Determinant Factors and Estimation for Early Retirement in Korean Workers

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Abstract

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Introduction: The increasing proportion of the ageing working population is recognized as a significant public health challenge. Although many studies have reported on early retirement of vulnerable populations, only a few of these studies have examined the different early retirement predictors based on the type of retirement among self-employed and regular paid workers. To date, there have been no studies focused on developing an early retirement prediction model. Accordingly, the primary purposes of this study were to analyze the determinants of early retirement according to the retirement type among self-employed and regular paid workers, and to establish a prediction model of early retirement owing to the poor personal health status of the retirees.

Methods: This study analyzed the longitudinal data of 2,708 workers who had previously participated in the Korean Longitudinal Study of Ageing (KLoSA), from 2006 to 2014. The prevalence of early retirement was calculated according to the type of retirement. Multivariate Cox regression analyses were conducted to identify the predictors for early retirement according to the type of retirement. Moreover, the current study constructed a prediction model for early retirement due to poor personal health status using a Cox regression model.

Results: Over the 8-year follow-up, 314 workers retired early, including 31, 88, 124, and 71 because of sufficient economic status; leisure or volunteer activities; personal health problems; and family members' health problems, housekeeping, or childcare, respectively. In all strata, multivariable analysis revealed that older and female workers were significantly more vulnerable towards early retirement.

Sufficient economic status was an important determinant of voluntary early retirement (hazard ratio [HR], 1.22; 95% confidence interval [CI], 1.08–1.39). Significant predictors for early retirement among workers who retired due to poor personal health included hypertension (HR, 1.52; 95% CI, 1.01–2.28), abnormal body mass index (BMI) (HR, 1.60; 95% CI, 1.10–2.35), decreased grasping power index, and perceived health status. A prediction model designed to estimate the risk of early retirement because of poor personal health status—using age, sex, hypertension, diabetes, abnormal BMI, smoking, alcohol consumption, perceived health status, and working life expectancy—showed fair performance (areas under the curve = 0.784 [± 0.023] in the training dataset, 0.781 [± 0.047] in the test dataset, and 0.751 [± 0.029] in the external validation dataset from the English Longitudinal Study of Ageing).

Conclusion: The current study including both self-employed and regular paid workers revealed the specific determinants of shortened working life according to the type of early retirement. From these results, it seems that, to understand the process of shortened working life, different determinants of early retirement according to the main reasons of retiring should be considered. The performance of our prediction model for early retirement because of poor personal health remained stable even after external validation, suggesting the possibility of prediction of unwanted early retirement. Taken together, our findings suggest a role of our prediction model as a preventive strategy of unwanted retirement from the workplace.

Key words: early retirement, prediction, Korean Longitudinal study of Ageing, English Longitudinal Study of Ageing, elderly workers

I. Introduction

Ageing workers have increased both in number and in proportion in the working population; this has led to significant worldwide economic and public health challenges. The main reasons for these increases in ageing workers include the increasing life expectancy, decreasing birth rates, and the entrance into old age of the large "baby boomer" generation born after World War II [1]. The International Labour Organization has estimated that, by 2025, the proportion of the working population aged ≥55 years will be 21%, 32%, 30% and 17% in Asia, Europe, North America, and Latin America, respectively [2].

The Republic of Korea is one of most rapidly aging countries in the world. The Korean citizens' average life expectancy has increased from 72 years in 1990 to 84 years in 2014. As seen globally, the increasing age among Koreans has resulted in an increasing elderly working population. The era of 'homo-hundred' is almost upon us. However, an increasing older population without social or economic activity is directly associated with heavy economic and health burdens [3]. Thus, several countries have established policies focused on lengthening the working life, and the determinants of early retirement among aging workers are hence of interest [4].

To understand the determinants and the process of early retirement can play a key role in an ageing society. However, previous investigations of early retirement determinants and predictors have been limited by lack of homogeneity of the main

reason to leave their workplace (voluntary or non-voluntary), various social circumstances, different types of job, and different ageing processes among older workers. As a result, few studies have addressed the determinants of early retirement with advanced investigations according to the type of early retirement, including in subgroups according to the main reason for early retirement, and among both self-employed and regular paid workers. Furthermore, to date, there has been no investigation using an early retirement prediction model.

Therefore, this research attempted to identify the determinants of early retirement after subgroup stratification of the main reason of early retirement among Korean workers, including, both self-employed and paid workers. In Korea, many workers retire early because of poor health conditions [5]. Thus, to assess the probabilities of non-voluntary early retirement due to the workers' health condition may be helpful to ensure a longer working life among older workers. Thus, this study also attempted to estimate the probabilities of early retirement due to the workers' personal health status, by construction of a prediction model.

II. Methods

1. Study Design and Data Collection

The current study used data from the first to fifth (2006–2014) waves of the Korean Longitudinal Study of Ageing (KLoSA), conducted by the Korea Labour Institute and the Korea Employment Institute Information Service. The KLoSA was conducted to obtain an overview of what it means to grow older and to help us understand what accounts for the variety of patterns that are seen. The KLoSA was started with surveys and interviews of 10,254 randomly selected adults (aged >45 years) residing in one of 15 city-size administrative areas in the Republic of Korea in 2006. The KLoSA collected information about household and individual demographics; medical, physical, and psychosocial health; work and pensions; income and assets; housing; cognitive function; social participation and networks; expectations; and objective estimations, including physical and performance measures. The participants were interviewed using computer-assisted personal interviews, where the professional interviewers instructed the respondents to read the questions on a computer and input their answers directly.

A longitudinal approach was adopted to develop an 8-year early retirement prediction model; the baseline period used for this study was the first phase of KLoSA (n=10,254) conducted in 2006. In order to investigate the predictors of early retirement, the non-working population (n=6,295) and unpaid family workers (n=334) were excluded from the study. In Korea, the beginning ages of old-age

retirement are separated according to the year of birth (~1952, 1952–1962, 1963–1964, and 1965~). Most people born after 1965 will retire at 65 years. Workers who retire before this age are defined as early retirement workers. Thus, workers aged >65 years (n=617) at baseline were also excluded. Moreover, 300 participants who refused to participate or those with missing relevant covariates data were also excluded from the study. Finally, 2,708 workers were included in the current study at baseline (Figure 1).

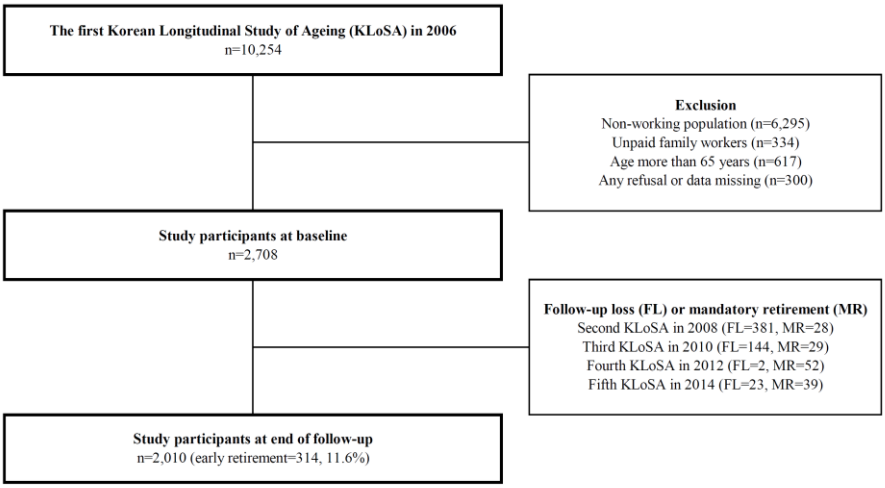

Figure 1. Schematic diagram of the study participants

Each KLoSA participant was identified using a randomly selected number to protect anonymity. Interviewers provided information about the research objectives and potential risks and benefits to all survey respondents before they answered any questions. All respondents also agreed to participate in further scientific research. The present study was approved by the Institutional Review Board of Yonsei University Graduate School of Public Health, Korea (No. 2-1040939-AB-N-01-2016-167).

2. Early Retirement

Early retirement can be defined as retirement before the retirement from old age, which is generally >65 years in Korea. Early retirement may also be defined as retirees who retire despite the ability and will to work due to various reasons. While the latter is hard to evaluate due to the inclusion of large numbers of super-aged workers, the former has enough consensus as a standard of early retirement in the study field of working populations. Accordingly, this study used the former definition of early retirement.

In order to identify early retirement status, newly recognized retirees during the follow-up periods were asked regarding the reason for retirement in each wave. The possible answers were categorized as follows: 1) sufficient income; 2) sufficient income of their spouse; 3) being weary of work; 4) wanting to have more leisure time; 5) wanting to spend time volunteering or on a hobby; 6) poor personal health, 7) poor health of their spouse, or 8) poor health of family members; 9) housework or childcare; 10) unable to find other work; 11) regular retirement; and 12) any other reasons. Participants who answered with 11 and 12 were excluded from the study, and the remaining participants with early retirement were defined and divided into two groups based on their reason for retirement: retirees who answered with 1–5 were classified as having voluntary early retirement, while retirees who answered with 6–10 were classified as having involuntary early retirement. Subsequently, voluntary retirement was divided into the following two sub-categories: ‘Due to sufficient economic status’ (answers 1 and 2) and ‘Due to leisure or volunteer

activity' (answers 3–5). Similarly, involuntary retirement was also divided into sub-categories, as follows: retirees who answered '6) Due to poor personal health status' were grouped as 'Due to personal health status', while all others (answers 7–10) were grouped as 'Due to family health status, housekeeping, or childrearing'.

3. Socioeconomic Variables

The current study used age, sex, marital status, education, and household income as socioeconomic variables. Marital status was divided into two categories (married vs. divorced, separated, or never). Educational level was divided into the following three categories: less than middle school graduation, high school graduation, and above. Household income level was categorized as follows: <20,000$, <30,000$, <40,000$, and ≥40,000$.

4. Occupational Characteristics

Occupational characteristics included the type of work, occupational classification, size of enterprise, and time of work. The occupational classifications that were regrouped into six out of the 10 major categories (suggested by the International Standard Classifications of Occupations, as per the social and cultural circumstances of the Republic of Korea as well as the skill and duty levels reported in a previous study [6]) included higher-skilled white-collar workers (legislators, senior officials, managers, and professionals), lower-skilled white-collar workers (technicians and associated professionals), pink-collar workers (clerk, sales, and customer service workers), green-collar workers (agriculture, fishery, and forestry), skilled blue-collar workers (craft, plant and machine operators, and assemblers), and unskilled blue-collar workers (elementary workers). The size of the enterprise was divided into two categories considering the type of work (regular paid workers and self-employed), as follows: self-employed one-man companies and companies with <30 workers among paid workers were grouped into same category, while all other enterprises were grouped together.

5. Health Status

Smoking, alcohol consumption, and exercise level were considered as health behavior-related covariates. Smoking history was categorized as never/past smokers or current smokers. Heavy alcohol consumption was defined as alcohol consumption of at least 15 drinks per week in men and at least 8 drinks per week in women. Regular exercise level was defined as exercising more than once a week, as determined according to the questionnaire.

The KLoSA included information about the participants' history of medical diseases. A diagnosis of hypertension, diabetes, depression, and measured abnormal BMI ($\geq$25 kg/m^2, obesity; <18.5 kg/m^2, underweight) was included as relevant diseases histories of the participants, as chronic diseases can lead to work disability in the older population [7,8].

The grasping power index reflects age-related health conditions, similar to the gait speed and balancing on one-foot tests. For each hand, the mean of three trials of grip strength was calculated while considering the participants' conditions for gripping and hand dominance.

6. Perception Factors

The KLoSA included questionnaires about the self-rated expectations or satisfactions of the participants. The current study used three satisfaction factors (health, economic, and quality of life) and one expectation factor (working life expectancy). Self-rated satisfaction levels are considered key aspects related to early retirement among elderly workers [9,10]. The participants were asked about their health/economic/quality of life satisfaction as follows: "How satisfied are you with your health/economic/quality of life status?" Working life expectancy has also been reported as an important factor related to the ageing population [11]. The working life expectancy was asked to the participants according to their age group, using the following statements: "I can keep working in this job until 55 years old" to those <50 years of age, "I can keep working in this job until 60 years old" to those aged between 50–54 years, and "I can keep working in this job for 5 more years" to those aged >55 years. The possible answers to these statements were provided using a visual analogue scale (0–10 points). A score of 0 signified "never" or "it will never happen to me", while a score of 10 signified "always" or "it will definitely happen to me."

7. Statistical Analysis

The frequency of early retirement was calculated for each data category, and the chi-squared test or t-test was used to evaluate the association between each variable and early retirement. The survival time was defined as the interval between the survey date of the first wave and the date of early retirement. Hazard ratios (HRs) and 95% confidence intervals (CIs) were calculated by Cox regression models to evaluate the risks for early retirement, after which advanced analysis was conducted according to the subgroups of early retirement (voluntary early retirement and early retirement due to poor personal health status).

In occupational and environmental medicine, the number of workers who are vulnerable for early retirement without preparation due to personal health problems has rapidly increased. Early retirement without sufficient financial preparation could bring a financial crisis to both the workers and their family [12]. Especially, workers who cannot continue their working life due to decreased work ability secondary to personal health problems are an important concern in the field of occupational health [13]. Thus, a Cox regression model was used to construct a prediction model for the 8-year probability of early retirement due to poor personal health status as a means to identify vulnerable workers and to provide information related to unexpected early retirement. For the feature selection, backward stepwise elimination was conducted along with a literature review and expert discussion.

For internal validation, the dataset was divided randomly into training (80%, n=2,166) and test sets (20%, n=542), with conservation of the prevalence of early

retirement. The KLoSA was developed a part of a research network with the 'Health and Retirement Study (HRS)' in the US, 'Studies on Health and Retirement in Europe (SHARE)' in the EU, and 'English Longitudinal Study of Ageing (ELSA)' in the UK. These studies were deigned to share key areas of research, reflecting cultural circumstances, and using understandable measurements, and are international comparable studies to the KLoSA [14]. Thus, for external validation, data from the ELSA were used, with coincident follow-up periods. Area under the curve (AUC) and receiver operating characteristic (ROC) curve analyses were conducted to evaluate the performance of the prediction model for early retirement. All statistical analyses were performed with SAS (version 9.4, SAS Institute, Cary, NC, USA). Two-tailed p values <0.05 were considered to indicate statistical significance.

III. Results

1. Types of Early Retirement

There were 2,708 participants in our sample, including 314 (11.6%) early retirees, over the 8 years of follow-up. Approximately 62.1% (n=195) of these cases were non-voluntary early retirements, including 124 workers retiring because of personal health problems, and 71 workers who retired due to family health status, housekeeping, or childrearing (Figure 2 and Table 1.).

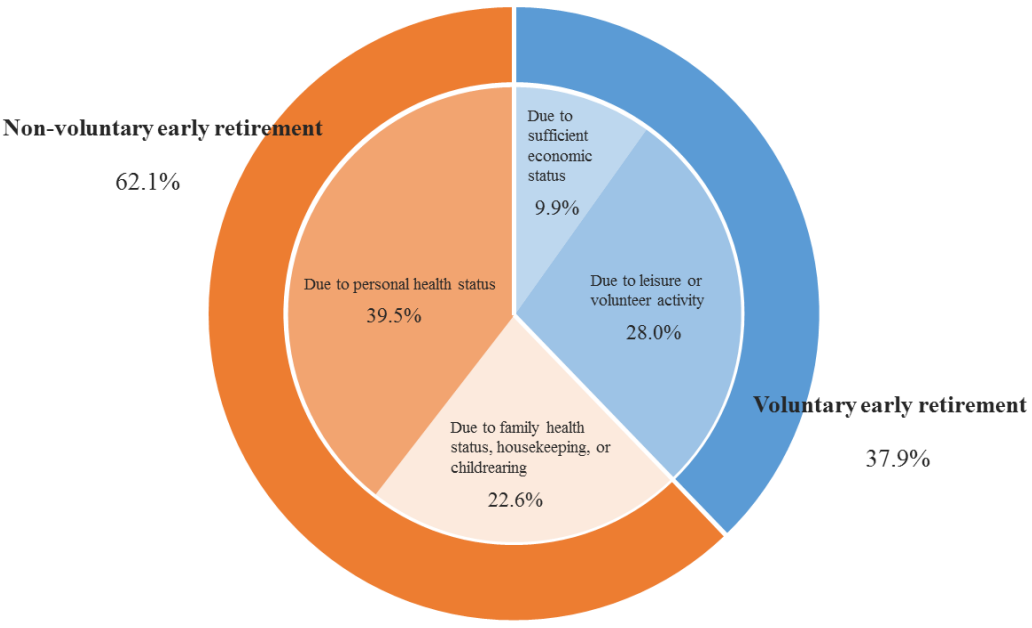

Figure 2. Types of early retirement.

Table 1. Types of early retirement

	Cases (n)	Proportion (%)	Person-years
Total participants	2,010	100	9,257
Overall early retirement	314	15.6	1,447
Voluntary early retirement	119	5.9	569
Due to sufficient economic status	31	1.5	159
Due to leisure or volunteer activity	88	4.4	410
Non-voluntary early retirement	195	9.7	878
Due to personal health status	124	6.2	539
Due to family health status, housekeeping, or childrearing	71	3.5	339

2. Characteristics of the Study Participants at Baseline

The basic characteristics of the study participants at baseline are presented in Table 2. In this study, 7.78% of male, and 19.66% of female workers retired early. The mean (standard deviation) ages at baseline were 55.48 (± 0.32) and 52.12 (± 0.11) years for early retirement and non-early retirement workers, respectively.

In terms of socioeconomic status, the highest proportions of early retirement were reported in those with an education status of less than middle school graduation (15.18%) and among participants with the lowest household income level (13.79%), with statistical significance (p value<0.0001 and 0.0084, respectively).

Regarding the occupational characteristics, regular paid workers showed a higher proportion of early retirement than those who were self-employed. Especially, unskilled blue-collar workers had the highest early retirement ratio, with statistical significance (p value<0.0001). Moreover, non-significant tendencies of higher prevalence of early retirement were noted in small-size enterprises (<30 workers and one-man companies) and part-time workers.

In terms of health status, participants who were classified as current smokers, with heavy alcohol consumption, and with no regular exercise showed higher early retirement prevalence rates than their counterparts. Furthermore, participants with hypertension, diabetes, abnormal BMI, and lower grasping power index demonstrated significantly higher prevalence rates of early retirement.

For the perception status, the participants with early retirement showed significant lower mean scores in the health and working life expectancy statuses.

Table 2. Characteristics of the study participants at baseline

	Early retirement [n (%) or mean (± standard deviation)]		*p* value
	No	Yes	
No. of participants	2,394 (88.40)	314 (11.60)	
Age (years)	52.15 (± 0.11)	55.48 (± 0.32)	<0.0001
Sex			<0.0001
Men	1,695 (92.22)	143 (7.78)	
Women	699 (80.34)	171 (19.66)	
Marital status			0.5683
Married	2,152 (88.52)	279 (11.48)	
Divorced, separated, or never	242 (87.36)	35 (12.64)	
Education			<0.0001
Middle school	905 (84.82)	162 (15.18)	
High school	1,010 (90.58)	105 (9.42)	
College or university	479 (91.06)	47 (8.94)	
Household income ($)			0.0084
<20,000	913 (86.12)	146 (13.79)	
<30,000	462 (89.02)	57 (10.98)	
<40,000	449 (90.52)	47 (9.48)	
≥40,000	570 (89.91)	64 (10.09)	
Type of work			0.0773
Paid worker	1,338 (87.45)	192 (12.55)	
Self-employed	1,056 (89.64)	122 (10.36)	
Occupational classification			<0.0001
Higher-skilled white collar	272 (89.77)	31 (10.23)	
Lower-skilled white collar	376 (88.26)	50 (11.74)	
Pink collar	538 (85.53)	91 (14.47)	
Green collar	168 (92.82)	13 (7.18)	
Skilled blue-collar	584 (92.55)	47 (7.45)	
Unskilled blue-collar	456 (84.76)	82 (15.24)	
Size of enterprise			0.2950
<30 or one-man company	1,599 (87.95)	219 (12.50)	
>30 or hired employee	795 (89.33)	95 (10.67)	
Time of work			0.6228
Part-time	216 (87.45)	31 (12.55)	
Full-time	2,178 (88.50)	283 (11.50)	

Table 2. Characteristics of the study participants at baseline (continued)

	Early retirement [n (%) or mean (± standard deviation)]		*p* value
	No	Yes	
Smoking			<0.0001
Never or past	1,594 (86.49)	249 (13.51)	
Current	800 (92.49)	65 (7.51)	
Alcohol consumption			0.0524
Never or social	2,011 (88.9)	277 (12.1)	
Heavy	383 (91.2)	37 (8.8)	
Exercise status			0.2138
None	1,422 (87.78)	198 (12.22)	
Regular	972 (89.34)	116 (10.66)	
Hypertension			<0.0001
No	2,061 (89.57)	240 (10.43)	
Yes	333 (81.82)	74 (18.18)	
Diabetes			0.0221
No	2,222 (88.81)	280 (11.19)	
Yes	172 (83.50)	34 (16.50)	
Obesity or underweight			0.0166
No	1,776 (89.29)	213 (10.71)	
Yes	618 (89.29)	101 (14.05)	
Depression			0.0712
No	2,003 (88.90)	250 (11.10)	
Yes	391 (85.93)	64 (14.07)	
Grasping power index	32.00 (± 0.17)	27.07 (± 0.43)	<0.0001
Perception factor scores			
Health status	6.67 (± 0.04)	6.36 (± 0.12)	0.0194
Economic status	5.37 (± 2.23)	5.57 (± 2.24)	0.1423
Quality of life	6.66 (± 0.04)	6.76 (± 0.09)	0.3253
Working life expectancy	8.15 (± 0.05)	7.25 (± 0.17)	<0.0001

3. Overall Risk of Early Retirement

Table 3 shows the results from the univariate and multivariate Cox regression analyses to estimate the overall risk of early retirement, including both voluntary and non-voluntary early retirement.

In the univariate analysis, significant linear trends of decreased risk for early retirement were observed according to increasing yearly household income and educational levels. However, those linear trends were attenuated in the multivariate analysis.

In the multivariate analysis over the 8-year follow-up, female participants showed an increased risk of early retirement (HR, 2.20; 95% CI, 1.42–3.42), while participants with green collar jobs showed a significantly decreased risk of early retirement (HR, 0.32; 95% CI, 0.15–0.69). Moreover, older age was significantly associated with an increased risk for early retirement in both univariate and multivariate analyses.

Table 3. Univariate and multivariate Cox regression analyses of the risk of early retirement

	Cases (n)	Person-years	Early retirement, HR (95% CI)	
			Univariate	Multivariate
Age (years)	-	-	**1.11 (1.08–1.13)**	**1.12 (1.09–1.15)**
Sex				
Men	143	716	reference	reference
Women	171	731	**2.72 (2.18–3.40)**	**2.20 (1.42–3.42)**
Marital status				
Married	279	1284	reference	reference
Divorced, separated, or never	35	163	1.26 (0.89–1.79)	1.39 (0.96–2.04)
Education (graduation)				
Middle school	162	730	reference	reference
High school	105	503	**0.60 (0.47–0.77)**	1.16 (0.87–1.56)
College or university	47	214	**0.62 (0.45–0.87)**	1.30 (0.85–2.01)
p value for linear trend			0.0002	0.2070
Household income ($)				
<20,000	146	673	reference	reference
<30,000	57	242	0.81 (0.60–1.10)	1.04 (0.76–1.43)
<40,000	47	218	**0.70 (0.51–0.98)**	0.97 (0.68–1.37)
≥40,000	64	314	0.76 (0.56–1.02)	0.88 (0.62–1.25)
p value for linear trend			0.0244	0.6151
Type of work				
Paid worker	31	115	reference	reference
Self-employed	283	1332	0.79 (0.55–1.15)	0.77 (0.59–1.01)
Occupational classification				
Higher-skilled white collar	31	145	reference	reference
Lower-skilled white collar	50	235	1.04 (0.67–1.63)	0.86 (0.52–1.42)
Pink collar	91	386	1.27 (0.84–1.90)	0.85 (0.51–1.45)
Green collar	13	67	0.53 (0.28–1.02)	**0.32 (0.15–0.69)**
Skilled blue-collar	47	230	0.65 (0.42–1.03)	0.68 (0.37–1.16)
Unskilled blue-collar	82	384	1.38 (0.91–2.09)	0.80 (0.47–1.36)
Size of enterprise				
<30 or one-man company	217	1007	reference	reference
>30 or hired employer	95	440	0.95 (0.75–1.21)	1.08 (0.83–1.41)
Time of work				
Part-time	192	881	reference	reference
Full-time	122	565	**0.76 (0.60–0.95)**	1.18 (0.79–1.75)

Table 3. Univariate and multivariate Cox regression analyses of risk of early retirement (continued)

	Cases (n)	Person-years	Early retirement, HR (95% CI)	
			Univariate	Multivariate
Smoking				
Never or past	249	1128	reference	reference
Current	65	318	**0.56 (0.42–0.73)**	1.10 (0.80–1.52)
Alcohol consumption				
Never or social	277	1273	reference	reference
Heavy	37	174	0.72 (0.51–1.02)	1.13 (0.71–1.46)
Exercise status				
None	198	885	reference	reference
Regular	116	561	0.86 (0.68–1.08)	0.82 (0.64–1.04)
Hypertension				
No	240	1118	reference	reference
Yes	74	329	**1.82 (1.41–2.37)**	1.29 (0.98–1.71)
Diabetes				
No	280	1272	reference	reference
Yes	34	174	1.42 (1.00–2.03)	1.14 (0.79–1.64)
Obesity or underweight				
No	213	978	reference	reference
Yes	101	469	**1.32 (1.04–1.67)**	1.22 (0.95–1.56)
Depression				
No	250	1155	reference	reference
Yes	64	292	1.28 (0.97–1.68)	1.05 (0.79–1.41)
Grasping power index	-	-	**0.93 (0.92–0.95)**	**0.97 (0.95–0.99)**
Perception factor scores				
Health status	-	-	**0.93 (0.88–0.98)**	0.94 (0.88–1.01)
Economic status	-	-	1.03 (0.98–1.09)	1.07 (1.00–1.15)
Quality of life	-	-	1.02 (0.96–1.08)	1.06 (0.97–1.15)
Working life expectancy	-	-	0.89 (0.85–0.92)	**0.95 (0.91–0.99)**

Bold values indicate statistical significance.

4. Risk of Voluntary Early Retirement

The main reason for early retirement, which had two major components, namely voluntary and non-voluntary, showed heterogeneity. Hence, stratified analyses were conducted according to the main reason for early retirement.

The results from the univariate and multivariate Cox regression analyses for the HRs of voluntary early retirement are shown in Table 4. There was no significant relationship of voluntary early retirement with marital status, type of work, alcohol consumption, exercise level, or chronic disorders. Green collar and full-time workers were associated with reduced risks of voluntary early retirement in the univariate analysis, while higher educational and household income levels related to increased HRs for voluntary early retirement, with significant linear trends in the univariate analysis.

Older age, female sex, and higher perceived economic status score were significantly associated with increased risks of voluntary early retirement in both the univariate and multivariate analyses.

Table 4. Results from the univariate and multivariate Cox regression analyses of voluntary early retirement

	Cases (n)	Person -years	Voluntary early retirement, HR (95% CI)	
			Univariate	Multivariate
Age (years)	-	-	**1.06 (1.03–1.10)**	**1.11 (1.07–1.16)**
Sex				
Men	54	249	reference	reference
Women	65	320	**2.74 (1.92–3.94)**	**3.62 (1.73–7.61)**
Marital status				
Married	109	517	reference	reference
Divorced, separated, or never	10	52	0.93 (0.49–1.78)	1.53 (0.76–3.08)
Education				
Middle school	40	190	reference	reference
High school	50	249	**1.69 (1.04–2.73)**	1.16 (0.76–1.76)
College or university	29	130	**2.06 (1.08–3.93)**	1.57 (0.97–2.53)
p value for linear trend			0.0261	0.0763
Household income ($)				
<20,000	38	189	reference	reference
<30,000	23	101	1.26 (0.75–2.12)	1.47 (0.86–2.52)
<40,000	19	81	1.09 (0.63–1.90)	1.19 (0.67–2.14)
≥40,000	39	198	**1.78 (1.36–2.78)**	1.27 (0.75–2.17)
p value for linear trend			0.0226	0.4360
Type of work				
Paid worker	73	365	reference	reference
Self-employed	46	204	0.75 (0.52–1.08)	0.94 (0.61–1.47)
Occupational classification				
Higher-skilled white collar	31	145	reference	reference
Lower-skilled white collar	50	235	0.85 (0.47–1.54)	0.93 (0.48–1.81)
Pink collar	91	386	0.81 (0.47–1.42)	0.94 (0.45–1.94)
Green collar	13	67	**0.07 (0.01–0.49)**	**0.11 (0.01–0.87)**
Skilled blue collar	47	230	**0.27 (0.13–0.56)**	0.49 (0.22–1.14)
Unskilled blue collar	82	384	0.71 (0.40–1.29)	0.93 (0.44–1.97)
Size of enterprise				
<30 or one-man company	217	1007	reference	reference
>30 or hired employer	95	440	**1.59 (1.11–2.29)**	1.43 (0.95–2.15)

Table 4. Results from the univariate and multivariate Cox regression analyses of voluntary early retirement (continued)

	Cases (n)	Person -years	Voluntary early retirement, HR (95% CI)	
			Univariate	Multivariate
Time of work				
Part-time	69	333	reference	reference
Full-time	50	236	**0.56 (0.34–0.94)**	0.65 (0.37–1.17)
Smoking				
Never or past	99	463	reference	reference
Current	20	106	**0.43 (0.27–0.69)**	0.93 (0.54–1.61)
Alcohol consumption				
Never or social	107	107	reference	reference
Heavy	12	67	0.61 (0.33–1.10)	1.01 (0.53–1.89)
Exercise status				
None	55	259	reference	reference
Regular	64	310	1.25 (0.87–1.79)	0.97 (0.66–1.43)
Hypertension				
No	98	467	reference	reference
Yes	21	102	1.27 (0.79–2.04)	1.20 (0.73–1.98)
Diabetes				
No	109	519	reference	reference
Yes	10	50	1.07 (0.56–2.04)	1.08 (0.55–2.12)
Obesity or underweight				
No	91	431	reference	reference
Yes	28	138	0.85 (0.56–1.31)	0.80 (0.51–1.25)
Depression				
No	102	482	reference	reference
Yes	17	87	0.83 (0.50–1.39)	1.01 (0.58–1.74)
Grasping power index	-	-	0.95 (0.93–0.97)	1.00 (0.94–1.04)
Perception factor scores				
Health status	-	-	1.09 (0.99–1.20)	0.98 (0.87–1.11)
Economic status	-	-	**1.23 (1.12–1.34)**	**1.22 (1.08–1.39)**
Quality of life	-	-	**1.17 (1.04–1.30)**	1.01 (0.87–1.16)
Working life expectancy	-	-	**0.93 (0.87–0.99)**	0.97 (0.90–1.04)

Bold values indicate statistical significance.

5. Risk for Early Retirement due to Poor Personal Health Status

Table 5 shows the risks for non-voluntary retirement due to poor personal health status according to several covariates. Significantly decreased risks of early retirement due to poor personal health were found to correlate with increased education (HR, 0.49–0.44) and household income levels (HR, 0.65, 0.55, and 0.49, respectively) in the univariate analysis.

Participants with older age, hypertension, and abnormal BMI associated increased risks for early retirement due to poor personal health status in the univariate analysis, and these associations remained in the multivariate analysis, with HRs (95% CIs) 1.15 (1.10–1.19), 1.52 (1.01–2.28), and 1.60 (1.10–2.35), respectively. Moreover, increased grasping power index and perceived health status score were significantly associated with a reduced risk of early retirement due to poor personal health status.

On the other hand, no significant association was observed between early retirement due to poor personal health status and marital status, enterprise size, alcohol consumption, or perceived quality of life in either the univariate or multivariate analysis.

Table 5. Results from the univariate and multivariate Cox regression analyses of early retirement due to poor personal health status

	Cases (n)	Person-years	Early retirement due to personal health status, HR (95% CI)	
			Univariate	Multivariate
Age (years)	-	-	**1.14 (1.11–1.18)**	**1.15 (1.10–1.19)**
Sex				
Men	59	295	reference	reference
Women	65	244	**2.49 (1.75–3.54)**	1.63 (0.81–3.26)
Marital status				
Married	107	467	reference	reference
Divorced, separated, or never	17	72	1.58 (0.95–2.64)	1.23 (0.71–2.12)
Education (graduation)				
Middle school	73	311	reference	reference
High school	36	158	**0.49 (0.31–0.68)**	1.11 (0.70–1.77)
College or university	15	70	**0.44 (0.25–0.78)**	1.10 (0.53–2.33)
p value for linear trend			0.0001	0.7157
Household income ($)				
<20,000	67	298	reference	reference
<30,000	21	74	**0.65 (0.40–1.06)**	1.01 (0.61–1.70)
<40,000	17	81	**0.55 (0.33–0.94)**	0.99 (0.56–1.75)
≥40,000	19	86	**0.49 (0.29–0.81)**	0.78 (0.43–1.44)
p value for linear trend			0.0016	0.5242
Type of work				
Paid worker	78	332	reference	reference
Self-employed	46	207	**0.59 (0.38–0.90)**	0.70 (0.49–1.01)
Occupational classification				
Higher-skilled white collar	12	60	reference	reference
Lower-skilled white collar	13	47	0.70 (0.32–1.54)	0.41 (0.17–1.00)
Pink collar	34	135	1.22 (0.63–2.36)	0.55 (0.24–1.30)
Green collar	8	39	0.86 (0.35–2.10)	**0.28 (0.09–0.83)**
Skilled blue-collar	25	119	0.90 (0.45–1.79)	0.57 (0.25–1.33)
Unskilled blue-collar	32	139	1.39 (0.72–2.71)	**0.42 (0.18–0.99)**
Size of enterprise				
≤30 or one-man company	90	390	reference	reference
>30 or hired employer	34	149	0.82 (0.55–1.22)	1.06 (0.69–1.64)

Table 5. Results from the univariate and multivariate Cox regression analyses of early retirement due to poor personal health status (continued)

	Cases (n)	Person-year	Early retirement due to own health status, HR (95% CI)	
			Univariate	Multivariate
Time of work				
Part-time	7	23	reference	reference
Full-time	117	516	**2.59 (1.17–5.72)**	1.47 (0.69–3.15)
Smoking				
Never or past	96	404	reference	reference
Current	28	135	**0.61 (0.40–0.94)**	1.08 (0.66–1.79)
Alcohol consumption				
Never or social	105	468	reference	reference
Heavy	19	71	0.98 (0.60–1.59)	1.18 (0.69–2.00)
Exercise status				
None	39	180	reference	reference
Regular	85	359	**0.67 (0.46–0.98)**	0.70 (0.47–1.06)
Hypertension				
No	86	381	reference	reference
Yes	38	158	**2.60 (1.78–3.82)**	**1.52 (1.01–2.28)**
Diabetes				
No	107	454	reference	reference
Yes	17	85	**1.87 (1.12–3.12)**	1.31 (0.77–2.23)
Obesity or underweight				
No	77	330	reference	reference
Yes	47	209	**1.69 (1.18–2.43)**	**1.60 (1.10–2.35)**
Depression				
No	95	428	reference	reference
Yes	29	111	1.51 (1.00–2.29)	0.94 (0.60–1.49)
Grasping power index	-	-	**0.93 (0.91–0.95)**	**0.95 (0.91–0.98)**
Perception factor scores				
Health status	-	-	**0.81 (0.75–0.87)**	**0.86 (0.78–0.95)**
Economic status	-	-	**0.92 (0.85–0.99)**	0.98 (0.88–1.09)
Quality of life	-	-	0.93 (0.84–1.02)	1.09 (0.96–1.24)
Working life expectancy	-	-	**0.85 (0.80–0.89)**	0.94 (0.88–1.00)

Bold values indicate statistical significance.

6. The Early Retirement Risk Score

To understand the key factors of non-voluntary early retirement due to poor personal health status, a prediction model was developed using the results from the Cox regression model shown in Table 5. By stepwise elimination of the Cox regression model, literature review, and discussion with occupational and public health professions, finally, nine covariates were selected as the main features related to early retirement due to poor personal health status. These included age and sex among the basic characteristics; smoking and alcohol consumption among health behaviors; hypertension, diabetes, and abnormal BMI among disease statuses; and the perceived health and working life expectancy scores among the perception factors.

HRs with exponentiated regression coefficients, obtained from the Cox regression model in Table 5, were used to build the risk score for the 8-year follow-up risk for non-voluntary early retirement due to poor personal health status. The early retirement risk score was constructed using beta estimates from the multivariate Cox regression analysis and the prevalence or mean of each predictive factor, as outlined in Table 6.

Table 6. The early retirement risk score

Probability(x) = (0.12465)(AGE-52.5489381) +(1.02939)*(SEX-0.3236)*
+(0.00648)(SMOKING-0.3163) +(0.13462)*(ALCOHOL-0.1565)*
+(0.37181)(DM-0.0711) +(0.38628)*(HTN-0.1477) +(0.09464)*(BMI-0.2715)*
+(-0.09659)(S_HEALTH-6.6629732) +(-0.08266)*(S_WORKING-8.0452447).*

AGE is a continuous variable, SEX has two categories (men or women); SMOKING has two categories (never or past/current); ALCOHOL has two categories (never or social/heavy); DM and HTN are diagnosed or treated diabetes mellitus or hypertension, respectively; BMI is an abnormal BMI (≥25 kg/m^2: obesity and <18.5 kg/m^2: underweight); S_HEALTH is the perceived health score (0–10 points with 1-point intervals); and S_WORKING is the perceived working life expectancy score (0≥10 points with 1-point intervals).

Finally, the absolute 8-year risk for early retirement due to poor personal health status is calculated as SCORE=1-(0.9391128136**exp(x)), where 0.9391128136 was calculated from the baseline survival rate.

Figures 3–6 demonstrate the mean and 95% CIs of the probability of early retirement due to poor personal health status estimated from the Cox regression model according to each predictive factor. In Figure 3, female workers, smokers, heavy alcohol consumption, and chronic disorders (hypertension, diabetes, and abnormal BMI) associated with high probabilities of early retirement due to poor personal health status. Figures 4, 5, and 6 show the probabilities of early retirement due to poor personal health status according to increasing age, decreasing perceived health score, and the working life expectancy score, respectively.

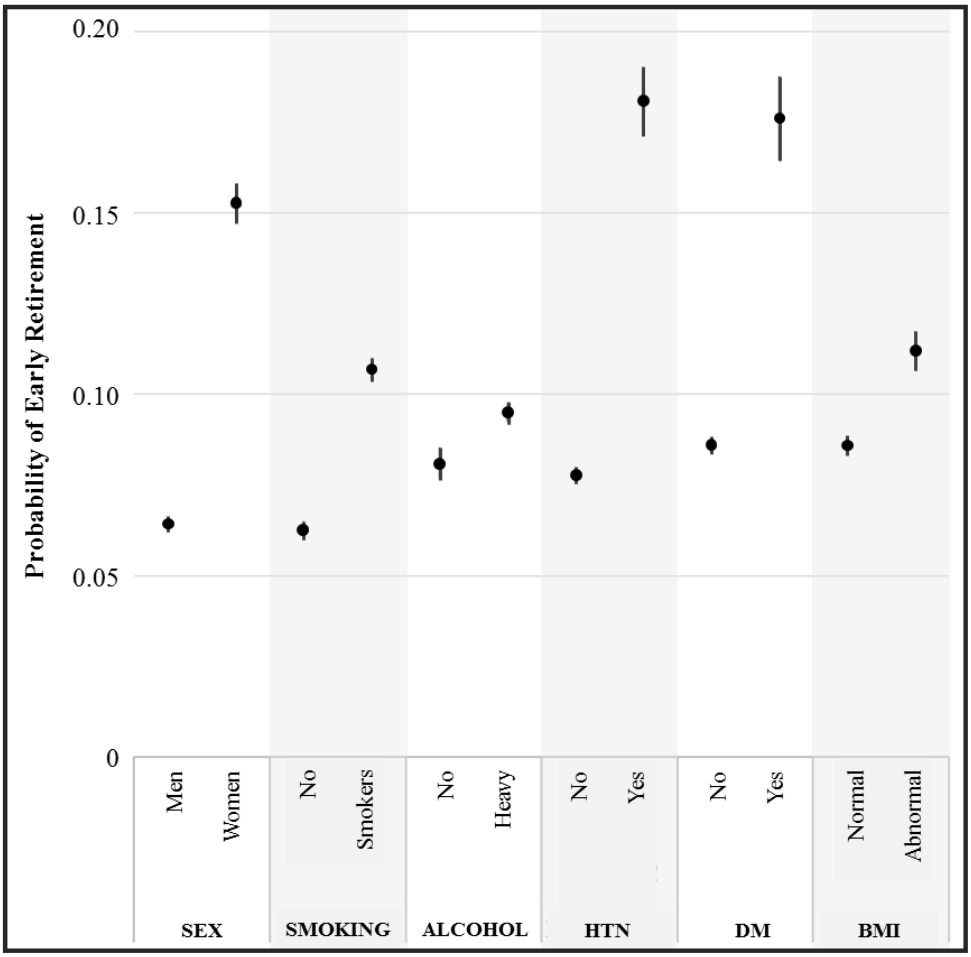

Figure 3. Mean probabilities of early retirement due to poor personal health status according to sex, health behaviors, and chronic disorders. HTN, hypertension; DM, diabetes mellitus; BMI, body mass index.

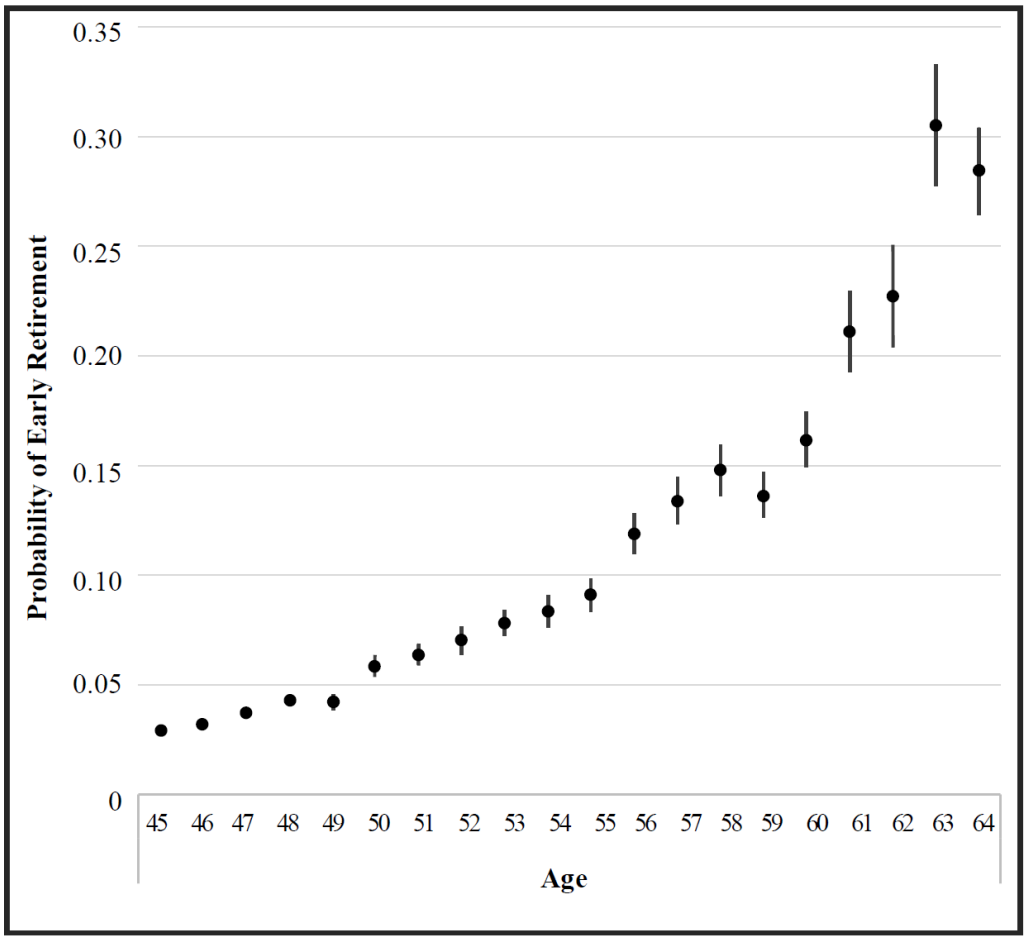

Figure 4. Mean probabilities of early retirement due to poor personal health status according to age (years)

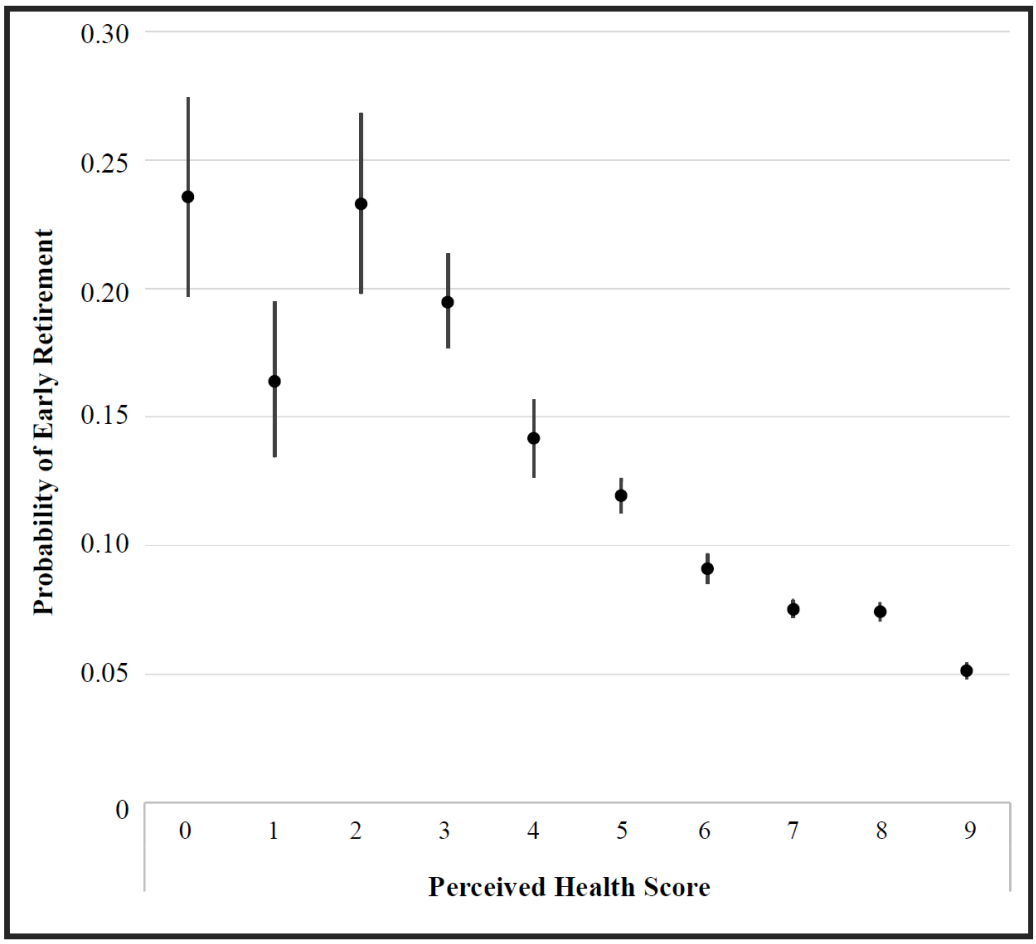

Figure 5. Mean probabilities of early retirement due to poor personal health status according to the perceived health score

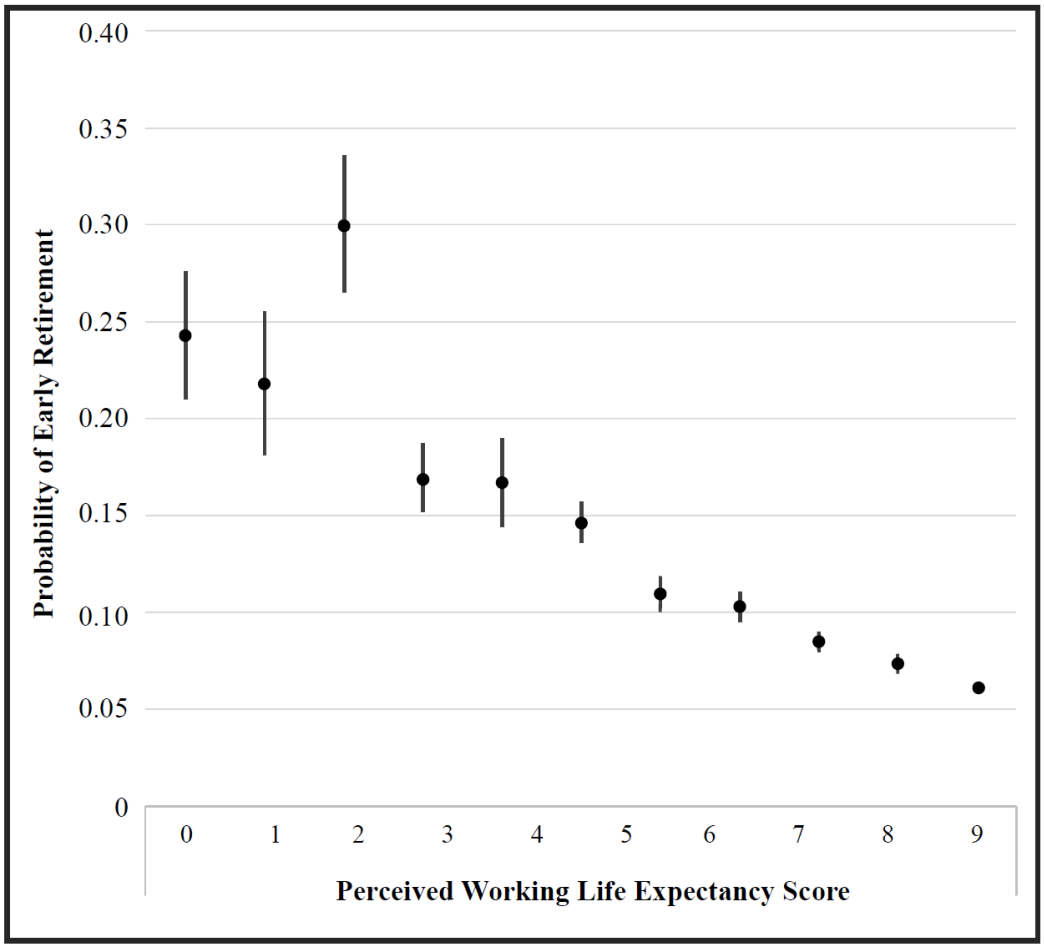

Figure 6. Mean probabilities of early retirement due to poor personal health status according to the perceived working life expectancy score

7. Performance of the prediction model for early retirement

To evaluate the performance of the prediction model for early retirement due to poor personal health status, ROC curve analysis with AUC calculations were conducted in three different datasets, as summarized in Figure 7. These included a (a) training dataset, (b) internal validation dataset from random split, and (c) external validation from the ELSA. Our prediction model based on Cox regression models showed fair AUCs of 0.784 (± 0.023) in the training data set, 0.781 (± 0.047) in the internal validation dataset, and 0.751 (± 0.029) in the external validation dataset.

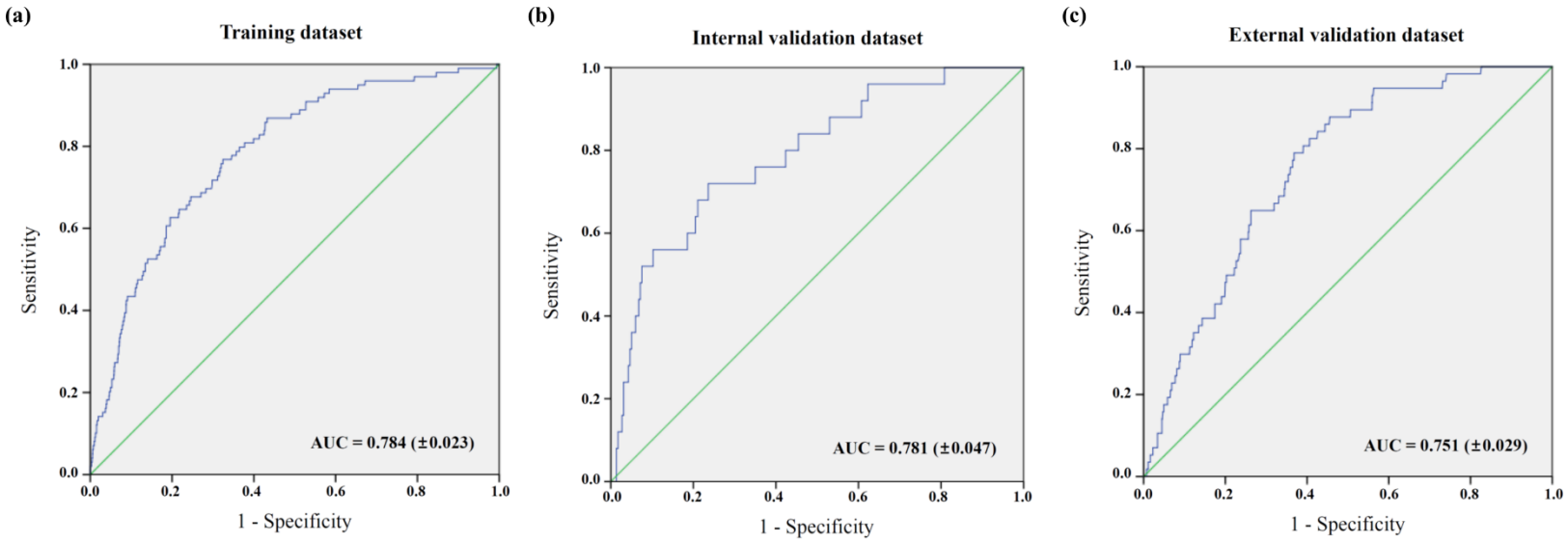

Figure 7. Areas under the curve (AUC) for early retirement due to poor personal health status. (a) Training, (b) internal validation, and (c) external validation datasets.

The predictive ability of the model was described by its sensitivity, specificity, positive predictive value, negative predictive value, and accuracy in each dataset, as summarized in Table 7. The internal validation dataset showed a sensitivity of 72.0%, specificity of 66.2%, positive predictive value of 9.3%, negative predictive value of 97.9%, and accuracy of 66.4%. The corresponding values in the external validation dataset were 94.7%, 63.0%, 6.4%, 99.7%, and 63.8%, respectively.

Table 7. Predictive ability of the model for early retirement due to poor personal health status

	Internal validation	External validation
n	542	2,204
Sensitivity	72.0%	94.7%
Specificity	66.2%	63.0%
Positive predictive value	9.3%	6.4%
Negative predictive value	97.9%	99.7%
Likelihood ratio positive	2.12	2.56
Likelihood ratio negative	0.42	0.08
Accuracy	66.4%	63.8%

Finally, advanced analyses for the evaluation of the model's prediction performance according to the type of early retirement were conducted with ROC curves using the training dataset. Figure 8 shows the ROC curves and corresponding AUCs according to the type of early retirement.

The AUCs of our Cox regression prediction model of non-voluntary early retirement due to poor personal health status were 0.7420, 0.6573, and 0.7705 for overall early retirement, voluntary early retirement, and non-voluntary early retirement, respectively. The model showed the lowest and highest prediction performances (AUC, 0.6194 and 0.7705, respectively) for voluntary early retirement due to sufficient economic status and non-voluntary early retirement for reasons other than due to poor personal health status, respectively.

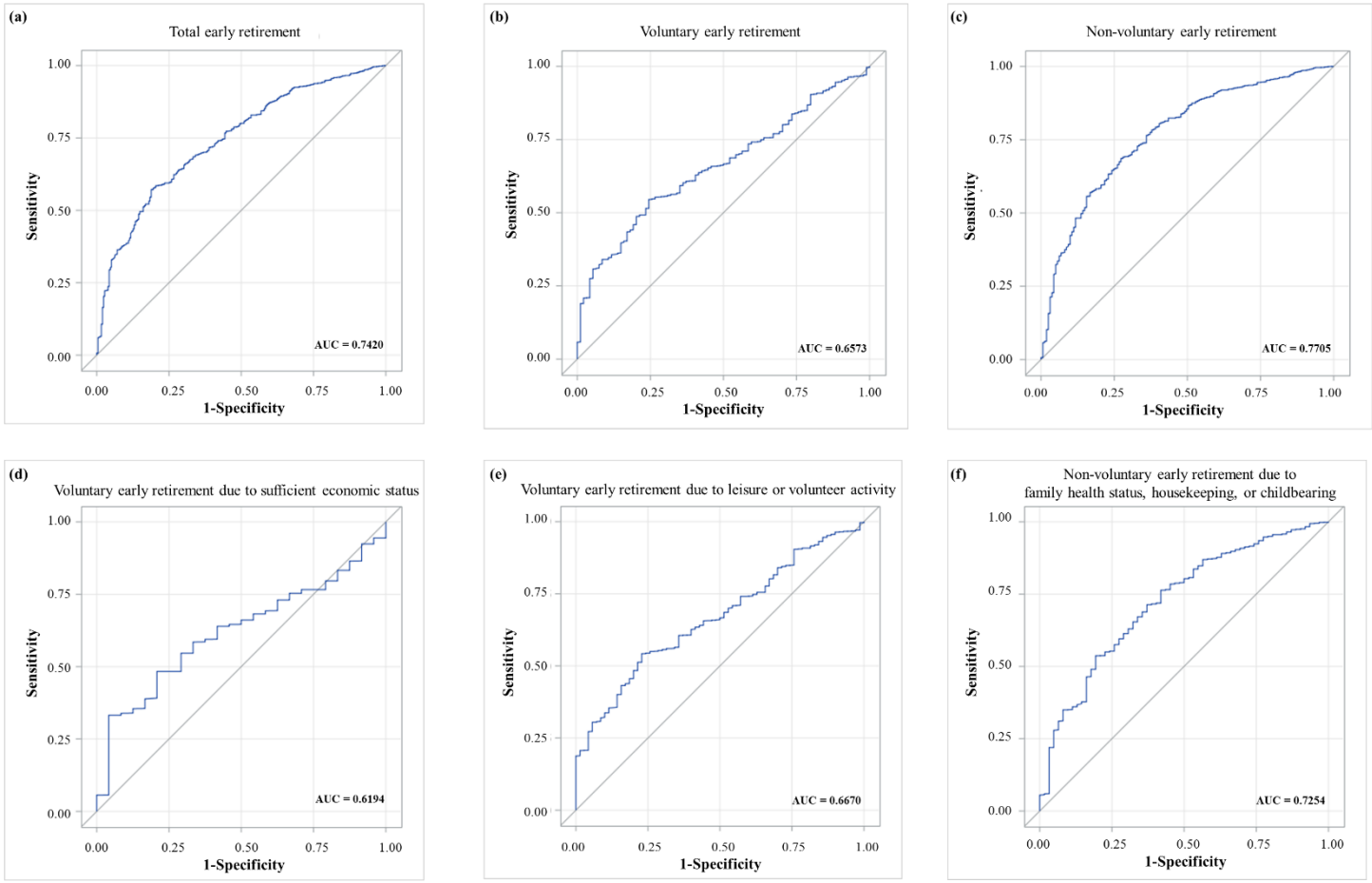

Figure 8. Areas under the curve (AUC) of the prediction model according to the type of early retirement. (a) Total early retirement, (b) voluntary early retirement, (c) non-voluntary early retirement, and (d) early retirement due to sufficient economic status, (e) leisure or volunteer activity, and (f) family health status, housekeeping, or childcare

IV. Discussion

To our knowledge, this study is the first attempt to investigate the risk factors of shortened working life according to the type of early retirement, including in both self-employed and regular paid workers, and to demonstrate the specific determinants of early retirement according to the main reasons for retirement. Specifically, we found that sufficient economic status associated with a higher likelihood of voluntary early retirement, while poor health status (hypertension and abnormal BMI) and low perceived health status were significantly associated with non-voluntary early retirement due to personal health status.

These results regarding the specific predictors according to the type of early retirement may help explain the findings of previous investigations. For example, chronic illness (hypertension or obesity) was reported as a risk factor of early retirement by a previous study using data from the SHARE [15]. However, the current investigation indicated that chronic disorders were significantly related with only non-voluntary retirement due to poor health, and not total or voluntary early retirement. Thus, studies on the effects of chronic disorders in workers should focus on early retirement due to poor health status rather than all types of early retirement. Furthermore, other previous studies have reported limited associations between perceived health status and early retirement [16,17]. The results from the current analysis, in which we stratified the participants according to the type of early retirement, suggested that perceived health status was significantly linked to only

non-voluntary early retirement due to poor personal health status. The heterogeneity in the early retirement type might have attenuated the effect of the perception of health status on early retirement in the previous studies.

Both for overall early retirement and non-voluntary early retirement due to poor personal health status, a low handgrip index significantly associated with shortened working life, and these results are in line with those of previous studies. For example, a Danish study using data from the SHARE reported a significant relationship between better grip strength and early retirement [15]. There are many ways to evaluate body strength among elderly. The grasping power index reflects age-related health conditions and physical performance [18,19]; to evaluate early retirement risk factors, the grasping power index may represent an objective measurement of strength and condition among older workers when used together with additional indices such as the duration of gripping, although it has poor reliability and validity [20].

According to a report from the US based on the HRS, more than 60% of workers were voluntary retired, owing to wanting to spend more time with their families or doing other activities [21]. Contrastively, in the current analysis, most of the participants retired early for non-voluntary reasons (62.1%), with the most common reason for retirement being due to their personal health condition (39.5%). There is an urgent need to address the occupational health problems related to early retirement due to poor health in Korea.

Furthermore, over 75% of ageing workers have been reported to choose to

continue working even if they develop a significant reduced work ability [22]. Unfortunately, the ageing process, which is often accompanied with disorders and inappropriate health behaviors, places burdens on the workers' health that may cut their working life short [23,24]. Poor health conditions can lead to poor work performance, and both are important factors related to early exits from working life [25,26]. Indeed, to encourage a working life without poor health conditions, the risk for early retirement due to the workers' health status needs to be assessed.

In the present study, to identify the key obstacles to a sustainable working life, a statistical approach based on the current data and a literature review was used. As a result, this study identified nine factors as determinants of unwanted early retirement due to poor personal health condition, including age, sex, health behaviors (smoking and alcohol consumption), chronic disorders (hypertension, diabetes, and abnormal BMI), and perception factors (health score and working life expectancy score).

Age is a fundamental component of researches in the elderly population, and plays a key role in early retirement [27]. A previous study reported that advancing age closely associates with both voluntary and non-voluntary early retirement [28]. In the current analysis, the risk of early retirement due to poor personal health also showed a significant positive association with increasing age. The biological process of ageing is directly linked to worsened general health conditions, including work ability [29]. It is hard to stop the effects of ageing in humans; however, understanding the effects of age is a cornerstone in the evaluation of sustainable working life.

Results from several studies have suggested different risks for early retirement among the sexes [30-32]. Especially, female workers are known as a high-risk group for early retirement. The results of this study matched those observed in earlier studies, in all type of early retirement; female workers had significant higher risks of early retirement than their male counterparts did for all types of early retirement. The significantly higher risk for non-voluntary early retirement in female workers could be explained by the fact that many of these women also carry the burden of household chores. While the proportions between women and men in the labor force participating in housework and childcare duties have increased, women still perform more housework and have more responsibilities than men [33,34]. Work-family conflicts are closely linked to early retirement decisions in both sexes [35]. Thus, female workers might be more vulnerable to all types of early retirement due to the higher responsibility to reduce work-family conflicts than male workers.

To remain as a worker is associated with full participation in society, and premature exit from work can indicate exit from such participation as well. However, in other cases, workers, and especially female workers, might want to retire early due to boring or hazardous jobs, or move to new opportunities and challenges [36]. Accordingly, in the current study, female workers also tended to retire early for voluntary reasons, including, making time for other experiences, as compared to their male counterparts. Thus, taken together, these results have important implications for developing a preventive approach for early retirement, particularly among women.

A much-debated question is whether health behaviors are related with early retirement. Many studies, including the current one, were not able to demonstrate significant relationships, while others reported inverse relationships between smoking or alcohol consumption status and early retirement [37,38]. However, one study focusing on retirement due to disability reported that smoking and alcohol were obvious risk factors of early retirement [39]. In general, smoking and heavy consumption of alcohol are known risk factors for reduced workability and increased disability from the workplace [40,41]. Furthermore, the workers' smoking and alcohol consumption habits are some of the first questions during the regular medical check-ups for workers in Korea. Thus, this study considered cigarette smoking and alcohol consumption as predictive factors for early retirement.

According to previous researches and the present study, chronic disorders, including hypertension, diabetes, and abnormal BMI, can be strong factors shortening the working life [42-46]. In public health policies, these illnesses are given priority, and in clinical practice, evaluations of blood pressure, blood glucose, and anthropometry are fundamental in regular workers' medical examinations.

The close linkage between perception and decision-making represents a well-established theory to explain human behavior. Perception is a serial process of organizing and interpreting stimuli from the environment in order to give it meaning. Based on these interpretations and analyses of the situation, combined with a rational analysis, individuals will make a decision [47,48]. In occupational health, subjective perception is an important factor to understand workers' health and

behaviors. For example, workers who report higher perceived work stress and physical workload were more likely to have neuromuscular disorders than those with lower scores [49-51]. Thus, we hypothesize that, in non-voluntary early retirement cases, positive perceptions of health and sustainability of work life were unlikely to remain.

In the current study, decreased perceived health condition significantly associated with an increased risk for non-voluntary early retirement due to poor personal health status. Previous studies have also reported that perceived health status could be used as a predictor of unwanted early retirement related to poor health [26,52,53]. Workers' self-perceived health status deteriorates with age, and chronic diseases are common in older populations [7]; moreover, participants in surveys related to old age are frequently asked about their subjective health status. Thus, using perceived health status is associated with several advantages for predicting the risk of early retirement.

There are currently limited published data on the relationship between perceived working life expectancy and early retirement. However, the current study and a previous study by our group showed the possibility of using perceived working life expectancy as a predictor of early retirement [11]. Using the exact working life expectancy score, similar to in the KLoSA and ELSA, a previous study reported that self-rated workability was closely related with unwanted exit from working life [54]. Hence, these two perception factors could potentially be applied to build a prediction model.

The current study suggested a novel prediction model for early retirement due to poor personal health status in older workers considering nine core factors, including basic characteristics, health behaviors, chronic disorders, and perception factors. The performance of the prediction model was fair, and it was not attenuated even external validation using data from the ELSA. More information regarding ageing workers at risk of non-voluntary early retirement secondary to their health behaviors or chronic disorders may help increase the awareness of the importance of good health behaviors such as quitting smoking, reducing consumption of alcohol, and losing weight. It can thus be suggested that the prediction model from this study can be used to evaluate the risk of, or to identify vulnerable workers for, early retirement due to poor health.

In Korea, occupational health is assessed through regular medical examinations (annually for labor workers and biennially in office workers) to prevent poor workers' health. Nonetheless, many workers in this study could not keep their workplace due to poor personal health conditions. This is also a main issue for lengthening working life, as poor health is, at least partially, preventable with appropriate knowledge and health management among elderly workers. Thus, occupational health professionals can also use our prediction model for early retirement due to poor health to improve the workers' health.

In general, it seems that for understanding the process of shortened working life, different determinants of early retirement should be considered according to the main reasons for retirement. The current study has important implications on

occupational health in that it revealed the possibility of prediction of unwanted early retirement. Predictability allows for the possibility of prevention. Taken together, these findings suggest a role of our prediction model as a preventive strategy of unwanted early exit from the workplace.

Nevertheless, despite these implications of our study, the results from the current analysis must be interpreted with caution because of the nature of the data. The KLoSA was designed to be representative of the general elderly population in Korea, not the elderly working population. Furthermore, this study excluded unpaid family workers and others. Thus, the results from the present study were not representative of the full scope of elderly Korean workers. Moreover, the survey data from the KLoSA were based on self-administered questionnaires. Surveys based on questionnaires are likely to have various errors such as specification, frame, nonresponse, measurement, and processing errors. While the KLoSA applied computer-assisted interviews by trained researchers to reduce these errors, these limitations are not specific to research based on the KLoSA, and have been reported for surveys of the elderly population in various countries worldwide, including for the HRS, ELSA, and SHARE [55,56]. More subjective measurements and reports are needed to ensure the reliability and validity, as well as the practical applicability, of the KLoSA questionnaires.

V. Conclusion

The present large-scale longitudinal study focusing on the older working population (including regular paid and self-employed workers) revealed several

specific determinants of shortened work life according to the type of early retirement. A prediction model for early retirement was proposed to evaluate the risk of early retirement due to the workers' health status. The performance of this prediction model was fair and was not attenuated even after external validation. Taken together, our results suggest that it is important to understand the different characteristics of early retirement according to the reason for retirement, and estimations of the probabilities of unwanted early retirement due to poor health condition should be considered a key factor in extending the working life in ageing workers.

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국문 초록

조기 은퇴에 영향을 미치는 요인 및 예측 모형

서론: 고령 인구가 증가하면서 근로환경에도 많은 변화가 생기고 있다. 특히 고령 근로자의 증가는 사회적인 관심이 높아지고 있다. 기존에도 근로 가능한 근로자가 노령 연금 개시 이전에 은퇴하는, 조기 은퇴에 대한 연구는 있었다. 하지만 기존 연구는 조기은퇴의 종류를 구분하지 않고, 자영업자를 배제한 연구집단을 분석하였다. 또한 위험 인자에 대한 고찰은 있었지만, 예측 모형을 구축하여 근로자의 조기은퇴 위험을 평가하는 데 활용한 연구는 매우 부족하다. 이번 연구에서는 임금 근로자와 자영업자를 포함하고, 다양한 조기 은퇴의 주된 유형(자발/비자발, 경제적 여유, 여가활동, 건강 상태, 가족 부양 등)에 따라 층화 분석하여 조기 은퇴 위험 인자를 고찰하였다. 또한 예측 모형을 구축하여 조기 은퇴 중 건강악화에 의한 조기 은퇴 예측을 시도 하였다.

방법: 2006년부터 2014년까지의 한국 고령화연구패널조사 자료를 활용하였다. 근로자 2,708명을 8년간 추적 관찰하여, 주된 은퇴 사유에 따른 조기 은퇴의 유병율을 확인하였다. 조기 은퇴 사유에 따라 층화 하여, Cox 회귀분석을 시행 하여 조기 은퇴 유형에 따른 위험 인자를 고찰하였다. 여기서 확인된 조기 은퇴 위험 인자들과 문헌고찰 등을 통해, 근로자의 개인 건강 악화에 따른 조기 은퇴 예측 모형을 구축, 적용하였다.

결과: 관찰기간 동안 314명의 근로자가 조기은퇴 하였다. 조기 은퇴 근로자 중에서 가장 많은 숫자인 124명이 본인의 건강을 이유로 은퇴하였다. 조기 은퇴 유형에 상관없이, 연령과 여성은 조기 은퇴의 통계적으로 유의한 위험 인자로 확인 되었다. 자발적 은퇴에서는 경제적 만족도가 높은 근로자가 의미 있게 높은 조기 은퇴를 나타냈으며, 본인의 건강 악화로 인한 비자발적 은퇴 근로자 집단에서는 고혈압 (HR: 1.52, 95% CI: 1.01-2.28), 비정상 체질량 지수 (HR: 1.60, 95% CI: 1.10-2.35)가 유의하게 조기 은퇴와 관련 있었으며, 악력지수가 높고, 주관적 건강상태가 양호할수록 조기

은퇴가 유의하게 감소되었다. 위의 Cox 회귀분석에서 관찰된 조기 은퇴 위험인자들과 문헌고찰 등을 통해, 개인의 건강 악화로 인한 조기 은퇴 예측 모형을 구축하였다. 이때 활용된 인자는 나이, 성별, 음주, 흡연, 고혈압, 당뇨, 체질량지수, 주관적 건강 상태, 주관적 근로 지속 가능성이었다. 조기 은퇴 예측 모형은 fair 예측력을 나타냈으며, 구체적으로 AUC는 각각 다음과 같이 나타났다. 원자료에서는 0.784 (±0.023)를 나타냈으며, 무작위로 선정한 내부 타당도 검사 자료에서는 0.781 (±0.047), 마지막으로 영국 고령화연구패널조사 자료를 활용한 외부 타당도 검사 자료에서는 0.751 (±0.029)로 확인 되었다.

고찰: 본 연구에서는 임금 근로자와 자영업자를 포함하고 다양한 은퇴 유형에 따른 층화 분석을 통해, 조기 은퇴의 위험 인자를 고찰하였다. 은퇴 유형에 따라 각기 다른 조기 은퇴 위험인자가 있는 것이 확인된 만큼, 조기 은퇴 위험의 파악은 은퇴 사유에 따른 유형을 반영해야 한다. 또한 예측 모형을 통해서, 근로자의 건강악화로 인한 원치 않는 조기 은퇴의 위험성을 확인하였다. 해당 예측 모형은 외부 자료를 통한 신뢰도 검사에서도 준수한 예측력을 보인만큼, 근로자의 건강악화로 인한 조기 은퇴를 예방하기 위한 방안에 적용될 가능성이 높을 것으로 기대된다.

핵심어: 조기은퇴, 예측, 한국 고령화연구패널조사, 영국 고령화연구패널조사, 고령 근로자