

**Abstract**

**Risk Factors Related to Musculoskeletal Symptoms in Shipyard Workers**

Byung-Chan Park, Hae-Kwan Cheong, Soo-keun Kim

*Department of Preventive Medicine, College of Medicine, Dongguk University*

**Objectives:** The aim of this study is to determine the risk factors related to musculoskeletal disorders in shipyard workers.

**Methods:** A questionnaire survey was performed on 2,140 shipyard workers in a shipyard in Ulsan city. The questionnaire consisted of questions on the general characteristics, the health behavior, work type and duration, physical burden, job control, type of instruments used, posture, and musculoskeletal symptoms. Definition of musculoskeletal disorders was based on either NIOSH criteria and Kim 's criteria.

**Results:** Positive rate of musculoskeletal disorders in any one part of the body was 77.2% by NIOSH criteria and 60.7% by Kim 's criteria. Positive rate of the symptoms increased in workers with longer work hours, with a severe physical burden, and without any control over their job. Work with a more frequent unstable posture and for longer hours was also associated with increased musculoskeletal symptoms. Multiple logistic regression analysis showed that unstable posture and physical burden is closely related to the positive rate of musculoskeletal symptoms after controlling for age, smoking, drinking, exercise, duration of work, and job control; showing a good dose-response relationship.

**Conclusion:** Inadequate posture and physical burden were the most significant factors affecting musculoskeletal disorders in shipyard workers in this study. Therefore, it will be necessary to make efforts to reduce the prevalence of musculoskeletal disorders related to a specific job, instrument, physical burden, and posture. Workers should be educated on the types and prevalence of musculoskeletal disorders, how to improve the ergonomic occupational environment and to set up preventive measures against the risk factors during work.

**Key Words:** Work related musculoskeletal disorders, Cumulative trauma disorders, Risk factors, Shipyard

( , 1989; , 1997), ( , 1992), VDT ( , 1995), 가 ( , 1996) 가 ( , 2000), ( , 2000) 가 . 가 가 , (NIOSH, 1988). (VDT) 가 가 ( , 1996), 가 , 가(NIOSH, 1988), (Wilder, 1993) (WHO, 1985; 1996). 가 ( , 1997) 가 . 1990 가 , 가 10 (Zenz , 1994), 가 , 가 1998 64% . 2001 (OSHA, 2000). 2001 0.77 1.71 2,192 242 (12.4%) 가 , 820 298 (57.1%) 가 ( , 2001). 2002 778 291 (59.8%) 가 1998 3.1 , 1997 8.8 , 1996 7.8 ( , 2001). 2002 가 11.8% 가 ( , 2002), , 2000), 68.4%, 2003 31.6% 가 6 가 79.1% 가 ( , 2003). 가 2002). 가 1990 가 가 , 가 ( , 1989; , 1992; , 1995; , 1996; , 1997; , 2000; , 2000).

1. , 45  
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 2,214  
 29 1 1  
 20 , , 2 , 2-4 , 4  
 25 2,140  
 43.3±7.3 (24 ~ 59 0-3  
 ) 40 75.4% 5  
 2,026 (94.7%) 가 1,205  
 (56.3%) , 1,759 (82.2%) 3)  
 , 541 / / 가 , /  
 (25.3%) 16.8±6.4 , , , ,  
 10 314 (14.7%), 10~19 , ,  
 1,230 (57.5%), 20 596 (27.9%) 가  
 10 가 85.3% National  
 (Table 1).

Institute for Occupational Safety and Health (NIOSH) 1 ,

2. 1 1 1  
 Table 2  
 1) 10 33  
 , , , , ,  
 , , , , , ( , 1998).  
 4)

2) SPSS  
 for Windows 10.1 EpiInfo 6.0  
 (ANSI, NIOSH  
 1996) ANSI Z-365 (Part 1: Upper  
 Extremities) OSHA  
 'OSHA Draft Ergonomics Standard' (OSHA,  
 1996)  
 ( , 1998).  
 7 , 9 Kg Chi-square for trend test

**Table 1.** General characteristics of the subjects

Characteristics		Number of subjects (N=2,140)	%
Age (yrs)	20-29	110	5.1
	30-39	416	19.4
	40-49	1,123	52.5
	50-	491	22.9
Smoking	Smoker	1,205	56.3
	Non-smoker	935	43.7
Drinking	Drinker	1,759	82.2
	Non-drinker	381	17.8
Marital status	Married	2,026	94.7
	Unmarried	114	5.3
Physical exercise	Yes	541	25.3
	No	1,599	74.7
Duration of work (yrs)	1-9	314	14.7
	10-19	1,230	57.5
	20-	596	27.9

Chi-square test 2.

Chi-square for trend test

NIOSH

(53.2%), (48.4%), (47.0%), /  
 (42.9%), / (41.9%) (40.8%)  
 (37.2%),  
 (31.4%), (29.9%), / (27.9%),  
 (23.9%) / (22.5%)  
 (Multiple Logistic Regression)

(Table 3).

NIOSH

1.

25.2%, / 38.0%,  
 44.3%, 28.0%,  
 34.4%가

(Table 3).

NIOSH

1,653 (77.2%)

1,299 (60.7%)

Kappa

0.57

0.69

.(Table 3).

(Percent agreement)

83.4%

, Kappa 0.62

3.

(Table 3).

NIOSH

**Table 2.** Criteria of musculoskeletal disorders based on symptom questionnaire

Symptom score	1	2	3	4	5
Duration	1 hr	<1 day	<1 week	<1 month	1 month
Frequency (time/interval)	Rare	1/2-3 month	1/month	1/week	Everyday
Severity	None	Mild	Moderate	Severe	Very severe

Source: Kim et al., 1998

**Table 3.** Positive rate of musculoskeletal symptoms by part of the body (N=2,140)

	NIOSH criteria		Kim 's criteria		Agreement between NIOSH and Kim 's criteria
	No. of cases	Prevalence	No. of cases	Prevalence	Kappa ± Standard error
Hand/wrist	897	41.9	481	22.5	0.57 ± 0.017
Arm/elbow	918	42.9	597	27.9	0.68 ± 0.016
Shoulder	1,139	53.2	796	37.2	0.69 ± 0.015
Neck	874	40.8	511	23.9	0.63 ± 0.017
Low back	1,036	48.4	672	31.4	0.65 ± 0.015
Knee	1,006	47.0	639	29.9	0.65 ± 0.016
Any part of the body	1,656	79.2	1,299	60.7	0.62 ± 0.017

/ 가 NIOSH  
 가 (p<0.05, p<0.01).  
 / , / , 가 가 (p<0.01).  
 , 가 NIOSH / , ,  
 (p<0.05, p<0.05), 가 /  
 가 가  
 (p<0.05, p<0.05). (p<0.05, p<0.01).  
 (Table 4). 2)  
 가 가 (p<0.05, p<0.01).  
 /  
 (p<0.05), 가  
 NIOSH 가 (38.9%), (35.6%),  
 가 (Table 4). (34.7%) , /  
 (60.0%), (50.0%),  
 4. (38.8%) ,  
 (72.2%), (60.0%),  
 1) (56.0%)  
 Table 5 (38.9%), (34.8%),

**Table 4.** Positive rate of musculoskeletal symptoms by general characteristics of the subjects (N=2,140)

		No. of subjects	Hand/wrist (%)	Arm/elbow (%)	Shoulder (%)	Neck (%)	Low back (%)	Knee (%)
<b>NIOSH criteria</b>								
Age	20-29	110	44(40.0)	28(25.5)**2)	46(41.8)**2)	42(38.2)	45(40.9)*2)	47(42.7)**2)
	30-39	416	179(43.0)	159(38.2)	211(50.7)	179(43.0)	191(45.9)	172(41.3)
	40-49	1,123	460(41.0)	484(43.1)	604(53.8)	460(41.0)	551(49.1)	534(47.6)
	50-	491	214(43.6)	247(50.3)	278(56.6)	193(39.3)	249(50.7)	253(51.5)
Smoking	Smoker	1,205	537(44.6)**1)	540(44.8)*1)	662(54.9)	531(44.1)**1)	596(49.5)	576(47.8)
	Non-smoker	935	360(38.5)	378(40.4)	477(51.0)	343(36.7)	440(47.1)	430(46.0)
Drinking	Drinker	1,759	765(43.5)**1)	775(44.1)*1)	957(54.4)*1)	743(42.2)**1)	866(49.2)	854(48.6)**1)
	Non-drinker	381	132(34.6)	143(37.5)	182(47.8)	131(34.4)	170(44.6)	152(39.9)
Exercise	Yes	541	225(41.6)	228(42.1)	288(53.2)	220(40.7)	251(46.4)	267(49.4)
	No	1,599	672(42.0)	690(43.2)	851(53.2)	654(40.9)	785(49.1)	739(46.2)
<b>Kim 's criteria</b>								
Age	20-29	110	17(15.5)*2)	11(10.0)**2)	23(20.9)**2)	17(15.5)**2)	25(22.7)**2)	24(21.8)**2)
	30-39	416	85(20.4)	75(18.0)	131(31.5)	93(22.4)	113(27.2)	92(22.1)
	40-49	1,123	245(21.8)	330(29.4)	419(37.3)	265(23.6)	361(32.1)	340(30.3)
	50-	491	134(27.3)	181(36.9)	223(45.4)	136(27.7)	173(35.2)	183(37.3)
Smoking	Smoker	1,205	292(24.3)*1)	344(28.5)	457(37.9)	301(25.0)	392(32.5)	366(30.4)
	Non-smoker	935	188(20.1)	253(27.1)	339(36.3)	210(22.5)	280(29.9)	273(29.2)
Drinking	Drinker	1,759	410(23.3)*1)	502(28.5)	659(37.5)	137(36.0)	567(32.2)	541(30.8)
	Non-drinker	381	71(18.6)	95(24.9)	430(24.4)	81(21.3)	105(27.6)	98(25.7)
Exercise	Yes	541	134(24.8)	157(29.0)	206(38.1)	137(25.3)	174(32.2)	174(32.2)
	No	1,599	347(21.7)	440(27.5)	590(36.9)	374(23.4)	498(31.1)	465(29.1)

\*1): p<0.05 by chi-square test, comparison between subgroups

\*2): p<0.05 by chi-square for trend test, comparison between subgroups

\*\*1): p<0.01 by chi-square test, comparison between subgroups

\*\*2): p<0.01 by chi-square for trend test, comparison between subgroups

(34.7%) / (55.6%), (50.0%), (31.1%) (37.8%), (30.0%), (45.0%) (44.4%), (41.7%), (39.0%), (38.0%) 가 (50.0%) (47.5%), (38.5%) (28.2%), (Table 6). (61.5%) (43.3%), 가 (36.4%) (35.0%) 3) (Table 7).

**Table 5.** Positive rate of musculoskeletal symptoms by job characteristics of the subjects (N=2,140)

	No. of subjects	Hand/wrist (%)	Arm/elbow (%)	Shoulder (%)	Neck (%)	Low back (%)	Knee (%)	
<b>NIOSH criteria</b>								
Duration of work (yr)	1-9	314	138(43.9)	112(35.7)*	146(46.5)*	129(41.1)*	137(43.6)	128(40.8)*
	10-19	1,230	516(42.0)	532(43.3)	671(54.6)	530(43.1)	605(49.2)	587(47.7)
	20-	596	243(40.8)	274(46.0)	322(54.0)	215(36.1)	294(49.3)	291(48.8)
Physical burden	None	20	1( 5.0)**	0( 0.0)**	6(30.0)**	4(20.0)**	2(10.0)**	5(25.0)**
	Moderate	423	94(22.2)	88(20.8)	126(29.8)	96(22.7)	118(27.9)	129(30.5)
	Hard	1,005	411(40.9)	423(42.1)	532(52.9)	409(40.7)	491(48.9)	458(45.6)
	Very hard	692	391(56.5)	407(58.8)	475(68.6)	365(52.7)	425(61.4)	414(59.8)
Job control	Full control	305	114(32.6)**	111(31.7)**	152(43.4)**	106(30.3)**	142(40.6)**	128(36.6)**
	Some control	1,186	487(41.1)	493(41.6)	619(52.2)	478(40.3)	554(46.7)	560(47.2)
	No control	604	296(49.0)	314(52.0)	368(60.9)	290(48.0)	340(56.3)	318(52.6)
<b>Kim 's criteria</b>								
Duration of work (yr)	1-9	314	60(19.1)	49(15.6)**	85(27.1)**	61(19.4)	75(23.9)**	63(20.1)**
	10-19	1,230	279(22.7)	352(28.6)	471(38.3)	309(25.1)	396(32.2)	364(29.6)
	20-	596	142(23.8)	196(32.9)	240(40.3)	141(23.7)	201(33.7)	212(35.6)
Physical burden	None	20	0( 0.0)**	0( 0.0)**	3(15.0)**	1( 5.0)**	1( 5.0)**	2(10.0)**
	Moderate	423	35( 8.3)	43(10.2)	70(16.5)	40( 9.5)	54(12.8)	66(15.6)
	Hard	1,005	207(20.6)	262(26.1)	350(34.8)	217(21.6)	300(29.9)	280(27.9)
	Very hard	692	239(34.5)	292(42.2)	373(53.9)	253(36.6)	317(45.8)	291(42.1)
Job control	Full control	305	58(16.6)**	71(20.3)**	105(30.0)**	54(15.4)**	78(22.3)**	82(23.4)**
	Some control	1,186	246(20.7)	302(25.5)	419(35.3)	267(22.5)	352(29.7)	345(29.1)
	No control	604	177(29.3)	224(37.1)	272(45.0)	190(31.5)	242(40.1)	212(35.1)
	No	1,599	347(21.7)	440(27.5)	590(36.9)	374(23.4)	498(31.1)	465(29.1)

\*: p<0.05 by chi-square for trend test, comparison between subgroups

\*\* : p<0.01 by chi-square for trend test, comparison between subgroups

4) NIOSH Table 8 NIOSH /  
 가 20 30 , 40 , 50  
 가 가 ,  
 / 40 , 50 ,  
 50 (p<0.05).  
 가 (p<0.01).  
 NIOSH  
 가  
 5. (p<0.05),  
 NIOSH  
 가

**Table 6.** Positive rate of musculoskeletal symptoms by job (Kim 's criteria, N=2,140)

	No. of subjects	Hand/wrist (%)	Arm/elbow (%)	Shoulder (%)	Neck (%)	Low back (%)	Knee (%)
Welding	627	140(22.3)	164(26.2)	241(38.4)	164(26.2)	206(32.9)	207(33.0)
Mounting	479	110(23.0)	147(30.7)	181(37.8)	113(23.6)	164(34.2)	143(29.9)
Grinding, cleaning	98	34(34.7)	38(38.8)	50(51.0)	34(34.7)	34(34.7)	35(35.7)
Painting	101	36(35.6)	38(37.6)	54(53.5)	24(23.8)	38(37.6)	36(35.6)
Crane operating	55	2( 3.6)	3( 5.5)	7(12.7)	4( 7.3)	5( 9.1)	9(16.4)
Driving	55	8(14.5)	11(20.0)	19(34.5)	12(21.8)	14(25.5)	15(27.3)
Signaling	50	14(28.0)	21(42.0)	28(56.0)	16(32.0)	18(36.0)	19(38.0)
Machining	33	2( 6.1)	1( 3.0)	5(15.2)	2( 6.1)	4(12.1)	4(12.1)
Cutting	54	10(18.5)	16(29.6)	19(35.2)	18(33.3)	18(33.3)	21(38.9)
Pressing, bending	19	4(21.1)	4(21.1)	6(31.6)	5(26.3)	5(26.3)	5(26.3)
Electro-device constructive work	63	13(20.6)	19(30.2)	23(36.5)	15(23.8)	23(36.5)	17(27.0)
Electro-device repair	30	6(20.0)	7(23.3)	6(20.0)	4(23.8)	4(13.3)	5(16.7)
Heavy machinery repair	23	6(26.1)	7(30.4)	8(34.8)	8(34.8)	7(30.4)	7(30.4)
Platform establishment	20	4(20.0)	12(60.0)	12(60.0)	6(30.0)	10(50.0)	6(30.0)
Hammering	18	7(38.9)	9(50.0)	13(72.2)	7(38.9)	10(55.6)	8(44.4)
Machinery establishment	22	5(22.7)	6(27.3)	10(45.5)	7(31.8)	8(36.4)	5(22.7)
Marking	45	7(15.6)	7(15.6)	13(28.9)	10(22.2)	17(37.8)	17(37.8)
Steel sorting	12	1( 8.3)	2(16.7)	4(33.3)	2(16.7)	4(33.3)	5(41.7)
Quality control	29	3(10.3)	3(10.3)	6(20.7)	6(20.7)	6(20.7)	8(27.6)
Official work	43	4( 9.3)	1( 2.3)	3( 7.0)	3( 7.0)	4( 9.3)	1( 2.3)
Direction	15	2(13.3)	3(20.0)	3(20.0)	3(20.0)	5(33.3)	5(33.3)
Others	130	41(31.5)	51(39.2)	51(39.1)	27(20.8)	40(30.8)	34(26.2)
Unknown	105	22(21.0)	27(25.7)	34(32.4)	21(20.0)	28(26.7)	27(25.7)

10 10 3.72-5.58(NIOSH ), 3.16-4.69( ) .(Table 9, 10).

가 (p<0.05). NIOSH

가 가

(p<0.05).

5 가

가 0-3 가 4-7

1.53-2.00(NIOSH ), 1.24-2.10( ( , 1994), ), 8-11 1.98-2.78(NIOSH ), 1.86-3.44( ), 12-15 2.82-3.60 (NIOSH ), 2.25-2.93( ), 16-21

**Table 7.** Positive rate of musculoskeletal symptoms by type of main instrument used (Kim 's criteria, N=2,140)

	Subject	Hand/wrist (%)	Arm/elbow (%)	Shoulder (%)	Neck (%)	Low back (%)	Knee (%)
Gas cutter	231	53(22.9)	64(27.7)	81(35.1)	59(25.5)	76(32.9)	84(36.4)
Welding device	631	150(23.8)	179(28.4)	254(40.3)	172(27.3)	218(34.5)	209(33.1)
Grinder	177	55(31.1)	69(39.0)	79(44.6)	50(28.2)	59(33.3)	60(33.9)
Paint sprayer	50	14(28.0)	16(32.0)	25(50.0)	12(24.0)	17(34.0)	17(34.0)
Paint roller or brush	30	9(30.0)	6(20.0)	12(40.0)	5(16.7)	13(43.3)	9(30.0)
Impact wrench	97	24(24.7)	32(33.0)	41(42.3)	19(19.6)	34(35.1)	23(23.7)
Drill	40	9(22.5)	18(45.0)	19(47.5)	10(25.0)	14(35.0)	14(35.0)
Air hammer	13	2(15.4)	2(15.4)	5(38.5)	5(38.5)	8(61.5)	4(30.8)
Hammer	195	43(22.1)	57(29.2)	80(41.0)	51(26.2)	69(35.4)	67(34.4)
Press jack, lever block	44	11(25.0)	13(29.5)	15(34.1)	8(18.2)	12(27.3)	11(25.0)
Others	317	79(24.9)	101(31.9)	123(38.8)	78(24.6)	88(27.8)	84(26.5)
None	90	9(10.0)	18(20.0)	18(20.0)	14(15.6)	14(15.6)	12(13.3)
Unknown	225	23(10.2)	33(14.7)	44(19.6)	28(12.4)	50(22.2)	45(20.0)

**Table 8.** Positive rate of musculoskeletal symptoms by posture stability scale (N=2,140)

Scale	Subject	Hand/wrist** (%)	Arm/elbow** (%)	Shoulder** (%)	Neck** (%)	Low back** (%)	Knee** (%)
<b>NIOSH criteria</b>							
0-3	439	96(21.9)	87(19.8)	141(32.1)	89(20.3)	125(28.5)	114(26.0)
4-7	519	178(34.3)	188(36.2)	237(45.7)	172(33.1)	219(42.2)	214(41.2)
8-11	444	200(45.0)	200(45.0)	245(55.2)	182(41.0)	217(48.9)	217(48.9)
12-15	357	189(52.9)	189(52.9)	241(67.5)	191(53.5)	217(60.8)	196(54.9)
16-21	381	234(61.4)	254(66.7)	275(72.2)	240(63.0)	258(67.7)	265(69.6)
<b>Kim 's criteria</b>							
0-3	439	35( 8.0)	52(11.8)	95(21.6)	50(11.4)	71(16.2)	72(16.4)
4-7	519	91(17.5)	109(21.0)	149(28.7)	96(18.5)	139(26.8)	125(24.1)
8-11	444	117(26.4)	131(29.5)	170(38.3)	101(22.7)	140(31.5)	141(31.8)
12-15	357	92(25.8)	125(35.0)	167(46.8)	114(31.9)	136(38.1)	116(32.5)
16-21	381	146(38.3)	180(47.2)	215(56.4)	150(39.4)	186(48.4)	185(48.6)

\*\* : p<0.01 by chi-square for trend test, comparison between scale categories

가 . 가 (Hagberg , 1987; Torner , 1991). 가 (Boos , 1985).

NIOSH

**Table 9.** Odds ratios of factors related to musculoskeletal symptoms by multiple logistic regression  
(NIOSH criteria, N=2,140)

Factors		Odds ratio (95% Confidence interval)					
		Hand/wrist	Arm/elbow	Shoulder	Neck	Low back	Knee
Age (20-29)*	30-39	1.20 (0.73-1.97)	1.92 (1.12-3.30)	1.26 (0.77-2.07)	1.19 (0.73-1.97)	1.09 (0.67-1.78)	0.80 (0.49-1.31)
	40-49	1.05 (0.61-1.80)	2.19 (1.22-3.93)	1.19 (0.69-2.03)	0.95 (0.55-1.64)	1.06 (0.62-1.80)	0.88 (0.52-1.50)
	50-	1.27 (0.73-2.23)	3.35 (1.83-6.13)	1.44 (0.83-2.53)	0.93 (0.53-1.64)	1.21 (0.70-2.11)	1.12 (0.65-1.95)
Smoking (Non-smoker)*	Smoker	0.82 (0.68-0.99)	0.85 (0.71-1.03)	0.88 (0.73-1.06)	0.76 (0.63-0.92)	0.95 (0.79-1.14)	0.97 (0.81-1.17)
Drinking (Non-drinker)*	Drinker	1.34 (1.04-1.72)	1.24 (0.97-1.60)	1.23 (0.96-1.57)	1.21 (0.94-1.55)	1.12 (0.88-1.43)	1.37 (1.07-1.75)
Exercise (No)*	Yes	1.07 (0.86-1.32)	1.02 (0.82-1.26)	1.09 (0.88-1.34)	1.09 (0.88-1.35)	0.94 (0.77-1.16)	1.21 (0.98-1.49)
Duration of work (<10 yrs)*	10yrs	0.92 (0.65-1.32)	1.05 (0.73-1.52)	1.35 (0.95-1.92)	1.18 (0.83-1.69)	1.25 (0.88-1.77)	1.38 (0.97-1.97)
Physical burden (None+ moderate)*	Hard	1.90 (1.44-2.49)	1.99 (1.50-2.64)	1.96 (1.52-2.52)	1.67 (1.27-2.19)	1.92 (1.49-2.49)	1.36 (1.05-1.76)
	Very hard	3.15 (2.33-4.26)	3.36 (2.47-4.57)	3.33 (2.49-4.43)	2.25 (1.67-3.03)	2.72 (2.04-3.63)	2.14 (1.61-2.85)
Job control (Full control)*	Some control	1.18 (0.90-1.54)	1.25 (0.95-1.65)	1.14 (0.88-1.48)	1.31 (1.00-1.72)	1.03 (0.80-1.33)	1.34 (1.03-1.74)
	No control	1.18 (0.88-1.60)	1.36 (1.00-1.85)	1.17 (0.87-1.57)	1.37 (1.01-1.86)	1.15 (0.86-1.55)	1.25 (0.93-1.67)
Posture stability scale (0-3)*	4-7	1.59 (1.18-2.14)	2.00 (1.48-2.72)	1.53 (1.16-2.01)	1.71 (1.27-2.32)	1.59 (1.21-2.11)	1.85 (1.40-2.45)
	8-11	2.39 (1.76-3.24)	2.78 (2.03-3.80)	2.14 (1.61-2.85)	2.32 (1.71-3.17)	1.98 (1.49-2.65)	2.43 (1.81-3.25)
	12-15	2.97 (2.16-4.09)	3.39 (2.44-4.71)	3.27 (2.39-4.47)	3.60 (2.60-4.97)	2.97 (2.18-4.05)	2.82 (2.07-3.86)
	16-21	3.78 (2.73-5.27)	5.58 (3.99-7.80)	3.69 (2.68-5.08)	4.90 (3.53-6.81)	3.72 (2.72-5.11)	5.07 (3.67-7.00)

\*Reference category

NIOSH 1 (Hales, 1994),

**Table 10.** Odds ratios of factors related to musculoskeletal symptoms by multiple logistic regression

(Kim 's criteria, N=2,140)

Factors		Odds ratio (95% Confidence interval)					
		Hand/wrist	Arm/elbow	Shoulder	Neck	Low back	Knee
Age (20-29)*	30-39	1.34 (0.71-2.54)	1.72 (0.83-3.60)	1.50 (0.85-2.66)	1.41 (0.75-2.65)	0.99 (0.56-1.74)	0.75 (0.42-1.34)
	40-49	1.31 (0.66-2.61)	2.87 (1.33-6.22)	1.64 (0.89-3.02)	1.31 (0.66-2.58)	1.03 (0.56-1.88)	0.92 (0.50-1.72)
	50-	1.95 (0.96-3.95)	4.56 (2.07-10.03)	2.54 (1.36-4.76)	1.74 (0.87-3.49)	1.27 (0.68-2.38)	1.38 (0.73-2.61)
Smoking (Non-smoker)*	Smoker	0.80 (0.64-0.99)	0.92 (0.75-1.14)	0.93 (0.76-1.12)	0.88 (0.71-1.09)	0.90 (0.74-1.10)	0.96 (0.78-1.17)
Drinking (Non-drinker)*	Drinker	1.24 (0.92-1.68)	1.20 (0.91-1.59)	1.05 (0.81-1.35)	1.14 (0.85-1.52)	1.21 (0.93-1.57)	1.28 (0.98-1.68)
Exercise (No)*	Yes	1.27 (1.00-1.63)	1.11 (0.88-1.41)	1.09 (0.87-1.35)	1.16 (0.92-1.48)	1.10 (0.88-1.38)	1.18 (0.95-1.48)
Duration of work (<10 yrs)*	10yrs	1.14 (0.74-1.75)	1.37 (0.89-2.13)	1.36 (0.93-1.98)	1.25 (0.83-1.90)	1.50 (1.01-2.23)	1.69 (1.11-2.56)
Physical burden (None+ moderate)*	Hard	2.18 (1.47-3.2 2)	2.24 (1.56-3.22)	2.06 (1.53-2.77)	1.97 (1.36-2.84)	2.26 (1.63-3.13)	1.60 (1.18-2.18)
	Very hard	3.85 (2.56-5.79)	4.00 (2.74-5.84)	4.06 (2.95-5.58)	3.50 (2.38-5.14)	3.90 (2.76-5.51)	2.77 (1.99-3.86)
Job control (Full control)*	Some control	1.08 (0.78-1.51)	1.08 (0.79-1.49)	1.02 (0.77-1.35)	1.33 (0.95-1.85)	1.22 (0.90-1.64)	1.14 (0.85-1.54)
	No control	1.22 (0.86-1.75)	1.36 (0.97-1.91)	1.08 (0.79-1.47)	1.51 (1.06-2.17)	1.39 (1.00-1.92)	1.10 (0.80-1.53)
Posture stability scale (0-3)*	4-7	2.10 (1.38-3.20)	1.70 (1.17-2.46)	1.24 (0.91-1.69)	1.50 (1.03-2.19)	1.60 (1.15-2.22)	1.45 (1.04-2.03)
	8-11	3.44 (2.27-5.22)	2.60 (1.80-3.77)	1.86 (1.36-2.54)	1.86 (1.27-2.73)	1.90 (1.36-2.66)	2.06 (1.47-2.88)
	12-15	2.91 (1.89-4.49)	2.93 (2.00-4.29)	2.32 (1.68-3.22)	2.64 (1.80-3.88)	2.25 (1.59-3.18)	1.89 (1.33-2.69)
	16-21	4.69 (3.08-7.15)	4.54 (3.12-6.62)	3.16 (2.28-4.39)	3.31 (2.27-4.84)	3.18 (2.26-4.49)	3.57 (2.53-5.04)

\*Reference category

NIOSH

가

가

( , 1998).

10

가

가  
NIOSH (Kiesler Finholt, 1988).

NIOSH , 가  
가 , 가  
가 , 가

20% 가

1 NIOSH 가  
355 , NIOSH (Kivimaki , 1992), /  
가 .

NIOSH

가 54  
kappa가 0.62 . 23 가

가 , / ( , 2002).

가 / 가 21 . 4 가 0 5

가 , 가 가 가

34.9%, 10% 가  
/ 31.3%, 30.1%, / 18.0% ,

NIOSH

( , 2000), , , , ,  
52.0%, 47.1%, / , , ,

39.4%, / 26.2%  
( , 1999). ( , 2000).

1 , 가 , ,  
70% 가 , ,  
가 , 가

가 , 가

(Hales, 1994) ,

(Bigos , 1991).

가 가 가



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