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Strategic Dissemination for Flour Mill Worker's Safety: Mitigating Health Hazards through Informed Practices

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Abstract— *Amongst the hum of machinery and the ceaseless production of a dietary staple, the occupational health hazards confronting flour mill workers demand attention. This research undertook a comprehensive examination, shedding light on the intricate interplay between the working conditions and the problems faced by the workers within the confines of flour mills. In the heart of grain processing facilities, the health and safety of flour mill workers emerged as critical concerns. This research elucidates the complicated terrain of occupational health risks, highlighting the day-to-day struggles experienced by employees in this vital but frequently disregarded sector. This study was conducted on a sample of 100 respondents randomly selected from 20 flour mills of Ludhiana city. Ergonomic scales like OWAS and WERA were used to assess the work related postural discomfort experienced by the respondents. Results of postural analysis showed that for postures like full forward bending, half forward bending and standing with raised hands corrective measures need to be recommended in the near future and for postures like side bending and lifting immediate change is required. Factors contributing to worker's declined health were working in filthy conditions without using any personal protective equipment leading to respiratory issues whereas injuries like dislocations, slips, cuts, falls were also reported due to carrying heavy load on slippery floor and due to unguarded machines. Remedial measures like head cum face mask and information dissemination in the form of booklet were suggested for better workplace environment, reducing the musculoskeletal problems and injuries among the workers of the flour mills.*

Keywords— ***Occupational health hazards, Flour dust, Flour mill workers, Postural discomfort, Indoor environment.***

I. INTRODUCTION

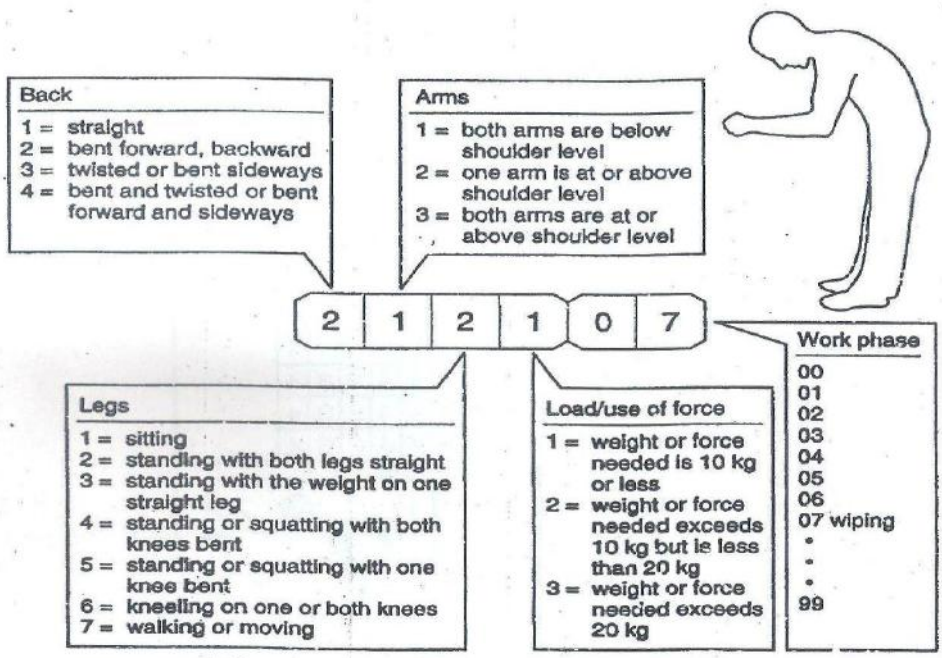
Flour mills, integral to the global food production landscape, are not only the crucibles of sustenance but also environments where the well-being of the workforce faces nuanced challenges. As essential components in the grain processing chain, these facilities provide a cornerstone for society's dietary needs. However, within the intricate machinery and rhythmic processes lies a less visible concern – the occupational health hazards that cast shadows over the daily lives of flour mill workers. Since the 19th century, flour mills have been regarded as a boon for the purpose of turning cereals and grains into fine flour for consumption. Previously, a fully mechanical process known as stone milling was used to grind the grains into a fine powder. This process used circular weights with a hole in the centre and a wooden handle at the periphery to rotate the upper stone disc weight. The upper stone's opening, known as the runner, was used to load grain, which was then spread across the lower stone, known as the sleeper, before being turned around by the wooden handle. Between the two substantial stone discs, the action of the stones smashes the entire grain, and the flour is gathered. As a result, preparing flour using conventional machinery takes a lot of time and work. On the onset of machines consisting shafts, belts and

gears that are intended to reduce physical work and additional labour while increasing production. However, loading and unloading grain into the machine still needed manual labour, which involved putting the bulky grain sacs into the machine. Workers must lift the bulky bags over their shoulders to load them into the grinder or machine, pack the flour that has been produced, and then reload it or deliver it to customers. Additionally, employees at flour mills are more likely to have negative health impacts when exposed to flour dust and other unfavourable environmental factors, such as high temperatures, high relative humidity, loud noises, and inadequate lighting. Along with the dangers already described, there is another category of health risks that coexists with the other occupational risk factors. These risks are linked to the employees' inappropriate postures, which can result in the onset of work-related musculoskeletal illnesses. Loading, unloading, lifting, and packing are a few of the manual material-handling duties that cause workers to experience acute postural pain at work and an increased risk of occupational health risks. The main contributing factors for the onset of job-related musculoskeletal problems include recurrent forceful effort, bad posture, and forceful labour. This research embarks on a thorough exploration of the multifaceted occupational health challenges faced by those working in flour mills. The goal is not only to identify and understand the risks but, crucially, to develop informed strategies for intervention and knowledge dissemination. The choice of ergonomic scales, specifically the OWAS and WERA systems, allowed for a nuanced evaluation of the working conditions, offering insights into the postural stresses endured by mill workers. Beyond analysis, this research extended its scope to practical solutions, culminating in the creation of a comprehensive booklet and a head cum face mask. These interventions served a dual purpose: disseminating crucial knowledge among workers and providing tangible remedial measures for musculoskeletal disorders. As we delve deeper into the following sections, the focus will shift from the identification of occupational health hazards to the formulation of informed interventions. By acknowledging the pivotal role of knowledge dissemination and practical measures, this study aspires to contribute not only to the academic discourse but, more importantly, to the well-being and safety of the dedicated individuals who form the backbone of the flour milling industry.

II. METHODOLOGY

The goal of this study was to compile and assess data on work related musculoskeletal disorders as well as the occupational health risks that workers in the city of Ludhiana's flour mills must deal with. The study was designed to be carried out in a certain order, starting with data collection, compilation, analysis, and ultimately data explanation. For the purpose of the mentioned study, 100 flour mill workers of Ludhiana city were selected for the study of prevalence of musculoskeletal disorders. Using the personal contact approach and the self-observation methodology, a field study of a sample of flour mill workers was undertaken. An interview schedule was created, pretested and utilised to collect information from the respondent's in-person. The use of relevant tools, subjective evaluation methods and objective assessment techniques was done in relation to the study of identifying work-related risk factors encountered by the workers. For assessing extent of postural discomfort ergonomic scales were used which are as follows:

a. **OWAS method:** Ovako Working Position Analysis System, as provided by Karhu et al (1981). It defines the three primary areas—arms, back, and legs—where labour postures are most frequently used. The weight of the cargo carried is taken into account while calculating points. With the aid of these body components, a four-digit code is employed to depict the posture of the entire body. Four action types that were gleaned from the sources can be used to determine the necessity for ergonomic modifications. "Snapshot" observations were taken at regular intervals.



Achieving at Grand Score to identify the Action Level

Back	Arms	1			2			3			4			5			6			7			Legs
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	Use of force
1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	
	2	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	
	3	1	1	1	1	1	1	1	1	1	2	2	3	2	2	3	1	1	1	1	1	2	
2	1	2	2	3	2	2	3	2	2	3	3	3	3	3	3	3	2	2	2	2	3	3	
	2	2	2	3	2	2	3	2	3	3	3	4	4	3	4	4	3	3	4	2	3	4	
	3	3	3	4	2	2	3	3	3	3	3	4	4	4	4	4	4	4	4	2	3	4	
3	1	1	1	1	1	1	1	1	2	3	3	3	4	4	4	1	1	1	1	1	1		
	2	2	2	3	1	1	1	1	2	4	4	4	4	4	4	3	3	3	1	1	1		
	3	2	2	3	1	1	1	2	3	3	4	4	4	4	4	4	4	4	4	1	1	1	
4	1	2	3	3	2	2	3	2	2	3	4	4	4	4	4	4	4	4	4	2	3	4	
	2	3	3	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4	
	3	4	4	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4	

Load / Force Use:

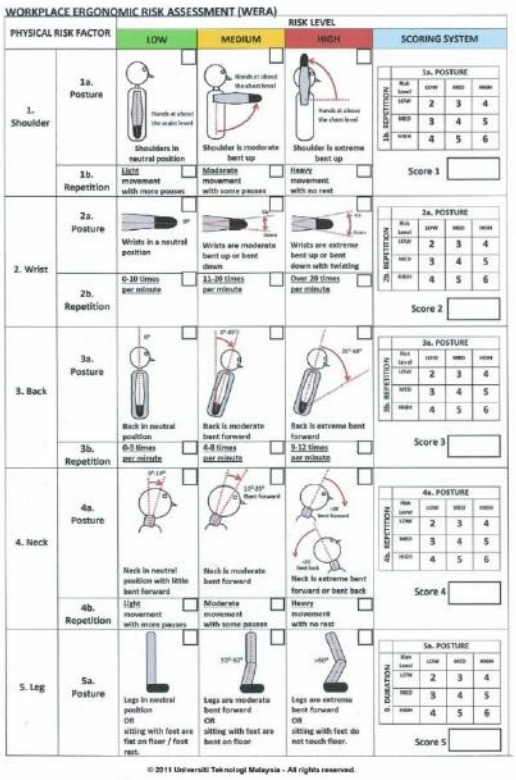
1= </= 10 Kg

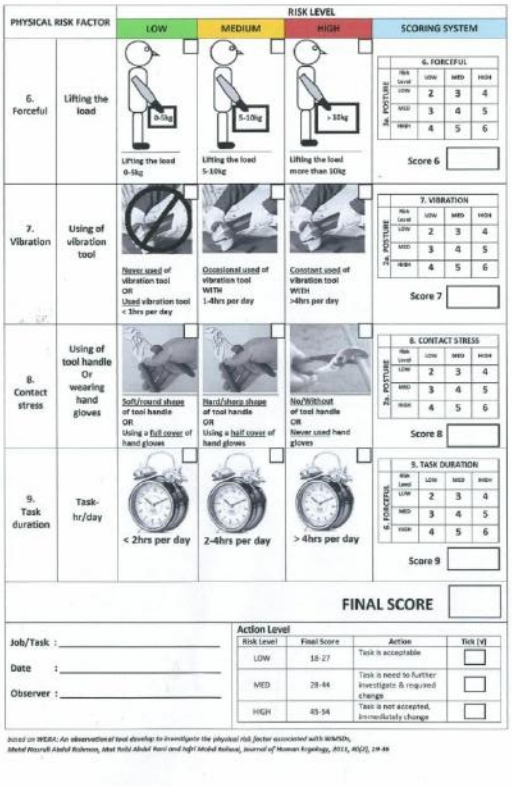
2= 10 – 20 Kg

3= > 20 Kg

Action categories
1 no corrective measures
2 corrective measures in the near future
3 corrective measures as soon as possible
4 corrective measures immediately

b. **WERA method**: Workplace Ergonomic Risk Assessment, or WERA, was created by Rahman et al (2011). It is a tool for observation that offers a fast way to check working activities for exposure to physical risk factors linked to occupational musculoskeletal illnesses. This instrument addresses the five primary body areas of the shoulder, wrist, back, neck, and leg as well as the six risk variables of posture, repetition, forceful, vibration, contact stress, and work length. It contains a score system and action levels that serve as a reference to determining the danger level. There are five stages involved in utilising this tool. Task observation is followed by task selection for assessment, task scoring, exposure calculation, and evaluation of action levels.





c. Some statistical techniques such as frequency and percentages, mean scores and standard deviation were used to analyze the collected data.

d. Also for investigating the comfort and satisfaction level of the developed interventions data was collected through scoring as per the table given below:

For comfort level

Response	Score
Extremely comfortable	
Comfortable	
Uncomfortable	

Scores: 3-Extremely comfortable, 2- Comfortable, 1- Uncomfortable

For satisfaction level

Response	Score
Highly satisfied	
Satisfied	
Moderately satisfied	

Scores: 3- Highly satisfied, 2- Satisfied, 1- Moderately satisfied

III. RESULTS

When the data collected was analysed it was observed that according to the socio personal profiles of the chosen respondents, 35% of the respondents were between the ages of 26 and 35and majority of the respondents (65%), according to their employment profiles, put in 10 to 12 hours a day at their jobs with just 1.5 to 2 hours of rest break. There were 12 percent such respondents who used to cover a distance of 3.5 to 5 km daily to reach their workplace. The remuneration obtained by the workers in exchange of performing such hazardous work was also not very satisfactory, 68% of the respondents were getting paid less than Rs.15,000 per month. It has been observed during survey that the main tasks performed at flour mills were loading, unloading, stacking grain bags, cleaning the workplace, moving grain bags to the grinder machine, packaging the flour into bags, and distributing it to clients. Along with the aforementioned tasks, some workers were also involved in the operation of machinery installed at flour mills, such as the weighing scale used to measure grain and flour before and after grinding, the trolley frequently used to move grain bags, and the wheelbarrow used to guarantee the continuous operation of the grinding machine. Every action was carried out by every respondent at some point, according to observations.

Table 1: Job profile of the respondents n=100

Job profile	Frequency	Percentage (%)
Mill job		
Owner cum worker	08	08.00
Worker	92	92.00
Distance from home to workplace (km)		
Less than 1.5 km	45	45.00
1.5 to 3 km	43	43.00
3.5 to 5 km	12	12.00
Work duration		
8-9 hours	30	30.00
10 -12 hours	65	65.00
More than 12 hours	05	05.00
Monthly income of respondent (Rs) from the mill job		
Less than 15,000	68	68.00
15,000-20,000	24	24.00
More than 20,000	08	08.00
Average	**Rs 12530/-**	
Years of working in flour mill		
1 to 5 years	50	50.00
6 to 10 years	44	44.00
11 to 15 years	06	06.00
Reasons to take up mill worker job		
To inherit family business	08	08.00
Sole bread earner of the family	47	47.00
Near to home	35	35.00
Other	10	10.00

During the research survey it has been observed that it was not only the extreme environmental conditions responsible for ruining the health of the workers, but the other factor that was contributing in deteriorating the health of the respondents was the prevalence of musculoskeletal disorders. Every activity performed in the flour mill requires a lot of exertion and typical body postures which results in development of many problems immediately or gradually. Majority of the selected respondents being illiterate were unaware regarding adoption of correct body postures during work to minimize their exertion. They were informed about the activities to be performed according to their convenience without being aware about the adoption of wrong postures. They face the difficulty as such and accepted that there is only one way to perform that particular activity. When asked the selected respondents about which activity they find most difficult to perform, multiple responses were observed depicted by the table below. As results reported by Petit *et al* (2016) are also in line with these findings who reported that half of the unskilled employees are exposed to Manual Material Handling (MMH) leading to chronic low back pain (LBP) and work impairment. Occupational injuries, limb musculoskeletal problems, and cardiovascular disease are all caused by manual material handling.

Table 2: Distribution of respondents as per difficulty in performing different activities n=100

Activities	Frequency	Percentage (%)
Loading	56	56.00
Lifting	54	54.00
Cleaning	43	43.00
Unloading	40	40.00
Delivery	45	45.00

Injury or discomfort in the muscles, ligaments, and joints that support the limbs, neck, and back are referred to as MSDs (musculoskeletal diseases). A quick physical effort (such as carrying a heavy object), repetitive strain, or recurrent exposure to force, vibration, or an uncomfortable posture can all lead to MSDs [3]. As a result, respondents' musculoskeletal issues were evaluated using ergonomic scales. Two objective scales were used to assess the postures adopted by the respondents while carrying out their regular tasks at workplace.

Five of the most uncomfortable and common positions were chosen in order to analyse respondents' working postures while engaging in various tasks at work. As described in the methodology, the low cost posture analysis techniques OWAS (Ovako Work Assessment system) and WERA (Work Ergonomic Risk Assessment) were utilised to examine the chosen postures and have been discussed below from table 2 to table 6.

Fig. 1: Full forward bending

Table 3: Analysis of posture I: Full forward bending

OWAS						
Posture	**Back**	**Arms**	**Legs**	**Load/Effort**	**Final score**	**Action category**
Score	2	1	2	1	2	Corrective measures in the near future

WERA											
Posture	**Shoulder**	**Wrist**	**Back**	**Neck**	**Leg**	**Forceful**	**Vibration**	**Contact stress**	**Task duration**	**Final score**	**Action level**
Score	4	2	6	5	4	5	2	4	5	37	Task in need to further investigate and required change

Fig 2: Half forward bending

Table 4: Analysis of posture II: Half forward bending

OWAS						
Posture	**Back**	**Arms**	**Legs**	**Load/Effort**	**Final score**	**Action category**
Score	2	1	3	1	2	Corrective measures in the near future

WERA											
Posture	**Shoulder**	**Wrist**	**Back**	**Neck**	**Leg**	**Forceful**	**Vibration**	**Contact stress**	**Task duration**	**Final score**	**Action level**
Score	3	4	4	2	4	3	4	5	3	32	Task in need to further investigate and required change

Fig 3: Standing with raised hands

Table 5: Analysis of posture III: Standing with raised hands

OWAS						
Posture	**Back**	**Arms**	**Legs**	**Load/Effort**	**Final score**	**Action category**
Score	2	3	2	3	2	Corrective measures in the near future are required

WERA											
Posture	**Shoulder**	**Wrist**	**Back**	**Neck**	**Leg**	**Forceful**	**Vibration**	**Contact stress**	**Task duration**	**Final score**	**Action level**
Score	6	5	3	4	3	2	6	6	3	38	Task in need to further investigate and required change

Fig 4: Side bending

Table 6: Analysis of posture IV: Side bending

OWAS						
Posture	**Back**	**Arms**	**Legs**	**Load/Effort**	**Final score**	**Action category**
Score	3	1	4	1	3	Corrective measures as soon as possible are required

WERA											
Posture	**Shoulder**	**Wrist**	**Back**	**Neck**	**Leg**	**Forceful**	**Vibration**	**Contact stress**	**Task duration**	**Final score**	**Action level**
Score	5	6	6	4	5	4	6	6	3	45	Task is not accepted, immediately change

Fig 5: Lifting

Table 7: Analysis of posture V: Lifting

OWAS						
Posture	**Back**	**Arms**	**Legs**	**Load/Effort**	**Final score**	**Action category**
Score	3	1	4	1	3	Corrective measures as soon as possible are required

WERA											
Posture	**Shoulder**	**Wrist**	**Back**	**Neck**	**Leg**	**Forceful**	**Vibration**	**Contact Stress**	**Task duration**	**Final score**	**Action level**
Score	3	4	5	4	4	4	6	5	5	37	Task is not accepted, immediately change

As per the scores shown by the tables above, the most dangerous postures, according to the Ovako Working Posture Analysis System (OWAS), were lifting, side bending, half forward bending, and front bending. These postures required immediate correction. However, Work Ergonomic Risk Assessment (WERA) found that the side-bending position was unacceptable and needed to be changed right now. Based on the aforementioned findings, it is inferred that workers at flour mills put in a lot of overtime in challenging conditions for little pay. The risk factors for accidents and musculoskeletal problems, as well as various safety and security issues, were all presented to the respondents. The responders' postures were also the most hazardous and needed immediate attention, according to objective ratings. As a result, the user group should be offered suitable solutions to lessen the suffering. In order to prevent compromises with the company's productivity and health, one should be vigilant about adhering to the fundamental requirements connected to the job and the workplace.

Use and type of Personal Protective Equipment preferred by the respondents while working in the flour mills.

Personal Protective Equipment (PPE) aids in the protection of workers' health from hazardous working circumstances. During the current investigation, because of the prevalence of contagious viral infection, it was discovered that overall personal protective equipment (PPE) kit was used by a small number of workers at workplace while performing usual tasks, recommended by the customers to ensure safety and protection. Hence, some flour mill owners provided their workers the overall PPE kit. As Table 7 indicates that only 34 percent agreed with the using of PPE while 66 percent didn't bother about using any kind of PPE while working in the flour mill during viral infection. However, due to the abundance of flour dust and workers' close proximity with the flour grinding machine makes it a pre requisite to use PPE for their safety. Personal protective equipment was substantially connected with chronic respiratory health complications among flour mill industrial workers; therefore workers used pieces of cloth

instead of respirators/dust masks. It has been concluded that, workers in flour mills who wore pieces of cloth were less likely to acquire long term respiratory issues than those who did not. Along with this they found that the use of respiratory safety equipment among flour mill workers was quite low. Even though the majority of workers recognized the need of wearing PPE to protect themselves from wheat dust particles, the mill owners did not provide workers with PPE. Following are some of the PPE discussed along with the percentage used by the workers of the flour mills in order to protect them from the flour dust and other debris to some extent.

Table 8: Use and type of PPE preferred by the workers in the flour mills.

n=100

PPE	Always		Sometimes		Never	
	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)
Overall PPE kit	34	34.00	-	-	66	66.00
Other PPE						
Head gear	06	06.00	56	56.00	38	38.00
Mask	49	49.00	35	35.00	16	16.00
Apron	-	-	-	-	100	100.00
Gloves	-	-	08	08.00	92	92.00

Score: 3-always, 2-sometimes, 1-never

Reasons for not using any PPE while working

On observation it has been seen that workers were all covered in flour dust while working and not provided with any kind of PPE by the owners. Because of low finances they were not able to afford buying proper PPE for themselves. It has been seen that few workers tied a piece of cloth on their head and mouth to safeguard them against the flour dust. Even after knowing that it is beneficial to wear PPE, the flour mill workers were seen without wearing one, it is understandable that the activities performed by the flour mill workers requires a lot of frequent movement that may be restricted by wearing another layer of fabric. But one can use proper head gear, masks and apron just to minimize the adherence of flour dust on their body parts. The reasons given by the workers for not wearing PPE are discussed as follows.

Uncomfortable: When enquired for the reason of not using PPE, data revealed that more than half of the respondents (57%) found it uncomfortable wearing any kind of PPE while working at their workplace.

Unaffordable: It has been observed through the data collected that 40 percent of the respondents agreed with the statement that using PPE is useful for them but they can't afford purchasing good quality PPE. Due to their limited wages and family expenses they could not afford of purchasing PPE of adequate quality.

Don't know how to use it: It has been concluded through the field study that due to the onset of pandemic only few owners provided their workers with PPE kits because of the pressure build by the customers on them for checking the viral infection. But the problem was that they didn't give any information regarding how to use that PPE kit and how to maintain it further**.** Subsequently, as per the data of Table 8, it was concluded that 85 percent of the respondents actually did not know the correct ways of using proper PPE kit.

Creates hindrance while working: Concerning about hindrance created to the workers by wearing PPE while working, it was found that 43 percent of respondents agreed with the statement that PPE does provide a hindrance in body movements, impacting their work effectiveness.

Never been informed to use PPE: When the selected respondents were enquired about having knowledge about the use of PPE, then it has been revealed that only five percent of the respondents knew about the PPE and their use, whereas 95 percent were not having any awareness regarding PPE use and its maintenance.

Table 9: Distribution of respondents as per the reasons for not using PPE

n=100

Reasons	Frequency	Percentage (%)
Uncomfortable	57	57.00
Unaffordable	40	40.00
Don't know how to use it	85	85.00
Creates hindrance while working	43	43.00
Never been informed to use PPE	95	95.00

DEVELOPING INTERVENTION AND PREPARATION OF GUIDELINES.

On the basis of results of field survey and suggestions given by the flour mill workers an intervention was designed i.e Head Cover cum Face Mask. This intervention was designed and tested on selected respondents to protect them from excessive inhaling of flour dust. Concerning to minimize the extent of risk factors faced by the workers engaged in flour mills, significant remedial and corrective measures in the form of booklet including various exercises and curative postures were suggested for the workers of the flour mills.

Head Cover Cum Face Mask: To protect the workers from excessive inhaling of flour dust, which was the main health problem they were facing in flour mills, a suitable head cover cum face mask was designed. This mask is made from soft cotton fabric which is breathable and comfortable to wear. It has two soft fabric bands on either side with Velcro fastened at their ends that help it fit properly according to the wearer's comfort. This intervention was introduced to the workers for assessing its comfort and satisfaction level among them while performing flour mill activities. This intervention was introduced to them and their comfort and satisfaction level was assessed while performing different flour mill activities. The comfort and satisfaction level of flour mill workers have been discussed in Fig 6 and 7 respectively.

Comfort level of the workers while using the developed intervention

Regarding comfort Fig.6 indicates that 70 percent of the respondents felt extremely comfortable while using head cover cum face mask as it completely fit to their head and face and their exposure to excessive flour dust was minimized, whereas 30 percent of the respondents find the intervention comfortable. However, none of the respondents felt that it was uncomfortable to use while performing various activities.

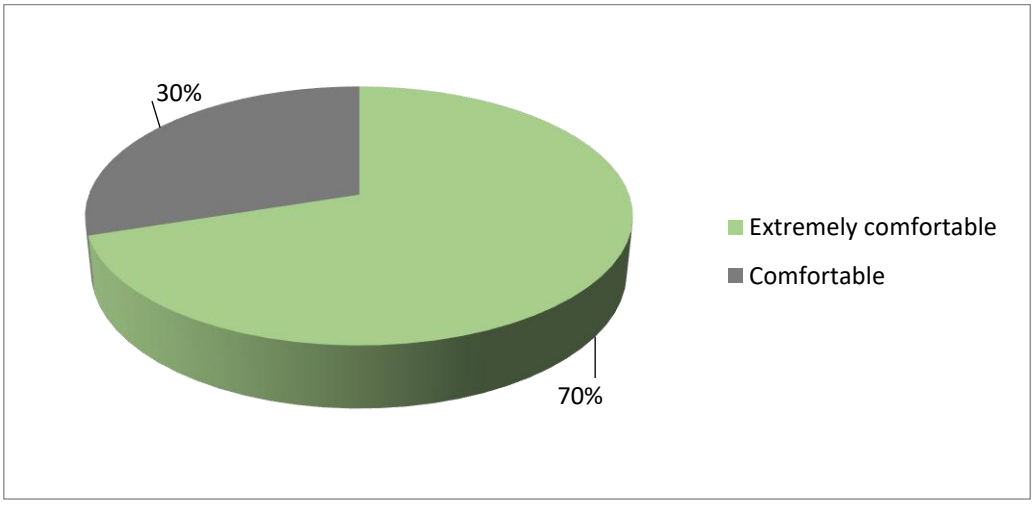


Fig 6: Distribution of the respondents as per comfort level achieved with the intervention

Satisfaction level of the workers while using the developed intervention

Regarding satisfaction Fig.7 indicates that 80 percent of the respondents were highly satisfied while using head cover cum face mask, whereas 10 percent of the respondents found the intervention satisfactory. Further, moderate satisfaction was reported by 10 percent of the

respondents as they were not use to of wearing any kind of PPE while performing various activities.

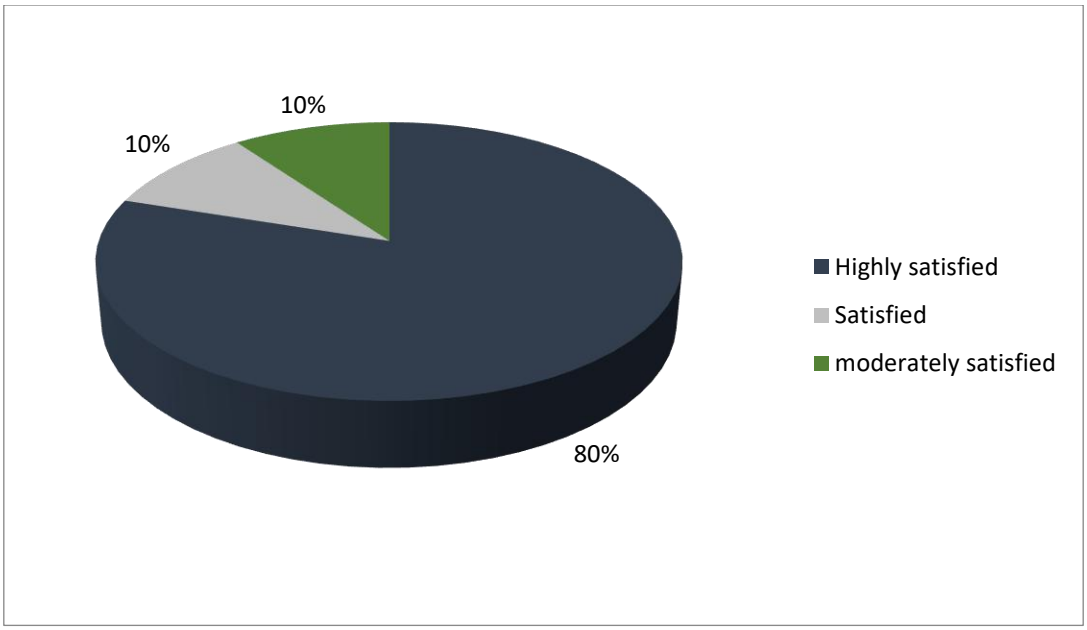


Fig.7: Distribution of respondents as per satisfaction level after using head cover cum face mask

A small booklet constituting the guidelines for minimising the health risks among flour mill workers was also developed. It included certain instructions to be considered for workplace environment with some modifications in techniques like anti slip flooring and safe load carrying. Also there were some suggested postures to reduce the injuries and musculoskeletal problems of the workers for seated as well as for the standing tasks. Then there mentioned some yoga exercises like tadasana, shoulder shrugs, balasana and some exercises to strengthen neck upper back, shoulders, arms ,wrist and hand muscles and to prevent future injuries at workplace.

IV. CONCLUSION

A pleasant workplace atmosphere encourages employees to be productive enough to complete the tasks. For occupational health services to be provided in the flour mill's workplace in a practical and efficient manner, both the owners and managers of the company must be attentive of occupational health and safety. Additionally, it's important to be aware of the numerous hazards connected to adopting poor postures and to properly occupy the workplace with hazard management measures. This will improve the productivity of the company, lower the chance of accidents, and undoubtedly improve the health of the employees. Investment in ergonomic treatments is highly necessary to reduce deaths and health risks associated with working in a dangerous workplace. Only by carefully taking into account the physical, mental, and social factors while building a workplace can the efforts be optimised. Small processing facilities reportedly lack these crucial factors, and the employees go about their business without taking any safety precautions. When picking and implementing a technology, planning and creating any workspace in line with ergonomic principles is essential since it creates compatibility between the worker and their environment. Only by incorporating ergonomics into workplace design can one accurately balance the needs of the task with the peculiarities of the personnel.

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