): p<0.001		
Measure of interaction on multiplicative scale: ORs	1.36 (1.11 to 1.66): p=0.003		

*Age, gender, income, education, occupations, smoking and alcohol consumption were adjusted in the model.

†Stable employment: regular employment in Korea.

‡Unstable employment: temporary and daily employment in Korea.

RERI, relative excess risk due to interaction.

poor self-rated health, but unstable employment (OR: 1.04; 95% CI: 0.93 to 1.17) was not significantly associated with poor self-rated health (table 3). A significant interaction was not found on an additive scale (RERI: 0.18; 95% CI: -0.36 to 0.71), nor on a multiplicative scale (ORs: 1.02; 95% CI: 0.85 to 1.24).

DISCUSSION

The primary purpose of this study was to investigate the interaction between perceived risk at work and employment status in Korea and EU countries. In Korea, both perceived risk at work and employment status were

associated with increased proportions of poor self-rated health, and a significant interaction between perceived risk at work and employment status was found both on additive scale and on multiplicative scale. The results indicate that the interaction between perceived risk at work and employment status could have a synergistic detrimental effect on workers' health in Korea. In EU countries, however, an interaction between perceived risk at work and unstable employment was not found.

We previously mentioned the topic of employment conditions in the results, specifically that Korea and EU countries may have different labour contract systems.

Table 3 Effect of the perceived risk and employment status on self-rated health among employees in EU countries*

	No perceived risk at work	Perceive risk at work	OR for perceived risk versus no perceived risk within strata of employment
	OR (95% CI): p value	OR (95% CI): p value	OR (95% CI): p value
Stable employment†	Reference	3.20 (2.93 to 3.49): p<0.001	3.20 (2.93 to 3.49): p<0.001
Unstable employment‡	1.04 (0.93 to 1.17): p=0.490	3.41 (2.93 to 3.98): p<0.001	3.28 (2.75 to 3.90): p<0.001
OR for unstable employment versus stable employment within strata of perceived risk at work	1.04 (0.93 to 1.17): p=0.490	1.07 (0.91 to 1.25): p=0.405	
Measure of interaction on additive scale: RERI	0.18 (-0.36 to 0.71): p=0.519		
Measure of interaction on multiplicative scale: ORs	1.02 (0.85 to 1.24): p=0.802		

*Age, gender, income, education and occupations were adjusted in the model.

†Stable employment: indefinite employment in EU countries.

‡Unstable employment: fixed-term and temporary employment in EU countries.

EU, European Union; RERI, relative excess risk due to interaction.

This difference might reflect dissimilarities between the labour market in EU countries and Korea. In Korea, it is more fragmented and divided due to neoliberalisation reform after an International Monetary Fund economic crisis.¹⁴ Korea also has a lower labour union density and a lower collective agreement coverage rate.^{15 16} Evident from our results, a proportion of working population's employment is set on a daily contract basis. The existence of daily employment indicates that there are workers under extremely unstable employment conditions. This unstable employment is not only short term, but is generally precarious. Some of the many aspects of precarious employment include low job security and unfavourable working conditions.¹⁷

Although the cause of the interaction can be explored through a more detailed investigation of occupational hazard exposure and other social determinants of health, there are two possible explanations for this in Korea. First, there is the possibility that at-risk workers were working under even more dangerous and less healthy working conditions than the quantitative analysis could capture. Another possibility is that precarious workers were more seriously affected by health problems due to harmful social circumstances, such as discrimination and de-unionisation. If the first explanation was the cause of the interaction, working conditions for precarious workers should be improved. If the second was the cause of interaction, socioeconomic inequalities between regular workers and precarious workers should be reduced. Future studies, particularly in Korean, should explore working conditions of workers with unstable employment to identify the causes of the interaction between unstable employment and perceived risk at work.

In both Korea and EU countries, gradients in perceived occupational hazard exposures were observed (online supplementary table 1). There were differences between stable employment and unstable employment in both Korea and EU countries, more significant in Korea. These exposure differences might imply that Korean workers under unstable employment have to bear the heavier burden of hazardous exposure, and reflect the reality that some workplaces do not follow regulations that prohibit subcontracting or outsourcing harmful tasks.

There is increasing concern among the public and researchers about the consequences of unstable employment; several studies in a variety of national and organisational contexts have provided evidence about its negative effect on health. Unstable employment seems more strongly associated with mental health than physical health. A significant amount of literature has demonstrated that workers reporting unstable employment have a higher risk of psychiatric morbidity^{18–20} and suicide.^{21 22} Moreover, previous evidence also suggests that unstable employment may be associated with poor self-rated health.^{7 23 24} While some studies have found a significant negative relationship between unstable employment and physical health, there are still uncertainties regarding the intensity of impact, and some studies have found

no evidence for a significant relationship between these variables. A meta-analysis of 72 studies suggested that employees with unstable employment generally have poorer mental and physical health.⁶

This study has several methodological shortcomings. First, the cross-sectional nature of the study does not enable the establishment of a causal relationship between exposure and health outcomes. It is possible that people with poor self-rated health tend to have an unstable job, which can lead to an underestimation of actual risk. Second, the measurement of risk at work and health status was subjective which may lead to information bias. In particular, self-rated health is a subjective measurement of health status. However, previous research, including a prospective cohort study, has consistently reported that poor self-rated health is associated to objective health outcomes, such as mortality.^{25–27} After adjusting for other health-related covariates, self-rated health could predict future mortality. Moreover, perceived risk at work reflects a subjective experience and must be self-reported. Therefore, it is challenging to obtain a valid and reliable assessment of risk at work and its subsequent impact on health. Third, self-employed workers were not considered in this study. Self-employment accounts for more than one-fourth of Korea's entire labour force. Self-employed individuals in Korea are concentrated in similar business fields, which results in a higher risk of competition and vulnerability to the influence of the economy. However, this large group of self-employed workers with unstable employment were excluded from our study. Therefore, future studies are required to fully understand this aspect. Finally, we could not identify a specific cause of the negative synergistic effect of unstable employment and perceived risk at work only in Korea. Although discrimination, de-unionisation and insufficient employee protection regulations were suggested as possible causes, these should be supported in empirical studies.

Nonetheless, our sample included a very large number of workers from the general working population, allowing us to study a nonselective population, which has been shown to be crucial. Moreover, as we used representative data from Korea and EU countries, surveyed using almost identical methodologies and survey questionnaires, it was possible to present results of Korea parallel to those of EU.

CONCLUSION

The results of our study suggest that the combination of both perceived risk at work and unstable employment has a synergistic detrimental effect on workers' health in Korea. To reduce the gap generated by the interaction between perceived risk at work and unstable employment, the cause of these inequalities must be investigated and a specific action plan should be built.

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Data availability statement Data are available at the following websites: <http://www.eurofound.europa.eu/working/surveys/for> the EWCS and <http://www.kosha.or.kr/jsp/kwcs/> for the KWCS.

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