

# IDENTIFICATION OF ERGONOMIC RISK LEVELS IN FOUNDRY INDUSTRY BY CORNELL MUSCULOSKELETAL DISORDER QUESTIONNAIRES

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**Abstract** : Ergonomic is an important factor of any business. In Productivity improvement every factor play vital role. Hence Ergonomic is very much essential factor while considering Productivity Improvement. After visiting many small scale industries it was found that Ergonomics was hardly preferred. The Ergonomic Risks are most commonly found in Foundry section of any industry. Hence in order to improve productivity ergonomic risk factors in foundry section can be identified and minimized with the help of CMDQs. Cornell Musculoskeletal Disorder Questionnaires gives the Discomfort levels of different parts of body as well Left & Right Hand. The study was conducted for 15 workers in small scale Casting industry. Results are presented in Graphical format. According to Survey Average Score of each Body Part and Average of All MSDs of All Samples in % are calculated. According to which Lower Back part of body have higher percentage of both Average MSDs and Average Score. Higher percentage of MSDs in Left hand i.e. 40.99 % in Upper Palm. Whereas Higher percentage of MSDs in Right hand i.e.36.84 % in Upper Palm.

**IndexTerms** - Cornell Musculoskeletal Disorder Questionnaires, Discomfort, MSDs, Ergonomic Risks.

## I. INTRODUCTION

The Survey of different 15 Workers in the small scale Casting industry is carried out and fill the Cornell (CMDQ) sheets. The sheets gives us the discomfortable level of workers and most common part of body caused due to MSDs.

### Cornell Musculoskeletal Disorder Questionnaires :

The questionnaire (CMDQ) used in this study is comprised of three sections, as follows:

- Section A: In this section, a questionnaire was designed to cover personal work related profile information such as sex, age, work experience in years, height and current weight, and medical history (if any) of relevance to the ergonomic study.
- Section B: In this section, the part of the (CMDQ-part 1) questionnaire that covers objective pain related questions in different parts of body such as neck, shoulder, arm, back and lower limbs, etc.
- Section C: In this section, the part of the (CMDQ- part 2) questionnaire covers pain in the fingers, palm, and operational body parts. In terms of the musculoskeletal symptoms prevalence of the MSDs is recorded in this questionnaire like (ache, pain, discomfort) in preceding 4 months.

The Cornell Musculoskeletal Discomfortable Questionnaires (CMDQ) includes a diagram of human body (viewed from the back, divided into the twelve anatomical areas) to help the participants in identifying pain in the areas of the body. The questions are directed to three parameters: frequency, discomfort level and interference. Pain or discomfort felt by the respondents performing the same task for various body parts was ascertained in the same questionnaire. All workers could not answer all the questions in a single session and the questionnaire for each worker was followed up with a minimum of three sessions so that each of them could regularly experience the pain in specific regions and then point out the severity of the symptom with better accuracy. In some cases where in the respondents needed more than a month, data was collected over a spanned time frame and revalidated after a period of 15 days.[10]

The diagram below shows the approximate position of the body parts referred to in the questionnaire. Please answer by marking the appropriate box.

		During the 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	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Shoulder (Right)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Shoulder (Left)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Upper Back	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Upper Arm (Right)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Upper Arm (Left)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Lower Back	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Forearm (Right)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Forearm (Left)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Wrist (Right)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Wrist (Left)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Hip/Buttocks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Thigh (Right)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Thigh (Left)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Knee (Right)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Knee (Left)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Lower Leg (Right)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Lower Leg (Left)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Foot (Right)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Foot (Left)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Figure-1 : Objective pain related questions in different parts of body[10]

The shaded areas in the diagram below show the position of the body parts referred to in the questionnaire. Please answer by marking the appropriate box.

		During the 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
	Area A (Shaded area)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Area B (Shaded area)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Area C (Shaded area)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Area D (Shaded area)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Area E (Shaded area)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Area F (Shaded area)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Figure-2 : Objective pain related questions in Left Hand[10]

The shaded areas in the diagrams below show the position of the body parts referred to in the questionnaire. Please answer by marking the appropriate box.

**Complete only for RIGHT HAND**

Pinkie Ring Middle Index Thumb

	During the 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?
Area A (Shaded area)	Never <input type="checkbox"/> 1-2 times last week <input type="checkbox"/> 3-4 times last week <input type="checkbox"/> Once every day <input type="checkbox"/> Several times every day <input type="checkbox"/>	Slightly uncomfortable <input type="checkbox"/> Moderately uncomfortable <input type="checkbox"/> Very uncomfortable <input type="checkbox"/>	Not at all <input type="checkbox"/> Slightly interfered <input type="checkbox"/> Substantially interfered <input type="checkbox"/>
Area B (Shaded area)	Never <input type="checkbox"/> 1-2 times last week <input type="checkbox"/> 3-4 times last week <input type="checkbox"/> Once every day <input type="checkbox"/> Several times every day <input type="checkbox"/>	Slightly uncomfortable <input type="checkbox"/> Moderately uncomfortable <input type="checkbox"/> Very uncomfortable <input type="checkbox"/>	Not at all <input type="checkbox"/> Slightly interfered <input type="checkbox"/> Substantially interfered <input type="checkbox"/>
Area C (Shaded area)	Never <input type="checkbox"/> 1-2 times last week <input type="checkbox"/> 3-4 times last week <input type="checkbox"/> Once every day <input type="checkbox"/> Several times every day <input type="checkbox"/>	Slightly uncomfortable <input type="checkbox"/> Moderately uncomfortable <input type="checkbox"/> Very uncomfortable <input type="checkbox"/>	Not at all <input type="checkbox"/> Slightly interfered <input type="checkbox"/> Substantially interfered <input type="checkbox"/>
Area D (Shaded area)	Never <input type="checkbox"/> 1-2 times last week <input type="checkbox"/> 3-4 times last week <input type="checkbox"/> Once every day <input type="checkbox"/> Several times every day <input type="checkbox"/>	Slightly uncomfortable <input type="checkbox"/> Moderately uncomfortable <input type="checkbox"/> Very uncomfortable <input type="checkbox"/>	Not at all <input type="checkbox"/> Slightly interfered <input type="checkbox"/> Substantially interfered <input type="checkbox"/>
Area E (Shaded area)	Never <input type="checkbox"/> 1-2 times last week <input type="checkbox"/> 3-4 times last week <input type="checkbox"/> Once every day <input type="checkbox"/> Several times every day <input type="checkbox"/>	Slightly uncomfortable <input type="checkbox"/> Moderately uncomfortable <input type="checkbox"/> Very uncomfortable <input type="checkbox"/>	Not at all <input type="checkbox"/> Slightly interfered <input type="checkbox"/> Substantially interfered <input type="checkbox"/>
Area F (Shaded area)	Never <input type="checkbox"/> 1-2 times last week <input type="checkbox"/> 3-4 times last week <input type="checkbox"/> Once every day <input type="checkbox"/> Several times every day <input type="checkbox"/>	Slightly uncomfortable <input type="checkbox"/> Moderately uncomfortable <input type="checkbox"/> Very uncomfortable <input type="checkbox"/>	Not at all <input type="checkbox"/> Slightly interfered <input type="checkbox"/> Substantially interfered <input type="checkbox"/>

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Figure-3 : Objective pain related questions in Right Hand [10]

**Objectives :-**

1. Identify the Ergonomic risk levels for Foundry Industry by CMQs.
2. Analysis of MSDs percentage with the help of CMQs sheets.
3. Find out MSDs percentage for different Body parts and identify higher risk body part with the help of scoring charts.

**Methodology :-**

**Cornell Musculoskeletal Disorder Questionnaires:**

The Cornell Musculoskeletal Discomfortable Questionnaires (CMDQ) includes a diagram of human body (viewed from the back, divided into the twelve anatomical areas) to help the participants in identifying paining the areas of the body. The questions are directed to three parameters: frequency, discomfort level and interference.

➤ **Participants :-**

In this study, all the respondents (n=15) were categorized in 4 major age groups of 20-29 (13.33%), 30-39(46.66%), and 40-49(13.33%), 50-59(26.66). According to the survey results, 80% of all respondents' reported that they are not under any medication, 60 % of them are not performing any physical exercise, and 40% are doing some exercises.

➤ **Scoring of questionnaire :-**

In this study the total Score is analyzed by weighting the rating scores. It helps to identify the most serious problems easier. The scoring are as follows: Never = 0 ,1-2 times/week = 1.5 , 3-4 times/week = 3.5 ,Every day = 5 ,Several times every day = 10 . By multiplying the above Frequency score (0, 1.5, 3.5, 5, 10) by the Discomfort score (1, 2, 3) by the Interference score (1, 2, 3). The resulting scores range from 90 (very high) to 0(minimum value).This illustrates the score associated for each body part gathered from the questionnaire. [10]

## Result and Discussion:-

Table-1: Scoring Sheet for Body Parts

Workers Body Parts → ↓	1	2	3	4	5	6	7	8
Neck	3	6	14	14	14	14	14	14
Shoulder (Right)	1.5	6	6	14	14	14	1.5	14
(Left)	1.5	6	6	14	14	14	1.5	14
Upper Back	14	14	14	6	14	6	14	14
Upper Arm (Right)	14	6	14	20	14	20	6	6
(Left)	14	6	14	20	14	20	6	6
Lower Back	20	14	45	30	45	20	45	20
Forearm (Right)	1.5	20	14	14	14	3.5	14	7
(Left)	1.5	20	14	14	14	3.5	14	7
Wrist (Right)	3	14	6	6	14	7	14	14
(Left)	3	14	6	6	14	7	14	14
Hip/Buttocks	1.5	1.5	14	6	14	3.5	1.5	3
Thigh (Right)	14	14	14	14	14	20	20	14
(Left)	14	14	14	14	14	20	20	14
Knee (Right)	1.5	14	3	1.5	14	14	6	6
(Left)	1.5	14	3	1.5	14	14	6	6
Lower Leg (Right)	6	14	14	14	20	20	14	14
(Left)	6	14	14	14	20	20	14	14
Foot (Right)	1.5	1.5	1.5	1.5	6	14	3.5	1.5
(Left)	1.5	1.5	1.5	1.5	6	14	3.5	1.5

Workers Body Parts → ↓	9	10	11	12	13	14	15	TOAL SCORE
Neck	14	14	14	14	14	30	7	200
Shoulder (Right)	6	20	20	30	20	14	7	188
(Left)	6	20	20	30	20	14	7	188
Upper Back	14	14	20	20	20	20	20	224
Upper Arm (Right)	6	14	20	45	14	20	14	233
(Left)	6	14	20	45	14	20	14	233

Lower Back	14	14	14	30	14	20	20	365
Forearm (Right) (Left)	14	6	20	14	14	14	3.5	173.5
	14	6	20	14	14	14	3.5	173.5
Wrist (Right) (Left)	6	6	14	1.5	14	14	1.5	135
	6	6	14	1.5	14	14	1.5	135
Hip/Buttocks	14	14	14	14	14	14	1.5	130.5
Thigh (Right) (Left)	14	1.5	14	14	14	20	14	215.5
	14	1.5	14	14	14	20	14	215.5
Knee (Right) (Left)	6	14	14	14	14	14	20	156
	6	14	14	14	14	14	20	156
Lower Leg (Right ) (Left)	14	14	14	14	14	20	30	236
	14	14	14	14	14	20	30	236
Foot (Right) (Left)	14	1.5	7	14	1.5	1.5	6	76.5
	14	1.5	7	14	1.5	1.5	6	76.5

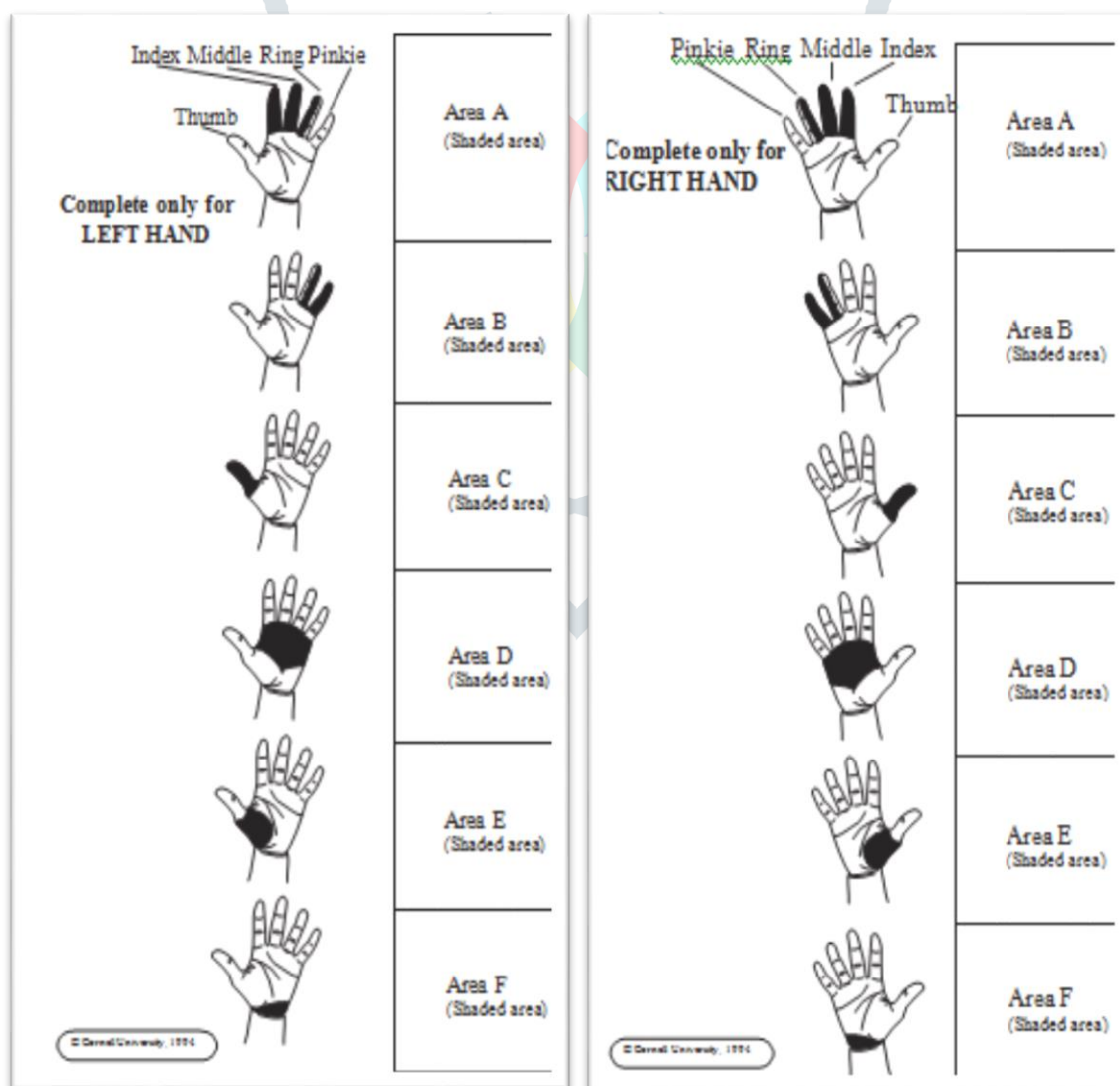


Figure-4 : Shaded Areas for Left Hand and Right Hand [10]

Table 2 :Scoring sheet for Left Hand

Workers Areas → ↓	1	2	3	4	5	6	7	8
Area A	3	14	14	14	14	14	14	14
Area B	1.5	14	6	14	14	6	6	14
Area C	1.5	14	1.5	3	14	1.5	1.5	6
Area D	14	21	30	30	40	40	45	30
Area E	1.5	14	14	14	14	3.5	14	14
Area F	0	1.5	14	14	3	3.5	1.5	14

Workers Areas → ↓	9	10	11	12	13	14	15	Total Score
Area A	14	14	14	45	14	14	1.5	217.5
Area B	14	30	14	14	6	14	6	173.3
Area C	3	20	1.5	14	1.5	6	1.5	90.5
Area D	45	90	20	90	20	14	3.5	532.5
Area E	14	14	14	20	1.5	14	3	169.5
Area F	6	14	14	20	1.5	7	1.5	115.5

Table 3 :Scoring sheet for Right Hand

Workers Areas → ↓	1	2	3	4	5	6	7	8
Area A	6	14	14	14	14	14	14	14
Area B	1.5	14	6	3.5	1.5	6	1.5	1.5
Area C	1.5	1.5	1.5	14	6	14	7	1.5
Area D	6	30	14	14	30	45	20	20
Area E	3	14	14	14	6	6	14	14
Area F	0	0	1.5	1.5	3	14	14	1.5

Workers Areas → ↓	9	10	11	12	13	14	15	Total Score
Area A	14	14	14	20	14	14	3	197
Area B	1.5	30	14	1.5	6	14	1.5	104
Area C	1.5	31.5	20	14	6	14	0	134
Area D	20	21	90	45	20	14	1.5	390.5
Area E	14	14	14	14	14	6	3.5	164.5
Area F	1.5	3.5	3.5	20	1.5	3	1.5	70

### Cornell Average Score charts and Graphs for All Body parts ,Right Hand and Left Hand

Average Score of each Body Part and Average of All MSDs of All Samples in % are calculated. According to which Lower Back part of body have higher percentage of both Average MSDs and Average Score.

TABLE 4 : AVERAGE SCORE OF EACH BODY PART AND AVERAGE OF ALL MSDs OF ALL SAMPLES IN %

Sr.No	NAME OF PART	TOTAL SCORE	AVERAGE OF MSDs OF ALL SAMPLES (%) [15 Workers x 90 =1350 ]	AVERAGE SCORE OF EACH BODY PART (%) [2363]
1	NECK	200	14.81	8.46
2	SHOULDER	188	13.92	7.95
3	UPPER BACK	224	16.59	9.47
4	UPPER ARM	233	17.25	9.86
5	LOWER BACK	365	27.03	15.44
6	FOREARM	173.5	12.85	7.34
7	WRIST	135	10	5.71
8	HIP /BUTTOCKS	130.5	9.66	5.52
9	THIGH	215.5	15.96	9.11
10	KNEE	156	11.55	6.60
11	LOWER LEG	236	17.48	9.98
12	FOOT /ANKLE	76.5	5.66	3.23
	<b>TOTAL</b>	<b>2363</b>		

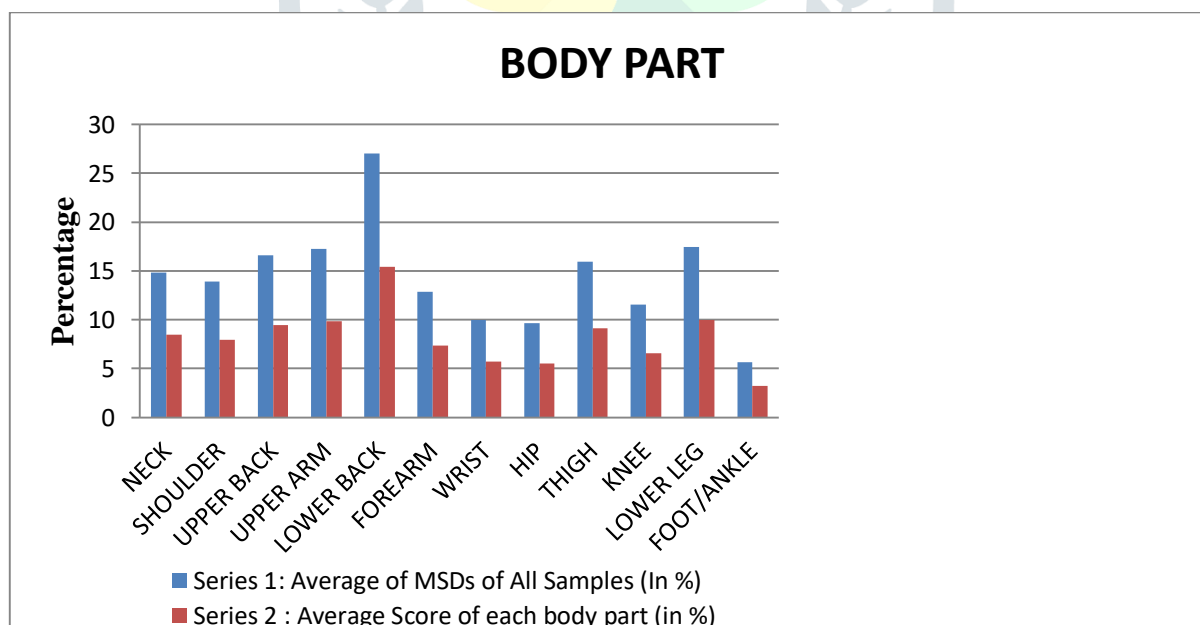


Figure-5 : Average score and sample percentage of all body part comparison

Average Score for Area-D : Upper Palm have Higher percentage of MSDs in Left hand. Average of MSDs for every Areas of Left hand can be shown in table. The graph for that can be shown in Figure 6

Table 5 : AVERAGE OF MSDs CALCULATION FOR LEFT HAND (%)

Sr.NO.	NAME	TOTAL SCORE	AVERAGE OF MSDs CALCULATION FOR LEFT HAND (%)
1	AREA -A : INDEX,MIDDLE,RING	217.5	16.74
2	AREA -B : RING,PINKIE	173.5	13.36
3	AREA -C : THUMB	90.5	6.97
4	AREA -D : UPPER PALM	532.5	40.99
5	AREA -E : THUMB,MIDDLE, PALM	169.5	13.05
6	AREA -F : LOWER PALM	115.5	8.89
TOTAL		1299	

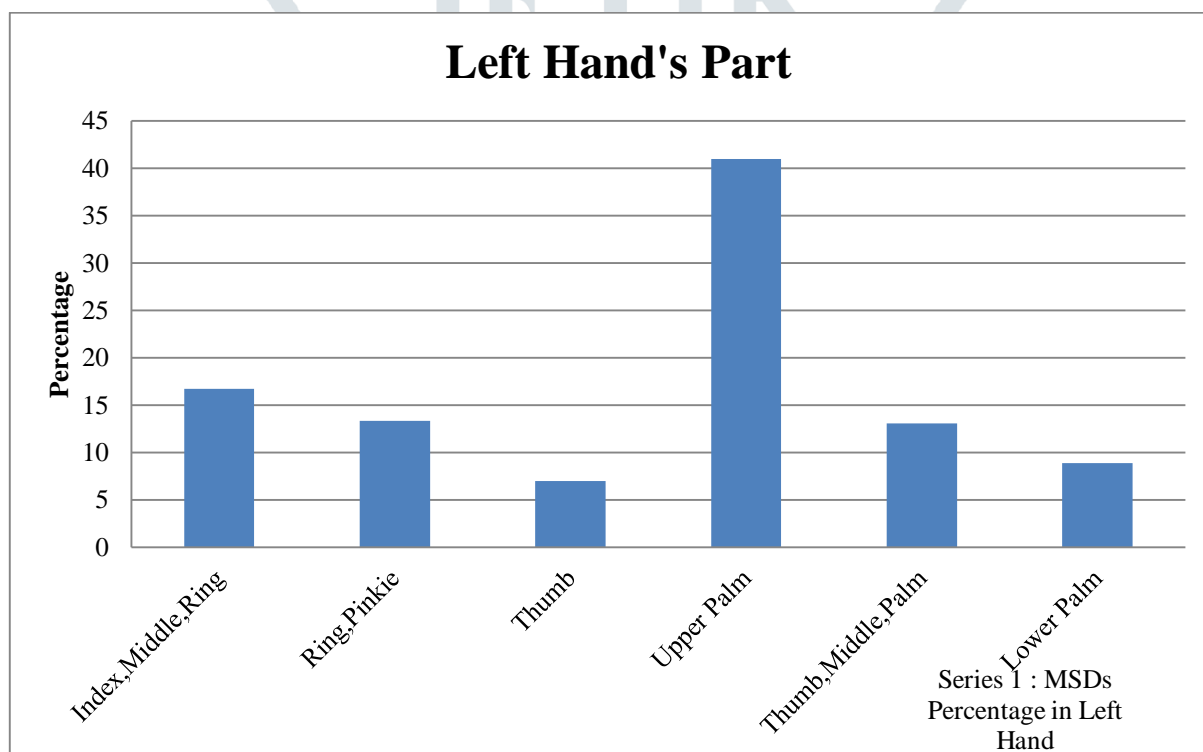


Figure-6 : MSDs Percentage in Left Hand

Average Score for Area-D : Upper Palm have Higher percentage of MSDs in Right hand. Average of MSDs for every Areas of Right hand can be shown in table. The graph for that can be shown in Figure 7.

Table-6 : AVERAGE OF MSDs CALCULATION FOR RIGHT HAND (%)

Sr.NO.	NAME	TOTAL SCORE	AVERAGE OF MSDs CALCULATION FOR RIGHT HAND (%)
1	AREA -A : INDEX,MIDDLE,RING	197	18.59
2	AREA -B : RING,PINKIE	104	9.81
3	AREA -C : THUMB	134	12.64

4	AREA -D : UPPER PALM	390.5	36.84
5	AREA -E : THUMB,MIDDLE PALM	164.5	15.52
6	AREA -F :LOWER PALM	70	6.60
TOTAL		1060	

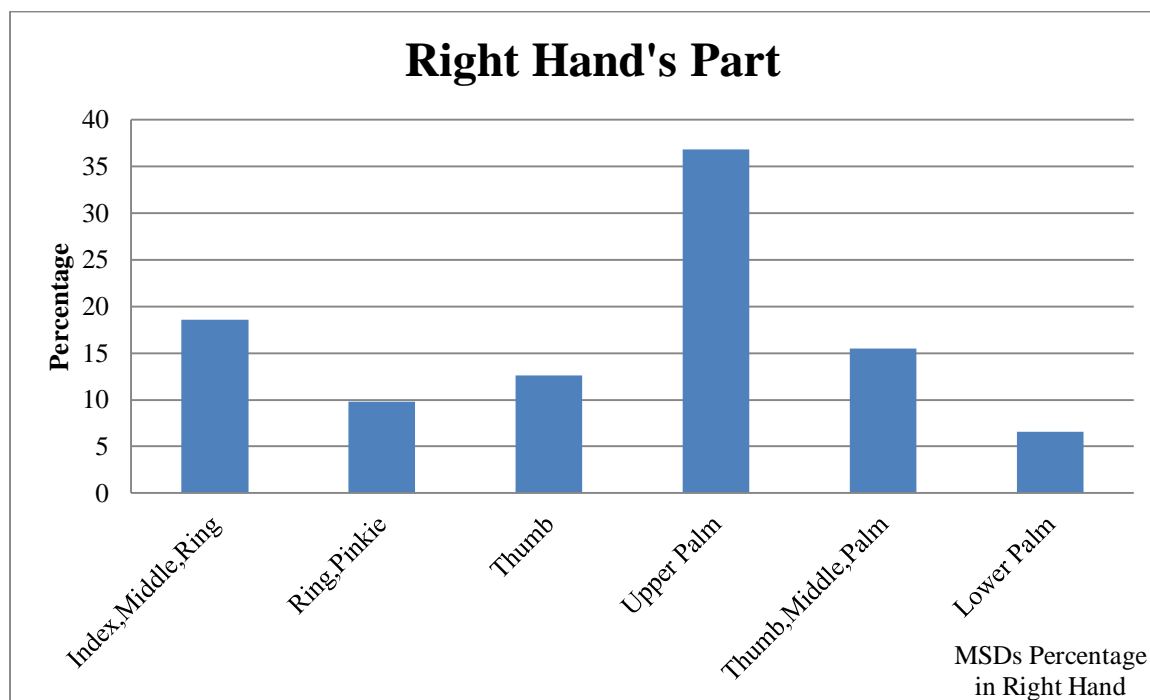


Figure-7 : MSDs Percentage in Right Hand

**Conclusion :-**

- According to Survey Average Score of each Body Part and Average of All MSDs of All Samples in % are calculated. According to which Lower Back part of body have higher percentage of both Average MSDs and Average Score.
- Higher percentage of MSDs in Left hand i.e. 40.99 % in Upper Palm.
- Higher percentage of MSDs in Right hand i.e. 36.84 % in Upper Palm .
- A cross sectional descriptive study in which a self-administered questionnaire (Body part discomfort survey) is used to assess the musculoskeletal symptoms among Foundry workers in small scale casting industry.

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