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MUSCULOSKELETAL DISCOMFORT ANALYSIS IN MOBILE CRANE OPERATIONS

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Abstract - *Although mobile cranes are well suitable for lifting and moving the loads, there are factors that cause musculoskeletal disorders to the mobile crane operators, such as seriously contorted stances, prolonged sitting and inadequately composed work environments ultimately leading to low productivity. The main objective of this study is to investigate subjective assessment of musculoskeletal distress surveyed by the portable crane administrators utilizing the Cornell musculoskeletal discomfort questionnaire. A total of 18 mobile crane operators aged between 20-52 years were selected in a heavy manufacturing industry for this study. The study revealed that mobile crane operators felt most of the musculoskeletal discomfort at hip (28.9%) and in the lower back (23.25%). Discomfort was less pronounced in the Left fore arm (0.3%) and in the right fore arm (0.38%). Specifically, the results revealed that 10 out of 18 (55.55%) mobile crane operators sensed discomfort in the hip once in a day; 10 out of 18 (55.55%) mobile crane operators reported discomfort was moderate and above. Because of this, 11 (61.11%) and 7 (38.89%) operators individually have felt slight and generous level of distress that affects their capacity to work.*

Keywords: Musculoskeletal disorders; Cornell musculoskeletal discomfort questionnaire; Discomfort; mobile crane operators

1.INTRODUCTION

Productivity is an essential marker of monetary development of an industry. The productivity mainly depends on the operator performance. This can be accomplished just when they are agreeable in their work environments intended for their best execution. Poorly designed work stations, force operator to perform at awkward postures, which leads to Musculoskeletal Disorders (MSD), thereby reducing their efficiency and productivity. There are factors that cause MSD to the mobile crane operators such as severely twisted postures, prolonged sitting and ineffectively planned working environments. The road profile and the condition of the tires also influence the development of MSD to the operators. Among these one of the major factors to develop the MSD is not having a work system design fully incorporating anthropometry based ergonomics. The working stances of the operators can be impacted by numerous variables, for example, workstation design, area and introduction of work, singular work techniques and the workers' anthropometric attributes. The operator's workplace, which includes the operator cabin, exposure to noise and the driving posture, needs to be considered as a stress factor contributing to the operational health status. The driver's situation in the lodge is firmly identified with the measurements of the workstation and to the customizability of the seat, specifically, standard seats have been believed to be inadmissible for both small and substantial drivers. Poor body posture and inadequate seat support have been described as cofactors in the pathogenesis of MSD of the spine in operators. Therefore, seat comfort has attracted much research focus and continues to receive more support of the automotive industry. Seating discomfort can be highly subjective as different people may assess it differently based on factors like environment, the nature of the task at hand and other internal conditions . Considering these, versatile crane administrator needs appropriate seating course of action to forestall cumbersome stances amid the activity, through this, their issues in regards to the MSD can be reduced and in the meantime productivity will be expanded. This is a preliminary study to investigate the prevalence of MSD problems among the mobile crane operators working in heavy equipment manufacturing industry. The result of this study will be used to further investigate the effect of the MSD on the operator's productivity.

2. MATERIALS AND METHODS

2.1. Operators data

A study was conducted among the mobile crane operators in a heavy equipment manufacturing industry. Total 18 mobile crane operators (100% of all male operators) in the age group between 20-52 years participated in this study. The minimum and maximum height of the operator was 145 cm and 170 cm respectively. The minimum and maximum weight was 50 kg and 91 kg respectively. The minimum and maximum number of years of experience in operating the forklift was 2 years and 18 years respectively. All operators were provided with the information about the study and consent was obtained from all operators prior to their participation in the study. None of the operators involved reported with health issues that are likely to affect or to be affected by participation in this study.

2.2. Mobile crane survey

In this survey about 18 mobile crane consisting types of 2 diesel operated from makes of Ace and escort respectively are operated by the contractors. All mobile

cranes are of 10 tons to 12 tons capacity. In this industry , mobile cranes are used to lift and transport large jobs like valve bodies, pipes and other heavy metals weighing 8 to 12 tons. These materials are transported within the shop floor or to other workshops and even materials shipped for a distance of 1.5 km. While transporting heavy jobs like valve body packing, mobile cranes have to be driven in reverse direction because the jobs will block the front vision of the operator. Therefore, in such situations, operators must twist their trunk to get visibility. It is interesting to know that, most of the mobile cranes were not provided with seat height (vertical) adjustment mechanism.

2.3. Discomfort assessment

Discomfort assessment was carried out using the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ). The CMDQ is a 54-item questionnaire containing a body map diagram and questions about the prevalence of musculoskeletal ache, pain or discomfort in 20 regions of the body during the previous week. It has been used in the assessment of musculoskeletal discomfort among different working populations, such as nursing personnel and Computerized Numeric Control machine operators. To determine the frequency of discomfort and quantify the discomfort level, the musculoskeletal discomfort score was calculated as per the CMDQ scoring guidelines. The musculoskeletal discomfort score was calculated as follows. First, the frequency of discomfort reported by the operators during the survey was scored as: Never (0), 1 or 2 times/week (1.5), 3 or 4 times/week (3.5), every day (5), or several times every day (10). The score obtained is then multiplied by the severity score (slightly uncomfortable = 1, moderately uncomfortable = 2, very uncomfortable = 3) and interference score (Not at all = 1, slightly interfered = 2, substantially interfered = 3) to arrive at the weighted musculoskeletal discomfort score. This helped to identify the most severe cases.

3. RESULTS AND DISCUSSIONS

3.1. Discomfort assessment

In this study face to face interview was conducted to obtain the discomfort information from the mobile crane operators and their operations were also observed directly in their course of work. Normal working shift hours for the mobile crane operation was from 8 to 16.30 hours and in-between there are three breaks such as morning break (10 minutes), lunch break (30 minutes) and afternoon break (10 minutes). Most operators are operating the mobile crane from 5 to 6 hours a day. The questionnaire results are shown in Table 1 and Table 2. According to Table 1, more specifically the results revealed that, in the hip, 11.11% of the mobile crane operators reported discomfort 3 to 4 times in a week, 55.55% reported the discomfort daily and 33.33% had discomfort several times a day. Further results revealed that, 10 out of 18 (55.55%) mobile crane operators expressed that, discomfort level was moderate and above in the hip, because of this, 11 operators assessed that, this discomfort has slightly interfered with their ability to work and 7 out of 18 mobile crane operators assessed that substantially have an effect on their ability to work. Similarly, in the lower back, 44.44% experienced discomfort 3 to 4 times in a week, 22.22% reported the discomfort daily and 33.33% had discomfort several times a day. 32 out of 47 (68.09%) forklift operators sensed discomfort was moderate and above in the neck, because of this 13 out of 18 and 5 out of 18 mobile crane operators were assessed that, this discomfort slightly and substantially had an effect on their ability to work respectively. According to Table 2, mobile crane operators felt most of the musculoskeletal discomfort in the hip (28.9%) and in the lower back (23.25%), while the discomfort is the least pronounced in the left fore arm (0.3%) and in the right fore arm (0.38%). The study suggests that, the causative factors may be the seat heights widely vary from the anthropometrically recommended value and the prolonged sitting time during transporting the heavy jobs.

Body parts	During last work week how often did you experience ache, pain, discomfort in:					If you experienced ache, pain, discomfort, how uncomfortable was this?			If you experienced ache, pain, discomfort, did this interfere with your ability to work?		
	Never	1-2 times last week	3-4 times last week	Once every day	Several times every day	Slightly uncomfortable	Moderately uncomfortable	Very uncomfortable	Not at all	Slightly interfered	Substantially interfered
Neck	9	3		6		8	1		7	2	
Shoulder(r)	4	3	4	6	1	9	5		8	6	
Shoulder(l)	3	7	6	2		14	1		13	2	
Upperarm(r)	4	7	5	1	1	10	3	1	11	3	
Upperarm(l)	4	8	5	1		12	2		13	1	
Upper back	7	1	5	4	1	9	2		8	3	
Lower back			8	4	6	3	6	9		12	6

Forearm(r)	7	7	3	1		11			11		
Fore arm(l)	8	6	3	1		10			10		
Hip			2	10	6		8	10		10	8
Knee(r)		5	1	10	2	13	5		13	5	
Knee(l)		4	2	10	2	9	9		9	9	
Lower leg(r)	5	3	10			10	3		10	3	
Lower leg(l)	2	2	8		6	6	9	1	7	8	1
Foot(r)	3	3	3	7	2	11	3	1	11	4	
Foot(l)	3	4	1	7	3	8	6	1	9	6	
Wrist(r)	2	3	8		5	11	3	2	13	2	1
Wrist(l)	3	7	8			13	2		13	2	
Thigh(r)	2	6	10			14	2		14	2	
Thigh(l)	2	6	9		1	12	4		12	3	1

Table 1: Subjects' variations of estimating the feeling of discomfort by using CMDQ

Body parts referred in the questionnaire	Frequency of discomfort	Intensity of discomfort	interference	Total discomfort score	%
Neck	34.5	10	11	3795	0.46
Shoulder(r)	58.5	19	20	22230	2.71
Shoulder(l)	41.5	16	17	11288	1.38
Upper arm(r)	43	17	17	12427	1.52
Upper arm(l)	34.5	16	15	8280	1.01
Upper back	49	13	14	8918	1.09
Lower back	108	42	42	190512	23.25
Fore arm(r)	26	11	11	3146	0.38
Fore arm(l)	24.5	10	10	2450	0.3
Hip	117	46	44	236808	28.9
Knee (r)	81	23	23	42849	5.23
Knee (l)	83	27	27	60507	7.38
Lower leg(r)	39.5	16	16	10112	1.23
Lower leg(l)	91	27	24	58968	7.2
Foot(r)	70	20	19	26600	3.25
Foot(l)	74.5	23	21	35983.5	4.39
Wrist(r)	82.5	23	20	37950	4.63
Wrist(l)	38.5	17	17	11126.5	1.35
Thigh(r)	44	18	18	14256	1.74
Thigh(l)	50.5	20	21	21210	2.59

Table 2: Total discomfort felt by the forklift operators

4. Conclusions

The study indicated that the feeling of discomfort, subjectively felt by mobile crane operators was higher in the lower back and hip. Further research is needed on the relationship between musculoskeletal discomfort and productivity. Hence the result of this study will be used to further investigate the effect of the MSD on productivity.

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