

Abstract

**Symptom Prevalence and Primary Intervention
of Work-related Musculoskeletal Disorders
and Their Related Factors Among Manufacturing Workers**

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Objectives: To investigate the symptom prevalence and the primary intervention of work-related musculoskeletal diseases(WMSDs) and their related factors among manufacturing workers.

Method: A self-administered questionnaire survey was conducted on 2,457 workers, at 22 enterprises in Chungnam province, Korea, from September 1 to December 1, 2003. The contents of the questionnaire included general and work-related characteristics, musculoskeletal symptoms and workers' past one-year experience of primary interventions.

Results: 1. The overall symptom prevalence of the musculoskeletal diseases was 23.9%. The WMSD symptom prevalences at the neck/shoulder, arm/elbow, hand/wrist and back/leg were 14.8%, 2.7%, 7.3% and 12.0%, respectively. 2. In multivariate analysis, all WMSD symptom prevalences were high in the high workload, high force & high repetitiveness, and 'high job strain' groups. The WMSD symptom prevalence at neck/shoulder was also high in females and the group experiencing low social support from the supervisor. 3. The rates of the primary interventions were as follows : 13.7% for health education, 5.8% for health counselling, 18.8% for preventive exercise, 24.7% for ergonomic intervention, and 9.8% for administrative intervention. 4. In multivariate analysis, the size of the enterprises and the type of occupational health management system(OHMS) were significantly associated with all primary interventions except health counselling($p<0.05$). The other individual-level predictive factors were as follows. Those for the health education were male and union presence. Those for the health counselling were older age(≥ 40 years), irregular employment, and the active group of Karasek's job strain model. Those for the preventive exercise were male, older age, longer tenure and regular employment. Those for the ergonomic intervention were longer tenure, job of physical force and/or repetitiveness, high job strain and the group experiencing high social support from the supervisor. The predictive factor for the administrative intervention was male ($p<0.05$).

Conclusions: To establish an effective strategy for the primary prevention of WMSDs, approaches are needed which consider the individual nature of small and medium sized enterprises. Also necessary is to promote the participation of labor and management because the activation of the primary intervention

was associated with the type of OHMS and union presence. Moreover the reduction of workload and increased intervention into the high risk group could be effective in the prevention of WMSDs.

Key Words: Work-related musculoskeletal diseases, Primary intervention, Occupational health management system, Small and medium sized enterprises

(Kogi & Kawakami., 1997; Kogi & Kawakami 2002; ETUC, 2002).

가 2000 1,076 2004 4,112 (, 2005). (, 2004),

가 가 (Kim et al., 2004; Kim et al., 2004).

(primary interven- tion)가 (Lotters & Bardot, 2002), 가

가

1.

(job rotation), 가 2003 9 -12 , (administrative) 22 (Zwerling et al., 1997). 2003 7 1 3,059 2,457 (80.3%)

2.

가

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가

1

가 2004 6 30 245 가 (workload) KOSHA code H-30 144 31 , 70 , 5 9 , 10~19 (, 2004) , , 20~25 가

가

가

(2001)
Karasek

(NIOSH,

National institute of occupational health and safety)
NIOSH

1.

971 (39.5%),
1,486 (60.5%) , 29 가 732
(29.8%), 30~39 가 1,225 (49.9%), 40
500 (20.4%) , 4 가 1,723
(70.1%), 5~9 449 (18.3%), 10 285
(11.6%) , 2,200
(89.5%), 257 (10.5%)
50~99 769 (31.3%),
100~299 1,032 (42.0%), 300~499 656
(26.7%) ,
3. () 1,371 (55.8%),
()가 508 (20.7%),
SPSS 11.0 ()가 578 (23.5%) ,
가 1,731 (70.5%),
가 726 (29.5%) (Table 1).

(p<0.05)

Table 1. General characteristics of the study population (N=2,457)

General characteristics		n (%)
Gender	female	971 (39.5)
	male	1,486 (60.5)
Age (years)	29	732 (29.8)
	30~39	1,225 (49.9)
	40	500 (20.4)
Tenure (years)	4	1,723 (70.1)
	5~9	449 (18.3)
	10	285 (11.6)
Status of employment	regular	2,200 (89.5)
	irregular	257 (10.5)
Size of enterprise	50~99	769 (31.3)
	100~299	1,032 (42.0)
	300~499	656 (26.7)
OHMS type	group	1,371 (55.8)
	cooperative	508 (20.7)
Labor union	inside	578 (23.5)
	absent	1,731 (70.5)
	present	726 (29.5)

OHMS = occupational health management system,

group: group OHS only, cooperative =group OHS + full-time safety personnel inside=full-time health personnel

2. 가 (10.6%) (27.2%), 698 (28.4%), 668 (21.1%), 가 (12.6%) 183 (7.4%), 908 (12.8%), (24.0%), (37.0%), 530 (21.6%), (8.3%), (8.7%) 1,486 (60.5%), 441 (17.9%) (18.5%) (21.4%), , 454 (18.5%), (7.7%) (13.1%), 495 (20.1%), 673 (12.6%), (21.3%), (27.4%), 835 (34.0%), 가 (11.7%) (19.0%) (1,430 (58.2%), p<0.01), (10.5%) (15.3%) 1,027 (41.8%) (Table 2). (p<0.05) , 가 .

3. (1.6%) (4.4%), 가 (1.1%) (2.3%) (6.1%), (1.1%) 23.9% , 14.8%, (1.0%) (2.8%) 2.7%, 7.3%, (4.9%) (p<0.01), 29 (2.0%) 30 ~ 39 12.0% . (2.4%) 40 (4.6%), (19.9%) (1.4%) (2.2%), %) (29.9%), 가 (19.6%) (3.7%), (3.6%) (p<0.05) (21.2%) (37.9%), , , , (13.7%) (19.7%), 가 . (26.1%) (36.5%), (5.6%) (12.6%) (21.6%), (9.9%), 10 (3.2%) 5 ~ 9 (20.5%), (34.0%), (6.5%), 4 (8.2%), 가 가 (20.2%) (29.2%), (4.5%) (6.3%) (14.1%), , 10 (17.5%) 5 (24.3%) 5- (3.3%) 9 (26.3%) (p<0.01) , (7.6%), (6.0%)

Table 2. Risk factors of the WMSDs(N=2,457)

Risk factors		n (%)
Job characteristics	LFLR	908 (37.0)
	HFLR	183 (7.4)
	LFHR	698 (28.4)
	HFHL	668 (27.2)
Workload	low	530 (21.6)
	intermediate	1,486 (60.5)
	high	441 (17.9)
Job strain	low	454 (18.5)
	active	495 (20.1)
	passive	673 (27.4)
Social support by supervisor	high	835 (34.0)
	low	1,430 (58.2)
		1,027 (41.8)

LFLR: low force & low repetitiveness, HFLR: high force & low repetitiveness, LFHR: low force & high repetitiveness, HFHR: high force & high repetitiveness

(12.7%) , (3.1%) 1.90 ,
 (8.1%), (4.5%), (11.4%) (, , 2.07 ,
 p<0.01) , , , 1.46 , 3.00 , ,
 가 . 1.68 , 2.09 , 2.69
 가 8.6% (Table 4).
 (8.7%) (11.0%) (19.5%) ,
 (6.6%) 5.
 (13.1%), (11.0%),
 (20.1%) , (5.5%)
 (10.3%), (11.6%), (16.9%) , 337 (13.7%),
 가 (10.3%) 143 (5.8%), 가 461 (18.8%),
 (14.3%) (p<0.01), 29 (12.8%) 가 606 (24.7%), 가 240
 30-39 (12.8%) 40 (8.8%) , (9.8%) .
 4 (11.7%) 5~9 (14.7%) 10 ((8.4%) (17.2%) ,
 9.8%) (p<0.05) , , 4 (11.1%) 5~9 (19.4%), 10
 가 (Table 3). (20.7%) , 가 50~99
 (13.4%) 100~299 (17.3%), 300~499
 (8.4%) ,
 4. (9.4%) (25.4%) (13.7%)
 : , (10.9%)
 가 1.68 , (20.5%) (
 1.66 , 29 (5.7%) 30~39 (4.7%)
 3.05 , 40 (8.8%) , (4.0%)
 , 1.47 , 1.73 , 2.47 , (6.7%) , 가 300~499
 가 1.25 (2.9%) 50~99 (6.0%)
 , 1.30 , 5 100~299 (7.6%) ,
 5-9 가 1.38 , (4.7%) (4.7%)
 12.6% . (10.0%) (p<0.01), 4
 1.86 , (5.0%) 5~9 (7.8%), 10 (7.4%) ,
 0.47 , 가 (5.5%) (8.9%) ,
 1.42 , (6.2%), (4.6%), (5.0%)
 1.89 2.56 , (8.5%) (p<0.05)
 1.64 .
 1.88 , 가 (13.4%) (22.3%) , 29
 1.33 , (13.5%) 30~39 (19.6%) 40
 10.7% . (24.4%) , (9.7%) (19.8%)
 29 40 , (15.0%)
 2.61 , 가 3.80 (20.4%) , 가 50~99 (20.7%)
 , 2.81 , 100~299 (20.0%), 300~499
 10.4% . (14.6%) ,
 가 (14.4%) (25.4%) (23.4%) (
 2.22 , 2.21 p<0.01) .
 , 2.91 , (20.4%) (27.5%)
 10.0% . (19.6%)
 가 (26.9%) , (21.4%) (22.6%)

Table 3. Symptom prevalence of the WMSDs by the general characteristics and the risk factors(N=2,457)

Unit : n(%)

General characteristics	& risk factors	Neck/Shoulder	Arm/Elbow	Hand/Wrist	Back/Leg	More than one
Gender	female	205 (21.1) [†]	43 (4.4) [†]	96 (9.9) [†]	113 (11.6)	290 (29.9) [†]
	male	158 (10.6)	24 (1.6)	83 (5.6)	182 (12.2)	296 (19.9)
Age (years)	≤29	124 (16.9)	15 (2.0)*	57 (7.8)	94 (12.8)*	192 (26.2)
	30~39	171 (14.0)	29 (2.4)	92 (7.5)	157 (12.8)	291 (23.8)
	40 ≤	68 (13.6)	23 (4.6)	30 (6.0)	44 (8.8)	103 (20.6)
Tenure(years)	≤4	263 (15.3)	49 (2.8)	141 (8.2) [†]	201 (11.7)*	418 (24.3) [†]
	5~9	67 (14.9)	15 (3.3)	29 (6.5)	66 (14.7)	118 (26.3)
	10 ≤	33 (11.6)	3 (1.1)	9 (3.2)	28 (9.8)	50 (17.5)
Status of employment	regular	336 (15.3)*	61 (2.8)	159 (7.2)	270 (12.3)	532 (24.2)
	irregular	27 (10.5)	6 (2.3)	20 (7.8)	25 (9.7)	54 (21.0)
Workload	low	67 (12.6) [†]	6 (1.1) [†]	24 (4.5) [†]	46 (8.7) [†]	104 (19.6) [†]
	intermediate	190 (12.8)	34 (2.3)	93 (6.3)	163 (11.0)	315 (21.2)
	high	106 (24.0)	27 (6.1)	62 (14.1)	86 (19.5)	167 (37.9)
Job characteristics	LFLR	75 (8.3) [†]	13 (1.4)*	30 (3.3) [†]	60 (6.6) [†]	124 (13.7) [†]
	HFLR	16 (8.7)	4 (2.2)	53 (7.6)	24 (13.1)	36 (19.7)
	LFHR	129 (18.5)	26 (3.7)	11 (6.0)	77 (11.0)	182 (26.1)
	HFHR	143 (21.4)	24 (3.6)	85 (12.7)	134 (20.1)	244 (36.5)
Job strain	low	35 (7.7) [†]	5 (1.1) [†]	14 (3.1) [†]	25 (5.5) [†]	57 (12.6) [†]
	active	65 (13.1)	14 (2.8)	40 (8.1)	51 (10.3)	107 (21.6)
	passive	85 (12.6)	7 (1.0)	30 (4.5)	78 (11.6)	138 (20.5)
Social support	high	178 (21.3)	41 (4.9)	95 (11.4)	141 (16.9)	284 (34.0)
	low	168 (11.7) [†]	33 (2.3)	92 (6.4)	148 (10.3) [†]	286 (20.2) [†]
by supervisor	low	195 (19.0)	34 (3.3)	87 (8.5)	147 (14.3)	300 (29.2)
Total	363 (14.8)	67 (2.7)	179 (7.3)	295 (12.0)	586 (23.9)	

WMSDs: Work related musculoskeletal disease, *p<0.05 [†]p<0.01 by Chi-square test.

LFLR: low force & low repetitiveness, HFLR: high force & low repetitiveness, LFHR: low force & high repetitiveness, HFHR: high force & high repetitiveness

Table 4. Associated factors of the prevalence of the WMSDs: multiple logistic regression analysis

Unit: Odds ratio (95% C.I)

Associated factors	Neck/Shoulder	Arm/Elbow	Hand/Wrist	Back/Leg	One more site
Gender	female/male	1.59 (0.90-2.80)	1.21 (0.85-1.71)	-	1.30 (1.04-1.62)
Age	30-39/≤29	1.25 (0.66-2.37)	-	1.07 (0.81-1.43)	-
	40≤/≤29	2.61 (1.32-5.18)	-	0.75 (0.51-1.11)	-
Tenure(years)	5-9/≤4	-	0.97 (0.63-1.49)	-	1.38 (1.07-1.77)
	10≤/≤4	-	0.50 (0.24-1.02)	-	0.86 (0.61-1.22)
Status of employment	irregular/regular	-	-	-	-
	intermediate/low	0.47 (0.31-0.72)	1.34 (0.94-2.15)	1.31 (0.92-1.97)	1.07 (0.83-1.39)
Workload	high/low	1.42 (0.99-2.03)	2.22 (1.34-3.70)	1.90 (1.20-2.69)	1.68 (1.24-2.28)
	HFLR/ LFRL	1.04 (0.59-1.85)	1.62 (0.99-2.63)	2.07 (1.12-3.45)	1.48 (0.97-2.25)
Job characteristics	LFHR/ LFRL	1.89 (1.36-2.62)	1.85 (0.90-3.91)	1.46 (1.07-2.11)	1.66 (1.26-2.19)
	HFHR/ LFRL	2.56 (1.87-3.52)	3.22 (2.06-5.03)	3.00 (2.14-4.20)	3.05 (2.36-3.94)
Job strain	active/low	1.23 (0.78-1.94)	2.21 (1.17-4.19)	1.68 (1.01-2.81)	1.47 (1.02-2.13)
	passive/low	1.64 (1.07-2.50)	1.39 (0.72-2.67)	2.09 (1.31-3.36)	1.73 (1.23-2.44)
Social support by supervisor	high/low	1.88 (1.25-2.85)	2.91 (1.55-5.09)	2.69 (1.69-4.30)	2.47 (1.76-3.47)
	low/high	1.33(1.04-1.69)	-	1.14(0.87-1.49)	1.25(1.02-1.53)
R ²		0.107	0.100	0.86	0.125

WMSDs : Work related musculoskeletal disease, ‘-’ means the variables that were excluded from each statistical models, LFRL: low force & low repetitiveness, HFRL:high force & low repetitiveness, LFHR : low force & high repetitiveness, HFHR:high force & high repetitiveness

1.42 , 1.80 , 4
 2.01 , 29
 9.1% , 40
 가 300 ~ 499 , 50 ~ 99
 100 ~ 199 , 가 1.92
 8.4% , 1.37 , 29
 1.94 , 1.90 ,
 가 300-499 , 100 ~ 299
 가 1.97 , 1.57 ,
 1.49 ,
 가 300 ~ 499 , 50 ~ 99
 100 ~ 299 , 가
 (26.9%) , 가
 (19.2%) , (28.6%) ,
 가 300 ~ 499 (18.4%)
 50 ~ 99 (31.9%) 100 ~ 299
 (23.3%) ,
 (15.9%) , (25.4%)
 (32.7%) (p<0.01),
 4 (23.7%) 5 ~ 10 (23.8%)
 10 (31.6%) (p<0.05)
 (7.6%)
 (11.2%) , 가 300 ~ 499
 (7.9%) 100 ~ 299 (7.6%)
 50 ~ 99 (14.3%) ,
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 p<0.01), (7.3%)
 (9.6%) (11.5%)
 (11.9%) , 가
 (8.4%) (10.8%) ,
 (7.4%)
 (10.7%) (p<0.05)
 (Table 5).
 6.
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Table 5. Primary interventions of the WMSDs by various factors (N=2,457)

Unit: n(%)

Factors	Health education	Health counselling	Preventive exercise	Ergonomic intervention	Administrative intervention
Gender	female male	67 (6.9) 76 (5.1)	130 (13.4) [†] 331 (22.3)	198 (20.4) [†] 408 (27.5)	74 (7.6) [†] 166 (11.2)
Age (years)	≤29 30~39 40≤	94 (12.8) 163 (13.3) 80 (16.0)	42 (5.7) [†] 57 (4.7) 44 (8.8)	164 (22.4) 313 (25.6) 129 (25.8)	72 (9.8) 121 (9.9) 47 (9.4)
Tenure (years)	≤4 5~9 10≤	191 (11.1) [†] 87 (19.4) 59 (20.7)	87 (5.0) [*] 35 (7.8) 21 (7.4)	409 (23.7) [*] 107 (23.8) 90 (31.6)	167 (9.7) 51 (11.4) 22 (7.7)
Status of employment	regular irregular	293 (13.3) 44 (17.1)	120 (5.5) [*] 23 (8.9)	547 (24.9) 25 (9.7)	212 (9.6) 28 (10.9)
Workload	low intermediate high	86 (16.2) 192 (12.9) 59 (13.4)	29 (5.5) 84 (5.7) 30 (6.8)	151 (28.5) 356 (24.0) 99 (22.4)	57 (10.8) 149 (9.9) 36 (8.2)
Job characteristics	LFLR the others	92 (12.1) 245 (14.4)	30 (4.0) [†] 113 (6.7)	149 (19.6) [†] 347 (20.4)	61 (8.0) 179 (10.5)
Job strain	low active passive	71 (15.8) 69 (13.7) 100 (14.9)	28 (6.2) [*] 42 (8.5) 31 (4.6)	134 (29.5) [†] 112 (22.6) 181 (26.9)	54 (11.9) [*] 57 (11.5) 49 (7.3)
Social support	high low	99 (11.7) 208 (14.5)	42 (5.0) 85 (5.9)	179 (21.4) 409 (28.6) [†]	80 (9.6) 154 (10.8) [*]
by supervisor	low ≤99 100~299 300~499	129 (12.6) 103 (13.4) [†] 179 (17.3) 55 (8.4)	58 (5.6) 46 (6.0) [†] 78 (7.6) 19 (2.9)	179 (17.4) 159 (20.7) [†] 206 (20.0) 96 (14.6)	86 (8.4) 110 (14.3) [†] 78 (7.6) 52 (7.9)
OHIMS type	group cooperative inside absent present	129 (9.4) [†] 129 (25.4) 79 (13.7) 188 (10.9) [†] 149 (20.5)	65 (4.7) [†] 51 (10.0) 27 (4.7) 109 (6.3) 34 (4.7)	197 (14.4) [†] 129 (25.4) 135 (23.4) 310 (17.9) 151 (20.8)	146 (10.6) [†] 75 (14.8) 19 (3.3) 186 (10.7) [*] 54 (7.4)
Total	337 (13.7)	461 (18.8)	606 (24.7)	240 (9.8)	

WMSDs : Work related musculoskeletal disease, OHMS : occupational health management system , group: group OHS only, cooperative =group OHS + full-time safety personnel inside=full-time health personnel

*p<0.05 † p<0.01 by Chi-square test.

Table 6. Associated factors of the primary interventions: multiple logistic regression analysis

Associated factors	Unit : Odds ratio(95% C.I)				
	Health education	Health counselling	Preventive exercise	Ergonomic intervention	Administrative intervention
Gender	male/female	-	1.37 (1.04-1.80)	1.21 (0.94-1.54)	1.73 (1.21-2.47)
Age (years)	30-39/≤29	1.01 (0.65-1.54)	1.42 (1.08-1.87)	-	-
	40 ≤ / ≤29	2.01(1.26-3.21)	1.80(1.29-2.50)		
Tenure (years)	5-9/ ≤4	-	1.67 (1.25-2.19)	0.98 (0.75-1.27)	-
	10 ≤ / ≤4	-	1.59 (1.14-2.20)	1.58 (1.17-2.13)	-
Status of employment	irregular/regular	1.90 (1.14-3.16)	0.60 (0.38-0.94)	-	-
Job characteristics	the others/LFLR	1.53 (0.99-2.37)	1.86 (1.45-2.38)	1.61 (1.29-2.01)	-
	low/high	1.49 (0.88-2.50)	-	1.36 (1.01-1.83)	1.02 (0.68-1.54)
Job strain	active/high	1.96 (1.24-3.10)	-	1.02 (0.77-1.34)	1.18 (0.81-1.71)
	passive/high	1.00 (0.61-1.64)	-	1.18 (0.90-1.54)	0.63 (0.42-0.94)
Social support by supervisor	high/low	-	-	1.57 (1.28-1.94)	1.25 (0.92-1.69)
WMSDs	present/absent	1.65 (1.26-2.15)	-	-	-
	50-99/300-499	1.34 (0.92-1.94)	1.28 (0.94-1.76)	1.64 (1.26-2.14)	1.57 (1.07-2.30)
Size of enterprise	100-299/300-499	1.97 (1.32-2.95)	1.06 (0.77-1.46)	0.84 (0.63-1.12)	0.34 (0.21-0.57)
	group/inside	1.07 (0.75-1.54)	0.61 (0.45-0.81)	1.87 (1.40-2.48)	1.97 (1.08-3.59)
OHMS type	cooperative/inside	1.57 (1.09-2.27)	0.97 (0.70-1.34)	2.94 (2.10-4.10)	6.82 (3.83-12.14)
	present/absent	1.94 (1.40-2.70)	-	-	0.41 (0.26-0.63)
R ²		0.091	0.087	0.081	0.107

WMSDs : Work related musculoskeletal disease, OHMS : occupational health management system

group: group OHS only, cooperative =group OHS + full-time safety personnel inside=full-time health personnel

' - ' means the variables that were excluded from each statistical models

5~9 10 1.67 1.59 ,
1.86 , 가 , 가
0.60 , 가 (Heo et al., 2003; Jung-Choi
가 0.61 0.97 et al., 2004). 가
, 8.7% 1.68 ,
4 10
1.58 ,
1.61 , 1.36 , (Kim et al., 2004; Kim et al., 2004; Kim &
가 1.57 , Jeong, 2004),
가 300~499 50~99 가 가
1.64 , 가 가 (Kivimaki et al., 2001).
1.87 , 2.94
(p<0.05), 8.1%

1.73 ,
0.63 , 가 300~499
50~99 100~299 가 (24.7%), (18.8%),
1.57 0.34 , 가 (13.7%), (9.8%), (5.8%)
1.97
6.82 , 가 가
0.41 ,
10.7% (Table 6). 50 28.6%

(US. department of health and
human services. 1991).

14.8%,
2.7%, 12.0% ,
23.9%
가 (2003)
77.2% 가 ,
가 Park 가
(2004), Heo (2004), Jung-Choi (2004)
7.7%~30.4%, 28.5%~35.5%, 24.9% 가

가

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가

가 가

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1.94

가

가

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5.7

(Morse et al.,

2004).

가

(Lee et al., 2004)

(Street et al., 2003; Moore et al., 1996).

가

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2,457 2003 9 ~ 12 22

1. 14.8%, 2.7%, 7.3%, 12.0% . 2.

가 3. 13.7%, 5.8%, 가 18.8%, 가 24.7%, 가 9.8% . 4.

40 , 30 , 5 , 10

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