

## 사업장 규모별 제조업 근로자의 안전보건교육 참여도와 관련된 PRECEDE 요인

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### PRECEDE factors associated with workers' participation in safety and health education by business size in Korean manufacturing sector

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#### ABSTRACT

**목적:** 산업장 안전보건교육에서 근로자의 자발적인 참여는 그 효과와 관련된 핵심적인 도전과제이다. 본 연구는 PRECEDE 모델을 중심으로 일부 제조업 사업장 근로자의 안전보건교육 참여도와 관련된 요인을 규명하는데 그 목적을 두었다.

**방법:** 전국 133개 제조업체의 450명(50인 미만 사업장 근로자 160명, 50인 이상 사업장 근로자 290명)의 근로자를 대상으로 자기기입식 설문조사를 실시하였다. 설문지는 일반적 특성과 함께 산업재해 및 안전보건교육과 관련된 역학적, 교육적, 생태학적 특성에 관한 문항으로 구성되었다.

**결과:** PRECEDE 특성 중 대규모 사업장 근로자의 사내 안전보건교육 관련 교육·생태학적 여건이 소규모 사업장 근로자보다 나은 것으로 나타났다. 근로자의 사내 안전보건교육 참여도와 관련된 PRECEDE 특성은 소규모 사업장에서는 안전보건교육 담당자에게 필요한 연수교육요구도, 안전보건교육을 위한 사회적 지지, 전체적인 사내 안전보건관리 수준이었는는데, 사업장 규모 50인 이상의 사업장에서는 근로자의 연령, 사내안전보건교육 효능감, 사내교육을 위한 사회적 지지도, 사내 안전보건교육담당자의 교육역량이었다.

**결론:** 소규모 사업장 근로자의 사내 안전보건교육 참여도와 관련된 요인은 주로 조직 수준의 특성이었는데 반해(사내교육을 위한 환경적, 사회적 지지), 50인 이상 사업장에서 유의미한 특성은 주로 개인 수준의 특성으로(안전보건교육 효능감, 사내교육담당자의 교육역량) 사업장 규모에 따라 다른 양상을 보였다. 이를 기반으로 사업장 규모에 따라 차별화된 사내 안전보건교육 지원이 이루어져야 하겠다.

**Key words:** Business size, Manufacturing, PRECEDE model, Safety and health education, Worker's participation

Received : 11 June 2018, Revised : 19 July 2018, Accepted : 23 July 2018

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## I. INTRODUCTION

Creating supportive work environment and ensuring organizational participation had been major strategies to reduce occupational injuries for healthy workplace in the western pacific countries including Korea (Burton, 2010). Planned and enduring educational strategies increase comprehensive effectiveness of occupational injury prevention activities by improving workers' safety attitudes and behaviors, and those improved individual perceptions and behaviors build better organizational safety environments and cultures (Lee & Park, 2006). The annual cost of occupational accidents was approximately more than 17 billion US dollars, which was greater than that from all of the traffic accidents in Korea. Thus, effective strategy development is a continuing issue in occupational safety and health (SH) management (Korea Ministry of Employment and Labor, 2015).

Manufacturing is still the major industry class and the primary sector for occupational SH management in Korea. Incidence of occupational accidents in the manufacturing sector has decreased in the last decade, but it is still sizable in small businesses (Korea Ministry of Employment and Labor, 2015). Furthermore, it has been reported that the primary causes of occupational accident death were directly associated with unsafe behaviors such as 'leaving hazardous conditions' and 'poor workplace safety monitoring and communication (Korea Ministry of Employment and Labor, 2015; Rahmani et al., 2013). Thus, workplace

safety education has become more significant than ever in occupational SH.

Workers' voluntary participation in safety and health education at work (SHEW) is the major determinant of its effectiveness, consistent with the fact that the majority of a community-based adult health education program's success involves the target population's interests and high participation. The PRECEDE-PROCEED model is a well-known theoretical and practical framework for providing effective health program planning (Predisposing, Reinforcing, and Enabling Constructs in Educational/Environmental Diagnosis; PRECEDE) and evaluation (Policy, Regulatory, and Organizational Constructs in Educational/Environmental Development; PROCEED). PRECEDE provides series of assessment processes that generate information to develop intervention programs for health behavior changes (Green & Kreuter, 2005). PRECEDE includes important indicator groups related to the target behavior change through the assessment processes, and these essential indicator groups are epidemiological, environmental, educational, and ecological factors. Major SHEW problems that have been reported by occupational safety and health managers (SHM) were related to organizational support and infrastructure such as environmental and human SHEW resources (Park, 2016). These problems should be fully considered in educational and ecological characteristics of the PRECEDE model, and the significant predictors identified in the processes can be utilized in developing intervention to increase workers' participation behaviors in SHEW.

All workers should complete one or two hours of SHEW per month, but the related regulations and conditions such as environments, organizational support, and safety climates are diverse in Korea, particularly by business size (Korea Ministry of Government Legislation, 2016). Small businesses tend to have weak organizational support and environments. As such, the purpose of this study was to identify the perceptual and environmental factors associated with workers' participation in SHEW based on the educational and ecological characteristics of the PRECEDE.

## II. METHODS

### 1. Subjects and Survey methods

The participants were 450 workers (160 from small businesses, 290 from large ones) who successfully completed survey and were employed in manufacturing businesses in Korea. From the initially collected 484 cases, 34 were dropped due to missing responses.

A self-administered survey was distributed to 133 manufacturing businesses (52 small and 81 large) for two months in 2007. We selected seven high-risk sub-categories in terms of incidence of occupational injuries and SHEW status in the Korean manufacturing industry based on the annual report of occupational injury statistics (Korea Ministry of Labor, 2006). The seven sub-categories were metal materials, food and drink merchandise, transportation machines, chemical merchandise,

shipbuilding materials, wood materials, and mechanic materials. Then, 70–90 businesses (10–15 per sub-category) were conveniently sampled by size among large and small businesses. The cut-off for large business was a total of at least 50 employees, based on the fact that any company of 50 employees or more must assign a SHM in accordance with the Korea Occupational Safety and Health Act (Korea Ministry of Government Legislation, 2016).

For the large sites, we utilized the membership lists of the Korea Business Occupational Safety and Health Council, a nationwide network of occupational SHMs in Korea. We found the small business survey sites with the help of the Korea Industrial Safety Association (KISA), a well-known non-governmental organization that conducted commissioned workplace environment management and safety education for businesses, particularly small ones in Korea.

On average, we distributed five questionnaires to the workers at each site with an official letter from the Korea Ministry of Labor requesting participation in the survey. We thoroughly respected the human right to freedom and confidentiality in the survey; the cover letter emphasized both the confidentiality of the responses and the voluntary nature of participation, in addition to the survey purposes and methods and the limited use of the data for research only. There was little potential risk to survey participants because the questions were about organization-level workplace SH management, not respondents' job performance or privacy. The principal investigator's contact

information (phone, fax, and email) was provided in the questionnaire, and the participants could return their responses or ask questions using their preferred channels. All of those survey processes were moderated by the occupational SHMs at the survey sites and the KISA associates.

## 2. Measures

The questionnaire consisted of general characteristics, epidemiological characteristics, educational and ecological characteristics related

to SHEW, and workers' participation in SHEW as the dependent variable of this study. The theoretical framework of this study was PRECEDE model and phase 2 (epidemiological characteristics) and phase 3 (educational and ecological characteristics) were the core parts to identify significant factors of intervention development in PRECEDE. That's why this study developed survey items based on phase 2 and phase 3 constructs of PRECEDE for identifying significant environmental and perceptual factors related to workers' participation in SHEW (Figure 1).

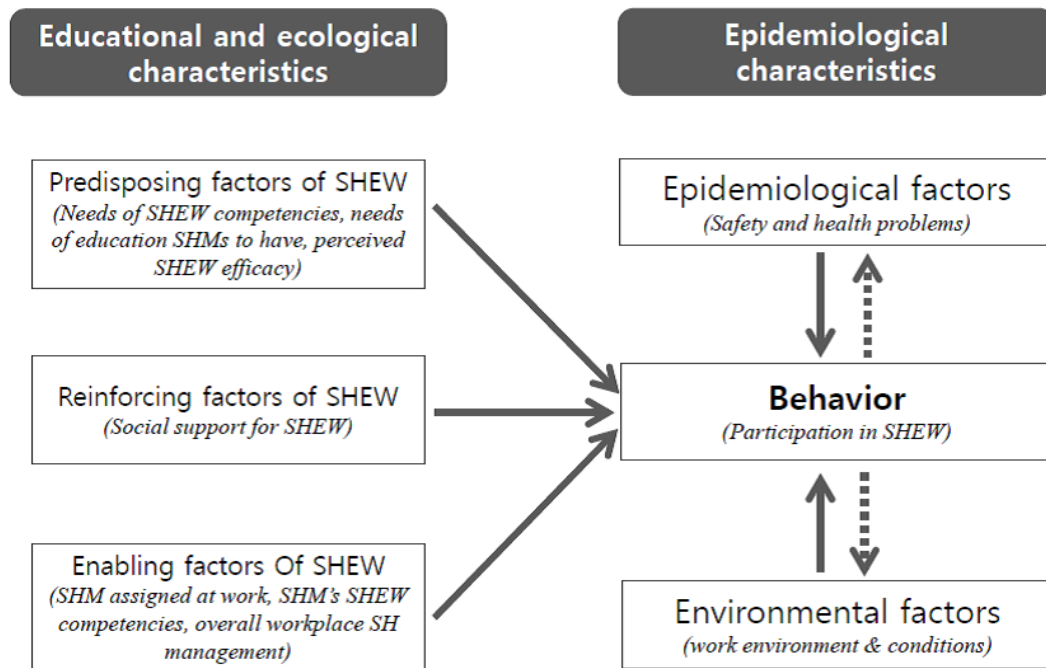


Figure 1. Framework of this study based on PRECEDE model

### 1) Participation in SHEW

Participation in SHEW, the dependent variable in this study, was measured with one question rated on four-point scale from 1 (almost no participation) to 4 (high participation). The greater the score the higher the participation in SHEW.

### 2) Epidemiological characteristics

Epidemiological characteristics were consisted of the environmental factors and the epidemiological factors related to SHEW participation (Green & Kreuter, 2005). Environmental factors were type of business, business size, daily working hours, shift work, exposure to environmental hazards (e.g., noise, dust, organic materials), and labor union at work. Labor union had been, particularly, addressed as a work environmental factor encouraging and monitoring SHEW (Lee & Park, 2006). Epidemiological factors included lifetime occupational injuries or diseases, SH problems at work, SH problems out of work, and perceived health risk at work. General characteristics included region, sex, age, marriage, education, and employment duration.

All questions of general and epidemiological characteristics were addressed based on the survey items of the Korea Occupational Safety and Health Trend Survey (Occupational Safety and Health Research Institute, 2007) and the Lee and Park's study (2006).

### 3) Educational and ecological characteristics

Educational and ecological characteristics

were identified with three sub-factors of predisposing, reinforcing, and enabling factors in the phase 3 of PRECEDE framework (Green & Kreuter, 2005).

#### Predisposing factors

The predisposing factors in this study referred to worker's knowledge, values, and needs that facilitated or hindered their motivation to participate in SHEW; they were needs of SHMs' SHEW competencies, needs of education SHMs to have, and perceived SHEW efficacy (Linnan et al., 2001). Needs of SHMs' SHEW competencies referred to workers' perceived needs of the types and levels of competencies their SHMs should have in order to perform SHEW well. This measure was consisted of 10 questions that were rated on a 4-point scale; the questions were developed based on the core competency areas of the health education specialist credentialing in Korea (Kim, 2009) and the National Commission for Health Education Credentialing (NCHEC) in the United States (Gilmore et al., 2005). Cronbach's alpha for the competency measure was .918.

Needs of education SHMs to have referred to workers' perceived needs of the types and levels of education their SHMs should have in order to perform SHEW well. This measure was developed based on the principle roles of occupational SHMs established in the Korea Occupational Safety and Health Act (Korea Ministry of Government Legislation, 2016), the safety education and climate questions of the Korea Occupational Safety and Health Trend Survey (Occupational Safety and Health

Research Institute, 2007), and the health education specialist credentialing in Korea (Kim, 2009). The initial questions were modified and confirmed with statistical validation using a preliminary survey. The 29-item measure consisted of 4 sub-factors: general occupational safety (5 items), SHEW competencies (6 items), occupational injury and disease control (13 items), and personal health management (5 items) rated on a 4-point scale from 1 (not necessary) to 4 (very necessary). The Cronbach's alpha values by sub-factor were .832 for general occupational safety, .908 for SHEW competencies, .934 for occupational injury and disease control, and .894 for personal health management, which all indicated high reliability. Perceived SHEW efficacy was measured with one question that asked employees how much they personally believed that SHEW contributed to occupational injury and disease prevention; this question was also rated on a 4-point scale from 1 (strongly disagree) to 4 (strongly agree).

#### Reinforcing factors

The reinforcing factors, that is, workers' perceived rewards or encouragement related to SHEW participation, were measured as 6 different sources of social support for SHEW: employers, supervisors, coworkers, labor union associates, community governmental organizations, and non-governmental organizations. All 6 questions were rated on a 4-point scales from 1 (strongly disagree) to 4 (strongly agree), and Cronbach's alpha was .894.

#### Enabling factors

The enabling factors, which in this study

referred to the skills, resources, or barriers associated with workers' participation in SHEW, were SHM assigned at work, SHMs' SHEW competencies, and overall workplace SH management status. SHMs' SHEW competencies were measured with 10 questions rated on 4-point scale from 1 (strongly disagree) to 4 (strongly agree). Most concepts and structures of this measure were from the same sources as the needs of SHMs' SHEW competencies among the predisposing factors (Gilmore et al., 2005; Kim, 2009). Cronbach's alpha for SHMs' SHEW competencies was .959. Overall SH management status referred to workers' individual evaluations of overall SH management level in their workplaces and was measured with the 5 questions from the Korea Occupational Safety and Health Trend Survey that addressed general workplace safety and health conditions (Occupational Safety and Health Research Institute, 2007); these were rated on a 4-point scale from 1 (poorly managed) to 4 (managed well) and Cronbach's alpha was .904.

## 4. Data analyses

All survey responses were coded and analysed in SPSS 23.0 and the coding accuracy was confirmed. Basic descriptive statistics such as frequency, percentage, mean, and standard deviation were generated for each variable. Simple comparisons by business size of epidemiological and educational and ecological characteristics were analysed by Chi-square test and t-test. Simple correlation coefficient analysis and hierarchical multiple regression analysis were conducted based on the 5 PRECEDE factor

models to identify the significant epidemiological characteristics and educational and ecological characteristics associated with workers' participation in SHEW.

The factors with tolerances below .30 were deleted from the regression analysis to minimize multicollinearity problems between the PRECEDE factors (independent variables). It was suggested that tolerances, the reciprocals of variance inflation factors (VIF), below .10 should be avoided as multicollinearity indicators (Lee & Lim, 2005), and it was also recommended that even moderately correlated independent variables be avoided if possible (Howell, 2014).

### III. RESULTS

#### 1. Characteristics of participants by business size

##### 1) General characteristics of participants

The majority of the participants were men

(83.0%) and the people who completed high school or lower education were 49.8%. There was no statistical difference in sex and education between the small and large businesses (Table 1). Nearly 70% were in their 30s and 40s, and the workers in small businesses were younger than those in large ( $\chi^2=8.33$ ,  $p=.04$ ). More than two thirds of the participants were married (71.7%) and the married people were more in large businesses than in small ones ( $\chi^2=9.16$ ,  $p=.003$ ). Generally employment duration tended to be larger at large businesses than that at small ones ( $\chi^2=27.66$ ,  $p=.000$ ); of the employees who had worked for longer than 10 years, 25.3% worked at small businesses whereas 50.9% worked at large ones.

Participation in SHEW was not statistically different by business size ( $\chi^2=7.03$ ,  $p=.071$ ), but more workers who showed higher participation in SHEW (almost participation or high participation) appeared to work at large businesses (87.6%) than at small ones (78.0%).

Table 1. General characteristics of participants

(Unit: n(%))					
Variables	Business size (Number of employee)		Total	X <sup>2</sup>	p
	< 50	≥ 50			
Region					
Metropolitans	28(17.5)	86(29.7)	114(25.3)	8.05	.005
Others	132(82.5)	204(70.3)	336(74.7)		
Sex					
Man	127(80.4)	245(84.5)	372(83.0)	1.22	.293
Woman	31(19.6)	45(15.5)	76(17.0)		

(Unit: n(%))

Variables	Business size (Number of employee)		Total	χ <sup>2</sup>	p
	< 50	≥ 50			
Age (year)					
20 ~ 29	48(30.4)	64(22.3)	112(25.2)	8.33	.040
30 ~ 39	63(39.9)	99(34.5)	162(36.4)		
40 ~ 49	41(25.9)	106(36.9)	147(33.0)		
50 ~	6( 3.8)	18( 6.3)	24( 5.4)		
Marital status					
Married	101(63.1)	219(76.6)	320(71.7)	9.16	.003
Unmarried	59(36.9)	67(23.4)	126(28.3)		
Educational level					
High school or less	74(48.1)	144(50.7)	218(49.8)	.30	.862
College	45(29.2)	80(28.2)	125(28.5)		
University or more	35(22.7)	60(21.1)	95(21.7)		
Duration of work (year)					
Less than 3	45(30.0)	56(20.1)	101(23.5)	27.66	.000
3 ~ 4.9	32(21.3)	33(11.8)	65(15.2)		
5 ~ 9.9	35(23.3)	48(17.2)	83(19.3)		
10 ~ 19.9	29(19.3)	97(34.8)	126(29.4)		
20 ~	9( 6.0)	45(16.1)	54(12.6)		
Participation in SHEW					
Almost not	6( 3.9)	5( 1.7)	11( 2.5)	7.03	.071
Sometimes participatory	28(18.1)	31(10.7)	59(13.3)		
Participatory	56(36.1)	117(40.5)	173(39.0)		
Highly participatory	65(41.9)	136(47.1)	201(45.3)		
Total	160(100.0)	290(100.0)	450(100.0)		

(Note) N<50=160, N≥50=290, The total frequencies of each variable may not add to 450 due to missing values.

## 2) Epidemiological characteristics

Concerning the epidemiological characteristics, the environmental factors were significantly better in large businesses than in small ones ( $p<.01$ ), but there was no statistical difference between the two groups in the epidemiological

factors (Table 2). For environmental factors, more workers in small businesses worked 8 hours or more per day ( $p=.04$ ), worked shift work ( $p=.000$ ), and were exposed to environmental hazards at work than in large businesses ( $p=.000$ ); whereas more large business employees belonged to labor unions ( $p=.000$ ).



Table 2. Epidemiological characteristics of participants

Unit: n(%)					
Variables	Business size (Numbers of employee)		Total	$\chi^2$	p
	< 50	≥ 50			
<b>Environmental factors</b>					
Working hours (per day)					
≤ 8 hours	74(47.1)	172(61.6)	246(56.4)	8.61	.004
> 8 hours	83(52.9)	107(38.4)	190(43.6)		
Shift work					
No	135(85.4)	191(67.0)	326(73.6)	17.76	.000
Yes	23(14.6)	84(33.0)	117(26.4)		
Exposure to environmental hazards at work (noise, dust, etc.)					
No	22(13.8)	82(28.3)	104(23.1)	12.24	.000
Yes	138(86.3)	208(71.7)	346(76.9)		
Labor union					
No	105(77.2)	97(35.9)	202(49.8)	61.65	.000
Yes	31(22.8)	173(64.1)	204(50.2)		
<b>Epidemiological factors</b>					
Lifetime occupational injuries					
No	144(90.0)	249(87.4)	393(88.3)	.69	.445
Yes	16(10.0)	36(12.6)	52(11.7)		
SH problems at work					
No	14( 8.8)	33(11.4)	47(10.4)	.76	.424
Yes	146(91.3)	257(88.6)	403(89.6)		
SH problems out of work					
No	18(11.3)	47(16.2)	65(14.4)	2.05	.164
Yes	142(88.8)	243(83.8)	385(85.6)		
Health risk factors at work					
No	7( 4.4)	11( 3.8)	18( 4.0)	.09	.804
Yes	153(95.6)	279(96.2)	432(96.0)		
Total	160(100.0)	290(100.0)	450(100.0)		

(Note) N&lt;50=160, N≥50=290, The total frequencies of each variable may not add to 450 due to missing values.

### 3) Educational and ecological characteristics

The educational and ecological characteristics, except perceived SHEW efficacy, were significantly greater in the large businesses than small ones (Table 3). For predisposing factors, needs of education SHMs to have were greater in large businesses than in small ones ( $p=.034$ ), and perceived SHEW efficacy was also greater in large businesses, although the

difference was not statistically significant. Social support for SHEW as a reinforcing factor was greater in large businesses than in small ones ( $t=-2.951$ ,  $p=.003$ ), as were all three enabling factors ( $p=.000$ ). More large businesses had assigned SHMs than small ones, and SHM's SHEW competencies and overall workplace SH management status were significantly greater in large businesses than in small businesses.

Table 3. Educational and ecological characteristics of participants

				Unit: mean±S.D.	
Variables	Business size (Numbers of employee)		t	p	
	< 50	≥ 50			
Predisposing factors					
Needs of SHMs' SHEW competencies	3.03±.37	3.19±.48	-3.218	.001	
Needs of education SHMs to have	3.07±.53	3.18±.46	-2.124	.034	
Perceived SHEW efficacy	3.06±.72	3.18±.72	-1.677	.094	
Reinforcing factors					
Social support for SHEW	2.90±.68	3.11±.65	-2.951	.003	
Enabling factors					
SHM assigned at work (no/yes)*	0.84±.74	0.97±.16	-3.859	.000	
SHM's SHEW competencies	2.62±.74	2.88±.63	-3.698	.000	
Overall workplace SH management	2.98±.78	3.27±.65	-3.946	.000	

\* Four-point scales were used for all except 'SHM assigned at work'.

## 2. PRECEDE factors associated with workers' SHEW participation in small businesses

Table 4 showed the regression coefficients of the PRECEDE factors associated with workers' SHEW participation in small businesses. The regression model with general and epidemiological characteristics was not appropriate to SHEW

participation, but the model combined with the educational and ecological characteristics was statistically significant ( $F=7.249$ ,  $p<.001$ ). Model 5, which included all 5 group characteristics, accounted for 55.1% of the variability in workers' SHEW participation. Concerning the  $R^2$  changes in the educational and ecological characteristics (Models 3 through 5), the  $R^2$

change of Model 3 was the largest, followed by those of Model 4 and Model 5 in order. Workers' greater needs of education SHMs to have (about personal health management), greater perceived social support for SHEW, and

higher overall workplace SH management level were significant PRECEDE factors associated with workers' SHEW participation in small businesses ( $p < .05$ ).

Table 4. Hierarchical regression coefficients of PRECEDE factors associated with workers' SHEW participation in small businesses ( < 50)

Variables	Correlation coefficient (One-way)	Beta†				
		Model1	Model2	Model3	Model4	Model5
General characteristics						
Region (metropolitan/others)	-.166	-.154	-.148	-.003	.033	.033
Age	.164	.152	.162	.184	.134	.083
Epidemiological characteristics						
Labor union (no/yes)	.137		.127	.122	.006	-.069
Health risk factors at work	-.214*		-.167	-.168	-.091	-.098
Educational & ecological characteristics						
(Predisposing factors)						
Perceived SHEW efficacy	.413***			.337**	.168	.080
Needs of education SHMs to have						
General occupational safety	.302**			.023	-.052	-.019
Occupational injury and disease control	.203*			-.097	-.081	-.163
Personal health management	.358***			.410**	.333*	.314*
(Reinforcing factors)						
Social support for SHEW	.625***				.456***	.297*
(Enabling factors)						
SHM assigned at work (no/yes)	.294**					.052
SHM's SHEW competencies	.544***					-.129
Overall workplace SH management	.673***					.437**
R <sup>2</sup> (Adjusted R <sup>2</sup> )		.050(.027)	.104(.059)	.357(.288)	.479(.416)	.551(.475)
R <sup>2</sup> change		.050	.054	.253	.122	.072
F		2.147	2.296	5.207***	7.561***	7.249***

\*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

† Predictor of Model 1: General characteristics,

Predictor of Model 2: General characteristics + Epidemiological characteristics

Predictor of Model 3: General characteristics + Epidemiological characteristics + Educational and ecological characteristics (predisposing factors)

Predictor of Model 4: General characteristics + Epidemiological characteristics + Educational and ecological characteristics (predisposing+enabling factors)

Predictor of Model 5: Social characteristics + Epidemiological characteristics + Educational and ecological characteristics (predisposing+enabling+reinforcing factors)

### 3. PRECEDE factors associated with workers' SHEW participation in large businesses

Table 5 showed the regression coefficients of the PRECEDE factors associated with workers' SHEW participation in large businesses. All five models with the PRECEDE factors were

statistically significant for workers' SHEW participation ( $p < .001$ ), and the  $R^2$  of the significant factors was .431 in model 5 ( $F = 9.893$ ,  $p < .001$ ); this Model which included the most significant characteristics accounted for 43.1% of the total variance of workers' SHEW participation.

Table 5. Hierarchical regression coefficients of PRECEDE factors associated with workers' SHEW participation in large businesses ( $\geq 50$ )

Variables	Correlation coefficient (One-way)	Beta†				
		Model1	Model2	Model3	Model4	Model5
General characteristics						
Region (metropolitan/others)	-.120*	-.038	.000	.035	-.018	-.027
Sex	-.347***	-.246**	-.241**	-.198**	-.116	-.102
Age	.347***	.222**	.207*	.199**	.200**	.181*
Marital status (married/unmarried)	-.268**	-.060	.032	.055	.040	.005
Epidemiological characteristics						
Working hours (per day)	-.170**		-.105	-.033	-.043	-.040
Labor union (no/yes)	.240**		.090	.057	.046	.012
Educational and ecological characteristics						
(Predisposing factors)						
Needs of SHMs' SHEW competencies	.328**			.084	.073	.021
Perceived SHEW efficacy	.468**			.335***	.194**	.156*
Needs of education SHMs to have						
General occupational safety	.254***			.019	-.001	.020
SHMs' competencies at work	.312**			.067	.052	.096
Personal health management	.155*			-.017	-.044	-.061
(Reinforcing factors)						
Social support for SHEW	.517**				.315***	.230**
(Enabling factors)						
SHM's SHEW competencies	.484***					.225**
Overall workplace SH management	.401***					-.031
R <sup>2</sup> (Adjusted R <sup>2</sup> )		.183(.166)	.204(.179)	.346(.307)	.406(.368)	.431(.387)
R <sup>2</sup> change		.183	.021	.142	.061	.025
F		10.833**	8.152**	8.933**	10.546**	9.893**

\*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

† Predictor of Model 1: General characteristics,

Predictor of Model 2: General characteristics + Epidemiological characteristics

Predictor of Model 3: General characteristics + Epidemiological characteristics + Educational and ecological characteristics (predisposing factors)

Predictor of Model 4: General characteristics + Epidemiological characteristics + Educational and ecological characteristics (predisposing+enabling factors)

Predictor of Model 5: Social characteristics + Epidemiological characteristics + Educational and ecological characteristics (predisposing+enabling+reinforcing factors)

For the  $R^2$  changes in the educational and ecological characteristics, the  $R^2$  change of the predisposing factors in Model 3 was .142, which was greater than those of the reinforcing factors (Model 4,  $R^2_{\text{change}}=.061$ ) and enabling factors (Model 5,  $R^2_{\text{change}}=.025$ ). The significant PRECEDE factors were age, perceived SHEW efficacy, social support for SHEW, and SHM's SHEW competencies ( $p<.05$ ). Thus, old age, high SHEW efficacy, high perception of social support for SHEW, and high perception of SHM's SHEW competencies were significantly associated with workers' SHEW participation in large businesses.

#### IV. DISCUSSION

This study was conducted to identify the PRECEDE factors associated with workers' participation in SHEW in Korean manufacturing sector, particularly by business size. Demographic characteristics in this study showed general distributions similar to those of recent workplace safety studies in Korea. The distributions of age, employment duration, and education in Moon et al.'s study (2013), conducted in some constructing and manufacturing companies, were similar to those in this study; approximately half of those participants were high school graduate and had work experience of less than 10 years. Baek et al. (2015) also reported similar age, education levels, and employment durations to those in this study. By size, the large businesses were more often located in metropolitan areas and

showed more stable demographic characteristics (older, married, better educated, and longer work experience).

Concerning epidemiological characteristics, all environmental factors were better in large businesses than small ones. That result should be discussed in terms of governmental and organizational support. Organizational as well as governmental support for workplace SH was more affordable for large businesses than small ones because most national-level regulations for workplace SH have been primarily applied in large businesses in Korea. However, there was no significant difference in epidemiological factors by business size. Park reported similar findings to those of this study that large businesses had better environments and higher perceived occupational safety than did small businesses but that there was no difference in injury incidences or SH risk factors (Park, 2016). However, occupational injuries and diseases had been more serious worldwide in small businesses (Morrison, 2011). The results of this study might be discussed in the context of sampling and response bias in part as mentioned in study limitation. The data were generated from individual workers' recalls and subjective perceptions, and any workers who had ever an accident at work were less likely to answer a survey of this kind.

Most educational and ecological characteristics were better in large businesses than in small ones in Table 3 except for perceived SHEW efficacy. Choi et al. (2012) reported, similar to this study, that large businesses were better than small ones in executives' interest in and

support for safety, organization-level safety regulations, and organizational support for SHEW in Korean steel industry. Predisposing factors were related to workers' individual perceptions, and reinforcing and enabling factors were related to legal protection and organizational support for SHEW. Most regulations to protect workers' SH at work in the Korea Occupational Safety and Health Act are mandatory for large businesses, which thus encourage higher organizational support and more SH enabling factors. For example, in Korea, at least one SHM must be assigned in each large business, but this was not mandatory for small businesses.

An important point found in the environmental as well as educational and ecological differences by business size was that large businesses showed not only better working conditions but also better worker perceptions of SHEW from this study; it was valuable to discuss further how environments and workers' beliefs and perceptions moved together more positively in large businesses than in small ones. Neal and Griffin (2006) discussed that there were close positive correlations between safety environment and safety behaviors such as perceived safety support, managers' commitment, and safety climate. Choi and Kim (2006) also found the same results with their construction industry research. Safety climate referred to overall individual evaluations of the work environment (Neal et al., 2000). That is, workers' individual perceptions of workplace SH were more likely to align with organization-level safety infrastructure such as environments and support, which were better in large businesses

because of the greater legal protections and social support for occupational SH in these businesses.

As shown in Table 4, which presented the hierarchical regression analysis results, needs of education SHMs to have for personal health management, social support for SHEW, and overall workplace SH management status were significantly associated with workers' SHEW participation in small businesses. In particular, reinforcing and enabling factors, generally operationalized as organizational and governmental support, appeared to be more related to SHEW participation in small businesses. The significant educational and ecological factors in Table 4 indicated that organizational infrastructure including physical work environment and management support for SH should be effective in changing workers' SHEW attitudes and behaviors in small ones. Different from small businesses, in large businesses, the significant PRECEDE factors associated with worker's participation in SHEW were related to individual-level traits such as age, SHEW efficacy perception, and SHM's personal competency of SHEW in this study. Middlestadt et al. (2011) also reported some individual characteristics of age, attitudes toward action, and perceived norm as significant factors associated with participation in workplace wellness program for service workers.

Therefore, significant PRECEDE factors by business size identified in this study provided important information to develop and modify workplace SHEW participation strategies. It should be related to 'voluntariness' both in

organizational and individual levels for large businesses. In the context of SH legal protections and basic organizational SH infrastructure relatively better in large businesses in Korea, significant individual-level factors in Table 5 were consistent with the traits, specifically for encouraging workers' voluntary participation in SHEW. Worker's SHEW efficacy and SHM's SHEW competencies were significant individual level assets for improving individual confidence of SHEW participation and such improved confidences could increase voluntary behaviors. Additionally, social support on diverse levels had been widely known to encourage individual intentions to participation in SHEW. The significant factors of workers' SHEW participation of this study had been discussed as essential sources of choosing behaviors voluntarily in many previous studies. A two-year workplace cancer prevention study addressed 'involuntary' as a primary concern of intervention participation (Sorensen et al., 1996). That study suggested interdisciplinary efforts combined by environment protection for safety and behavior changes for health, which were similar concepts of participation strategies by business size suggested from the findings of this study. Robroek et al. (2009) also reported that higher participation was more associated with multi-component intervention in a systematic review of workplace health promotion intervention research.

Social support was primary significant factor of SHEW participation regardless of business size in this study. Many previous studies

reported social support as a significant factor related to occupational safety behaviors consistent with the results of this study. Safety climate should be addressed with social support as many organizational studies report close relationships between social support and organizational climate. Glasgow et al. (1993) recommended to modify organizational climate and social support to increase workplace health promotion participation in relation to organizational values. Neal and Griffin (2006) emphasized safety climate as the significant determinant of safety behaviors moderated by organizational motivation in Australian hospital worker research. Nahrgang et al. (2011) also found social support, leadership, and safety climate to be the significant factors of safety engagement behaviors in a meta-analysis. In Korea, Moon et al. (2013) identified age, safety leadership (organizational support and safety competencies) and safety climate as the significant factors of workers' participative behavior of safety, and Choi and Kim (2006) also reported that safety climate and safety competency were major factors in safe work behaviors in Korean manufacturing and constructing industries.

Social support also played a mediating role between organizational infrastructure and individual assets for workers' participation in SHEW; it might be understood that enabling factors influence predisposing factors mediated by reinforcing factors in the PRECEDE context. Karasek and Theorell (1990) described the role of social support in occupational well-being from a job design perspective and found that

changes in social support were directly linked to changes in workers' decision latitude for their behaviors at work; in addition, individual workers more voluntarily participated in the target behavior. House referred to these 'participatory work design processes' as a combination of control and social support changes (1981). That is, more controllable conditions and appropriate social support for SH drive workers to engage more SHEW. Therefore, social support should be a common bridging strategy for increasing workers' overall voluntary SHEW participation in Korean manufacturing businesses. On-site consultation and alliance assistance programs had been recommended and implemented for SH in small businesses by the U.S. Occupational Safety and Health Administration (2005). The training programs to improve SHMs' professional and educational competencies should also be continually updated to improve workers' SHEW efficacy. Linnan et al. (2001) identified individual and organizational support from family, coworkers, and supervisors as significant factors associated with voluntary participation in workplace health promotion programs based on ecological model of health behavior. Clarke and Ward (2006) also reported rational persuasion and consultation to be efficient support tactics for workers' safety participation in a U.K. manufacturing sector study.

Finally, it is necessary to discuss the limitations of this study. The first limitation was about convenient sampling method related to recruitment of survey sites. The principle investigator (PI) contacted with the companies

that had any relationships with several representative organizations of occupational safety and health in Korea, which means that the companies participating the survey might have more interests and needs of SHEW than the others. Another one was about survey method and process. PI used self-administered method for the survey because most research questions were related to personal perceptions and experiences based on PRECEDE framework. However, self-administered survey depends on participant's recalls and thoughts. It might, in particular, be weak method to collect the data of epidemiological factors such as injury incidence or risk factors of occupational SH. It would have better check organizational data availability, at least for the epidemiological factors to decrease survey response bias. Furthermore, PI indirectly controlled overall survey with the help of SHMs of survey sites and might fail to check some methodological points such as survey response rate throughout survey. The other point to address about the survey was that it had passed almost 10 years from the survey and authors should be careful to understand the results of this study although results of this study still showed significant suggestions to modify current workplace safety and health education.

In conclusion, PRECEDE factors associated with workers' SHEW participation were different by business size in this study. There were some significant differences in educational and ecological characteristics between small and large businesses; whereas, little difference in general characteristics and epidemiological



characteristics by size. Reinforcing and enabling factors contributed more on SHEW participation in small business than in large one. That indicated that workplace physical environment and social support for SHEW were significant factors encouraging workers' participation in SHEW and most of the significant factors were parts of organization-level support. Whereas, predisposing and reinforcing factors tended to be more effective to SHEW participation in large businesses than in small ones, and all significant educational and ecological factors were related to 'voluntariness' of SHEW participation. Perceived SHEW efficacy, social support for SHEW, and SHM's SHEW competencies were all individual assets about value, support, and controllability of SHEW. And those positive individual perceptions and competencies effectively encouraged workers' voluntary SHEW participation in large businesses. Therefore, based on major outcomes of this study, it was recommended to develop SHEW participation strategies by business size that organizational-level infrastructure and support need to be primarily considered in small businesses; while both organizational and individual assets related to voluntariness were be more useful in large businesses.

## ACKNOWLEDGEMENTS

We thank the Korea Occupational Safety and Health Agency for funding this study (OSHRI 2007-77-983).

## REFERENCES

1. Bake JB, Uhm M, Kim JS. The relationship between workers' safety behaviors and safety climate in chemical industry. *J Korean Soc Safety*. 2015; 30: 100-7.
2. Burton J. WHO healthy workplace framework and model: Background and supporting literature and practice. Geneva (Switzerland): WHO Press; 2010. 17-25.
3. Clarke S, Ward K. The role of leader influence tactics and safety climate in engaging employees' safety participation. *Risk Anal*. 2006; 26: 1175-85.
4. Choi SI, Kim H. A study on the safety climate and worker's safety work behavior in construction site. *J Korean Soc Safety*. 2006; 21: 60-71.
5. Choi SJ, Lee KG, Shin WH, et al. A survey study on occupational safety and health management activities in contractor and supplier companies of the steel industry. *J Korean Soc Safety*. 2012; 27: 190-5.
6. Gilmore GD, Olsen LK, Taub A, et al. Overview of the national health educator competencies update project, 1998-2004. *Health Educ Behav*. 2005; 32: 725-32.
7. Glasgow RE, McCaul KD, Fisher KJ. Participation in worksite health promotion: A critique of the literature and recommendations for future practice. *Health Educ Q*. 1993; 20: 391-408.
8. Green LW, Kreuter MW. Health promotion planning: An educational and ecological approach (4<sup>th</sup> ed). New York, NY: McGraw-Hill; 2005. 9-17.
9. House JS. Work stress and social support.

- Menlo Park (CA): Addison-Wesley Publishing Co; 1981.
10. Howell DC. Fundamental statistics for the behavioral sciences (8<sup>th</sup> ed). Belmont, CA: Wadsworth, Cengage Learning; 2014. 266.
11. Karasek R, Theorell T. Healthy work: stress, productivity, and the reconstruction of working life. Basic books; 1990. 68-76.
12. Kim M. Preliminary study on the national examination and question management of the health education specialist credentialing. Seoul (Korea): Health Personnel Licensing Examination Institute; 2009.
13. Korea Ministry of Employment and Labor. 2014 Occupational injury analysis. Government Complex Sejong (Korea); 2015.
14. Korea Ministry of Government Legislation: Occupational safety and health act [Internet]. Government Complex Sejong (Korea): [cited 2016 April 19]. Available from: <http://www.law.go.kr/lsSc.do?menuId=0&subMenu=1&query=%EC%82%B0%EC%97%85%EC%95%88%EC%A0%84%EB%B3%B4%EA%B1%B4%EB%B2%95#undefined>
15. Korea Ministry of Labor. 2006 Occupational injury statistics. 2007.
16. Lee HS, Lim JH. SPSS 12.0 manuals: statistical analysis methods and interpretations. Paju : Bobmunsa; 2005. 301-2.
17. Lee MS, Park KO. Workplace safety education and management factors associated with the organizational safety culture in Korean manufacturing companies. Korean Public Health Res. 2006; 32: 75-83.
18. Linnan LA, Sorensen G, Colditz G, Klar N, Emmons KM. Using theory to understand the multiple determinants of low participation in worksite health promotion programs. Health Educ Behav. 2001; 28: 591-607.
19. Middlestadt SE, Sheats JL, Geshnizjani A, Sullivan MR, Arvin CS. Factors associated with participation in work-site wellness programs: Implications for increasing willingness among rural service employees. Health Educ Behav. 2011; 38: 502-509.
20. Moon K, Lee J, Oah S. The effects of safety leadership of manager and safety climate in the organization on the workers' safety behaviors. J Korean Soc Safety. 2013; 28: 66-72.
21. Morrison KW. Small business big problems. Saf Health. 2011; 183: 44-8.
22. Nahrgang JD, Morgeson FP, Hofmann DA. Safety at work: A meta-analytic investigation of the link between job demands, job resources, burnout, engagement, and safety outcomes. J Appl Psychol. 2011; 96: 71-94.
23. Neal A, Griffin MA. A study of the lagged relationships among safety climate, safety motivation, safety behavior, and accidents at the individual and group levels. J Appl Psychol. 2006; 91: 946-53.
24. Neal A, Griffin MA, Hart PM. The impact of organizational climate on safety climate and individual behavior. Saf Sci. 2000; 34: 99-109.
25. Occupational Safety and Health Research Institute. 2006 Korea occupational safety and health trend survey. Incheon: Korea Occupational Safety & Health Agency; 2007.
26. Occupational Safety and Health Administration. Small business handbook. Small business safety and health management series. Washington, DC: U.S. Department of Labor; 2005. Report No.: OSHA 2209-02R 2005.

27. Park KO. Organizational factors associated with safety and health managers' educational needs in Korean manufacturing industry. *Korean Public Health Res.* 2016; 42: 41-52.
28. Rahmani A, Khadem M, Madreseh E, et al. M. Descriptive study of occupational accidents and their causes among electricity distribution company workers at an eight-year period in Iran. *Saf Health Work.* 2013; 4: 160-5.
29. Robroek SJ, Lenthe FJ, Empelen P, Burdorf A. Determinants of participation in worksite health promotion programmes: A systematic review. *Int J Behav Nutr Phys Act.* 2009; 6: 26.
30. Sorensen G, Stoddard A, Ockene JK, Hunt MK, Youngstorm R. Worker participation in an integrated health promotion/health protection program: Results from the WellWorks project. *Health Educ Q.* 1996; 23: 191-203.