Musculoskeletal Discomforts among Assembly Team Members performing Assembly Welding Task

Fazilah Abdul Aziz (fazilahaa@ump.edu.my)[1], Zakri Ghazalli (zakri@ump.edu.my)[1], Nik Mohd Zuki Nik Mohamed (nikzuki@ump.edu.my)[1], Amri Isfar (amri@ingress.corp.com.my)[2] Nurul Shahida Mohd Shalahim (shahida@ump.edu.my)[1]

[1]Faculty of Mechanical Engineering, University Malaysia Pahang, 26600 Pekan, Pahang, Malaysia
[2]Safety, Health and Environment Department, Ingress Technologies Sdn Bhd, 48300, Rawang, Selangor, Malaysia

ABSTRACT

Work in the automotive assembly plant is physically strenuous and assembly team members are particularly at risk for developing symptoms of musculoskeletal discomforts (MSDs) compared to other sectors. The main aim of this study was to determine the prevalence rate of musculoskeletal discomforts based on the frequency, severity and performance interference among production assembly team members in an automotive component assembly plant. A cross-sectional study was carried out among the production assembly team members who performed manual assembly welding task. The Cornell Musculoskeletal Disorders Questionnaire (CMDQ) data sheets were used in interview with the assembly team members to obtain the prevalence of MSDs. The prevalence of pain in the upper back, lower back, right shoulder and right wrist have been reported to be higher in comparison with pain in other parts of the body. The current study identified the severe musculoskeletal discomfort allies with production assembly line. Assembly team member's lines 4 were reported high mean frequency discomfort, severely discomfort and interfered assembling task performance. It has been discovered; nonetheless, that assembly team member's assembling task performance has interfered with lower back pain. MSD's survey appeared to be very helpful to screen the production assembly team member's health,well-being and performance. The results are also useful for assessing the ergonomics risks factors in the future study.

Keywords: Musculoskeletal discomforts (MSDs), Assembly team members, Assembly Plant

1. Introduction

The manufacturing sector needs to perform continuous improvement on the working environment to facilitate the company to sustain in the global competition. Being competitive includes not only focus on production performance as well as giving attention to the workforce, all the more particularly the employee's health and wellbeing (Okun, Guerin, & Schulte, 2016; Tong, Rasiah, Tong, & Lai, 2015). Musculoskeletal discomforts (MSDs) signify one of the main sources of occupational injury and disability in the automotive industry (Ferguson, Marras, Gary Allread, Knapik, & Splittstoesser, 2012; Zare, Mlinge-Oudenet, Hoglund, Biau, & Roquelaure, 2016).

According to Ferguson et al., (2012), body movement will cause the skeletal muscle produce large internal forces on the joints, tendons, and nerve, which may lead to MSDs. In the manufacturing industry, the work movements are repetitive and awkward postures often cause pain in the body region (Anita, Yazdani, Hayati, & Adon, 2014; Aqlan, Lam, Testani, & Ramakrishnan, 2013).

MSDs due to high physical activities are common in the automotive industry. However, it's still uncertain which MSDs of the body are to be expected in the production assembly team members in the automotive component assembly plant. It is also unclear which assembly line could produce high prevalence of MSD rates. The Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) was chosen to measure the level of MSD among production assembly team members related to their ergonomic situation. CMDQ is easy to understand, fast, efficient and collectively applicable methods for the assessment of MSD. The main aim of this study was to determine the prevalence rate of MSDs based on the frequency, severity and assembling task performance interference among production assembly team members in an automotive assembly plant.

2. Method

The current study data were collected by conducting structure interview with all participants by referring to the CMDQ (Hedge, 1999). The responses on the frequency scale, the severity scale, and the assembly performance interference scale can be given predefined discomfort scores. Total discomfort score was calculated by using the following formula.

Discomfort score = Discomfort frequency × Severity of discomfort × Performance interference (1)

Participants were the assembly team members performed manual assembly welding task from various assembly lines. The sample size for this study was 40% from the total production assembly team members who worked in the different shift including normal shift, day shift and night shift. All of respondents were male. Each assembly line unit produces different components based on carmakers vehicle model. Given the variation in an assembly line, there are extra or different tasks which cause variations in musculoskeletal discomforts.

3. Results

There were four body parts with musculoskeletal discomfort (MSDs) prevalence rates about equivalent and above 60% were included in further investigations (refer Table 1). These body parts were the lower back (75.4%), right shoulder (61.4%), right wrist (60%) and upper back (63.2%). These four body parts involved the highest assembly process performance interference with rates of 70.1%, 50.6%, 50.6% and 54.4%, respectively. As displayed in Table 2 assembly team members from line 4 was reported high mean frequency discomfort ratings (> 2.0) for lower back, right shoulder, and upper back, except for right wrist.

Meanwhile, the high severity score was reported by assembly team member's line 4 for all prevalence MSD body (refer Table 3). As presented in Table 4, assembly team member's line 4 has involved the highest assembling task performance interference for all prevalence MSD. The lower back pain was found a high rate of assembly performance interference for line 2, line 4 and line 5. In the meantime, assembly team member's line 5 also has involved assembly performance interference with rates of 100% due to upper back pain.

Table 1. The prevalence and assembly activity interference of musculoskeletal discomfort

Body regions	Frequency Discomfort					Severity Discomfort			Interference with assembly activities			Discomfort score
	Never n (%)	1-2 times last week n (%)	3-4 times last week n (%)	Once every day n (%)	Several times every day n (%)	Slightly n (%)	Moderately n (%)	Severely n (%)	Not at all n (%)	Slightly n (%)	Substantially n (%)	Mean (SD)
Lower Back	**14 (24.6)**	**19 (33.3)**	**9 (15.8)**	**10 (17.5)**	**5 (8.8)**	**17 (29.8)**	**13 (22.8)**	**13 (22.8)**	**3 (5.3)**	**29 (50.9)**	**11 (19.3)**	**5.16 (7.24)**
Shoulder R	**22 (38.6)**	**12 (21.1)**	**12 (21.1)**	**8 (14)**	**3 (5.3)**	**16 (28.1)**	**14 (24.6)**	**5 (8.8)**	**6 (10.8)**	**21 (37.9)**	**7 (12.6)**	**3.09 (5.53)**
Lower Leg L	28 (50)	12 (21.4)	8 (14.3)	7 (12.5)	1 (1.8)	13 (23.2)	10 (17.9)	**5 (8.9)**	4 (7.1)	17 (30.4)	7 (12.5)	2.89 (5.47)
Wrist R	**23 (40.4)**	**16 (28.1)**	**8 (14.0)**	**8 (14.0)**	**2 (3.5)**	**15 (26.3)**	**13 (22.8)**	**6 (10.5)**	**5 (9.0)**	**20 (36.1)**	**8 (14.4)**	**2.72 (4.58)**
Lower Leg R	28 (48.3)	13 (22.4)	9 (15.5)	7 (12.1)	1 (1.7)	14 (24.1)	11(19.0)	**5 (8.6)**	6 (10.3)	16 (27.6)	8 (13.8)	2.70 (5.35)
Upper Back	**21 (36.8)**	**21 (36.8)**	**5 (8.8)**	**6 (10.5)**	**4 (7)**	**15 (26.3)**	**13 (22.8)**	**8 (14.0)**	**5 (8.8)**	**27 (47.4)**	**4 9 (7.0)**	**2.59 (5.01)**
Shoulder L	24 (44.4)	12 (22.2)	8 (14.8)	9 (16.7)	1 (1.9)	14 (25.9)	12 (22.2)	**4 (7.4)**	6 (11.1)	18 (33.4)	6 (11.1)	2.58 (4.81)
Wrist L	27 (47.4)	15 (26.3)	8 (14)	6 (10.5)	1 (1.8)	11 (19.3)	15 (26.3)	4 (7.0)	4 (7.0)	21 (36.8)	5 (8.8)	2.05 (3.27)
Knee L	39 (69.6)	8 (14.3)	4 (7.1)	3 (5.4)	2 (3.6)	7 (12.5)	8 (14.3)	2 (3.6)	7 (13.3)	7 (13.3)	2 (3.8)	2.02 (7.48)
Lower Arm R	34 (58.6)	12 (20.7)	5 (8.6)	5 (8.6)	2 (3.4)	12 (20.7)	8 (13.8)	4 (6.9)	4 (6.9)	15 (25.9)	5 (8.6)	1.83 (4.03)
Lower Arm L	36 (63.2)	10 (17.5)	7 (12.3)	3 (5.3)	1 (1.8)	9 (15.8)	10 (17.5)	2 (3.5)	4 (7.4)	12 (22.1)	4 (7.4)	1.46 (3.47)
Upper Arm R	27 (46.6)	22 (37.9)	4 (6.9)	4 (6.9)	1 (1.7)	17 (29.3)	11 (18.9)	3 (5.2)	6 (11.0)	20 (36.8)	3 (5.5)	1.40 (3.17)
Knee R	39 (66.1)	10 (16.9)	5 (8.5)	4 (6.8)	1 (1.7)	10 (16.9)	7 (11.86)	3 (5.08)	5 (8.9)	12 (21.4)	2 (3.6)	1.36 (4.15)
Neck	33 (55.9)	17 (28.8)	4 (6.8)	5 (8.5)	0	11 (18.7)	11 (18.7)	4 (6.8)	5 (9.2)	18 (33.1)	1 (1.8)	1.33 (3.07)
Upper Arm L	30 (51.7)	19 (32.8)	5 (8.6)	3 (5.2)	1 (1.7)	15 (25.9)	11 (19.0)	2 (3.5)	6 (10.7)	18 (32.2)	3 (5.4)	1.26 (3.00)
Thigh L	36 (64.3)	12 (21.4)	5 (8.9)	2 (3.6)	1 (1.8)	9 (16.1)	10 (17.9)	1 (1.8)	8 (13.6)	13 (22.1)	0 (0)	1.01 (2.50)
Hip/Buttocks	45 (78.9)	6 (10.5)	3 (5.3)	1 (1.8)	2 (3.5)	5 (8.8)	6 (10.6)	1 (1.8)	4 (6.0)	9 (13.6)	1 (1.5)	0.77 (3.30)
Thigh R	38 (67.9)	9 (16.1)	6 (10.7)	2 (3.6)	1 (1.8)	9 (16.1)	8 (14.3)	1 (1.8)	7 (13.6)	12 (23.2)	0 (0)	0.75 (1.99)

Table 2. The frequency and discomfort score of prevalence musculoskeletal discomfort among assembly line

Assembly line	n	Lower back		Right shoulder		Right wrist		Upper back	
		Frequency discomfort	Discomfort score	Frequency discomfort	Discomfort score	Frequency discomfort	Discomfort score	Frequency discomfort	Discomfort score
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Line 1	19	1.47 (1.35)	6.32 (9.12)	1.21 (1.51)	3.84 (7.30)	0.95 (1.27)	3.31 (6.14)	1.11 (1.20)	3.11 (6.02)
Line 2	16	1.53 (1.30)	4.47 (5.50)	0.75 (0.86)	1.13 (1.64)	0.88 (0.96)	2.19 (3.35)	1.00 (1.15)	2.25 (3.34)
Line 3	12	1.25 (1.05)	1.75 (2.30)	1.58 (1.16)	2.10 (2.33)	1.00 (1.13)	1.45 (3.08)	1.25 (1.36)	0.40 (0.70)
Line 4	3	**2.67 (0.58)**	**14.67 (5.77)**	**2.67 (0.58)**	**16.0 (3.46)**	1.67 (0.58)	**4.00 (2.00)**	**2.33 (1.53)**	**10.67 (11.72)**
Line 5	9	1.78 (1.39)	5.22 (7.92)	1.44 (1.13)	1.56 (1.42)	**1.78 (1.48)**	3.55 (5.05)	1.00 (1.12)	1.89 (2.85)

Table 3. Prevalence rate of musculoskeletal discomforts and severity discomfort among assembly line

MSDs	Lower back				Right shoulder				Right wrist				Upper back			
	∑n	SLU	MLU	SVU	∑n	SLU	MLU	SVU	∑n	SLU	MLU	SVU	∑n	SLU	MLU	SVU
		n (%)	n (%)	n (%)		n (%)	n (%)	n (%)		n (%)	n (%)	n (%)		n (%)	n (%)	n (%)
Line 1	15	6 (40)	3 (20)	6 (40)	10	5 (50)	3 (30)	2 (20)	9	3 (34)	4 (44)	2 (22)	11	3 (27)	6 (55)	2 (18)
Line 2	11	3 (27)	5 (46)	3 (27)	7	3 (43)	4 (57)	0	9	4 (45)	3 (33)	2 (22)	10	4 (40)	3 (30)	3 (30)
Line 3	8	4 (50)	4 (50)	0	8	4 (50)	4 (50)	0	6	4 (66)	1 (17)	1 (17)	7	6 (86)	1 (14)	0
Line 4	3	0	0	**3 (100)**	3	0	0	**3 (100)**	3	0	2 (67)	**1 (33)**	3	0	1 (33)	**2 (67)**
Line 5	7	4 (57)	1 (14)	2 (29)	7	4 (57)	3 (43)	0	7	4 (57)	3 (43)	0	5	2 (40)	2 (40)	1 (20)

Table 4. Prevalence musculoskeletal discomforts based on the interference with assembly activities

MSDs	Lower back				Right shoulder				Right wrist				Upper back			
	∑n	NAL	SLI	SUI	∑n	NAL	SLI	SUI	∑n	NAL	SLI	SUI	∑n	NAL	SLI	SUI
		n (%)	n (%)	n (%)		n (%)	n (%)	n (%)		n (%)	n (%)	n (%)		n (%)	n (%)	n (%)
Line 1	15	2 (13)	7 (47)	6 (40)	10	2 (20)	5 (50)	3 (30)	9	1 (11)	5 (56)	3 (33)	11	1 (9)	9 (82)	1 (9)
Line 2	11	0	**9 (82)**	**2 (18)**	7	1 (14)	5 (72)	1 (14)	9	1 (11)	5 (56)	3 (33)	10	1 (10)	8 (80)	1 (10)
Line 3	8	1 (12)	7 (88)	0	8	2 (25)	5 (62)	1 (13)	6	3 (50)	3 (50)	0	7	3 (43)	4 (57)	0
Line 4	3	0	**1 (33)**	**2 (67)**	3	0	0	**3 (100)**	3	0	**3 (100)**	0	3	0	**2 (67)**	**1 (33)**
Line 5	7	0	**5 (71)**	**2 (29)**	7	1 (14)	6 (86)	0	7	1 (14)	4 (57)	2 (29)	5	0	**5 (100)**	0

NAL = Not at all, SLI = Slightly interfered, SUI = Substantially interfered

4. Discussions

The current study contributed additional evidence to literature about the considerable prevalence of musculoskeletal discomfort among an automotive component assembly team member. The study identified the severe musculoskeletal discomfort allies with production assembly line. This finding is consistent with findings of past studies by (Farioli et al., 2014; Roquelaure, 2016; Yu et al., 2012), which showed that musculoskeletal disorders are main causes of work disability among the employees and also can give very serious effects on employee's health and efficiency. Furthermore, this study was pointed to noticeable assembly performance interference due to musculoskeletal discomfort among participants. The research study by (Mehta & Agnew, 2013; Mehta, Nussbaum, & Agnew, 2012) reported that the interaction between physical and mental demands, will

produce higher force levels result in greater physiological reactivity to added mental workload and obstructs worker performance.

4. Conclusion

In conclusion, this study indicated that the prevalence of pain in the upper back, lower back, right shoulder and right wrist have been reported to be higher in comparison with pain in other parts of the body. Current study also found that the feeling of discomfort, subjectively felt by assembly team member's line 4 was higher than other lines. It has been revealed; nonetheless, that assembling task performance has interfered with lower back pain among assembly team members. Musculoskeletal discomfort survey seemed to be very helpful to screen the production assembly team members' health, well-being and performance. The results are also useful for assessing the ergonomics risks factors in the future study.

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