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ERGONOMIC ASSESSMENT OF WORK-RELATED MUSCULOSKELETAL DISCOMFORT FACED BY BAKERY WORKERS

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Abstract: An exploratory study was conducted among 120 bakery workers working across various bakeries to evaluate the prevalence rate and potential risk factors associated with work-related musculoskeletal disorders and the discomfort they face. The specific objectives were to evaluate the risk factors to musculoskeletal discomfort experienced by the bakery workers.

It was reported that the neck, upper back, lower back, right forearm, right wrist, hip, and lower legs were the places where the bakery workers reported of pains, aches, or discomforts. 97.5(81.2%) bakery workers reported of having pain in their neck, 96.6(80.5%) had pain in their upper back, 99.2(82.6%) had pain in their right forearm and right wrist, which was due to continuous movement while kneading and rolling dough, cleaning pans/trays, or working above their shoulder level. Almost, 99.2(82.6%) of the workers had pain in their lower back and hip region, which was due to lifting heavy loads and equipment repeatedly, bending and twisting while picking or placing loaded trays on the ground. Whereas, 99.2(82.6%) reported having pain in both of their lower legs due to standing for long working hours.

Early detection and appropriate management such as consulting a doctor help in reducing the long-term discomfort, thus preventing the onset of a musculoskeletal disorder in the future. Muscles and tendons should be allowed to rest and recover at the first sign of pain; otherwise, the injury will become long-term and, in some cases, irreparable (https://www.ccohs.ca/oshanswers/diseases/rmirsi.html, n.d.). This paper focuses on and emphasizes the work-related musculoskeletal discomfort faced by bakery workers in their workplace, i.e., bakeries.

***Key Words*: Bakery Workers, Ergonomics, Work-related, Musculoskeletal Discomfort, Postures.**

I. INTRODUCTION

Bakery workers are mainly migrant labourers, who have been in the baking business as a traditional activity. A bakery worker is involved in the production of baked goods such as bread, biscuits, pastries, croissants, and other products made of flour by using an oven or other concentrated heat source (https://en.wikipedia.org/wiki/Bakery , n.d.). There are no minimum educational requirements to become a bakery worker, they typically learn their skills through long-term on-the-job training, some may learn through an apprenticeship program or by attending a technical or culinary school (https://www.bls.gov/ooh/production/print/bakers.htm, n.d.).
Ergonomics is the science of balancing workplace conditions and job demands to the working population's capabilities (https://www.cdc.gov/niosh/docs/97-141, n.d.). Ergonomics aims to alleviate stress while also preventing injuries and diseases caused by misuse of muscles, poor posture, and repetitive jobs. A workplace ergonomics programme might use engineering and administrative procedures to try to avoid or manage accidents and illnesses by removing or reducing worker exposure to WMSD risk factors including force, repetition, awkward or static postures, and contact stress.

Musculoskeletal disorders refer to issues with the locomotor apparatus, which includes muscles, tendons, the skeleton, cartilage, ligaments, and nerves. Musculoskeletal disorders that occur in the workplace or due to work-related factors are commonly known as Work-related Musculoskeletal Disorders (WMSDs). tasks (https://scholar.googleusercontent.com/scholar?q=cache:oFcKrSDOCA8J:scholar.google.com/+preventing+musculoskeletal+disorders+in+the+workplace&hl=en&as_sdt=0, n.d.).

Workers in bakeries are exposed to many hazards in the daily course of their duties. Although their work is usually safe, they face back strains, pain, and trauma caused by lifting or moving heavy bags of flour or other products. They work in the heat or other irregular hours and such as at night which causes fatigue, overexertion, and other harmful effects. Slips, trips, and falls are caused due to wet or contaminated areas with food products (flour), poor housekeeping or obstructions, and uneven surfaces. They work with hot equipment and sharp tools, which may cause accidents such as burns, cuts, etc. They may suffer from allergies caused by substances used in their

work (https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/publication/wcms_184767.pdf, n.d.).

II. REVIEW OF LITERATURE

Habib, R. R., et. al. (2019), in their study concluded that there exists a connection between heavy physical workload, awkward working postures adopted and upper musculoskeletal pain, predominantly in the neck, shoulders, wrist, and elbow regions (https://www.researchgate.net/publication/332551920_Musculoskeletal_pain_among_bakery_workers_in_Lebanon_A_national_survey, n.d.).

Sahu, S., et. al. (2013), observed that the workers were exposed to improper work postures, hazardous working environment, and heavy workload. Implementation of a proper workstation, work environment, workers should be allotted specific activities according to their experience, adequate rest breaks in between work period, while they should focus on avoiding awkward postures to prevent the risk of WMSDs (http://ajms.alameenmedical.org/ArticlePDFs/10 AJMS V6.N2.2013 p 150-157.pdf, n.d.).

Yi-Lang Chen, et. al. (2020) in their study stated that, dough operations such as kneading and rolling are a serious challenge to bakery staff, and further enhancement and redesign of work-station are required. The workers themselves report a high percentage of wrist and shoulder disorders, caused due to rearranging and redesigning activities (https://www.researchgate.net/publication/340777748_Musculoskeletal_Disorders_Symptoms_among_Taiwanese_Bakery_Workers, n.d.).

Musculoskeletal Disorders have a severe effect on the muscles, nerves, blood vessels, ligaments, and tendons of the body. The workers working in all the different industries and occupations, often have to carry out certain risk factor works, like lifting heavy items, bending, reaching overhead, pushing and pulling heavy loads, working in awkward body postures, and repetitively executing identical or similar jobs. Ergonomics aids in the fit of a job to its workers by minimising muscle fatigue, boosting productivity, and lowering the quantity and severity of work-related MSDs (https://www.osha.gov/SLTC/ergonomics/, n.d.).

With the help of literature review, it was noticed that there is a scarcity of knowledge on work-related musculoskeletal discomfort problems faced by Indian bakery workers in traditional bakeries. This study was conducted to bridge this gap mainly because most customers still think that traditionally made hand-kneaded bread such as pav and other bakery items are delicious but no one knows the risks associated with working in a bakery. The researchers strongly believe that even though bakery workers work in the back-end of a bakery, their health and safety are important, because if the hands that make such delicious baked goods face work-related challenges it can affect the bakery production. This study was conducted among bakery workers from Mumbai city and its suburbs to study the prevalence of work-related musculoskeletal discomfort they experience.

III. OBJECTIVES OF THE STUDY

The specific objectives of the study are to (i) understand the demographic profile of bakery workers, in traditional bakeries, (ii) explore the discomfort or symptoms of work-related musculoskeletal disorders among bakery workers, and (iii) suggest ergonomic solutions to reduce the incidences of pain, discomfort and/or injuries.

IV. MATERIALS AND METHODS

An exploratory study was conducted among 120 (aged 20 – 60 years) from 20 traditional bakeries in Mumbai city and its suburbs selected through snowball sampling technique. Since this profession is male-dominated, only male bakery workers were included within the study.

A self-constructed questionnaire was prepared during which the data collected was coded and systematically entered within the MS Excel spreadsheet, a version of MS Office. Pivot charts were constructed to analyze the data to prolong the relation between the several aspects of the research. Tools such as CMDQ and OWAS were used for assessing the prevalence of Musculoskeletal disorders.

The questionnaire consisted of the subsequent parts:

- Part A collected information about the Demographic profile of the participants
- Questions regarding the Work-related information formed Part B
- Part C comprises information associated with the Workplace hazards and Posture assessment tool (OWAS).
  - Ovako Working Posture Assessment System (OWAS) was implemented to assess the postures adopted by the bakery workers and the way they interfered with the task. It is a simple observation method for posture analysis. Posture analysis of the back, arms, neck and lower body is done and then the score is given to each posture adopted.
- Part D contains CMDQ and Characteristics of Manual baking activities in a bakery.
  - Cornell Modified Discomfort Questionnaire (CMDQ) was used to collect the discomfort experienced: It is a one-page questionnaire which focused on the frequency and intensity of pain, ache and discomfort and their ability to skip or interfere with work. The questionnaires are based on previously published research studies of musculoskeletal discomfort among office workers and Dutch Musculoskeletal Questionnaire (DMQ), which contained 163 questions on musculoskeletal workload and hazards associated with them.
- Part E consists of questions regarding environmental factors within the bakery such as illumination, noise and PPE used, etc. Others questions regarding burns, heat stress, and also about first aid being provided or not were included in the questionnaire.

V. RESULTS AND DISCUSSIONS

120 bakery workers from 20 traditional bakeries were interviewed and observed to understand their demographic profile. Majority of the bakery workers that is 70(58%) were from 21-30 age group with an average age of the sample being 24 years (Fig. 1). 30(25%) of the bakery workers had studied till below S.S.C. 42(35%) of the workers had completed their S.S.C., 20(16.6%) of the workers had completed their H.SC. Only, 2(1.6%) are graduates, whereas, 26(21.6%) are not educated (Table 1).

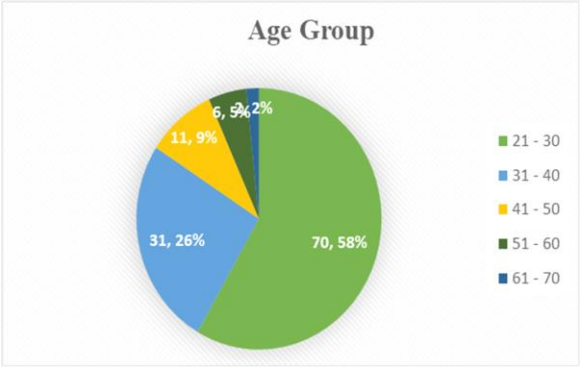

Fig. 1: Age Group

It was observed that, from the age group 21-30, 15(1.2%) of bakery workers were overweight and 3(2.5%) were obese. This can be mainly because of the practice of an unhealthy lifestyle. 11(9.2%) were overweight under the age of 31-40 years of age and 1(0.8%) worker was obese. 4(3%) workers were overweight and 2(1.65) were obese under the age group 41-50 years of age. While, 1(0.8%) worker was underweight under 21-30 years of age (Fig. 2).

42(35%) of the bakery workers in the age group of 21-30 had lesser work experience that is less than 5 years. 20(16.7%) had less than 10 years and 8(6.6%) had less than 15 years of experience (Fig. 3). 2(0.8%) reported having less than 40 years of work experience under the 51-60 age group. And only 2(0.8%) have less than 50 years of work experience from under 61-70 years of age group. 35(29%) were bakers under 21-30 years of age. 1(0.8%) were baker and helper from the 61-70 age group. Most workers were bakers and helpers from the 21-50 age group.

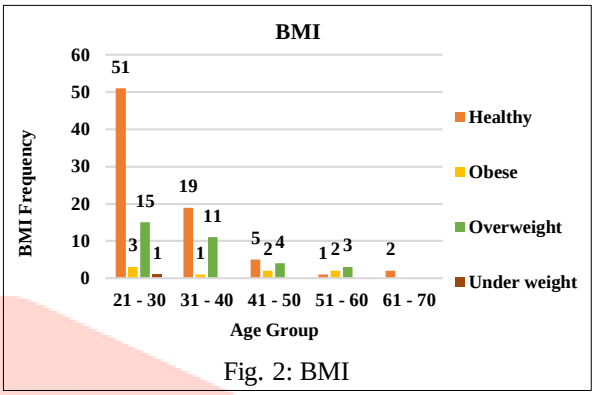

Fig. 2: BMI

The average age of the sample was 24.0 years, with 101 (84.2%) belonged to a young group of 21 – 40 years of age. This is similar to a study by Joshua, I. A., et. al (2017) in their study titled "Knowledge of occupational hazards and use of preventive measures among bakery workers in Kaduna north local government area, Kaduna State, Nigeria" conducted in Kaduna State, Nigeria.

The educational qualification and training capability of bakery workers in the bakery industry. It was gathered that; bakery workers are selected not based on experience but their physical capabilities and experience. The educational qualification is not a deterrent for employment in the bakery, it is the baking skills. Trainees in a bakery start with lower positions such as cleaner, followed by an upper post of the helper who is involved in carrying out tasks such as kneading and rolling dough.

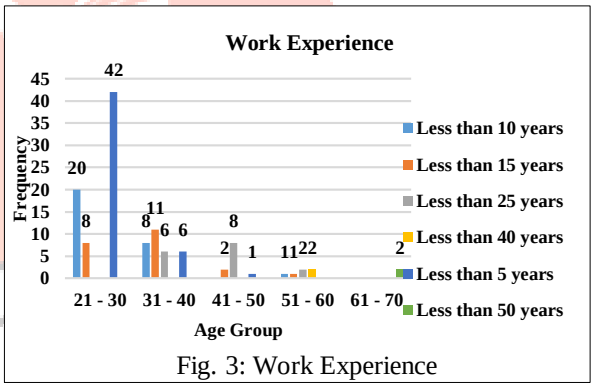

Fig. 3: Work Experience

Whereas (Fig. 2) shows that the BMI (Body Mass Index) of the bakery workers was calculated with the help of their weight and height which was asked in the questionnaire to analyze how fit they are. Even though most of the workers rated themselves as having good or very good health their Body Mass Index (BMI) when analyzed contradicted it. It was seen that they were still falling under the BMI category of overweight, obese, and even underweight. Their poor eating habits, sleeping patterns, working hours, and the lifestyle they followed affected their body mass index. It was observed that working for long hours can lead to fewer sleeping hours which is associated with weight gain. Since the workers are mostly in the bakery they end up eating baked goods which may thus lead to weight gain and an increase in their BMI making them tired quickly and lethargic. The bakery workers were not involved in physical activities due to long working hours and it affected their weight adversely.

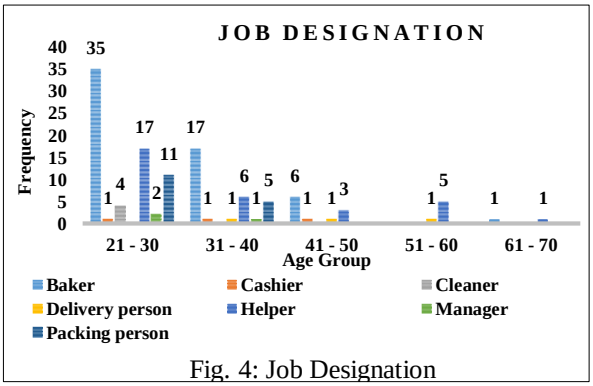

Fig. 4: Job Designation

A study conducted by "Sahu, S., et. al., (2013)" rightly stated that, as age increases, muscles tend to get rigid. Continuous exposure to a physically stressful job, would inflict an additional load on the bones and muscles. Hence, older bakery workers are not given physically straining jobs such as of a baker which requires strength as well as swiftness. And working near the heat can also negatively affect them. 35(29.2%) were in the position of a baker who was under the age of 21-30 (Fig. 4), which states that physical strength is required while carrying out their tasks such as placing and collecting trays from the oven using a rod. The bakery workers were mostly falling under the category of 21 – 30 years of age and were young adults. It was observed that most 58(48.3%) of the bakery workers rated their health as very good. 29(24.1%) of the workers rated their health as good, 21(17.5%) rated their health as average and only 12(10%) rated their health as poor. Younger adults were not in an experienced post, they were in posts such as helpers who assist others such as bakers to pick up trays and load them onto the rod, but due to their age, they were physically fit compared to the older bakery workers.

Musculoskeletal Pains and Aches

CMDQ (Cornell Modified Discomfort Questionnaire) analysis revealed the sites of bodily discomfort experienced. Work-Related Musculoskeletal disorders (WRMSDs) affect workers in many occupations including bakery workers. WRMSDs can be observed when the physical capabilities of the worker do not match with the physical requirements of the job. Prolonged exposure to ergonomic risk factors such as posture, force, repetition, and stress can cause damage to workers' bodies and leads to Musculoskeletal Disorder. Bakery workers are particularly at the risk for developing pains aches in Neck, Upper back, Lower back, Wrists, and Lower leg regions.

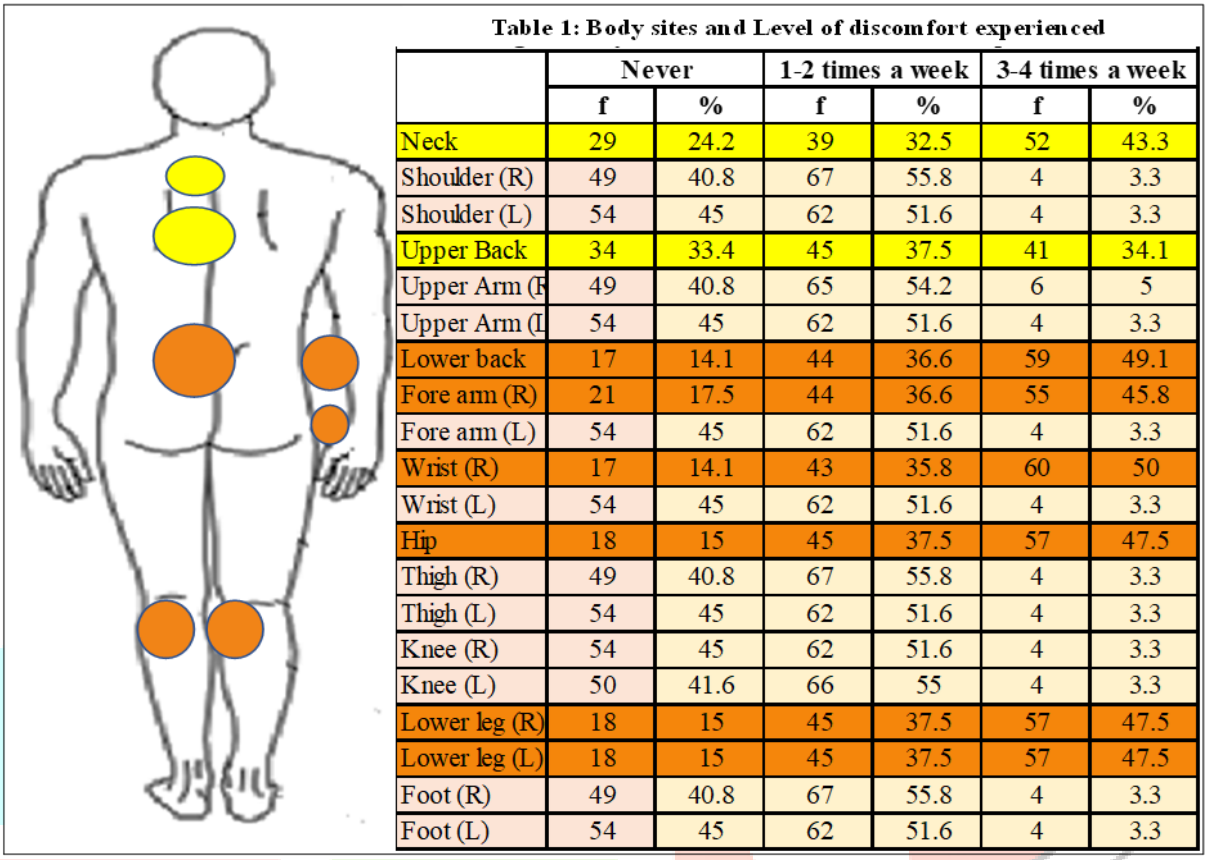

Table 1: Body sites and Level of discomfort experienced

	Never		1-2 times a week		3-4 times a week	
	f	%	f	%	f	%
Neck	29	24.2	39	32.5	52	43.3
Shoulder (R)	49	40.8	67	55.8	4	3.3
Shoulder (L)	54	45	62	51.6	4	3.3
Upper Back	34	33.4	45	37.5	41	34.1
Upper Arm (R	49	40.8	65	54.2	6	5
Upper Arm (L	54	45	62	51.6	4	3.3
Lower back	17	14.1	44	36.6	59	49.1
Fore arm (R)	21	17.5	44	36.6	55	45.8
Fore arm (L)	54	45	62	51.6	4	3.3
Wrist (R)	17	14.1	43	35.8	60	50
Wrist (L)	54	45	62	51.6	4	3.3
Hip	18	15	45	37.5	57	47.5
Thigh (R)	49	40.8	67	55.8	4	3.3
Thigh (L)	54	45	62	51.6	4	3.3
Knee (R)	54	45	62	51.6	4	3.3
Knee (L)	50	41.6	66	55	4	3.3
Lower leg (R)	18	15	45	37.5	57	47.5
Lower leg (L)	18	15	45	37.5	57	47.5
Foot (R)	49	40.8	67	55.8	4	3.3
Foot (L)	54	45	62	51.6	4	3.3

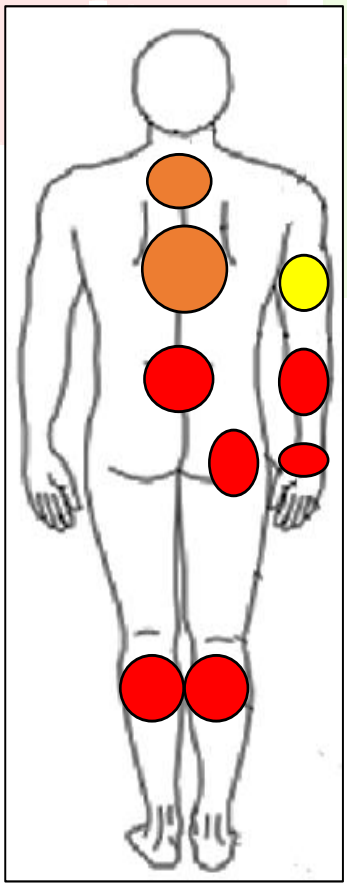

Table 2: Inference with ability to work

Body site	Not at all		Slightly interfered		Substantially interfered	
	f	%	f	%	f	%
Neck	21	17.5	42	35	57	47.5
Shoulder (R)	38	31.6	51	42.5	51	42.5
Shoulder (L)	50	41.6	41	34.2	29	24.2
Upper Back	19	22.8	55	45.8	46	38.3
Upper Arm (R)	33	27.5	56	46.6	31	25.8
Upper Arm (L)	50	41.6	41	34.2	29	24.2
Lower back	6	5	53	44.1	61	50.8
Fore arm (R)	6	5	58	48.3	56	46.6
Fore arm (L)	50	41.6	41	34.2	29	24.2
Wrist (R)	6	5	53	44.1	61	50.8
Wrist (L)	50	41.6	41	34.2	29	24.2
Hip	6	5	53	44.1	61	50.8
Thigh (R)	38	31.6	51	42.5	31	25.8
Thigh (L)	50	41.6	41	34.2	29	24.2
Knee (R)	50	41.6	41	34.2	29	24.2
Knee (L)	39	32.5	52	43.3	29	24.2
Lower leg (R)	6	5	53	44.1	61	50.8
Lower leg (L)	6	5	53	44.1	61	50.8
Foot (R)	38	31.6	51	42.5	31	25.8
Foot (L)	50	41.6	41	34.2	29	24.2

VI. DISCUSSION

(Table 1) shows that, 97.5(81.2%) of bakery workers reported of having pain in their neck, 99.2(82.6%) in their right forearm, and 99.2(82.6%) have pain in their wrist. 96.6(80.5%) of bakery workers have reported that they have pain in their upper back and 99.2(82.6%) experience pain in their lower back region. 99.2(82.6%) of bakery workers have reported having pain in their hip, right and left lower leg.

Musculoskeletal Questionnaires allow ergonomists and occupational health professionals to measure Work-Related Musculoskeletal risk factors and symptoms in worker populations in a quick yet standardized way. The prevalence of musculoskeletal discomfort was collected using the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ).

It deals with sites of bodily discomfort experienced. It was reported that the neck, upper back, lower back, right forearm, right wrist, hip, and lower legs were the places where the bakery workers reported pains, aches, or discomforts. 97.5(81.2%) workers reported having pain in their neck, 96.6(80.5%) had pain in their upper back, 99.2(82.6%) had pain in their right forearm and 99.2(82.6%) reported having pain in their right wrist which was due to continuous movement of kneading and rolling dough, cleaning pans/trays, or working above their shoulder level. The continuous movement of kneading, rolling the dough, and lifting of heavy equipment is the cause of pains in the neck to arm region respectively.

A study conducted by "Habib, R. R., et. al., (2019)" stated that workers face the negative effect of the workplace repetitive work and static loading area due to tasks such as mixing and handling dough, standing in awkward postures for a long period, working in cramped and hot spaces, carrying big loads, etc. Work-Related Musculoskeletal disorders (WRMSDs) affect workers in many occupations including bakery workers. Prolonged exposure to ergonomic risk factors such as posture, force, repetition, and stress can cause damage to workers' bodies and leads to Musculoskeletal Disorder. Working in the proper range of motion is very important. The workers should avoid stretching while doing any work. Hence, everything useful should be kept in easily reachable areas.

Almost, 99.2(82.6%) of the bakery workers had pain in their lower back and hip region, when bakery workers bend for doing their job the pressure builds up on their lower back. The tasks that require bending include lifting heavy flour packets or loaded trays from the ground. This is because they lift heavy equipment more frequently. Introducing machines in the workplace can be the best alternative that can be used for lifting heavy loads and equipment. The more common position adopted by bakery workers is bending in an awkward position. A person should never bend from their hips as it will lead to the development of musculoskeletal disorders, instead they should bend from their knees. But while doing this they should keep their knees in the proper position or else there may be pain seen in the knee region.

Whereas, 99.2(82.6%) reported having pain in both of their lower legs. Standing for long hours causes pain to and aches in the legs. Hence, adequate rest breaks and in-between breaks for some stretching are a must so that the job is not done for a prolonged time. If not then working for a long time may further cause musculoskeletal disorders in those areas. The power zone is also known as the comfort zone, for lifting is close to the body between mid-thigh and mid-chest height.

Bakery workers are particularly at the risk for developing pains and aches in body areas like the neck, shoulder, forearm, upper and lower back, and lower leg region which are said to hurt the most. This is related to a study conducted by "Sahu, S., et. al., (2013)" Standing for a long period and doing tasks can be the reason to have pains, aches, or discomfort in lower leg ranges. The tasks that might include standing posture can be kneading, rolling dough, placing and collecting trays from the oven, etc. It was observed that even when the bakery workers stand, they do not necessarily stand properly, they tend to bend or put more weight on one of their feet. There can be a bend in their back which may again be a reason for pain in the lower back.

The CMDQ (Table 2), also analyses the extent of discomfort or pain experienced, and how uncomfortable was it. Bakery workers reported that they faced low pain in some regions, while others reported their pain being moderately uncomfortable to very uncomfortable. 44(36.6%) bakery workers reported that they had moderately uncomfortable pain in the lower back region, while still 59(49.1%) reported that their pain was very uncomfortable in the same region. 45(37.5%) had reported moderate pain and 57(47.5%) had very uncomfortable pain in the hip region. In the lower leg region out of 102(85%) who had reported pain in the foot region 45(37.5%), bakery workers reported that the pain was moderately uncomfortable, while 57(47.5%) of them told that the pain was very uncomfortable. In the right forearm and wrist, 44(36.6%) and 43(35.8%) workers reported that the pain was moderately uncomfortable, while 55(45.8%) and 60(50%) of them reported that their pain was very uncomfortable. In the right upper arm, 7(6%) said that the pain was moderately uncomfortable, while 6(5%) told that the pain was very uncomfortable. The regions are marked red as they experience an extreme amount of pain. The level of pain is very important so as to determine how this pain has interfered with the ability to work.

It was reported that the pain they felt in the lower back, forearm (right), wrist(right), hip, and lower legs which interfered with their ability to work (Table 2), and hence these regions are marked red as they experience very high amounts of pain. The neck and upper back are marked orange because they experience high amounts of pain which cause discomfort. Through a discomfort questionnaire, one can get to know in which region pain occurs, how uncomfortable is that pain and does the pains, aches, and discomfort interfere in their workability. Through the Cornell Modified Discomfort Questionnaire, one can get to know about in which region pain occurs, how uncomfortable is that pain, and does the pain, ache, or discomfort interfere with their workability. So, it is really important to get preventive measures accordingly.

Posture Assessment (OWAS technique)

- OWAS 1 - No corrective measure is needed.
- OWAS 2 - They may need corrective measure in the near future.
- OWAS 3 - Corrective measure should be taken as soon as possible.
- OWAS 4 - Corrective measure should be taken immediately.

In (Fig. 5), 49(40.8%) bakery workers who bend at their waist rated 3 as OWAS score. 10(8.3%) workers who bend at their waist rated 4 as OWAS score. Whereas, 35(29.1%) and 3(2.5%) workers who stand while kneading dough rated OWAS score as 3 and 4 respectively (Fig. 6).

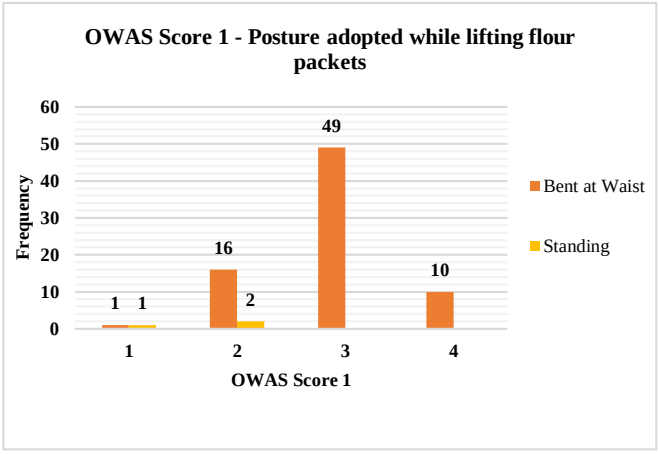

Fig. 5: OWAS Score 1

The Ovako Working Posture Assessment System (OWAS) was used to analyze specific postures like bending or standing which eventually differed for various activities like lifting flour packets and kneading dough and thus recommend corrective actions. These postures were most commonly seen in the bakery workers while doing these activities. OWAS is used to identify the most repeated postures of back, arms, legs, and weight of the load handled by the workers. Making observations of the work task, codifying the postures, assigning risk categories, and suggesting corrective action are all part of the OWAS technique. There can be a bend in his back which may then be a reason for pain in his lower back. Their back may be bent in awkward positions or hands may be stretched continuously or even while standing there can be different ways in which they may stand for example: standing with both legs straight or putting weight on one leg, standing or squatting with both knees or single knee bent, etc. Also, a load of force that a person may use while performing a job, all may hence affect the working posture of a person and this is evaluated by the OWAS Posture assessment technique.

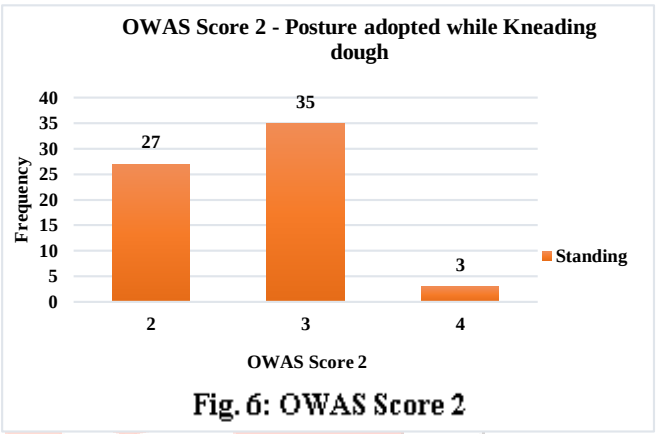

Fig. 6: OWAS Score 2

(Fig. 5) focuses on Posture assessed while lifting flour packets. Two kinds of posture were adopted during the task of lifting flour sacks. When analyzed with OWAS it was seen that around 16(%) bakery workers who used to bend and lift flour sacks had an OWAS scoring of 2 which means they may need corrective measures shortly.

When the bakery workers used to stand and lift the sacks 1(0.8%) had an OWAS scoring as 1 which means no corrective measure is needed 1(0.8%) used to bend at the waist to lift; 49(40.8%) used to bend at waist rated 3 (OWAS score) which implies Corrective measure should be taken as soon as possible, as they might be on the onset of Musculoskeletal Disorder. While standing and doing the job ensure you are standing in the right manner which means proper balance in both the legs and not applying pressure only in one leg. 10(8.3%) bakery workers rated 4 as OWAS score used to bend at the waist to lift the flour packets. OWAS score 4 suggests that the Corrective measures should be taken immediately, if not implemented immediately, then permanent damage may occur in the Musculoskeletal system, which is indeed not a good sign. The corrective measure may include proper bending which means one should not bend from their hip, rather they should bend from their knees. This will hence not put the load on their lower back.

Whereas, (Fig. 6) focuses on posture assessment observed while kneading dough. Only one posture Standing with the neck bent forward is used. When these postures were analysed with OWAS it was seen that majority of the bakery workers, had OWAS scoring 4 while having the same posture no one had an OWAS score of 1. This means when they stand for kneading dough many problems are seen in their posture. When there is high pressure and due to lack of time or working under pressure they won't realize that they are putting pressure on a single leg. While bending from the neck comes as a painful task, this may be because bending at the neck causes discomfort from the neck region to shoulder and so on. Standing with the neck bent forward for long hours affects the workers' neck region and legs which could lead to musculoskeletal disorders. Redesigning of work-station would be an essential step towards making the workplace better and safe.

Depending upon the OWAS score, proper corrective measures are essential, if not, then musculoskeletal disorders will occur which will then cause the worker in this case bakery worker unable to do his work properly due to which the productivity of the bakery will reduce. This is why proper corrective measures have to be taken, proper rest breaks should be taken by the bakery workers. Adapting correct posture while working is equally important so that the bakery workers will be more proficient in his job which can then improve the productivity and efficiency of the bakery.

VII. RECOMMENDATIONS

Ergonomics is the study of how to design a job so that it is safer and more efficient for the worker. Ergonomic solutions can help employees be more productive by making them more comfortable. The suggestions and control methods for this research study are as follows:

Engineering Controls

Engineering controls are ways for getting as close as feasible to removing a hazard without truly eliminating it. These are the most effective of all the three as it focuses on the principle of fitting the job to the man. Engineering controls are deemed more dependable than the use of personal protective equipment or behaviour guidelines (administrative controls), which can fail owing to individual human mistake when used (https://simplifiedsafety.com/blog/the-hierarchy-of-controls-part-two-engineering-controls/, n.d.).

- Proper workstation design modification - This will prevent bakery workers from adopting awkward postures while working like bending or stretching out of their power zone. This will result in not applying pressure in any part of their body and thus reducing the risk of musculoskeletal problems which may occur if the workstation design is not proper.
- Full range of motion is equally important - The workspace of the bakery workers should be clear. This is important to avoid stretching and causing the problem in the upper arm or shoulder area. The worker should be able to do his work without any problem (https://www.osha.gov/SLTC/ergonomics/controlhazards.html, n.d.).
- Use of trolleys/machines – Instead of carrying-out labour-intensive work like lifting loaded trays or heavy flour packets, an effective solution can be to introduce machines (i.e., conveyors), whereas, for small-scale bakeries trolleys can be the best.

Administrative Controls

To prevent fatigue and stress, actions can be taken by the management. These are the changes made in the work procedures that lessen the risk of an injury or an accident at the workplace. It is still better than personal control but not effective as an engineering control. It includes:

- Rest breaks and job rotation: Giving proper rest breaks in between working hours is very important so that they can relax from the work they do. To relax their body, the workers can stretch and rest their muscles, this will help in preventing onset to musculoskeletal disorders.
- Breaking down of complex tasks: This follows Fayol's principle of division of labour wherein one big task gets divided into many smaller simpler tasks (https://www.osha.gov/SLTC/ergonomics/controlhazards.html, n.d.).
- Adjustment in the pace of work: It helps bakers to work more efficiently according to their liking and thus can help in job satisfaction.
- Training and development: A training program can be implemented to demonstrate proper working practices that include adopting good working postures and eliminating work methods that have an inverse effect on the workers' bodies. e.g., teaching them exercises to relieve any pains and aches, if caused.

Personal Controls

These are equipment, tools, or clothing designed to guard the worker from any kind of infections, injuries, and accidents. PPE is said to be the last sense of defence and is the least effective of all three but still, it can reduce the effect of hazard. It includes:

- Gloves: While working in a bakery, the workers are at risk of cuts, or different wounds because of the workers coming into contact with very hot articles, working close to sparkles or flares, or from being in the presence of high temperatures from the oven in the work environment. These can be eliminated by using heat-resistant gloves or work gloves.
- Physical exercises: Stretching exercises that include 1. Elbow, hand & wrist stretches such as Elbow-Hand Bend, Active Hook Fist (for Carpal Tunnel Syndrome), etc. 2. Hamstring muscle stretching and back isometric exercises. 3. Plantar fascia release for heel pain (https://www.osha.gov/sites/default/files/2018-11/fy14_sh-26334-sh4_PocketGuide-English.pdf, n.d.).
- Behavioural changes: The bakers should have an optimistic approach with regards to these control methods and should follow them diligently. They should practice all exercises and also meditate for being more optimistic and work with happiness.

VIII. CONCLUSION

Bakery workers face many problems such as pain in the lower back because of frequent bending, twisting, and lifting of heavy loads; pain in the neck due to various tasks performed such as kneading and rolling dough, etc. These continuous repetitive movements without adequate breaks can cause pain in the neck and upper arm region. There is also pain in the lower leg region due to standing for long hours without rest breaks. These problems interfere with the working ability of the bakery's workers and hence, lowering productivity. The majority of the bakery workers have mentioned that performing similar jobs has led them to get accustomed to the pain but some of the workers do find difficulty with performing the job as they feel severe pain. While some of the bakery workers complain about the pain which hinders their performance. The implementation of three levels of control methods: Engineering controls, Administrative controls and Personal controls will help reduce the discomfort experienced by the bakery workers. Even though engineering control is the most expensive of all, it is still the most effective. Personal controls are the least effective but the easiest to implement, but the effectiveness relies completely on the user which makes it difficult to monitor

IX. SCOPE OF THE STUDY

The study can be taken forward to include many related aspects such as ergonomic redesigning of the workstations in bakeries, occupational stress faced by the bakery workers, job satisfaction and life-work balance, cardiac cost of tasks, and ergonomic tool design for bakery workers, which were compromised due to time constraints and unfavourable circumstances caused by Covid. Future researchers can further focus on allergens and irritations caused due to use of different types of flours and ingredients. As the workers made more use of traditional baking methods and less use of advanced technology research can be conducted on the handling of the advanced bakery equipment and their association with discomfort faced by the bakery workers.

X. AUTHOR STATEMENT

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