Job characteristics as risk factors for early retirement due to ill health: The Korean Longitudinal Study of Aging (2006-2014)

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INTRODUCTION

The aging of the workforce in most developed countries is unavoidable but predictable. Life expectancy is increasing along with low birth rates, which means that there are fewer workers in the labor market to cover the rising health care and social security costs of an aging society. Therefore, there is a societal need for workers to prolong their working lives. The issue of preventing the exit from working life as well as limiting voluntary early retirement is receiving more attention from different research fields, including epidemiology, medicine, psychology, and social sciences, in Korea and most other Organisation for Economic Co-operation and Development (OECD) countries that face a similar demographic challenge.

Abbreviations: CI, confidence interval; ERIH, early retirement due to ill health; HR, hazard ratios; JD-R model, Job-Demand-Resources model; KLoSA, Korean Longitudinal Study of Aging; OECD, Organisation for Economic Co-operation and Development; SD, standard deviation.
To develop successful interventions to keep aging worker populations at work in a healthy, productive, and sustainable way, it is necessary to gain more insight into the main determinants that prompt workers to leave paid employment due to ill health.

In previous studies, many factors influencing exit from the labor market have been identified. These factors include demographic predictors like age and gender as well as behavioral and lifestyle risk predictors such as physical inactivity and smoking, socioeconomic status, chronic diseases, welfare arrangements, working conditions, and so on. As Schultz proposed, these factors can be seen as “push” and “pull” factors. Typically, push factors, such as poor health, lack of job satisfaction, changes in work and work organization, work fatigue, are negative and lead individuals toward retirement. In contrast, pull factors are usually positive factors that motivate employees to retire early and might include having more time for hobbies, wanting to spend more time with a spouse who has already retired, having the opportunity for an early retirement pension, and wanting to volunteer. Push and pull factors interact in complex ways to influence a person’s intention to retire. This study focused specifically on health-related factors, a type of push factor. Until now, the most widely studied individual predictors related to health have been age, behavioral and lifestyle risks, and chronic diseases.

A relatively small number of studies have examined the relationship between the working environment and retirement due to ill health. Although previous studies have revealed that working conditions are associated with retirement due to a disability, their results were based on specific occupational groups and often included limited risk factors. To the best of our knowledge, no previous studies have investigated occupational differences or the effect of working conditions on the risk for early retirement due to ill health (ERIH) in an Asian population. Thus, the aim of our study was to investigate the work-related factors that contribute to ERIH in middle-aged and elderly people in Korea using nationally representative longitudinal data.

## Materials and Methods

### 2.1 Data collection and participants

Data were collected from a sample from the first through the fifth phases of the Korean Longitudinal Study of Aging (KLoSA) conducted by the Korean Labor Institute and Korean Employment Institute Information Service. These surveys were administered in 2006, 2008, 2010, 2012, and 2014. The KLoSA targeted Koreans aged 45 years or older and their families. A multistage stratified probability sampling based on geographical area was used to randomly select a total of 10,000 households. Regions were stratified into urban and rural areas based on the 15 metropolitan cities and provinces of Korea. Of these 10,000 households, successful interviews were conducted with 6171 households; the household response rate was 70.7% and the individual response rate within the households was 75.4%. After 6 months (July-November 2006) of in-home, face-to-face interviews, the KLoSA had assembled a panel of 10,254 respondents. These participants underwent biennial follow-up. The second phase of the interviews was conducted from July to November 2008, the third from October to December 2010, the fourth from July to December 2012, and the fifth from September to November 2014. The second survey in 2008 was a follow-up that included 8688 respondents who represented 86.9% of the original sample; the third survey in 2010 was administered to 7920 respondents, which was 77.2% of the original sample. In 2012, the fourth survey was given to 7486 respondents representing 73.0% of the original sample, while in 2014 the fifth survey was completed by 7029 people representing 68.5% of the original sample.

The KLoSA is a national public database; all personally identifiable information has been removed from the data to allow for anonymous analysis. Ethics approval for this study was not required because we used national statistical data that is free of personally identifiable information. Trained interviewers conducted interviews with each family and provided information about the study objective, methods, potential risks and benefits, and mode of compensation, and an informed consent was obtained from all participants prior to their participation. The participants also agreed to take part in future scientific research. All participants were interviewed face-to-face using the Computer-Assisted Personal Interviewing method using Blaise®, a software system developed by Statistics Netherlands that was designed for use in official statistics (http://www.blaise.com/onlinehelp). The interviewers asked the participants to read the questions and enter their answers themselves.

The following inclusion/exclusion criteria were used: (i) during the first phase, workers (n = 3,888) were selected from the total sample size (N = 10,254) and (ii) we restricted our sample to paid employees (n = 1,875). (iii) We also excluded those who were 70 years of age and older at baseline (n = 34). Our final evaluation included 1830 eligible participants (Figure 1).

### 2.2 Study variables and measurements

The date of retirement was collected from the questionnaire responses. New cases of ERIH were defined as those who retired due to health problems before their scheduled or regular retirement age as reported on one of the follow-up surveys. Any workers who died from a disease before retirement were also included as an event of ERIH. Cases of retirement
due to other reasons (eg, becoming a caregiver for a family member) were not considered as events but as censored data instead. The follow-up period was calculated as the difference between the date of the first survey and the date of the survey-identified ERIH. We organized the respondents in ascending order by length of follow-up. If a respondent had more than one retirement event during the study period, we used the first event for the calculation of the follow-up period length. Any working respondents lost to follow-up across the second to fourth waves of the surveys were all regarded as censored data, and their follow-up period was calculated as the difference between the date of the first survey and the date of the final survey that they completed. For the remainder of the respondents who did not experience an event or were not lost to follow-up, the follow-up period was calculated as the difference between the date of the first survey and the last date of the fifth survey.

Three broad subdomains of working conditions were examined: occupational class, work arrangements, physical working conditions, and job satisfactions. Occupations were classified into six groups: “managers and professionals,” “office workers,” “service and sales workers,” “agriculture, forestry, and fishery workers,” “craft, device and machine operators, and assembly workers,” and “unskilled manual workers.” The work arrangements were further divided as follows: (i) weekly working hours were measured as the actual number of hours the respondent worked per week (excluding mealtimes) at all jobs. Working-hour groups were defined as 0-29 h/ wk, 30-39 h/ wk, 40-49 h/ wk, 50-59 h/ wk, 60-69 h/ wk, and ≥70 h/ wk; (ii) employment status was categorized as those with permanent or temporary contracts or day laborers; (iii) work schedules were categorized by those with full-time or part-time jobs as well as whether respondents (iv) held industrial compensation insurance or not and received (v) retirement benefits.

Physical working conditions were measured based on the participants’ responses to questions about the respondents’ opinion about their own jobs: (i) My job requires lots of physical effort (“Physically demanding”); (ii) My job requires the lifting of heavy loads (“Lifting”); (iii) My job requires stooping, kneeling or crouching (“Awkward posture”); and (iv) My job requires me to work with a computer (“Computer use”). The job satisfactions were also measured using questions about the respondents’ opinions about their own jobs: (i) I am satisfied with the working environment of my job (“Satisfaction with the working environment”); (ii) I am satisfied with the job I do at my current job (“Satisfaction with the task”); (iii) My job is stressful (“Job stress”); and (iv) I am satisfied with my current job (“Global job satisfaction”). The dummy variables employed in the regression analyses that followed had a value of one if the answer to the question was positive (either “Always or almost all of the time” or “Most of the time”) and zero if the response was negative (either “Some of the time” or “None or almost none of the time”).

The KLoSA survey includes questions about a wide array of characteristics. We used age, gender, household income level, and property value as covariates. The income level was defined as the total annual household income among individuals in the study population. The value of property was computed by adding up the net values of all types of assets, such as an owned house, deposits for a rental house, various financial assets, and cash.

2.3 | Statistical analyses

We listed the frequencies of the respondents’ baseline characteristics and prevalence of ERIH according to demographic characteristics and working conditions by gender. To explore whether working conditions affected ERIH, we compared them to each categorized variable and analyzed the distribution of each group using chi-square tests.

Cox proportional hazard models were employed to evaluate the effects of working conditions on ERIH for each gender. The models were both crude and adjusted for age, household income, and property. Models were fitted to yield hazard ratios (HR) and their 95% confidence intervals (95% CI), indicating the risk for ERIH among those who experienced adverse working conditions. The validity of the proportional
hazards assumption was assessed using two approaches. First, we examined graphs of the log-minus-log-survival functions and found that the plots had grossly parallel lines. Second, time-dependent covariates were used to confirm proportionality, and we found that no time-dependent covariates were statistically significant, suggesting that the hazard was reasonably constant over time.

Statistical analysis was performed using SAS (Version 9.3, SAS Institute, Cary, NC). A two-tailed \( P < 0.05 \) was considered statistically significant.

### 3 | RESULTS

The mean age (and corresponding standard deviation [SD]) of the participants was 53.53 (6.71) years, and 65.25% of them were male. Table 1 shows the results obtained from the preliminary analysis of the prevalence of ERIH according to each variable. Females, older people, unskilled manual workers, and day laborers were more likely to experience ERIH. Additionally, ERIH was common among those with the following conditions: high physical demands, frequent lifting of heavy loads, awkward postures, dissatisfaction with their working environment, and low job satisfaction. Male workers with temporary jobs, part-time work schedules, or high job stress also had a higher prevalence of ERIH than others, although we could not observe these differences among female participants. The remaining descriptive characteristics of the study population are listed in Table 1.

The results of the gender-stratified analyses are presented in Tables 2 and 3. The hazard risk ratios of ERIH according to working conditions in this crude model had a pattern similar to the results in Table 1. However, after adjusting for age, household income, and property, the risk ratios were somewhat attenuated. Among male respondents, crafters, device machine operators, and assembly workers or unskilled manual workers were at increased risk for ERIH. In addition, there were statistically significant associations suggesting an increased risk of ERIH among those who were day laborers, had no industrial compensation insurance or no retirement benefits, and reported high physical demands, awkward postures, and dissatisfaction with their working environment (Table 2). Unskilled manual workers had the highest hazard ratio in this analysis (HR = 4.143, 95% CI = 1.689-10.158). In addition, marginally significant relationships were observed between ERIH and other working condition characteristics, including long working hours (≥70), short working hours (<30), temporary employment, frequent lifting of heavy loads, dissatisfaction with task, and low job satisfaction. Among female respondents, however, no significant association was found in the adjusted model, although some working conditions were closely associated with an elevated risk of ERIH in the crude model (Table 3). Of the working conditions, only dissatisfaction with the working environment and dissatisfaction with task had marginal significance on female workers’ ERIH after adjusting for age, household income, and property (HR = 1.384, 95% CI = 0.928-2.064 and HR = 1.349, 95% CI = 0.901-2.020, respectively). One notable finding of our analysis was that doing computer work was inversely associated with ERIH in both men and women.

### 4 | DISCUSSION

The main findings of this study were that in a representative population in Korea, individuals with a low-status occupation had a higher risk for ERIH than those in high-status occupations. In addition, physical working conditions, job satisfactions, extremely long working hours, and insecure employment contracts were associated with ERIH. These findings were significant only among male workers. The results of this study are largely in concordance with the results of previous studies featuring a similar outcome. A Finnish study also reported that physical and psychological working conditions played a significant role in occupational differences seen in disability retirement. Studies using outcomes other than disability retirement also have reached findings similar to our study; physical and psychosocial factors are relevant to the risk of long-term sickness absences, intentions to leave the job, and early exits from the labor force.

There are various ways in which occupational class may affect health, work ability, and subsequent disability retirement. One possible explanation for these occupational differences in ERIH is the differences noted in work-related exposure levels among occupational classes. Occupational class is closely associated with physical working conditions and job satisfactions, which contribute to working capacity not only through ill health but also through the job requirements expected from a person depending upon his or her occupational position. A study from Norway examined the association between occupational class and the subsequent awarding of disability pension among middle-aged men and women, as well as to what extent work-related factors accounted for this association. The authors found that workers in skilled and unskilled manual classes had a substantial and unexplained risk for receiving a disability pension. Work-related factors only had a moderate impact on the disability risk, and the association between occupational status and disability retirement was largely mediated through the accumulation of hazards in the manual working classes. In a Finnish study, the associations were largely mediated through the physical workload among men and women, as well as by hazardous exposures, particularly among men. Unhealthy behaviors have also been identified as key factors for occupational differences in retirement due to ill health. Such commonly reported predictors
| Characteristics                          | Male |         |       | Female |         |       |
|----------------------------------------|------|---------|-------|--------|---------|-------|
|                                        | N,a  | %      | P-value | N,a  | %      | P-value |
| Demographics                           |      |        |        |        |        |        |
| Age                                    |      |        |        |        |        |        |
| <50                                    | 10/395 | 2.53 | <0.001 | 33/268 | 12.31 | <0.001 |
| 50-55                                  | 23/301 | 7.64 |        | 23/166 | 13.86 |        |
| 55-60                                  | 31/218 | 14.22 |       | 15/96  | 15.63 |        |
| 60-65                                  | 24/163 | 14.72 |       | 21/63  | 33.33 |        |
| ≥65                                    | 41/117 | 35.04 |       | 15/43  | 34.88 |        |
| Occupation                             |      |        |        |        |        |        |
| Managers and professionals             | 10/299 | 3.34 | <0.001 | 8/88   | 9.09  | 0.259  |
| Office workers                         | 8/138  | 5.80 |        | 5/29   | 17.24 |        |
| Service and sales workers              | 1/286  | 2.86 |        | 40/205 | 19.51 |        |
| Agriculture, forestry, and fishery     | 3/17   | 17.65 |        | 3/14   | 21.43 |        |
| Crafters, device machine operators and | 39/343 | 11.37 |        | 11/82  | 13.41 |        |
| assembly workers                       |        |       |        |        |        |        |
| Unskilled manual workers               | 68/362 | 18.78 |        | 40/218 | 18.35 |        |
| Work arrangements                      |      |        |        |        |        |        |
| Weekly working hours (missing=10)      |      |        |        |        |        |        |
| <30                                    | 20/83  | 24.10 | <0.001 | 17/94  | 18.09 | 0.505  |
| 30-40                                  | 7/77   | 9.09  |        | 12/58  | 20.69 |        |
| 40-50                                  | 42/581 | 7.23  |        | 38/250 | 15.20 |        |
| 50-60                                  | 20/170 | 11.76 |        | 16/85  | 18.82 |        |
| 60-70                                  | 10/138 | 7.25  |        | 9/77   | 11.69 |        |
| ≥70                                    | 30/145 | 20.69 |        | 15/72  | 10.83 |        |
| Employment status                      |      |        |        |        |        |        |
| Permanent                              | 76/905 | 8.40  | <0.001 | 54/363 | 14.88 | 0.135  |
| Temporary                              | 19/95  | 20.00 |        | 21/129 | 16.28 |        |
| Day laborer                            | 34/194 | 17.35 |        | 32/144 | 22.22 |        |
| Work schedule                          |      |        |        |        |        |        |
| Full-time                              | 106/1051 | 10.09 | 0.030 | 77/454 | 16.96 | 0.885  |
| Part-time                              | 23/143 | 16.08 |        | 30/182 | 16.48 |        |
| Industrial compensation insurance      |      |        |        |        |        |        |
| (missing=4)                            |      |        |        |        |        |        |
| Yes                                    | 49/747 | 6.56  | <0.001 | 28/225 | 12.44 | 0.071  |
| No                                     | 79/445 | 17.75 |        | 79/409 | 19.32 |        |
| Retirement benefits (missing=5)        |      |        |        |        |        |        |
| Yes                                    | 42/669 | 6.28  | <0.001 | 24/194 | 12.37 | 0.041  |
| No                                     | 87/525 | 16.57 |        | 83/437 | 18.99 |        |
| Physical working conditions            |      |        |        |        |        |        |
| High physical demands                  |      |        |        |        |        |        |
| Yes                                    | 89/645 | 13.80 | <0.001 | 83/473 | 17.55 | 0.406  |
| No                                     | 40/549 | 7.29  |        | 24/163 | 14.72 |        |
| Frequent lifting of heavy loads        |      |        |        |        |        |        |
| Yes                                    | 66/492 | 13.41 | 0.015  | 62/331 | 18.73 | 0.180  |
| No                                     | 63/702 | 8.97  |        | 45/305 | 14.75 |        |
of ERIH in low occupational classes include smoking, high alcohol consumption, physical inactivity, and high relative body weight.

Many previous studies have investigated work arrangements and reported that disability pension is more prevalent among those with evening and night work, long working hours, and part-time jobs. As working more hours each week is generally associated with a higher income, individuals without functional limitations likely would not desire to work fewer hours, so they may have full-time work schedule. In our analysis, we also observed that extremely long working hours and having a part-time job were associated with an increased risk of ERIH, but this was not statistically significant after adjusting for household income and property. Moreover, the results of our analysis suggest that workers with insecure job characteristics, such as being a temporary or day laborer, having only part-time work schedules, and receiving no industrial compensation insurance or retirement benefits, have a higher risk for ERIH than those with a secure job position. Indeed, at least in Korea, job position with low security may be associated with poorer working conditions, which may in turn increase the risk for ERIH.

Our findings that physical working conditions and job satisfactions along with work arrangements affect workers’ risk for ERIH can be interpreted in the context of the Job-Demand-Resources (JD-R) model proposed by Bakker and Demerouti (2007). When the JD-R model is applied to retirement research, the results regarding the influence of job characteristics on ERIH can be interpreted as the effects of an imbalance between job demands and resources. According to the JD-R model, work characteristics can be classified into two global categories: job demands and job resources. Job demands refer to those aspects of the job “that require sustained physical and/or psychological effort and are therefore associated with certain physiological and/or psychological costs.” Therefore, these demands include burdens such as the physical/mental workload or time pressures. In contrast, job resources are positive aspects of the job characteristics that keep people healthy and motivate them to remain in the labor force even when they encounter high job demands. For example, social support and job security can act as job resource, which is related with some work arrangement variables in our study, such as permanent employment status or industrial compensation insurance. Furthermore, resources are functional in achieving work goals, reducing job demands and their associated costs (physiological and psychological costs), or stimulating personal growth, learning, and development. A recent

| Characteristics                          | Male N | Male % | Male P-value | Female N | Female % | Female P-value |
|------------------------------------------|--------|--------|--------------|----------|----------|----------------|
| Awkward posture                          |        |        |              |          |          |                |
| Yes                                      | 80/553 | 14.47  | <0.001       | 75/430   | 17.44    | 0.547          |
| No                                       | 49/641 | 7.64   |              | 32/206   | 15.53    |                |
| Computer work                            |        |        |              |          |          |                |
| Yes                                      | 12/427 | 2.81   | <0.001       | 6/97     | 6.19     | 0.002          |
| No                                       | 117/767| 15.25  |              | 101/539  | 18.74    |                |
| Job satisfaction                         |        |        |              |          |          |                |
| Dissatisfaction about working environment |        |        |              |          |          |                |
| Yes                                      | 75/490 | 15.31  | <0.001       | 60/283   | 21.20    | 0.008          |
| No                                       | 54/704 | 7.67   |              | 47/353   | 13.31    |                |
| Dissatisfaction with task                |        |        |              |          |          |                |
| Yes                                      | 56/402 | 13.93  | 0.013        | 57/266   | 21.43    | 0.009          |
| No                                       | 73/792 | 9.22   |              | 40/370   | 13.51    |                |
| High job stress                          |        |        |              |          |          |                |
| Yes                                      | 65/728 | 8.93   | 0.009        | 58/326   | 17.79    | 0.504          |
| No                                       | 64/466 | 13.73  |              | 49/310   | 15.81    |                |
| Low global job satisfaction              |        |        |              |          |          |                |
| Yes                                      | 63/442 | 14.25  | 0.003        | 49/262   | 18.70    | 0.289          |
| No                                       | 66/752 | 8.78   |              | 58/374   | 15.51    |                |
| Total                                    | 129/1194| 10.80  |              | 107/636  | 16.82    |                |

*Numerators indicate number of case for early retirement due to ill health and denominators indicate number of subjects for each group.
A qualitative study in older workers from 46 to 63 years of age who reported having poor health suggested that the influence of health on productivity depends on each individual’s unique imbalance between demands and resources. In addition, a prospective study in a population of Danish employees in elderly care revealed that high job demands and low resources explain the increase in early retirement intentions.

One important issue that arose from our analysis was the clear gender differences in the association between working characteristics and the risk for ERIH. Female workers traditionally have a higher risk of ERIH than males, but the influence of working characteristics is only significant for male workers. Gender differences have been found in studies conducted in other Nordic countries. For example, Thorsen et al. identified gender differences in the association between psychosocial factors in the workplace and older workers’ retirement plans. When stratified by gender, psychosocial factors (ageism, lack of recognition, lack of development possibilities) were significant for men.

### Table 2

Job characteristics influencing early retirement due to ill health in male employees

|                         | Crude Model |                  | Adjusted Model |                  |
|-------------------------|-------------|------------------|----------------|------------------|
|                         | HR 95% CI   | HR 95% CI        |                | HR 95% CI        |                |
| Occupation              |             |                  |                |                  |
| Managers and professionals | 1           | Reference        | 1              | Reference        |
| Office workers          | 2.110       | 0.681 6.543      | 1.592          | 0.508 4.990      |
| Service and sales workers | 1.566       | 0.189 13.010     | 1.109          | 0.133 9.239      |
| Agriculture, forestry, and fishery workers | 9.687 | 2.422 38.748 | 3.629          | 0.868 15.17      |
| Crafters, device machine operators, and assembly workers | 5.359 | 2.262 12.698 | 3.815          | 1.583 9.195      |
| Unskilled manual workers | 9.641       | 4.158 22.351     | 4.143          | 1.689 10.158     |
| Work arrangements        |             |                  |                |                  |
| Weekly working hours    |             |                  |                |                  |
| <30                     | 3.840       | 2.111 6.986      | 1.746          | 0.933 3.269      |
| 30-40                   | 1.274       | 0.538 3.013      | 0.986          | 0.416 2.341      |
| 40-50                   | 1           | Reference        | 1              | Reference        |
| 50-60                   | 1.609       | 0.908 2.851      | 1.263          | 0.709 2.250      |
| 60-70                   | 1.290       | 0.642 2.590      | 0.910          | 0.450 1.840      |
| ≥70                     | 3.437       | 2.098 5.633      | 1.655          | 0.983 2.788      |
| Employment status       |             |                  |                |                  |
| Temporary (vs permanent) | 2.819       | 1.632 4.868      | 1.485          | 0.848 2.603      |
| Day laborer (vs permanent) | 2.339       | 1.511 3.621      | 1.586          | 1.009 2.491      |
| Part-time work schedule (vs full-time) | 1.748 | 1.067 2.866 | 1.285          | 0.780 2.116      |
| Industrial compensation insurance (No vs Yes) | 3.325 | 2.258 4.896 | 1.790          | 1.167 2.745      |
| Retirement benefits (No vs Yes) | 3.384 | 2.263 5.060 | 1.802          | 1.157 2.807      |
| Physical working conditions (Yes vs No) |             |                  |                |                  |
| High physical demands   | 2.033       | 1.360 3.040      | 1.840          | 1.226 2.763      |
| Frequent lifting of heavy loads | 1.595 | 1.103 2.307 | 1.313          | 0.900 1.915      |
| Awkward posture         | 2.074       | 1.416 3.038      | 1.763          | 1.200 2.591      |
| Computer work           | 0.161       | 0.084 0.308      | 0.306          | 0.155 0.606      |
| Job satisfaction (Yes vs No) |             |                  |                |                  |
| Dissatisfaction with the working environment | 2.395 | 1.645 3.486 | 1.728          | 1.174 2.545      |
| Dissatisfaction about task | 1.723       | 1.189 2.498      | 1.239          | 0.847 1.812      |
| High job stress         | 0.681       | 0.470 0.985      | 0.982          | 0.672 1.433      |
| Low global job satisfaction | 1.768       | 1.222 2.557      | 1.342          | 0.921 1.956      |

aAdjusted for age, household income, and property.
(OR: 1.15–1.25), but no association was significant in the female subgroup. These results may suggest that female workers are less affected by work characteristics with regard to exist from jobs than male workers. However, to the best of our knowledge, no studies have examined the possible causes for this difference yet. With regard to general gender differences in psychological well-being, differential exposure and the differential vulnerability to social roles and role characteristics have been suggested. These gender differences in response to working characteristics can be explained in part by the collectivistic cultural value in Korea. The elderly people in Korea still hold onto traditional gender role stereotypes in general, even though the distinction of traditional gender roles has become ambiguous due to the increased economic activity of women. The traditional gender role expectations under patriarchal Confucianism assume that husbands take on the role of breadwinner and put greater value on the work domain, while wives are
primarily responsible for family demands. Especially, East Asian culture encourages husbands to dedicate prolonged years to their jobs to maximize the economic benefits for the family. Within the framework of the family ethic, a husband who delayed his decision to retire and temporarily sacrificed for the family would be perceived as “normal” and acceptable by the family members as long as his health allowed it, while wives’ threshold for ERIH seems lower and less affected by working conditions. Further research on gender differences in ERIH is warranted.

The strengths of this study are its prospective design using a nationally representative sample of middle-aged and elderly workers and the fact that it was conducted in an Asian country for the first time. However, this study also has a few limitations. First, work-related characteristics were based on self-reports assessed with simple, non-validated questions, which could have produced a reporting bias on baseline work-related characteristics. Second, because this study was carried out within the Korean social welfare context, the results cannot be directly generalized to other countries. Therefore, caution should be taken when applying the current results to other countries with a different type of social welfare system. Third, the cumulative effect of exposure could not be investigated because of the relatively short follow-up period and the time-varying nature of the study variables. Finally, health status is in causal pathway between job characteristics to ERIH, but we cannot investigate how differently certain disease or health problem caused ERIH according to various job characteristics because reason for ERIH was not directly surveyed in our dataset.

In conclusion, this study found that occupational class, work arrangement, and physical and psychological working conditions were the potential risk factors for ERIH among male workers in Korea. Our results also revealed gender differences in the risk for ERIH. These findings have clear implications. The contribution of job characteristics to ERIH was evident, so interventions aimed at improving working conditions and job security are essential for preventing the early exit of aging labor forces from work due to ill health. Further and more specific studies will be needed to identify which additional factors influence ERIH according to occupation and disease groups.

DISCLOSURE
Approval of the research protocol: The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. All study participants provided informed consent and all the authors have approved the manuscript and agree with submission to your esteemed journal. The dataset supporting the conclusions of this article is available on the KLoSA website (http://survey.keis.or.kr/eng/klosa/klosa01.jsp). Informed consent: All study participants provided an informed consent. Registry and the registration no. of the study/trial: NA. Animal studies: NA.

CONFLICT OF INTEREST
Authors declare no conflict of interests for this article.

AUTHORS’ CONTRIBUTION
MYK conducted the analysis and wrote manuscript in collaboration with HRK. MYK wrote the first draft of the manuscript. HRK and JPM provided the feedback and suggestions. All authors read the manuscript and approved to submission.

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24. How to cite this article: Kang M-Y, Myong J-P, Kim H-R. Job characteristics as risk factors for early retirement due to ill health: The Korean Longitudinal Study of Aging (2006-2014). *J Occup Health*. 2019;61:63-72. https://doi.org/10.1002/1348-9585.12014