

Original Research Article

<https://doi.org/10.20546/ijcmas.2023.1209.022>

## An Ergonomic Study on Musculoskeletal Discomfort and Postural Stress among Workers involved in Stone Masonry Work

Neha Arya\* and Promila Sharma

*Department of Family Resource Management, College of Home Science, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India*

*\*Corresponding author*

### ABSTRACT

In India, especially in the high hills of Uttarakhand, stone masonry work, is a commonly known practice followed by hilly people to support their life. It is basically a labour-intensive job, where most of the activities are performed manually by workers due to the unavailability of advanced tools and technologies at Hills. That's why musculoskeletal discomfort and postural stress are some of the major health problems faced by stone masonry workers. Therefore the present study was planned with the following objectives, to assess the demographic profile of stone masonry workers, musculoskeletal discomfort, and postural stress among stone masonry workers involved in various activities. A total of 120 male stone masonry workers were selected. Methodology: An interview schedule was planned for collecting data regarding the demographic profile of workers, tools, and technologies adopted by workers while performing various activities. A modified Nordic Musculoskeletal Questionnaire was adopted for collecting data regarding MSDs. The Workplace Ergonomic Risk Assessment (WERA) tool was used for assessing postural stress among workers. The results revealed that workers were at high risk of musculoskeletal discomfort, they were vulnerable to be affected by a wide range of injuries and accidents. They work for 8-9 hours in mostly awkward postures and suffer from pain in various body parts; in the case of extraction, 58.82 percent and 64 percent of workers were suffering from lower back pain and wrist pain respectively. In breaking 81.25 percent of workers were having pain in their shoulders. In crushing shaping and layering activity 73.33 percent, 76.47 percent, and 38 percent of workers complained about pain in the wrist or hands. On the basis of the WERA score majority, i.e. 82.66 percent of the workers involved in various activities lay under the medium action level that indicates (the task needs to be further investigated and requires change). Immense attention, in the form of appropriate preventive measures, is needed to protect workers.

#### Keywords

Masonry work, musculoskeletal discomfort, postural stress, pain, tools

#### Article Info

**Received:**

28 July 2023

**Accepted:**

30 August 2023

**Available Online:**

10 September 2023

## **Introduction**

In India, especially in high hills of Uttarakhand, stone masonry work, is commonly known practice followed by rural hill people. It is basically a labour intensive job. In this work stones are widely used building material for residential purposes as well as for commercial purposes for construction of buildings, houses, cottages, roads, walls, floors and so on. In this work most of the activities are performed manually by workers.

Major activities, namely, extraction of large size stones from barren lands by using traditional tool i.e sabbal/ Crowbar, then breaking of stones into small sizes with ghan/sledgehammer, loading and unloading of stones from one place to other by putting load on their head, shoulder and back, crushing and shaping the edge of the stones with traditional hammer i.e further used in construction, and the last activity was layering of stones, to construct residential and commercial buildings. High physical exertion, forceful motions, awkward positions, hand-arm vibration, contact stress, and repetitive tasks are involved in stone masonry work. Most of the workers working in stone masonry are economically poor and have less employment opportunities, therefore it is considered as economically important informal sector and providing direct employment to local people.

On the other hand, stone masonry work is one of the most dangerous informal sectors to work because of the enormous health hazards and musculoskeletal disorders are associated with this work. The workers who are involved in this sector, hardly provided or using personal protective equipments and ergonomically designed tools while performing activities. The workers have to perform all the activities by own, using traditional tools hence met with musculoskeletal discomfort, postural stress and injuries.

Musculoskeletal discomfort consists of functional impairments and physical disabilities that affect the muscles, bones, nerves and joints. This is a major

health problem faced by stone masonry workers. Symptoms include tenderness, aches and pains, tingling, stiffness and swelling. Lower and upper back pain and muscles pain could be due to incorrect working posture, improper material handling and load carrying practices which also affects the cervical spine and neck muscles and end with severe pain.

Awkward postures, repetitive and forceful motions, hand-arm vibration are involved in stone masonry work that leads to burden on muscles and joints that increase their efforts in response to fatigue which leads to musculoskeletal discomfort (Okello *et al.*, 2020). There was an emerging need for undertaking research work in this area for protecting workers and reducing ill effects among workers. For that innovative measures and technologies were planned for preventing the workers and providing safe working environment to them.

The main objectives of this study to assess demographic profile of stone masonry workers involved in various activities. To assess tools and technology adopted by workers while performing various activities. To assess musculoskeletal discomfort among stone masonry workers involved in various activities. And also To assess postural stress among stone masonry workers involved in various activities.

## **Hypothesis of the study**

H<sub>0</sub> : There is no significant relationship between musculoskeletal discomfort and work status.

H<sub>0</sub> : There is no significant relationship between load carrying practices and musculoskeletal discomfort.

## **Materials and Methods**

The present study was purposively conducted in Kumaon Region of Uttarakhand in Nainital district under Dhari block in India. A total of 120 male stone masonry workers were selected, who were

involved in various activities, namely extraction of stones from barren lands, breaking of large sized stones into small sizes, loading and unloading of stones, crushing, shaping of stones and layering of stones.

Interview schedule was planned for collecting data regarding demographic profile of workers, tools and technologies adopted by them. Workplace Ergonomic Risk Assessment sheet (WERA) was adopted for assessing postural stress and Modified Nordic Musculoskeletal Disorder based questionnaire was adopted for assessing musculoskeletal discomfort among workers involved in various activities.

Sixty five percent of the workers from each activity were selected to make the sample size 75 for experimental data. All the responses received on the data sheet were categorized and analyzed using (frequency, percentage, standard deviation,) and relational statistics (Correlation Coefficient) were computed with the help of SPSS 16.

## **Results and Discussion**

The mean age of stone masonry workers was  $38.9 \pm 9.2$ . On the bases of activities the mean age of workers involved in extraction, breaking, loading and unloading, crushing, shaping and layering activities were  $34.70 \pm 4.99$ ,  $33.12 \pm 4.6$ ,  $36.32 \pm 6.9$ ,  $42 \pm 7.48$ ,  $53.52 \pm 7.6$  and  $38.33 \pm 6.9$  years, respectively.

On the whole maximum 40 percent workers were fall under the age group of 25-35 years of age and minimum 8.33 percent workers were fall under the age group of 55 and above. The mean income of the workers was  $7424 \pm 2531$  Rs /month.

On the bases of activities it was investigated that the mean income of workers involved in extraction, breaking, loading and unloading, crushing shaping and layering activities were  $7588 \pm 2150$ ,  $7406 \pm 2085$ ,  $7010 \pm 1877$ ,  $3300$ ,  $7058 \pm 1908$  and  $15000$  Rs/month respectively. Out of total 60.83 percent workers had joint and 39.16 percent workers had

nuclear families.

## **Employment status**

On the whole maximum workers, 95 percent were working as labours and rest 5 percent were working as mystery/craftsman in stone masonry work. On the bases of activities it was found that all of the workers involved in extraction, breaking, loading and unloading, crushing and shaping were working as labours and all of the workers involved in layering activity were working as mystery in stone masonry work.

## **Work status**

Out of total workers majority, 90.83 percent workers were permanent in stone masonry work and a few proportions of workers 9.16 percent were temporary in this work. The workers were permanent in nature, working mostly from Monday to Saturday normally throughout the year.

## **Working hours**

It was found that out of total workers majority 88.33 percent of the workers reported that they work for 8-9 hours per day and rest of the workers i.e 11.66 percent workers work for 9-10 hours per day.

## **Work exposure of stone masonry workers**

The results revealed the period of work exposure of the workers varies from 1- 6 years to more than 13 years. The results revealed that out of total workers about 51.66 percent of the workers had 7-12 years of work experience and lowest 11.66 percent of the workers had more than 13 years of work experience.

## **Method of work**

As far as the method of work was concerned, it was found that all of the workers involved in various activities were performing activities manually. None of them were using any machine for accomplishing the activity.

### **Reasons of involvement in stone masonry work**

Data regarding reasons of involvement in stone masonry work. In today's world it is become hard to get a good job without attaining a high qualification. When the family was large in size, the daily needs also increases, therefore it become a family occupation for local people. As far as reasons were concerned, it was investigated that out of total workers, maximum 80 percent workers said that unemployment was the main reason for working in this sector. Along with that, 54.16 percent workers reported poverty, 55 percent workers said they have no agricultural land, 36.66 percent said job opportunity, rest 24.16 percent workers were also reported that, less yield were the reasons for involving in stone masonry work. The results are in line with the study conducted by Subhasis *et al.*, (2018) among stone quarry workers and stated that it become a source of income and employment generation for hilly people. He revealed some of the factors such as (poverty, insufficient income low level of education, unemployment, climatic change and lack of agriculture production). All these factors were also covered under the present study and found the same reasons for involvement of workers in this sector.

### **Work status of workers**

On the bases of results, it was found that out of total workers maximum, 94.16 percent workers were carried out the same work almost the whole day. Majority, 80.83 percent of the total workers stated that the work was not rotated with their colleagues they had to work by their own without others help. On the whole it was found that all workers had to performed repetitive task many times in a day. Repetitive movement and years of working experience were significantly associated with the occurrence of the musculoskeletal discomfort. Repetition of task was the major risk factor of low back discomfort among workers. Majority 60.83 percent of the workers stated that breaks were never sufficient for a day. The reason may be tidiness and high physical exertion while performing activities.

As per the study conducted by Lalzirliani (2014) on stone quarry workers, reported that majority of the workers not having sufficient breaks for relaxation from their tough job that increase the risk of musculoskeletal discomfort among workers.

On the bases of comparison it was found that all workers involved in various activities were carry out their work all most in whole day. In case of extraction and breaking the work was rotated between their co-workers, to take a small break between the activities but in loading and unloading activity rotation of work between two persons was not common. They used to carry heavy loads on their head, shoulder and back. It was observed that all activities were repetitive in nature and required movement of arm, wrist and hands many times per day. Mostly crushing and shaping activities were performed at one place.

Table 1 visualizes data regarding posture adopted by workers while performing various activities. On the bases of findings, it was revealed that out of total workers, 55 percent of the workers were working in standing and 50.83 percent of the workers were working in knee bending position while 50.83 and 23.33 percent workers were working in back bending and squatting position respectively. Whereas a small proportion i.e 8.33 percent of the workers were performing activities in sitting position.

### **Tools used by workers while performing activities**

All the workers engaged in the activity of extraction were using traditional tool, crowbar/ sabbal for extraction of stones. Whereas, the total workers involved in breaking activity were using ghan/ Sledgehammer as a tool for breaking large size stones into small sizes. The workers were using hammer as a tool while performing activities like crushing, shaping and layering. None of the worker was using chisel and machine as a tool while performing activities.

### **Experience in manual handling of tools**

Data regarding experience in manual handling of various tools while performing various activities in stone masonry work by workers. All the workers involved in extraction activity were using sabbal/crowbar as a tool for extraction of stones, more than half, 64.70 percent of the workers reported that the tool they were using was not comfortable.

Due to heaviness and direct contact with hard surface of tool, they felt pain in palm, and sometimes they had calluses in palm portion and it became difficult for them to carry out the activity.

Hence they had complained regarding unavailability of hand machines at worksite for making their work easy and safe. Therefore all of the workers were at the high risk of musculoskeletal discomfort at work.

In case of breaking activity more than half of the workers i.e 62.5 percent of them reported that the tool they were using was not comfortable. About 66.66 percent of the workers involved in crushing activity said that the traditional tool (hammer) they were using was not comfortable and not having proper palm support for carry work easily.

Similarly a large proportion i.e 64.70 percent of the workers involved in shaping activity reported that the tool (hammer) they were using was not comfortable. It was observed that the tool they were using, were not having any hand support and they were continuously in contact with hard surface of those tools for 8-9 hours while performing the activities. Therefore they were suffering from musculoskeletal discomfort or pain especially in hands/wrist and palm portion of the hands.

In totality it was found that the tools used in all activities were not accepted by workers and they were not comfortable with these traditional tools and asked for improved and comfortable ergonomically designed tools. Similar study was conducted by

Anandraj *et al.*, (2017) among 321 hammering tool workers and it was revealed that the hammering workers were exposed to musculoskeletal discomfort mostly on the neck, wrist/hand and shoulder, when they work for 8-10 hours regularly with poorly designed tools. Same findings were also found in the present study.

Table 2 visualizes that on the bases of activities, it was found that none of the workers involved in extraction breaking, loading and unloading, crushing, shaping and layering activities, using gloves, facemask, helmet, tools with hand support and eye goggle. This may increase the risk of injuries and accidental hazards. It was also observed that the workers had poor knowledge regarding using of protective clothing, especially masks, gloves, head support, helmet and eye goggles during work.

Therefore all of the workers were at high risk of musculoskeletal discomfort, respiratory hazards, eye injuries, cuts and wounds. Similar study was conducted by Prasad *et al.*, (2014), who revealed that the workers involved in stone crushing industry were not using any protective equipment during task and suffering with musculoskeletal problems, eye problems and respiratory problems.

According to Fig 1 it was observed that since last 7 days, on the whole 47 percent of the extraction workers were suffering from neck pain. Nearly 17.64 percent workers suffered from pain in the upper back while more than half 58.82 percent were suffering from lower back pain. It was found that 64 percent of the workers had pain in wrist or hands in last 7 days. The reason may be continuous repetitive activities performed by workers with heavy tools.

According to Fig 2 it was observed that since last 7 days, on the whole 37.5percent of the workers involved in breaking activity were suffering from neck pain. About 44 percent workers suffered from pain in the upper back.

**Table.1** Working postures adopted by workers while performing activities

n =120

Activity Posture	Extraction (n1= 17)	Breaking (n2= 16)	Loading and unloading (n3= 49)	Crushing (n4= 15)	Shaping (n5= 17)	Layering (n6=6)	Total (n=120)
Standing	17 (100)	-	49 (100)	-	-	-	66 (55)
Squatting	-	-	-	11 (73.33)	11 (64.70)	6 (100)	28 (23.33)
Back bending	17 (100)	16 (100)	-	11 (73.33)	11 (64.70)	6 (100)	61 (50.83)
Sitting	-	-	-	4 (26.66)	6 (35.29)	-	10 (8.33)
Knee bend	17 (100)	16 (100)	-	11 (73.33)	11 (64.70)	6 (100)	61 (50.83)

Note: Values in parenthesis indicates percentage

**Table.2** Safety practices adopted by workers while performing activities

n=120

Activity Safety Practices	Extraction (n1= 17)	Breaking (n2= 16)	Loading and unloading (n3= 49)	Crushing (n4= 15)	Shaping (n5= 17)	Layering (n6=6)	Total (n=120)
Gloves	-	-	-	-	-	-	-
Face mask	-	-	-	-	-	-	-
Helmet	-	-	-	-	-	-	-
Twisted cloth	-	-	21 (42.85)	-	-	-	21 (17.5)
Tasla/bucket	-	-	-	-	-	-	-
Tool with hand support	-	-	-	-	-	-	-
Handkerchief	-	4 (25)	-	3 (20)	2 (11.76)	-	9 (7.5)
Sleeper	4 (23.52)	3 (18.75)	7 (14.28)	4 (26.66)	5 (29.41)	-	23 (19.16)
Shoes	13 (76.47)	14 (87.5)	42 (85.71)	11 (73.33)	12 (70.58)	6 (1--)	98 (81.66)
Eye goggles	-	-	-	-	-	-	-



Note: Values in parenthesis indicates percentage





**Table.3** Workplace Ergonomic Risk Assessment (WERA) of workers involved in various activities

Activity	Extraction	Breaking	Loading and unloading	Crushing	Shaping	Layering	Risk level WERA	Total
WERA Action Level	n 1= 11	n 2 =10	n 3 =31	n 4= 9	n 5= 11	n 6= 3		(75)
Low	-	-	4 (12.90)	2 (22.22)	7 (63.63)	-	Task is acceptable	13 (17.33)
Medium	11 (100)	10 (100)	27 (87)	7 (77.77)	4 (36.36)	3 (100)	Task is need to further investigate and required change	62 (82.66)
High	-	-	-	-	-	-	Task is not accepted, immediately change	

Note: Values in parenthesis indicates percentage

**Table.4** Assessment of body posture by WERA

S.N.	Activities performed by workers in stone masonry work	Score	Result
1.	<p>Extraction of stones</p> 	39	Task is need to further investigate and required change
2.	<p>Breaking of stones</p> 	38	Task is need to further investigate and required change

3.	<p style="text-align: center;"><b>Loading/ unloading of stones</b></p> 	<b>41</b>	<b>Task is need to further investigate and required change</b>
4.	<p style="text-align: center;"><b>Crushing of stones</b></p> 	<b>35</b>	<b>Task is need to further investigate and required change</b>
5.	<p style="text-align: center;"><b>Shaping of stones</b></p> 	<b>28</b>	<b>Task is need to further investigate and required change</b>
6.	<p style="text-align: center;"><b>Layering of stones</b></p> 	<b>36</b>	<b>Task is need to further investigate and required change</b>

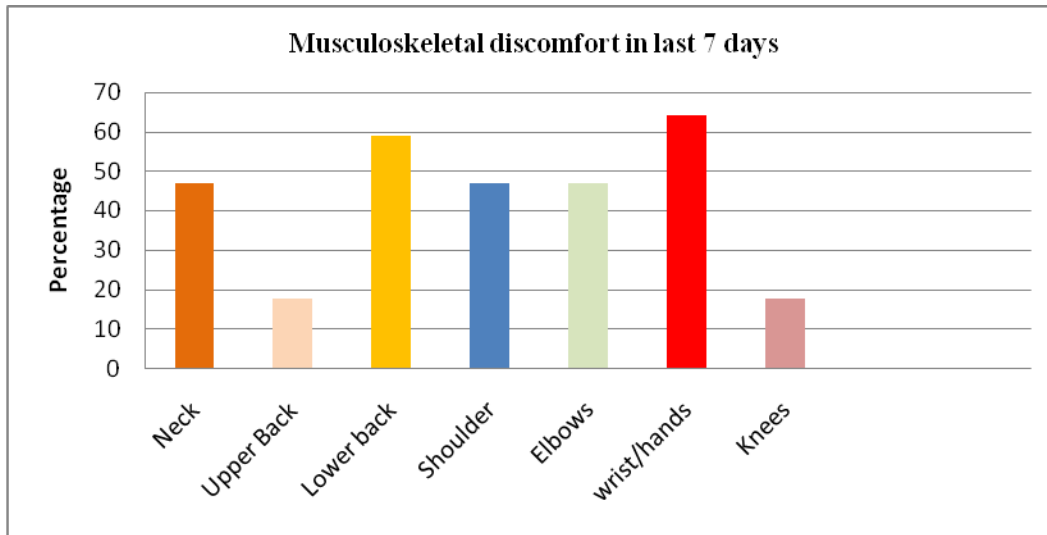


**Table.5 Hypothesis testing**

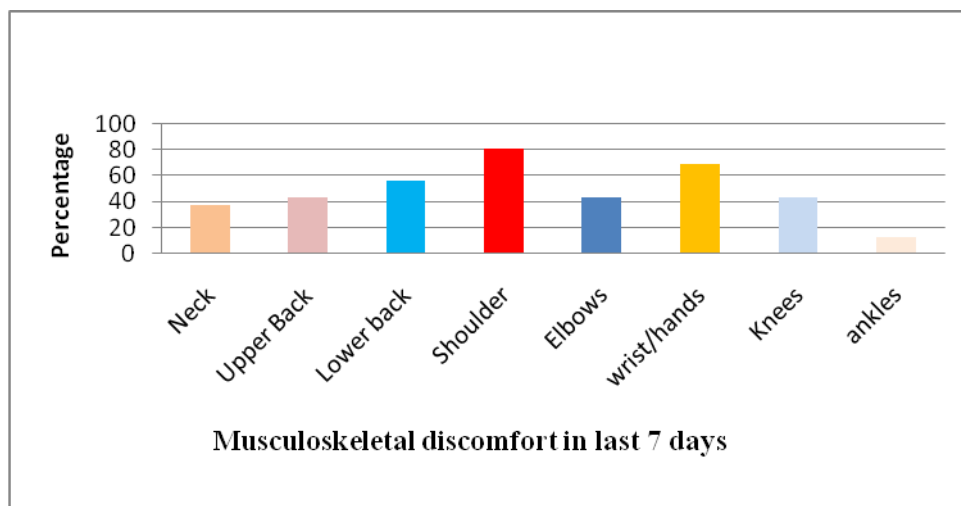
S. No.	Variables	Correlation coefficient	Significant level
1.	Musculoskeletal discomfort and Work status	.247**	Significant
2.	Musculoskeletal discomfort and Mode of load	.211**	Significant

\*\* Correlation is significant at the 1% level

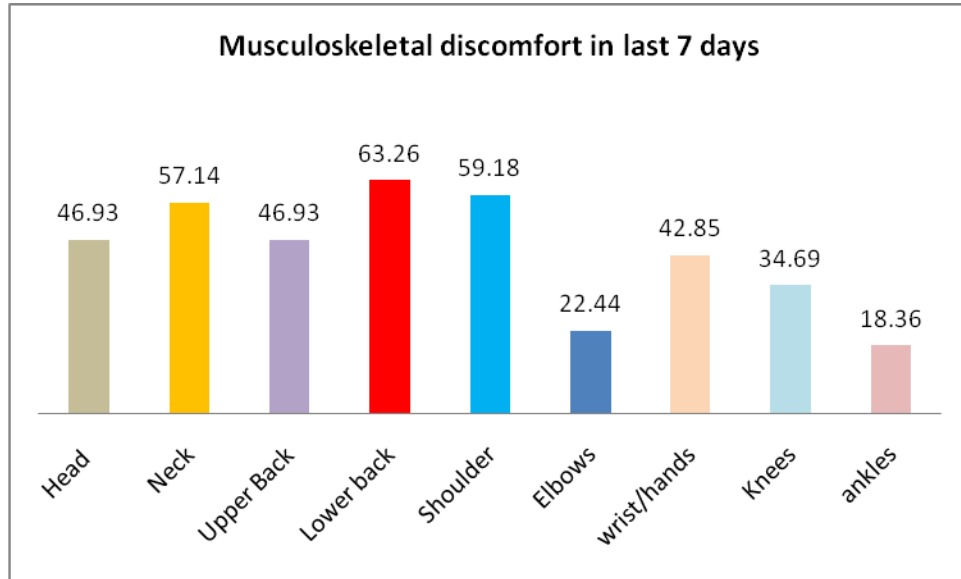
**Fig.1 Prevalence of musculoskeletal pain/ discomfort among workers involved in extraction activity in last 7 days**



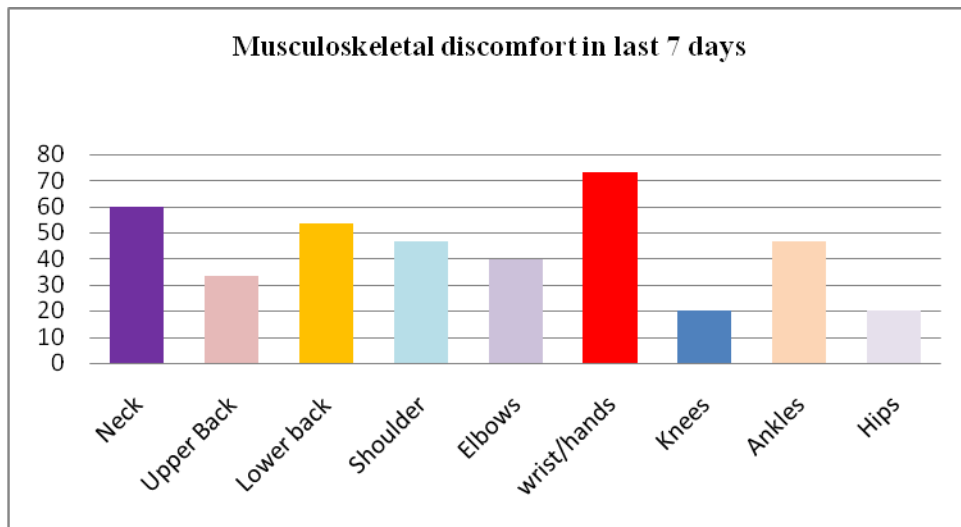
**Fig.2 Prevalence of musculoskeletal pain/ discomfort among workers involved in breaking activity in last 7 days**



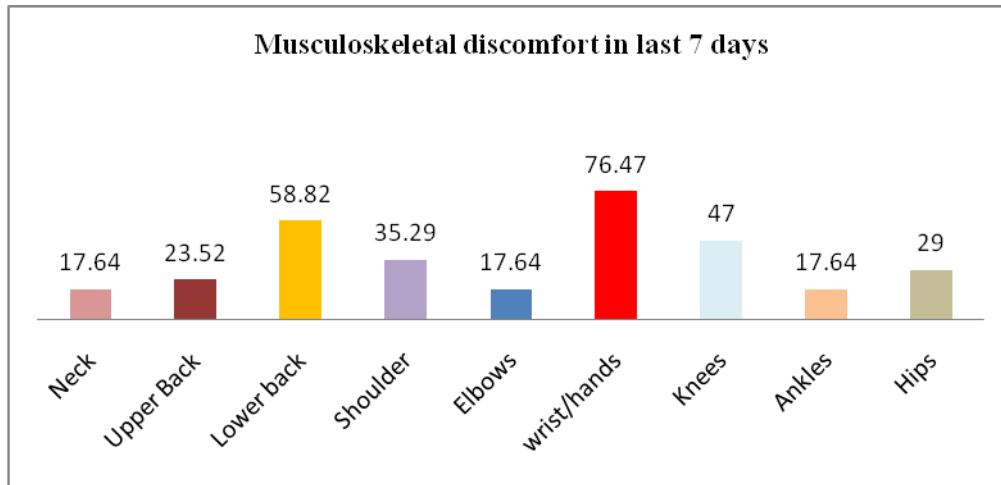
**Fig.3** Prevalence of musculoskeletal pain/ discomfort among workers involved in loading and unloading activity in last 7 days



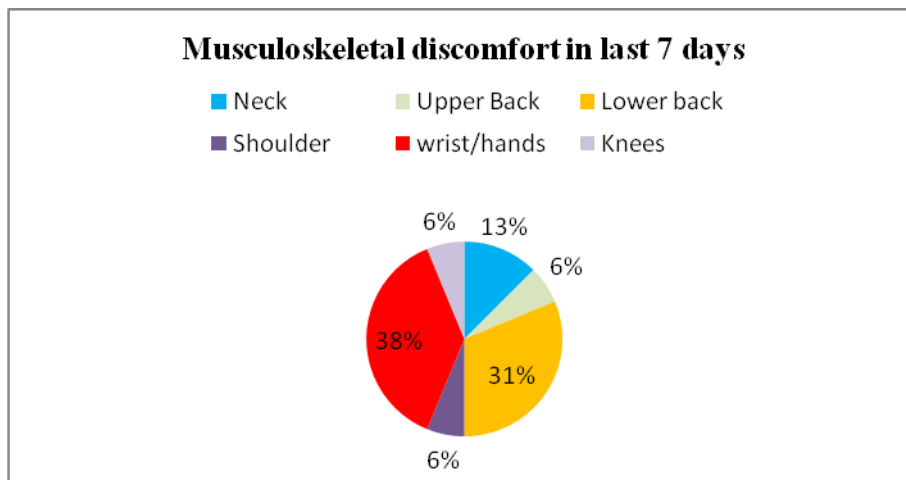
**Fig.4** Prevalence of musculoskeletal pain/ discomfort among workers involved in crushing activity in last 7 days



**Fig.5** Prevalence of musculoskeletal pain/ discomfort among workers involved in shaping activity in last 7 days



**Fig.6** Prevalence of musculoskeletal pain/ discomfort among workers involved in layering activity in last 7 days



More than half 56.25 percent were suffering from lower back pain in last 7 days. Whereas majority, i.e 81.25 percent and about 43.75 percent workers were having pain in shoulders and elbows respectively. It was reported that 68.75 percent of the workers had pain in wrist or hands and 43.75 percent of the workers were experiencing pain or discomfort in their knees in last 7 days. It was observed from the fig 3 that more than half 63.26 percent of the workers were suffering from lower back pain in last 7 days. Whereas 59.18 percent and 57.14 percent workers were having pain in shoulders and neck

respectively in last 7 days. It was observed from the fig 4 that more than half 53.33 percent of the workers were suffering from lower back pain in last 7 days. Whereas 46.66 percent and 40 percent workers were having pain in shoulders and elbows respectively. It was found that large proportion, i.e 73.33 percent of workers complained about pain in wrist or hands in last 7 days. Table 3 clearly shows that on the whole majority, i.e 82.66 percent of the workers involved in various activities were lied under the medium action level that indicating (Task is need to further investigate and required change),

very few only, 17.33 percent of the workers were lie under low action level predicting that task is acceptable. When comparison was made on the bases of activities it was found that all workers involved in extraction and breaking activity lie in action level medium, that indicating (Task is need to further investigate and required change).

In case of loading and unloading 87 percent, crushing 77 percent, shaping 36.36 percent and in layering all workers reported under medium action level. Six physical risk factors including posture, repetition, force, vibration, contact stress and duration and it involves the five body regions (shoulder, neck, back, leg and wrist) while performing various activities like extraction, breaking, loading and unloading, crushing, shaping and layering of stones at workplace. The reason for assessing the workplace was to assess all these physical risk at early stage before it become serious and cannot be changed. So it can be concluded that the work area was not safe and appropriate for workers therefore immediate changes were needed in this areas for safe work environment to workers by providing them tools with hand support to avoid contact stress, breaks at regular intervals, change in postures to eliminate the risk of health hazards and to provide ergonomically sound tools/machines to workers for eliminating the risk of vibration and musculoskeletal discomfort.

### **Hypothesis testing**

Karl Pearson's Correlation Coefficient values for relationship between musculoskeletal discomfort and work status, musculoskeletal discomfort and mode of load.

In conclusion, on the basis of findings of that investigation was made. The following conclusion was drawn: The workers, who were involved in stone masonry work, were highly at risk of musculoskeletal discomfort and postural stress. The workers were unaware about the risk associated with these activities; they were vulnerable to be affected by wide range of injuries and accidents. This work

required high physical exertion, force and repetitive motions of hands, arms and wrist and required proper breaks between the tasks for rest. But they were forced to work for several hours, without taking proper breaks that may cause fatigue and tiredness among workers. They used to adopt awkward postures while working, due to unawareness about its negative impact on their health. Due to unavailability of ergonomically designed tools and equipments, they are highly at risk of problem in disk, vertebral and spinal Column in near future. Therefore immersing need for precautions/safety measures should be take into account. The findings of this study suggested the needs for educating the workers about musculoskeletal disorders, postural stress and utilization of safety measures. Working posture should be appropriate for minimizing the negative impacts on health. Ergonomic interventions, small machines, medical and other facilities should be offered along with wages to reduce the economic constrains and enhance quality of life of the workers. Tools should be equipped with the hand support to minimize the discomfort or pain in the palm portion. Handle should be padded and avoid direct contact with the tool. Personal protective equipment specially head support, gloves, helmet, eye goggles, face mask must be provided to the workers during activities, that may reduce the risk of hazards and injuries at work. Suggestions for safe work culture for stone masonry work- involvement of AICRP, KVK, and Extension workers to help those workers by spreading knowledge and information among them.

### **References**

- Anandaraj, T. Nishant, S.; Sakthivelu, S. and Snthilraj, K. (2017). Work related musculoskeletal disorders among hammering workers. *Journal of Chemical and Pharmaceutical Sciences*, 3, 14-17. [file:///C:/Users/user/Downloads/MKCE\\_ME\\_CH4%20\(1\).pdf](file:///C:/Users/user/Downloads/MKCE_ME_CH4%20(1).pdf)
- Lalzirliani, R (2014). Socio economic and health condition of the stone quarry workers in

- Aizawl. Published Ph.D Thesis in Social Work, Mizoram University, Aizawl.
- Okello, A.; Wafula, S.; Sekimpi, K. D. And Mugamble, R. (2020). Prevalence and predictors of work related musculoskeletal disorders among workers of a gold mine in South Kivu. Democratic Republic of Congo. *BMC Musculoskeletal Disorders*,21(1),1-10  
<https://doi.org/10.1186/s12891-020-03828-8>
- Prasad, M. A.; Bhagat, V.; Wagh, V.; Mudey, A.; Nayak, S.; and Gaiki, V. (2014). Assessment of health status of stone quarry workers in Yelakeli, Wardha district in Central India. *Innovative Journal of medical and health science*, 4(6), 180-181.  
<http://dx.doi.org/10.15520/ijmhs.2014.vol4.iss6.34.180-181>
- Subhasis, B. Giyasuddin, S. and Arindam, R. (2018). Economic importance of stone quarrying in rural livelihood and its impact on environment: a case study of Saltora Block, Bankura, West Bengal. *International Journal of Scientific Research and Reviews*,7(3),1045-1062.  
[file:///C:/Users/user/Downloads/EconomicImportanceofStoneQuarrying%20\(1\).pdf](file:///C:/Users/user/Downloads/EconomicImportanceofStoneQuarrying%20(1).pdf)

**How to cite this article:**

Neha Arya and Promila Sharma. 2023. An Ergonomic Study on Musculoskeletal Discomfort and Postural Stress among Workers involved in Stone Masonry Work. *Int.J.Curr.Microbiol.App.Sci*. 12(09): 224-236.  
**doi:** <https://doi.org/10.20546/ijcmas.2023.1209.022>