Industrial Health 2017, **55**, 460–470

Country Report

Latent profile analysis of lifestyle characteristics and health risk behaviors among Koreans who have completed industrial accident care

Wan-Suk CHOI[1], Ok-Kon MOON[2] and Dong-Moon YEUM[3]*

[1]International University of Korea, Republic of Korea
[2]Howon University, Republic of Korea
[3]Changshin University, Republic of Korea

Received January 9, 2017 and accepted July 24, 2017
Published online in J-STAGE August 1, 2017

Abstract: This study investigated the characteristics and health behavior profiles of 1,803 workers who had experienced industrial accidents. Average weekly exercise days, average number of cigarettes smoked per day, average daily sleep duration, and number of days of alcohol consumption were selected to investigate health behavior profiles. Specifically, latent profile analysis was applied to identify the health behavior profiles of people who had completed industrial accident care; the latent classes were the health-conscious type (n=240), the potential-risk type (n=850), and the high-risk type (n=713). Comparison of the health-conscious and potential-risk types indicated that younger subjects, the employed, and those with lower social status and life satisfaction were more likely to be the potential-risk type. Comparison of the health-conscious and high-risk types revealed that males, younger subjects, the employed, those without chronic illnesses, and those with lower social status and life satisfaction were more likely to be the high-risk type. The results suggest that industrial accident victims who have completed accident care have different health behaviors and it is necessary to improve health promotion based on health type characteristics.

Key words: Exercise, Sleeping, Smoking, Alcohol consumption, Industrial accident care, Latent profile analysis

Introduction

Over the last 10 yr, more than 90,000 Korean workers have been injured. Industrial welfare services make it possible for workers to return to stable lives after industrial accidents, and for employers to preserve their scarce labor forces, through a variety of rehabilitation services, and this rehabilitation is important as it restores workers and fulfills corporate social responsibilities. However, in spite of the importance of workers' return to the workplace, South Korea's worker retirement system is not actively operated, in contrast with advanced countries that have mandatory retirement systems. The interest in industrial accidents and demands for rational changes in rehabilitation services for industrial accident victims, including earlier return to work, are driving changes in policies and institutions. However, there are no statistics that can provide in-depth and dynamic information on workers who have suffered industrial accidents[1)].

To resolve these problems, the Korea Workers' Compensation and Welfare Service (KWCWS) has conducted the Panel Study of Workers' Compensation Insurance (PSWCI)[1)] since 2013 to provide accurate statistics on industrial accident victims including their overall socio-

*To whom correspondence should be addressed.
E-mail: ksltv@hanmail.net

economic activity, physical characteristics and abilities, environmental factors, and other factors following accidents. Investigation of persistent health behaviors of those who have completed industrial accident care is important for future national health care policies and costs; analysis of this population will determine the length and quality of care and health education programs.

As known from researchers, behaviors such as physical inactivity, alcohol consumption, and smoking are high-cost[2], major contributors to chronic disease and death[3]. Regular engagement in preventive health behaviors such as physical activity and avoiding harmful health behaviors such as tobacco smoking reduce the risk of premature death, acute injury and illness, and some chronic diseases[4]. People who engage in healthy behaviors have a low incidence of functional disability, and the risk of disability decreases as the number of healthy behaviors increases[5]. As in the general population, factors that affect the health of those who have completed industrial accident care include average weekly exercise days, average daily sleep duration, average number of cigarettes smoked per day, and number of days of usual alcohol consumption. Variables such as exercise, sleep, smoking, and alcohol consumption are important determinants of health conditions[6]. Health behaviors including exercise, smoking, and alcohol consumption are greatly interrelated, and exercise[7, 8], smoking[9, 10], and alcohol consumption[11, 12] are potential influencing factors for osteoporotic fractures. In addition, alcohol consumption, lack of exercise, and smoking are associated with headache, and poor sleep and stress are often cited as the cause of headache[13, 14]. In high-risk patients with cardiovascular disease, primary prevention and risk stratification have been advocated, such as moderate alcohol consumption, increased physical activity, smoking cessation, and weight management[15]. In a study of male factory workers, sleeping less than seven hours a day, working more than nine hours a day, smoking, alcohol consumption, and not performing exercise were not related to depression[16].

In addition, recent policy studies have tended to focus on one side of a given behavior. For example, alcohol policy research is relatively isolated compared with tobacco policy research[17, 18]. However, lifestyles consist of multiple behaviors, and adults can fail to meet more than one government recommendation. In the UK, for example, 64% of 16-year-olds do not reach the recommended level of physical activity, 35% consume more than the recommended amount of alcohol on binge days, and 20% are regular smokers[19]. This suggests that young people are exposed to more than one health risk, and there is evidence of multiplicative rather than additive effects of health risk[20].

Smoking increases blood pressure in adults, although blood pressure among smokers varies according to age, weight, alcohol intake, and physical activity[21]. Sleep is also influenced by complex factors such as physical and psychological state, social environment, age, and lifestyle[22–25]. In particular, restful sleep is important for disease prevention and recovery; however, little attention has been paid to this area[26–29]. Both excessive and insufficient sleep has been recognized to significantly increase the incidence of cerebrovascular disease, heart disease, malignant neoplasia, and suicide[30]. In a study assessing the relationship between sleep duration and health status, both men and women most likely slept 7–8 h per night[31]. Additionally, a study investigated the relationship between health-related variables (including sleep duration) and biological indicators (chromosome aberrations and NK cells)[32] has addressed, and other studies have considered sleeping more than nine hours or less than six hours as a poor health habit[33, 34].

Exercise and rest have been reported to affect disease development and recovery[35–37], and alcohol consumption and physical activity were the most important lifestyle predictors of sleep disorders[38]. Smokers are less likely to exercise, and people who like to perform exercise tend to eat more fresh food[39]. Moreover, sleep experts and lay literature recommend regular exercise for better sleep[40–42]; surveys have consistently suggested a relationship between exercise and sleep[43–45], and epidemiologic studies have also indicated that exercise improves sleep[26, 46, 47]. In addition, positive changes in lifestyle behaviors such as losing weight and increasing exercise levels significantly reduce sleep disturbances and stress[48].

Alcohol consumption and smoking are positively correlated with each other, and smoking is associated with a variety of risk factors that require intervention and evaluation. Increased mortality and morbidity that characterize smokers can potentially be reduced by improving sleep and physical activity[49]. Smoking is also related to binge alcohol consumption[50] and decreased physical activity[51, 52], and it is associated with a lack of intake of major vitamins, minerals, and fiber[53–55]. In particular, smokers' poor diet and decreased physical activity increase the risk of chronic diseases[56].

Meanwhile, many studies have assumed single homogeneous populations and have analyzed the correlations between related variables such as exercise, smoking, drinking, and sleep[8, 9, 11, 46]. Therefore, these studies have

limitations because they do not reflect heterogeneous populations; they have been unable to provide comprehensive views without identifying qualitative differences within groups.

Although there is growing interest in industrial accidents, in-depth research on the subject is still lacking. In particular, little is known about the health behaviors of those who have completed industrial accident care after the accidents. Therefore, by analyzing patterns of the health behavior of those who complete industrial accident care after accidents, other researchers will be empowered to implement psychological, mental, social, and physical intervention for each type of health behavior based on the valuable data collected. Additionally, it will be possible to suggest a customized intervention method, thereby reducing national and individual medical costs and improving the quality of life of victims of industrial accidents. Thus, in the present study, exercise, smoking, alcohol consumption and sleep were used, which have been discussed in related studies, to distinguish between different health behaviors among people who have completed accident care, and it investigated their characteristics. Identifying health behaviors among a heterogeneous group of profiles rather than a single identical population may contribute to suggesting useful and appropriate practical interventions for individuals who have completed industrial accident care.

Subjects and Methods

Subjects

The following is an excerpt from the PSWCI data survey kit[1)], which describes the subjects and methods of the survey. The scope of the PSWCI can be broadly divided into industrial accident victims (persons who received disability grades due to industrial accidents), accident victims who have completed industrial accident care (persons who, after having completed medical care after an industrial accident, will be given a disability grade), and industrial accident workers (all workers injured while working in the industry). Separately, the rate of accidental injuries among foreign workers in Korea is increasing, although foreign workers are not suitable for the panel survey because of the difficulty in continuously investigating their accidents. Therefore, Korean industrial accident victims, victims who have completed medical care, and industrial accident workers, were considered as the subjects of the accident investigation in the PSWCI data survey.

Because the PSWCI considers industrial accident workers as a population, it is most appropriate to determine the entire worker group that is recognized to have experienced an industrial accident as the subject of the investigation[1)]. However, from the implementation of the industrial accident insurance in 1964 to the end of June 2012, the number of disasters caused by industrial accidents reached 4,290,935, and the number of industrial accident workers has remained at around 90,000. In the South Korea KWCWS data, 35,000 injured workers have a disability rate of 38.9% among industrial accident workers according to the year and grade. In addition, 35,000 injured workers receive regular medical care, and furthermore, 56.0% of the patients treated for industrial accidents complete treatment within six months; therefore, it is considered that many of the workers who suffer an industrial accident and are treated within six months do not have any disabilities. Taking these factors into consideration, the focus of industrial accident insurance policies should be on workers who have received a work injury disability grade or who have been receiving long-term care for six months or more. However, building a panel of all workers was not appropriate for the purpose of the survey because there are comparatively few employees in these two groups. Instead, the panel consisted of employees who had completed industrial accident care.

The PSWCI was conducted as a 1:1 interview with survey panel members; the interviewers visited the panelists directly and received their responses. Because it is a panel survey, the questionnaire's structure and content are complex, and there are so many questions that it is practically impossible for even skilled investigators to carry out investigations. In order to solve this problem, PSWCI used computer-assisted personal interviewing (CAPI), a computer-based interpersonal interview method. The interviewer was able to directly input responses into the CAPI program on a laptop rather than on paper and to immediately check the error response according to the logic of the program. This method improved the reliability, accuracy, and convenience of the survey.

The PSWCI has collected stratified systematic sampling data every year since 2013 on 2,000 employees who have completed industrial accident care (including non-disabled workers) from January 2012 to December 2012. The actual data identified a target population of 89,921, but there were 73 unknown addressees and 7,350 foreigners and Jeju Island residents in that population; after excluding these individuals, 82,498 persons comprised the survey population. Population stratification was analyzed based on gender, age (divided into five categories), region (nine areas),

Table 1. Characteristic analysis of the variables

Variables	Division	Persons	%	Variables	Division	Persons	%
Sex	Male	1,514	84.0	Education Level	No education	69	3.8
	Female	289	16.0		Elementary school	300	16.6
Presence of spouse	No spouse	520	28.8		Middle school	345	19.1
	Having spouse	1,283	71.2		High school	814	45.1
Employment condition	Unemployment	358	19.9		More than college graduates	275	15.3
	Employment	1,445	80.1	Socioeconomic status	Low	711	39.4
Presence of chronic disease	Disease not present	1,413	78.4		Middle	965	53.5
	Disease present	390	21.6		High	127	7.1
Age	Minimum=18, Maximum=76, M=50.54, sd=11.113						
Life satisfaction	Minimum=1, Maximum=5, M=3.27, sd=0.519						

disability grade (six categories), and rehabilitation service availability. As noted earlier, the PSWCI provides information on economic activity, health, quality of life, household status, income, and disbursement after industrial accidents. In the PSWCI survey data, 2,000 people were selected as the sample considering the limited research cost and statistical utilization[1)]. Finally, after excluding 197 non-respondents, the second-year (2014) PSWCI data for 1,803 of the 2,000 subjects were analyzed.

Data

Four health behavior variables were used to create the health behavior types: average weekly exercise days, average sleep duration per day, average number of cigarettes smoked per day, and number of days of alcohol consumption. The details of the questions used in the PSWCI survey[1)] are as follows: For average weekly exercise days, the PSWCI included exercise for rehabilitation and counted it as one day even if it occurred multiple times a day; if the response was ambiguous, the interviewer used the data for the previous week and rated it on a scale of 0–7. The survey did not include naps in the average sleep duration per day; however, if sleep was not possible at all due to nighttime pain, the interviewer included sleep during the day. Because respondents could have had insomnia, responses were based on the actual sleep duration, and not on the amount of time spent lying in bed waiting to fall asleep. When responses were ambiguous, respondents answered based on the previous week, and if they responded to the minute, their responses were rounded up; thus, the possible response range was from 0 to 24. Number of days of alcohol consumption was divided into the following five categories: less than once a month, two to three times a month, one to two times a week, three to four times a week, and almost every day.

After analyzing the health behavior types, the following variables were used to examine the characteristics of each type: gender, age, education background, marital status (none=0), employment status (unemployed=0), socioeconomic status, presence of chronic diseases (none=0), and life satisfaction. The response options for education level were no education, elementary school, middle school, high school, and more than college graduation. Employment status was based on being employed at the time of responding to the survey. Life satisfaction involved the following six questionnaire items: family income, leisure life, residential environment, family relationships, relative relationships, and social friendships. Respondents ranked each item on a 5-point Likert scale (1=very satisfied, 5=very dissatisfied), and the responses were reverse coded; i.e., the higher the score, the greater the life satisfaction based on the average values of the six sub-dimensions. The characteristic variables are presented in Table 1.

Data analyses

Mplus 5.21[57)] and SPSS version 20.0[58)] were used to analyze the data. Specifically, to investigate the health behavior type profiles of survey respondents who had completed industrial accident care, the four aforementioned behavior categories were inputted into the model and latent profile analysis (LPA) was conducted. Variance analysis and multinomial logistic regression analysis were also used to examine the characteristics of each group in each profile.

Potential profile analysis is excellent for estimating a unique profile of mean and variance[59)], and it has the advantage of optimizing the distinction between potential profiles and accurately estimating population parameters[60)]. Compared with the traditional group classification method, there is no restriction according to the scale such

Table 2. Applicable index and latent class rate

Model	BIC	SSABIC	LMR	BLRT	Latent class rate (%)				
					1	2	3	4	5
1-class	26,358.645	26,333.230	na	na	100				
2-class	24,580.051	24,538.750	0.0000	0.0000	60.5	39.5			
3-class	24,362.456	24,305.271	0.0000	0.0000	13.3	47.1	39.6		
4-class	23,380.760	23,307.690	0.0000	0.0000	42.5	13.0	27.6	16.9	
5-class	23,709.919	23,620.964	0.9725	1.0000	0.4	14.5	45.5	32.8	6.7

n: 1,803; na: not applicable

Table 3. Differences in health behavior type profiles by index

Group / Profile index	Health-conscious type (n=240)	Potential-risk type (n=850)	High-risk type (n=713)	Total (n=1,803)	F
Average weekly exercise days	5.90 (1.038)	0.88 (1.212)	1.46 (2.127)	1.77 (2.304)	921.922***
Average daily sleep duration	6.45 (1.116)	6.82 (1.162)	6.84 (1.106)	6.78 (1.141)	11.664***
Average number of cigarettes smoked per day	0.05 (0.227)	0.10 (0.297)	2.44 (0.530)	1.02 (1.22)	7,500.798***
Number of days of alcohol consumption	1.15 (1.422)	1.62 (1.502)	2.51 (1.496)	1.91 (1.574)	105.641***

Mean (SD) ***$p<0.001$

as the equal variance assumption, and the statistical model for the population can be set based on the model[61].

The following three criteria recommended in previous studies were used[62, 63]: First, the number of classes according to the potential profile was confirmed using the Bayesian information criterion (BIC) and the sample-size adjusted Bayesian information criterion (SSABIC), which is excellent in the information index. The BIC and SSABIC indicate better model fit with low indices[64]. Second, the bootstrap likelihood ratio test (BLRT) was used to test statistical significance between the alternative and null hypotheses; the BLRT supports the alternative hypothesis when $p<0.05$. Third, the minimum percentage of the classes was applied to the sample to assess the real usefulness of the latent profiles. For the minimum ratio, some researchers use at least 5% of the sample[65], and other researchers use more than 1% of the sample[66].

Results

Development of the latent profile model

To determine the health behavior type profiles, LPA was performed for the latent classes and characteristics of the latent class groups were identified; models with one to five classes were run (Table 2). The number of final classes was determined based on the results of the given conditions. Based on the four goodness-of-fit indices and latent class classification ratios (Table 2), neither the Lo-Mendell-Rubin (LMR) likelihood ratio test nor the BLRT supported the alternative hypothesis for the five-class model, and there was a class <1% in the latent class classification. Based on the five criteria—BIC, SSABIC, LMR, BLRT, and latent class classification ratios—four layers were the most appropriate. While selecting the final model, it is necessary to ensure that the differences between the groups are explained statistically and visually (graphically). In this study, four classes were statistically the most suitable based on the BIC and SSABIC. However, the three-class model was selected as the final model because the three classes in the graph represented the most obvious differences among the groups.

Profile group characteristics

The quality of classifications can be determined through entropy and posterior probability. The posterior probability range of the three classes used was 0.90–1.00[67], and the entropy value was 0.922, indicating high classification accuracy[68]. The profiles of the health behavior types based on the four indices are presented in Table 3. The group names were determined based on the characteristics of each subtype group in the health behavior type profiles; the names were simplified based on previous research to increase readability. The first group of respondents was designated as health conscious (n=240, 13.3%) because they reported the highest average number of weekly exercise days, the lowest average number of cigarettes smoked per day, and the lowest alcohol consumption frequency. Another group was designated as potential risk (n=850,

Table 4. Comparison of characteristics of health behavior type by group

Reference group	Predictive variable	Comparison group					
		Potential-risk			High-risk		
		B	Wald	odd	B	Wald	Odd
Health-conscious	Sex (male)	−0.237	1.745	0.789	3.944	55.640	51.649***
	Age	−0.021	5.238	0.979*	−0.036	13.812	0.965***
	Educational Level	−0.098	1.202	0.906	−0.155	2.640	0.857
	Presence of spouse	0.291	2.376	1.338	0.037	0.034	1.037
	Employment condition (employment)	1.229	47.936	3.416***	1.329	45.475	3.776***
	Presence of chronic disease	−0.322	3.442	0.725	−0.768	15.945	0.464***
	Socioeconomic status	−0.487	11.504	0.615**	−0.740	22.944	0.477***
	Life satisfaction	−0.421	5.887	0.656*	−0.615	11.279	0.540**
Potential- risk	Sex (male)				4.182	67.380	65.470***
	Age				−0.015	5.040	0.985*
	Educational Level				−0.056	0.725	0.945
	Presence of spouse				−0.255	3.544	0.775
	Employment condition(employment)				0.100	0.400	1.105
	Presence of chronic disease				−0.446	9.477	0.640**
	Socioeconomic status				−0.253	5.562	0.777*
	Life satisfaction				−0.194	2.543	0.824

*$p<0.05$; **$p<0.01$; ***$p<0.001$
Reference variables: Sex (Female=0), Presence of spouse (No=0), Employment condition (unemployment=0), Presence of chronic disease (No=0)

47.1%) because they had the lowest average number of weekly exercise days, low average number of cigarettes per day, and moderate alcohol consumption frequency. The remaining individuals were designated as high risk (n=713, 39.6%) because they reported the highest average number of cigarettes per day and the highest alcohol consumption frequency; they reported low average number of weekly exercise days, but they exercised more frequently than the potential-risk group. Each index had a statistically significant difference (F value) in the health behavior profiles ($p<0.001$; Table 3).

Prediction of the health behavior type characteristics

Multinomial logistic regression analysis was conducted using the health-conscious and potential-risk types to predict the respondents' characteristics based on their health behaviors (Table 4). On comparison of the health conscious and potential-risk types, the potential risk was associated with younger age (0.98 times), being employed (3.42 times), lower socioeconomic status (0.62 times), and lower life satisfaction (0.66 times). On comparison of the health conscious and high risk types, the high-risk type was associated with male (51.65 times), younger age (0.97 times), being employed (3.78 times), absence of chronic disease (0.46 times), lower socioeconomic status (0.48 times), and lower life satisfaction (0.54 times). On comparison of the high-risk and potential-risk types, the high-risk type was associated with being male (65.47 times) and younger (0.99 times), not having a chronic disease (0.64 times), and having lower socioeconomic status (0.78 times).

Discussion

In this study, the health behavior profiles of individuals who had completed industrial accident care were explored based on the KWCWS's two-year PSWCI survey data. The characteristics of the groups in each profile were examined, using average weekly exercise days, average sleep duration per day, average number of cigarettes per day, and alcohol consumption frequency as the profile indices. The resulting health behavior profile subtypes were health conscious (13%), potential risk (47%), and high risk (40%), and the indices differed significantly among the three groups. This means that the health behaviors of those who have completed industrial accident care differ, and it is necessary to apply different practical interventions for each type.

Multinomial logistic analysis used the health-conscious and potential-risk types as the reference groups to predict the characteristics of the groups in different health behavior profiles. Compared with the health-conscious type, the potential-risk type was likely to be younger and employed and to have lower socioeconomic status and less life satis-

faction. The 2003 Health Survey for England (n=11,492) reported similar results in its clustering; risk factors such as smoking, heavy drinking, and lack of physical activity were more prevalent among younger respondents, men, lower social class households, and respondents who were economically inactive[69].

In the present study, younger people were more likely to engage in risky health behaviors, and in a clustering study of 16,789 men and women aged 20–59 yr, alcohol and tobacco consumption were also higher among younger people[70]. In another study, "Knowledge, Attitude, and Practice of Health Promotion," the protective behavior pattern was dominant than the risky behavior pattern among those aged 55 and over whereas the risky behavior pattern was dominant among those under 55[71]. In contrast, a cross-sectional study of 4,812 community-dwelling residents older than age 60 found a higher prevalence of multiple risk factors (cigarette smoking, heavy alcohol drinking, physical inactivity) among the older age groups and a lower prevalence among those who were employed[72]. Interestingly, in the 2003 Scottish Health Survey (n=6,574), the prevalence of risky health behaviors had a strong relationship with poorer socioeconomic circumstances[73], and the 2002 wave of the English Longitudinal Study of Ageing (n=11,214) also found that risky health behaviors were rare among people with high socioeconomic status[74]. These results for large populations, including our study, suggest that health behavior policies need to address low socioeconomic groups.

In the present study, there were no significant differences in education level between the potential-risk and the health-conscious behavior types, and another researcher found that health-risk behaviors are more related to social status than to education[74]. There is still disagreement regarding whether education level is associated with less risky health behaviors among adults with higher education levels[75] or with more risky behaviors among adults with lower education levels[75–77].

In terms of life satisfaction and health behavior, there is one report which reveals that the two factors are independent of each other[78]. However, the 2005 Behavioral Risk Factor Surveillance System study represented that the lower the life satisfaction, the more risky the health behaviors such as alcohol consumption, smoking, and lack of exercise[79]. Similarly, a study of 102 teachers suggested that the greater the life satisfaction, the more the teachers engage in health-promoting behaviors[80].

There are also researches on health behaviors in relation to employment status. Some findings reveal that employed people report a higher frequency of smoking and alcohol consumption[81, 82] and less physical activity[83], but other studies found that the prevalence of multiple health risk factors was lower among the employed[72]. Another study found that unemployed participants had higher risky drinking and physical inactivity, but employed participants reported higher tobacco consumption[84].

The results of the comparison among the health behavior types are consistent with prior reports which suggest that low-income earners are more likely to engage in risky health behaviors[69, 73, 85] and that men are more likely to drink alcohol than women[86]. In the National Longitudinal Study of Adolescent Health (n=18,911), adolescents and young adult males were more susceptible to risky health behaviors, and these behaviors increased in frequency over time[87]. In addition, men represent a higher prevalence of engaging in multiple risky health behaviors[72], although cigarette consumption is steadily increasing in both men and women[88].

In our analyses, people with chronic illnesses were more likely to engage in healthy behaviors; the following associations between chronic diseases and smoking and alcohol consumption are sufficient reasons for those with chronic diseases to avoid risky health behaviors such as smoking and consuming alcohol. Smoking is a major factor for developing or worsening cardiovascular disease[89], coronary artery disease[90], acute coronary thrombosis and stroke[91, 92], diabetes[93], and major vascular complications[94, 95]. Alcohol consumption is also associated with epilepsy[96], hypertensive heart disease[97], ischemic heart disease[98], ischemic stroke[99], colorectal cancer, rectal cancer, and liver cancer[100].

Based on these results, the following action plan is suggested for managing industrial workers' health and for preventing industrial accidents. First, after these accidents, customized counseling and guidance are required for each health behavior type. This means that health care and prevention education programs should vary according to workers' health behavior types; in particular, to maintain workers' health, these programs should consider their gender, age, employment status, chronic illness status, socioeconomic status, and life satisfaction, which can be improved with treatment and leisure activity programs. Second, it is specifically necessary to secure the manpower required to conduct these specialized programs; leisure activity and health programs for industrial workers who have experienced accidents at work are insufficient, partly because of the lack of an available workforce. Third, the probability of belonging to the potential-risk and high-risk

behavior types increases for those of lower socioeconomic status, younger people, males, and people who do not have a chronic disease. These results suggest that young male workers are more exposed to risk factors that encourage exercise avoidance, smoking, and excessive alcohol consumption, and therefore, national institutional support is necessary for promoting more healthy behaviors among young male workers. In addition, public awareness campaigns are needed to decrease, and ultimately prevent, risky health behaviors.

The limitations of this study and suggestions for subsequent research are as follows: First, this study was based only on the second-year (2014) PSWCI data; therefore, follow-up studies are needed to analyze the data related to the health behavior types presented in this previous study. Second, in this study, the health behavior profiles of workers who had completed industrial accident care were analyzed based on cross-sectional data. In follow-up studies, it will be necessary to examine causality among the relationships between variables based on changes reflected in the longitudinal data. Third, it is necessary to re-investigate this topic because only self-reported data were used in this study. Fourth, all physical activities were counted in the exercise category in this study, and fifth, the PSWCI does not enquire about the severity of injuries among the patients on the panel, and thus, severity could not be discussed.

Despite these limitations, in this study, significant health behavior and lifestyle patterns were observed among people who had completed industrial accident care. These patterns, which connect factors such as physical activity, sleep, smoking, and alcohol consumption, enable tailored health promotion strategies for industrial accident victims who have completed industrial accident care and provide important insights into their health-related needs.

Acknowledgments

This study was funded by the International University of Korea.

References

1) http://www.moel.go.kr/english/main.jsp
2) Scarborough P, Bhatnagar P, Wickramasinghe KK, Allender S, Foster C, Rayner M (2011) The economic burden of ill health due to diet, physical inactivity, smoking, alcohol and obesity in the UK: an update to 2006–07 NHS costs. J Public Health (Oxf) **33**, 527–35. [Medline] [CrossRef]
3) WHO, 2008. Global Burden of Disease Update. WHO, Geneva.
4) US Department of Health and Human Services. Healthy People 2010: Understanding and Improving Health. 2nd ed. Washington, DC: US Government Printing Office; 2000: 7–51. 2. American College Health Association. American College
5) Liao WC, Li CR, Lin YC, Wang CC, Chen YJ, Yen CH, Lin HS, Lee MC (2011) Healthy behaviors and onset of functional disability in older adults: results of a national longitudinal study. J Am Geriatr Soc **59**, 200–6. [Medline] [CrossRef]
6) Goh VH, Tong TY, Mok HP, Said B (2007) Interactions among age, adiposity, bodyweight, lifestyle factors and sex steroid hormones in healthy Singaporean Chinese men. Asian J Androl **9**, 611–21. [Medline] [CrossRef]
7) Hourigan SR, Nitz JC, Brauer SG, O'Neill S, Wong J, Richardson CA (2008) Positive effects of exercise on falls and fracture risk in osteopenic women. Osteoporos Int **19**, 1077–86. [Medline] [CrossRef]
8) Yoshimura N (2003) [Exercise and physical activities for the prevention of osteoporotic fractures: a review of the evidence]. Nippon Eiseigaku Zasshi **58**, 328–37 (in Japanese). [Medline] [CrossRef]
9) Kanis JA, Johnell O, Oden A, Johansson H, De Laet C, Eisman JA, Fujiwara S, Kroger H, McCloskey EV, Mellstrom D, Melton LJ, Pols H, Reeve J, Silman A, Tenenhouse A (2005) Smoking and fracture risk: a meta-analysis. Osteoporos Int **16**, 155–62. [Medline] [CrossRef]
10) Vestergaard P, Mosekilde L (2003) Fracture risk associated with smoking: a meta-analysis. J Intern Med **254**, 572–83. [Medline] [CrossRef]
11) Berg KM, Kunins HV, Jackson JL, Nahvi S, Chaudhry A, Harris KA Jr, Malik R, Arnsten JH (2008) Association between alcohol consumption and both osteoporotic fracture and bone density. Am J Med **121**, 406–18. [Medline] [CrossRef]
12) Mukamal KJ, Robbins JA, Cauley JA, Kern LM, Siscovick DS (2007) Alcohol consumption, bone density, and hip fracture among older adults: the cardiovascular health study. Osteoporos Int **18**, 593–602. [Medline] [CrossRef]
13) Yokoyama M, Yokoyama A, Yokoyama T, Funazu K, Kondo S, Yamashita T, Nakamura H (2005) Hangover headache in Japanese male workers. Cephalalgia **25**, 988.
14) Yokoyama M, Yokoyama T, Funazu K, Yamashita T, Kondo S, Hosoai H, Yokoyama A, Nakamura H (2009) Associations between headache and stress, alcohol drinking, exercise, sleep, and comorbid health conditions in a Japanese population. J Headache Pain **10**, 177–85. [Medline] [CrossRef]
15) Pearson TA, Blair SN, Daniels SR, Eckel RH, Fair JM, Fortmann SP, Franklin BA, Goldstein LB, Greenland P, Grundy SM, Hong Y, Miller NH, Lauer RM, Ockene IS, Sacco RL, Sallis JF Jr, Smith SC Jr, Stone NJ, Taubert KA

(2002) AHA guidelines for primary prevention of cardiovascular disease and Stroke: 2002 update: consensus panel guide to comprehensive risk reduction for adult patients without coronary or other atherosclerotic vascular diseases. Circulation **106**, 388–91. [Medline] [CrossRef]
16) Suda M, Nakayama K, Morimoto K (2007) Relationship between behavioral lifestyle and mental health status evaluated using the GHQ-28 and SDS questionnaires in Japanese factory workers. Ind Health **45**, 467–73. [Medline] [CrossRef]
17) Department of Health, 2010. A Smokefree Future: a Comprehensive Tobacco Control Strategy for England. Department of Health.
18) Home Office, 2012. TheGovernment's Alcohol Strategy. The Stationary Office Ltd., London.
19) N.H.S. Information Centre, 2011. Health Survey for England 2010 Trend Tables. Leeds: NHS.
20) Conry MC, Morgan K, Curry P, McGee H, Harrington J, Ward M, Shelley E (2011) The clustering of health behaviours in Ireland and their relationship with mental health, self-rated health and quality of life. BMC Public Health **11**, 692–702. [Medline] [CrossRef]
21) Green MS, Jucha E, Luz Y (1986) Blood pressure in smokers and nonsmokers: epidemiologic findings. Am Heart J **111**, 932–40. [Medline] [CrossRef]
22) Gall R, Issac L, Kryger M (1993) Quality of life in mild sleep apnea syndrome. Sleep **16** Suppl, S59–61. [Medline] [CrossRef]
23) Spiegel K, Leproult R, Van Cauter E (1999) Impact of sleep debt on metabolic and endocrine function. Lancet **354**, 1435–9. [Medline] [CrossRef]
24) Campbell SS (1995) Effects of timed bright-light exposure on shift-work adaptation in middle-aged subjects. Sleep **18**, 408–16. [Medline] [CrossRef]
25) American Academy of Sleep Medicine (1999) Task force: Sleep-related breathing disorders in adults. Recommendations for syndrome definition and measurement techniques in clinical research. Sleep **22**, 667–89. [Medline] [CrossRef]
26) Kim K, Uchiyama M, Okawa M, Liu X, Ogihara R (2000) An epidemiological study of insomnia among the Japanese general population. Sleep **23**, 41–7. [Medline] [CrossRef]
27) Ohida T, Kamal AM, Uchiyama M, Kim K, Takemura S, Sone T, Ishii T (2001) The influence of lifestyle and health status factors on sleep loss among the Japanese general population. Sleep **24**, 333–8. [Medline] [CrossRef]
28) Palomaki H, Partinen M, Juvela S, Kaste M (1989) Snoring and health. Relationship between sleepiness and general health status. Stroke **20**, 1311–5. [Medline] [CrossRef]
29) Seki N (2001) Relationships between walking hours, sleeping hours, meaningfulness of life (ikigai) and mortality in the elderly: prospective cohort study. Nippon Eiseigaku Zasshi **56**, 535–40 (in Japanese). [Medline] [CrossRef]
30) Hammond EC (1964) Some preliminary findings on physical complaints from a prospective study of 1,064,004 men and women. Am J Public Health Nations Health **54**, 11–23. [Medline] [CrossRef]
31) Hammond EC, Garfinkel L (1969) Coronary heart disease, stroke, and aortic aneurysm:factors in the etiology. Arch Environ Health **19**, 167–82. [CrossRef]
32) Morimoto K (2000) Lifestyle and health. Nippon Eiseigaku Zasshi **54**, 572–91 (in Japanese). [Medline] [CrossRef]
33) Kusaka Y, Kondou H, Morimoto K (1992) Healthy lifestyles are associated with higher natural killer cell activity. Prev Med **21**, 602–15. [Medline] [CrossRef]
34) Belloc NB, Breslow L (1972) Relationship of physical health status and health practices. Prev Med **1**, 409–21. [Medline] [CrossRef]
35) Hara M, Mori M, Shono N, Higaki Y, Nishizumi M (2000) Lifestyle-related risk factors for total and cancer mortality in men and women. Environ Health Prev Med **5**, 90–6. [Medline] [CrossRef]
36) Fukuda S, Morimoto K (2001) Lifestyle, stress and cortisol response: Review II : Lifestyle. Environ Health Prev Med **6**, 15–21. [Medline] [CrossRef]
37) Morimoto K (1991) Lifestyle and Health. Tokyo, Igakusyoin Co. Ltd. (in Japanese).
38) Härmä M, Tenkanen L, Sjöblom T, Alikoski T, Heinsalmi P (1998) Combined effects of shift work and life-style on the prevalence of insomnia, sleep deprivation and daytime sleepiness. Scand J Work Environ Health **24**, 300–7. [Medline] [CrossRef]
39) Coulson NS, Eiser C, Eiser JR (1997) Diet, smoking and exercise: interrelationships between adolescent health behaviours. Child Care Health Dev **23**, 207–16. [Medline] [CrossRef]
40) Ancoli-Israel, S. All I Want Is a Good Night's Sleep. Chicago: Mosby-Year Book Inc.; 1996.
41) Lavie, P. The Enchanted World of Sleep. New Haven, CT: Yale University Press; 1996.
42) Dement, WC.; Vaughan, C. The Promise of Sleep. New York: Delacorte Press; 1999.
43) Urponen H, Vuori I, Hasan J, Partinen M (1988) Self-evaluations of factors promoting and disturbing sleep: an epidemiological survey in Finland. Soc Sci Med **26**, 443–50 (PubMed: 3363395). [Medline] [CrossRef]
44) Shapiro CM, Bachmayer D (1988) Epidemiological aspects of sleep in general public and hospital outpatient samples. Acta Physiol Scand Suppl **574**, 41–3 (PubMed: 3245466). [Medline]
45) 2003 Sleep in America Poll. Washington, DC: National Sleep Foundation; 2003. National Sleep Foundation.
46) Arakawa M, Tanaka H, Toguchi H, Shirakawa S, Taira K (2002) Comparative study on sleep health and lifestyle of the elderly in the urban areas and suburbs of Okinawa. Psychiatry Clin Neurosci **56**, 245–6. [Medline] [CrossRef]

47) Morgan K (2003) Daytime activity and risk factors for late-life insomnia. J Sleep Res **12**, 231–8. [Medline] [CrossRef]
48) Merrill RM, Aldana SG, Greenlaw RL, Diehl HA, Salberg A (2007) The effects of an intensive lifestyle modification program on sleep and stress disorders. J Nutr Health Aging **11**, 242–8. [Medline]
49) Strine TW, Okoro CA, Chapman DP, Balluz LS, Ford ES, Ajani UA, Mokdad AH (2005) Health-related quality of life and health risk behaviors among smokers. Am J Prev Med **28**, 182–7. [Medline] [CrossRef]
50) Morabia A, Wynder EL (1990) Dietary habits of smokers, people who never smoked, and exsmokers. Am J Clin Nutr **52**, 933–7. [Medline]
51) Klesges RC, Eck LH, Isbell TR, Fulliton W, Hanson CL (1990) Smoking status: effects on the dietary intake, physical activity, and body fat of adult men. Am J Clin Nutr **51**, 784–9. [Medline]
52) Marks BL, Perkins K, Meu K, Epstein L, Robertson RJ, Goss FL, Sexton JE (1991) Effects of smoking status on content of caloric intake and energy expenditure. Int J Eat Disord **10**, 441–9. [CrossRef]
53) Fehily AM, Phillips KM, Yarnell JW (1984) Diet, smoking, social class, and body mass index in the Caerphilly Heart Disease Study. Am J Clin Nutr **40**, 827–33. [Medline]
54) Fulton M, Thomson M, Elton RA, Brown S, Wood DA, Oliver MF (1988) Cigarette smoking, social class and nutrient intake: relevance to coronary heart disease. Eur J Clin Nutr **42**, 797–803. [Medline]
55) Margetts BM, Jackson AA (1993) Interactions between people's diet and their smoking habits: the dietary and nutritional survey of British adults. BMJ **307**, 1381–4. [CrossRef]
56) Istvan J, Matarazzo JD (1984) Tobacco, alcohol, and caffeine use: a review of their interrelationships. Psychol Bull **95**, 301–26. [Medline] [CrossRef]
57) Muthén LK, Muthén BO (1998–2009). Mplus User's Guide. Fifth Edition. Los Angeles, CA: Muthén & Muthén.
58) IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.
59) Muthén B, Muthén LK (2000) Integrating person-centered and variable-centered analyses: growth mixture modeling with latent trajectory classes. Alcohol Clin Exp Res **24**, 882–91. [Medline] [CrossRef]
60) Giang MT, Graham S (2008) Using latent class analysis to identify aggressors and victims of peer harassment. Aggress Behav **34**, 203–13. [Medline] [CrossRef]
61) Mun EY, Windle M, Schainker LM (2008) A model-based cluster analysis approach to adolescent problem behaviors and young adult outcomes. Dev Psychopathol **20**, 291–318. [Medline] [CrossRef]
62) Iwamoto DK, Corbin W, Fromme K (2010) Trajectory classes of heavy episodic alcohol consumption among Asian American college students. Addiction **105**, 1912–20. [Medline] [CrossRef]
63) Luyckx K, Schwartz SJ, Goossens I, Soenens B, Beyers W (2008) Developmental Typologies of Identity Formation and Adjustment in Female Emerging Adults: A Latent Class Growth Analysis Approach. J Res Adolesc **18**, 595–619. [CrossRef]
64) Lim CY, Jung HT, Yeum DM (2016) A Study on the Profile Analysis of Types of Adolescents' Stress. Korean J Soc Welf **68**, 213–32. [CrossRef]
65) Jung T, Wickrama KAS (2008) An introduction to latent class growth analysis and growth mixture modeling. Soc Personal Psychol Compass **2**, 302–17. [CrossRef]
66) Hill KG, White HR, Chung IJ, Hawkins JD, Catalano RF (2000) Early adult outcomes of adolescent binge drinking: person- and variable-centered analyses of binge drinking trajectories. Alcohol Clin Exp Res **24**, 892–901. [Medline] [CrossRef]
67) Nagin DS (2005). "Group-based modeling of development", Cambridge, MA: Harvard University Press. [CrossRef]
68) Hix-Small H, Duncan TE, Duncan SC, Okut H (2004) A multivariate associative finite growth mixture modeling approach examining adolescent alcohol and marijuana use. J Psychopathol Behav Assess **26**, 255–70. [CrossRef]
69) Poortinga W (2007) The prevalence and clustering of four major lifestyle risk factors in an English adult population. Prev Med **44**, 124–8. [Medline] [CrossRef]
70) Schuit AJ, van Loon AJ, Tijhuis M, Ocké M (2002) Clustering of lifestyle risk factors in a general adult population. Prev Med **35**, 219–24. [Medline] [CrossRef]
71) Tseng TS, Lin HY (2008) Gender and age disparity in health-related behaviors and behavioral patterns based on a National Survey of Taiwan. Int J Behav Med **15**, 14–20. [Medline] [CrossRef]
72) Chou KL (2008) The prevalence and clustering of four major lifestyle risk factors in Hong Kong Chinese older adults. J Aging Health **20**, 788–803. [Medline] [CrossRef]
73) Lawder R, Harding O, Stockton D, Fischbacher C, Brewster DH, Chalmers J, Finlayson A, Conway DI (2010) Is the Scottish population living dangerously? Prevalence of multiple risk factors: the Scottish Health Survey 2003. BMC Public Health **10**, 330. [Medline] [CrossRef]
74) Shankar A, McMunn A, Steptoe A (2010) Health-related behaviors in older adults relationships with socioeconomic status. Am J Prev Med **38**, 39–46. [Medline] [CrossRef]
75) van Oort FV, van Lenthe FJ, Mackenbach JP (2004) Cooccurrence of lifestyle risk factors and the explanation of education inequalities in mortality: results from the GLOBE study. Prev Med **39**, 1126–34. [Medline] [CrossRef]
76) de Vries H, van't Riet J, Spigt M, Metsemakers J, van den Akker M, Vermunt JK, Kremers S (2008) Clusters of lifestyle behaviors: results from the Dutch SMILE study. Prev Med **46**, 203–8. [Medline] [CrossRef]
77) Drieskens S, Van Oyen H, Demarest S, Van der Heyden J,

Gisle L, Tafforeau J (2010) Multiple risk behaviour: increasing socio-economic gap over time? Eur J Public Health **20**, 634–9. [Medline] [CrossRef]
78) Grant N, Wardle J, Steptoe A (2009) The relationship between life satisfaction and health behavior: a cross-cultural analysis of young adults. Int J Behav Med **16**, 259–68. [Medline] [CrossRef]
79) Strine TW, Chapman DP, Balluz LS, Moriarty DG, Mokdad AH (2008) The associations between life satisfaction and health-related quality of life, chronic illness, and health behaviors among U.S. community-dwelling adults. J Community Health **33**, 40–50. [Medline] [CrossRef]
80) Aydın PEKEL, Mehmet Behzat TURAN, Osman PEPE, Ziya BAHADIR The Relationship with Life Satisfaction between Health Promoting Behaviours of Special Education Teachers (Kayseri City Sample). International Journal of Science Culture and Sport (IntJSCS). Special Issue 3. P 125–132.
81) Guilbert P, Baudier F, Gautier A (2001) Baromètre santé 2000 – Résultats 2. Vanves: Editions CFES.
82) Haustein KO (2006) Smoking and poverty. Eur J Cardiovasc Prev Rehabil **13**, 312–8. [Medline]
83) Jennifer R. Pharr, Sheniz Moonie, and Timothy J. Bungum. The Impact of Unemployment on Mental and Physical Health, Access to Health Care and Health Risk Behaviors. International Scholarly Research Network ISRN Public Health. Volume 2012, Article ID 483432, 7 pages.
84) Caban-Martinez AJ, Lee DJ, Goodman E, Davila EP, Fleming LE, LeBlanc WG, Arheart KL, McCollister KE, Christ SL, Zimmerman FJ, Muntaner C, Hollenbeck JA (2011) Health indicators among unemployed and employed young adults. J Occup Environ Med **53**, 196–203. [Medline] [CrossRef]
85) Baumann M, Spitz E, Guillemin F, Ravaud JF, Choquet M, Falissard B, Chau N, Group L; Lorhandicap group (2007) Associations of social and material deprivation with tobacco, alcohol, and psychotropic drug use, and gender: a population-based study. Int J Health Geogr **6**, 50. [Medline] [CrossRef]
86) Nolen-Hoeksema S (2004) Gender differences in risk factors and consequences for alcohol use and problems. Clin Psychol Rev **24**, 981–1010. [Medline] [CrossRef]
87) Mahalik JR, Levine Coley R, McPherran Lombardi C, Doyle Lynch A, Markowitz AJ, Jaffee SR (2013) Changes in health risk behaviors for males and females from early adolescence through early adulthood. Health Psychol **32**, 685–94. [Medline] [CrossRef]
88) Chiolero A, Wietlisbach V, Ruffieux C, Paccaud F, Cornuz J (2006) Clustering of risk behaviors with cigarette consumption: A population-based survey. Prev Med **42**, 348–53. [Medline] [CrossRef]
89) Glantz SA, Parmley WW (1995) Passive smoking and heart disease. Mechanisms and risk. JAMA **273**, 1047–53. [Medline] [CrossRef]
90) Ockene IS, Miller NH (1997) Cigarette smoking, cardiovascular disease, and stroke: a statement for healthcare professionals from the American Heart Association. American Heart Association Task Force on Risk Reduction. Circulation **96**, 3243–7. [Medline] [CrossRef]
91) Bonita R (1992) Epidemiology of stroke. Lancet **339**, 342–4. [Medline] [CrossRef]
92) Burke AP, Farb A, Malcom GT, Liang YH, Smialek J, Virmani R (1997) Coronary risk factors and plaque morphology in men with coronary disease who died suddenly. N Engl J Med **336**, 1276–82. [Medline] [CrossRef]
93) Will JC, Galuska DA, Ford ES, Mokdad A, Calle EE (2001) Cigarette smoking and diabetes mellitus: evidence of a positive association from a large prospective cohort study. Int J Epidemiol **30**, 540–6. [Medline] [CrossRef]
94) Chase HP, Garg SK, Marshall G, Berg CL, Harris S, Jackson WE, Hamman RE (1991) Cigarette smoking increases the risk of albuminuria among subjects with type I diabetes. JAMA **265**, 614–7. [Medline] [CrossRef]
95) Morrish NJ, Stevens LK, Fuller JH, Jarrett RJ, Keen H (1991) Risk factors for macrovascular disease in diabetes mellitus: the London follow-up to the WHO Multinational Study of Vascular Disease in Diabetics. Diabetologia **34**, 590–4. [Medline] [CrossRef]
96) Samokhvalov AV, Irving H, Mohapatra S, Rehm J (2010) Alcohol consumption, unprovoked seizures, and epilepsy: a systematic review and meta-analysis. Epilepsia **51**, 1177–84. [Medline] [CrossRef]
97) Taylor B, Irving HM, Kanteres F, Room R, Borges G, Cherpitel C, Greenfield T, Rehm J (2010) The more you drink, the harder you fall: a systematic review and meta-analysis of how acute alcohol consumption and injury or collision risk increase together. Drug Alcohol Depend **110**, 108–16. [Medline] [CrossRef]
98) Roerecke M, Rehm J (2010) Irregular heavy drinking occasions and risk of ischemic heart disease: a systematic review and meta-analysis. Am J Epidemiol **171**, 633–44. [Medline] [CrossRef]
99) Patra J, Taylor B, Irving H, Roerecke M, Baliunas D, Mohapatra S, Rehm J (2010) Alcohol consumption and the risk of morbidity and mortality for different stroke types—a systematic review and meta-analysis. BMC Public Health **10**, 258. [Medline] [CrossRef]
100) Corrao G, Bagnardi V, Zambon A, La Vecchia C (2004) A meta-analysis of alcohol consumption and the risk of 15 diseases. Prev Med **38**, 613–9. [Medline] [CrossRef]