

Ergonomic assessment of musculoskeletal discomfort among chefs in commercial kitchens

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Abstract: An exploratory study was conducted among 121 chefs working in various types of commercial kitchens to investigate the prevalence rate and potential risk factors associated with work-related musculoskeletal discomfort. The specific objectives were to analyze the risk factors leading to bodily pains and aches. 96 (79%) chefs reported severe pain in the lower back due to bending and lifting heavy equipment 83 (69%) in shoulder due to repetitive activities and 88 (73%) feet due to prolonged standing. Early detection and reporting of musculoskeletal injuries help in reducing the long term discomfort. Moreover, recognizing risk factors that contribute to the development of musculoskeletal disorders and rectifying the awkward postures, workstation design so that forceful actions, repetitive motion, contact stress can be reduced. The results recognized the need and urgency to reduce the risk factors of work-related musculoskeletal disorders among chefs.

Key Words: Chefs, Commercial Kitchens, Ergonomics, Musculoskeletal Discomfort, Work-related, CMDQ, OWAS, Postures.

1. INTRODUCTION:

A chef is a trained cook who is proficient in all the aspects of cooking. They are vulnerable to different types of injuries and pains/aches and discomfort which may occur due to slips, trips or falls. Many, on the course of their daily course of work, adopt awkward postures subconsciously. Implementation of good Ergonomics ensures that most of these hazards can be controlled from being risks (<https://en.wikipedia.org/wiki/Chef>). Ergonomics is the study of skills regarding the job people are performing, the ways that job can be performed and the machines and gadgets that are utilized for that particular job. It also includes the study of psychosocial, physical and environmental aspects of the employee doing their job, where different spheres of job satisfaction, stress, posture, etc. are considered. Ergonomics as a field is concerned with fitting the job to the man. The aim is to achieve the most fitting job with the best possible match of the machine and the person who is utilizing that machine with regards to the work being performed. It is the study of making and planning the work or rather formulating the work to fit the workers body and his abilities. This will put the worker at ease and reduce the physical stress and just terminate many possible work-related musculoskeletal disorders and injuries (https://en.wikipedia.org/wiki/Human_factors_and_ergonomics.)

Prevention of the injuries and safety of the chefs are inter-related with the:

- Ergonomic and safety factors such as work postures, their injuries, musculoskeletal disorders;
- Psychological aspects such as work satisfaction, stress, optimal work capacity; and
- Environmental factors such as ventilation, illumination, temperature etc.,

All of these factors can affect the ability of chefs to work.

Musculoskeletal Disorders (MSDs) are disorders of the muscles, nerves, tendons, joints, cartilage and spinal disks. MSDs that occur in the work place or due to work-related factors are commonly known as Work Related Musculoskeletal Disorders (WMSDs). It is a condition in which the work environment and performance of work contribute significantly to the condition also, the condition is made worse or persists longer due to work conditions. Examples of work conditions that may lead to WMSDs include routine lifting of heavy objects, daily exposure to whole body vibration, routine overhead work, work with the neck in chronic flexion position, or performing repetitive forceful tasks. Chefs in commercial kitchens are exposed to risk factors such as lifting heaving items, bending, reaching overhead, working in awkward postures or performing repetitive tasks, exposure to all these risk factors for muscular skeletal disorder increases any worker's risk of injury.

(<https://www.cdc.gov/workplacehealthpromotion/health-strategies/musculoskeletal-disorders/index.html>).

Work Related Musculoskeletal Disorders can be prevented by fitting the job to man instead of fitting man to the job. This helps in lessening the muscle fatigue, reduces number and productivity of the work and hence helps in increasing the productivity of the work done.

2. LITERATURE REVIEW:

El Sayed, H. E. (2017) in their study titled, The effect of educational Intervention about Work related musculoskeletal disorders on restaurant workers, reported that more than two third of workers suffer from WRMSDs as most of them have lower back pain followed by wrist/ hand, neck and shoulder as the physical demands of restaurant work appeared to adversely impact the discomfort that developed. Throughout the study, prevalence of neck, shoulder and low back pain has been discussed as a common health problem among chefs and kitchen workers has been reported. This highest prevalence was reported in lower back, neck and upper back

(https://pdfs.semanticscholar.org/0969/33224dae09be93f420f9b08c7143f914a819.pdf?_ga=2.97640342.801820334.1585233494-700892291.1585233494)

Memkiya, A. and Dalal, P. (2017) in a study on different postures adopted by the food production staff aimed to explore different postures adopted by the food production staff to analyze the different body parts involved with musculoskeletal disorders. The results reported that workers were exposed to awkward postures during long working hours especially low back and hand postures; Repetitive work and static loading are responsible for most of the MSDs. The study concluded that Musculoskeletal disorders was mainly due to the awkward postures adopted by the food production staff. It also recommends proper postural practices, use of right equipment, short breaks, reducing the weight and size of items workers lift and putting supplies and equipment within easy reach of the worker can help prevent WRMSDs.

(https://archive.org/stream/69ASurveyOnDifferentPostureAdoptedByTheFoodProductionStaffAtWork/69%20A%20Survey%20on%20Different%20Posture%20Adopted%20by%20the%20Food%20Production%20Staff%20at%20Work_djvu.txt)

Ali, S., Kamat, S.R., and Mohamed S. B. (2018) analyzed the awkward postures by food production workers using RULA assessment method. Some parts of the study included chefs working in different awkward postures due to long working hours and cooking. The study reported a certain increase in the number of hazards cooking in an environment. The chefs performing different tasks did not adopt neutral postures resulting in pain and MSDs.

(https://www.researchgate.net/publication/327630943_ANALYSIS_AWKWARD_POSTURE_AT_FOOD_PRODUCTION_ACTIVITY_USING_RULA_ASSESSMENT/link/5b9a78c792851ca9ed0390af/download) Musculoskeletal Disorders: It affects the muscles, nerves, blood vessels, ligaments and tendons. Workers in many different industries and occupations can be exposed to risk factors at work, such as lifting heavy items, bending, reaching overhead, pushing and pulling heavy loads, working in awkward body postures and performing the same or similar tasks repetitively. Exposure to these known risk factors for MSDs increases a worker's risk of injury.

Work-related MSDs can be prevented. Ergonomics is used for fitting a job to a person which helps lessen muscle fatigue, increases productivity and reduces the number and severity of work-related MSDs

(<https://www.osha.gov/SLTC/ergonomics/>).

Through the literature review, it was noticed that there is a dearth of knowledge on work-related musculoskeletal discomfort problems faced by Indian chefs in Indian settings. This study was conducted to bridge this gap mainly because the contemporary society loves to celebrate even normal days with a good dinner out. The researchers strongly believe that the hands that cook the food should be safe for the society to be safe. This study was conducted among chefs from Mumbai city and its suburbs to study the prevalence of work-related musculoskeletal discomfort experienced. The specific objectives of the study were to (i) understand the demographic profile of chefs, in restaurants, outlets and commercial kitchens, (ii) investigate the prevalence of bodily pains and aches among chefs, and (iii) suggest ergonomic solutions to reduce the incidences of pain, discomfort and/or injuries.

3. MATERIALS AND METHOD:

An exploratory study was conducted among 121 (aged 20 – 60 years) from 30 restaurants, commercial kitchens and hotels in Mumbai city and its suburbs selected through snowball sampling technique. Since this profession is male-dominated, only male chefs were included in the study. A self-constructed and validated questionnaire was used to collect data. A self-constructed and validated questionnaire was used to collect information. The questionnaire was divided into 3 parts:

- Part A collected information on the demographic profile of the participants
- Questions probing the work-related information formed Part B
- Part C comprises of information related to the respondent's occupational health and posture assessment

The self-constructed questionnaire was made in which the data was entered. Data collected was coded and systematically entered in the MS Excel spreadsheet, a version of MS Office. Pivot charts were constructed to analyze the data to draw out the relation between the several aspects of the research. The musculoskeletal disorders were assessed with the help of CMDQ and OWAS tools. The disorders were compared with the tasks they performed.

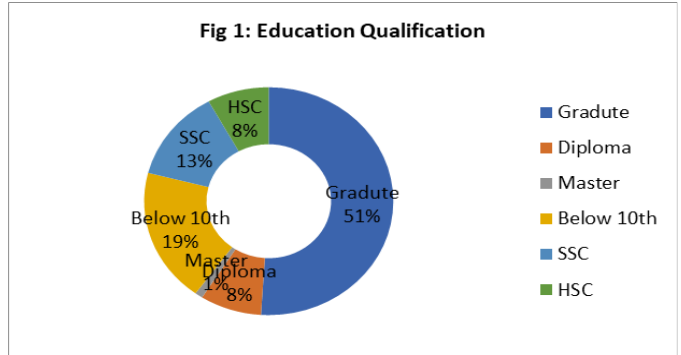
- Discomfort experienced was collated using the Cornell Modified Discomfort Questionnaire (CMDQ): It is a one-page questionnaire which focused on the frequency and intensity of pain, ache and discomfort and their

ability to skip or interfere with work. The questionnaires are based on previous 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.

- Ovako Working Posture Assessment System (OWAS): This method is a tool to identify those positions that could be responsible for musculoskeletal problems, in order to improve working conditions through the implementation of corrective measures and, eventually, to achieve a better technological planning for the production.

4. ANALYSIS, DISCUSSION AND FINDINGS:

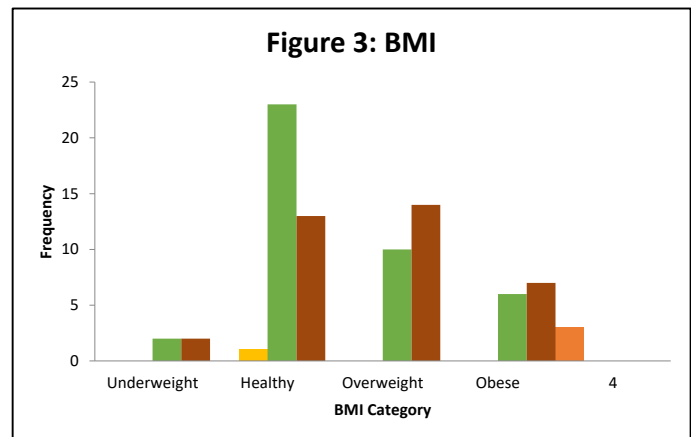
121 chefs from 30 commercial kitchens were interviewed and observed to understand their demographic profile. 23(19%) of the chefs were below 10th grade. 16(13%) of the chefs had completed their SSC. 9(8%) of the chefs had completed their 12th standards. 1(1%) of the employees working in the hotels had a post-graduation. 62(51%) of the workers who graduated were head chefs and executive chefs.



11(10%) of the chefs were overweight who were working between 5 to 10 hours. 17(14%) of the chefs were overweight who were working for more than 10 hours and slept for a lesser duration and had to skip meals once in a while. 8(7%) of the chefs were obese who worked for more than 10 hours. 5(4%) of the chefs were extremely obese working in between 5 to 10 hours.

BMI CATEGORY	f	%
Underweight	8	7
Healthy	41	34
Overweight	13	11
Obese	32	26
Extremely obese	27	22

It was observed that 1(1%) of the chefs were obese and Over weight at the age of 11-20 years of age and were healthy. 16(13%) of the chefs were overweight and were under 21-30 years of age and 10(9%) of the chefs were obese. This can be mainly because of practice of unhealthy lifestyle. 12 (10%) of the chefs were overweight under the age of 31-40 years of age. Under the category of 41-50 years of age, 4(3%) of the chefs were overweight and were more in number than the chefs who were healthy.



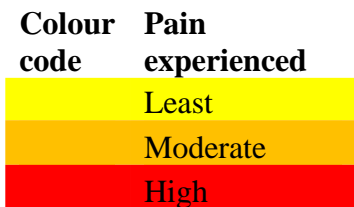
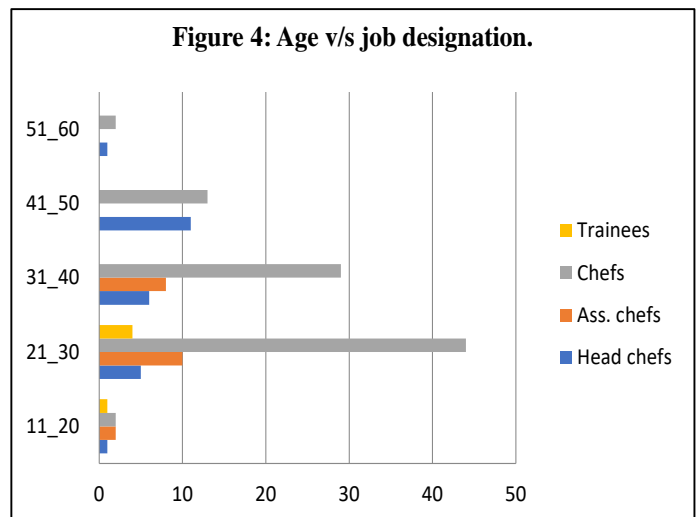
- 7(6%) of the chefs in the age group of 11 to 20 had lesser work experience that is less than 10 years.
- 57(47%) of the chefs falling under the age group of 21- 30 had a work experience between 0-10 years and 7(6%) of the chefs had a work experience between 10 – 20 years.
- 13(11%) of the chefs under 31 – 40 years of age had a work experience between 0-10 years, 20(17%) of the chefs had a work experience between 10-20 years and 3(2%) of the chefs had a work experience between 20 -30 years who were head chefs.
- 3(2%) of the chefs who fall under the age group of 51-60 years have a work experience of more than 20 years.
- 13(11%) of the chefs which were falling in the age group of 21 to 40 years of age were mainly head chefs.
- 1(1%) of the chefs are head chefs under the age group of 11 to 20 years.

Musculoskeletal Pains and Aches:

CMDQ A deals with sites of bodily discomfort experienced. Work Related Musculoskeletal Disorder (WRMSDs) affect worker in many occupations including chefs. When the physical capabilities of the worker do not match with the physical requirements of the job WRMSD can be observed. Prolonged exposure of ergonomic risk factors such as posture, force, repetition and stress can cause damage to workers body and leads to Musculoskeletal Disorder. Chefs are particularly at the risk

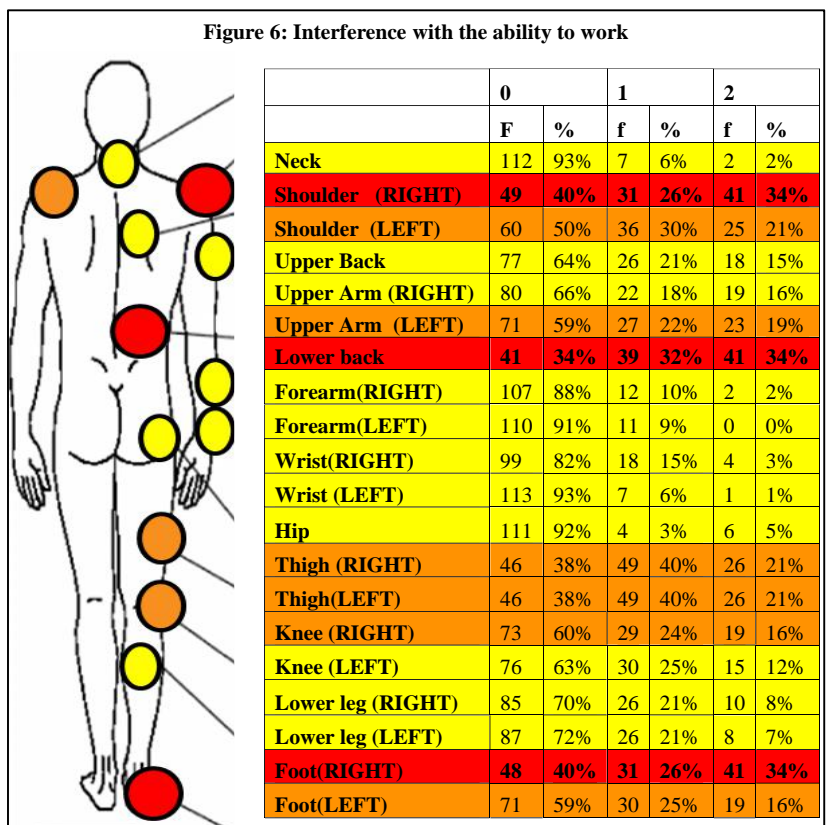
for developing pains aches in Shoulder, Upper arm, Lower back and foot region.

- 83(69%) of chef have pain in their right shoulder and 79(65%) in the right arm region.
- 96(79%) of chef have reported that they have pain in the lower back region.
- 86(71%) and 88(73%) of chefs have reported pain in right and left feet respectively.

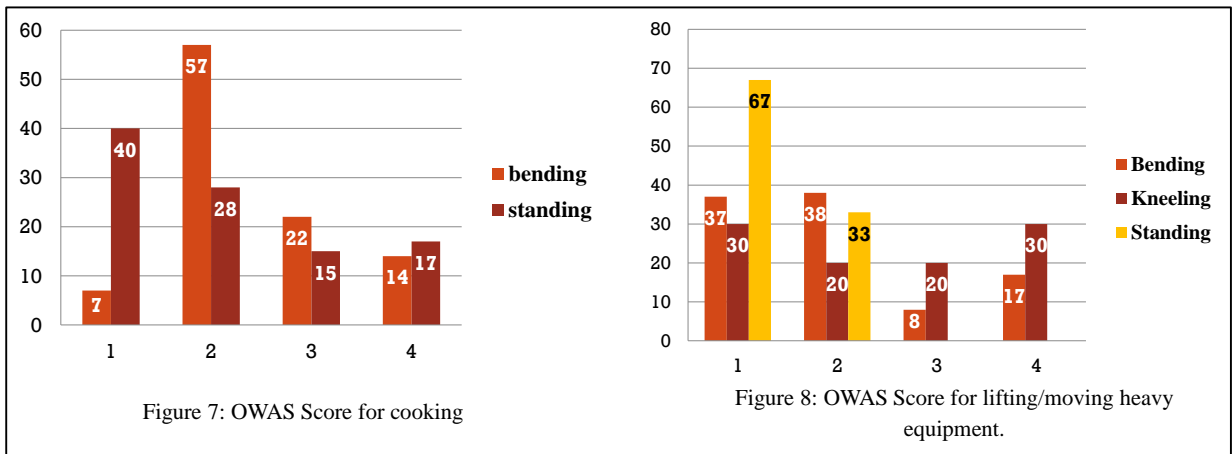


	0		1		2		3	
	F	%	F	%	f	%	f	%
Neck	85	70%	26	21%	7	6%	3	2%
Shoulder (RIGHT)	92	76%	16	13%	9	7%	4	4%
Shoulder (LEFT)	104	86%	9	7%	5	4%	3	3%
Upper Back	96	79%	11	9%	9	7%	5	2%
Upper Arm (RIGHT)	100	83%	11	9%	7	6%	3	2%
Upper Arm (LEFT)	105	87%	7	6%	6	5%	3	2%
Lower back	54	45%	34	28%	26	21%	7	6%
Forearm (RIGHT)	88	73%	18	15%	12	10%	3	2%
Forearm (LEFT)	110	91%	2	2%	6	5%	3	2%
Wrist (RIGHT)	82	68%	24	20%	14	5%	1	1%
Wrist (LEFT)	90	74%	19	16%	11	4%	1	1%
Hip	101	83%	10	9%	6	5%	4	3%
Thigh (RIGHT)	102	84%	12	10%	7	6%	0	0%
Thigh (LEFT)	102	84%	12	10%	7	6%	0	0%
Knee (RIGHT)	101	83%	11	9%	6	5%	3	2%
Knee (LEFT)	101	83%	12	10%	6	5%	2	2%
Lower leg (RIGHT)	92	76%	19	16%	7	6%	3	2%
Lower leg (LEFT)	96	79%	16	14%	6	5%	3	2%
Foot (RIGHT)	76	61%	28	24%	11	10%	6	5%
Foot (LEFT)	92	76%	13	11%	11	9%	5	4%

Figure 5: Pain/Discomfort experienced by the Chefs



Posture Assessment (OWAS technique)



8% chef who used to bend; 20% chef who used to kneel rated 3 as OWAS score
 17% chef who used to bend; 30% chef who used to kneel rated 4 as OWAS score

5. DISCUSSION:

According to Figure 1, chefs who were graduates were head chefs and executive chefs. The chefs who also had a higher work experience were working as a head chef or executive chef. One’s who were below 10th grade or those who have completed their 12th grade were involved in activities like cooking and chopping. Since some of them were not educated, they had to be trained to work efficiently and the skills of cooking. The interns were included in the study to see if they were exposed to any kind of injury or stress in the workplace and to study the prevalence of bodily pains and aches. The chefs were mostly falling under the category of 21 – 30 years of age and were young adults and were not satisfied with their job due to the hierarchical procedures followed in the hotels. It was observed that most 51(42%) of the chefs working in the kitchen rated their health as very good. 46(38%) of the chefs rated their health as very good, 22(18%) rated their health as average and only 2(2%) rated their health as poor.

Whereas figure 2 shows that the BMI (Body Mass Index) of the chefs was calculated with the help of their weight and height which was asked in the questionnaire so as to analyze how fit they are. Even though most of the chefs rated themselves having good health their Body Mass Index(BMI) when analyzed contradicted it. It was seen that they were majorly falling under the BMI category of underweight, overweight and obese. Their poor eating habits, sleeping patterns and the lifestyle they followed affected their body mass index. Through figure 3 it was observed that working for long hours can lead to less sleeping hours which is associated with weight gain. Since the chefs are mostly in the kitchen end up eating excess food which may thus lead to weight gain and increase in their BMI making them tired quickly and lethargic. The chefs were not involved in physical activities due to long working hours and it affected their weight adversely. It was seen that as their age increased and their BMI increased and they were falling under the category of overweight, obese and extremely obese. As the age increased, the number of healthy chefs decreased.

It was noted that chefs in the age group of 11 to 20 had lesser work experience and were mostly trainees who were in their learning stages and were supervised by their head chefs. The older chefs have acquired more job knowledge than younger chefs who have lesser work experience. Chefs having work experience 20 years and above were head chefs, their work ability was more but they were exposed to fatigue, stress and were physically weaker than the other age groups. Younger adults were not at a high post they were assisting their head chefs but due to their age they were physically fit compared to older chefs. Figure 4 represents that chefs under the age group of 21-40 years are experienced enough to look after the activities going around in the kitchen. So, they are mainly the head or executive chefs in the kitchen. The number of trainees decreases as their age increases. The assistant chefs who are also involved in the tasks performed in the kitchen either become head chefs or executive chefs. In the age group of 11 to 20 years since the chefs don't have work experience they are mostly assistant chefs, chefs or trainees or intern.

Musculoskeletal Pains and Aches: Musculoskeletal Questionnaires allows ergonomists and occupational health professionals to measure Work Related Musculoskeletal risk factors and symptoms in worker populations in a quick yet standardized way. The standard version of the questionnaire consists of 9 pages with around 25 questions per page, to be filled in by the workers themselves (Rao, R, 2018). The Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) has been developed by Dr. Alan Hedge and ergonomics graduate students at Cornell University. The questionnaire is based on previous published research studies of musculoskeletal discomfort among office workers. These questionnaires are for research screening purposes and not for diagnostic purposes. These can be divided into three parts :

1. CMDQ A- This deals with sites of bodily discomfort experienced.
2. CMDQ B- It deals with the level of discomfort of pain.
3. CMDQ C- This deals with the interference of ability to work.

The prevalence of musculoskeletal discomfort was collated using the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ).CMDQ A deals with sites of bodily discomfort experienced. It was reported that shoulder, upper arm region, lower back and foot were the places where the chefs reported pains, aches or discomforts. Almost 83(69%) chefs had pain in their right shoulder which was due to continuous movement of stirring while cooking whereas,79(65%) chefs experienced discomfort in the right arm region due to lifting of heavy equipments. Working in proper Range of motion is very important. Not to extent too much and stretch while doing any work. So for this everything which is used frequently should be kept near so that the chef won't stretch too much. 96(79%) chefs had reported that they have pain in the lower back region. When they bend for doing their job the pressure builds up on their lower back. The tasks which may include bending can be lifting any things like heavy equipments. Work Related Musculoskeletal Disorder (WRMSDs) affect worker in many occupations including chefs. When the physical capabilities of the worker do not match with the physical requirements of the job WRMSD can be observed. Prolonged exposure of ergonomic risk factors such as posture, force, repetition and stress can cause damage to workers body and leads to Musculoskeletal Disorder. Chefs are particularly at the risk for developing pains aches in Shoulder, Upper arm, Lower back and foot region. Continuous movement of stirring while cooking and lifting of heavy equipments is the of cause pains in the shoulder and arm region respectively.

A study conducted by "Memkiya, A. and Dalal, P. (2017)" stated that repetitive work and static loading are responsible for most of the Musculoskeletal disorders. Also, musculoskeletal disorders were mainly due to the awkward postures adopted by the food production staff. Working in proper Range of motion is very important. Not to extent too much and stretch while doing any work. So, for this everything which is used frequently should be kept near so that the chef won't stretch too much. When the chefs bend for doing their job the pressure builds up on their lower back. The tasks which may include bending can be lifting any things like heavy equipment. Pain in lower back is most common among chefs which was also seen when a study was conducted by "Elsayed, H.E (2017). This is because they lift heavy equipment more frequently. This can be reduced by introducing some machines which can be used for lifting such equipment. Bending in an awkward position is more common. One should not bend from their hips. Instead they should bend from their knees. But while doing this they should keep their knees in proper position or else there may be pain seen in knee region. Proper rest breaks and some stretching is must so that the job is not done for prolonged time. If not

then working for a long time may further cause musculoskeletal disorders in those areas. Power zone for lifting is close to the body between mid-thigh and mid chest height. Comparable to the strike zone in baseball, this zone is where arms and back can lift the most with the least amount of effort. Standing for a long period of time and doing tasks can be the reason to have pains, aches or discomfort in foot. The tasks that might include standing posture can be Cooking, cutting, chopping etc. Even when a person stands, it is not necessary that he may stand properly. There can be a bend in his back which may again be a reason for pain in lower back. The body map which deals with the level of discomfort of pain is also known as CMDQ B (Figure 5) Which means, if the worker, in this case chefs, have experienced pains, aches and discomfort then how uncomfortable was it. Many of the chefs had reported that their pain was moderately uncomfortable, while few of them reported that their pain was very uncomfortable. 25(21%) chefs reported that they had moderately uncomfortable pain in lower back region, while still 7(6%) reported that their pain was very uncomfortable in the same region. In the foot region out of 86-88(71%-73%) who had reported pain in foot region 11-12 (9%-10%) chefs reported that the pain was moderately uncomfortable, while 5-6 (4%-5%) of them told that the pain was very uncomfortable. In the right shoulder 8(7%) chef reported that the pain was moderately uncomfortable, while 5(4%) 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 extreme amount of pain. The comfort level of pain is very important to know so as to determine how this pain has interfered with the ability to work. According to figure 6, it was reported that there was pain in shoulder(right), lower back, and foot(right) which interfered with their ability to work(CMDQ C), and hence these regions are marked red as they experience extreme amounts of pain. Left shoulder and upper arm, both the thighs, right knee and left foot are marked orange because they experience moderate amounts of pain which causes 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 work ability. Hence it is very important to get preventive measures accordingly. Through the (CMDQ)- Cornell Musculoskeletal Discomfort Questionnaire, one can get to know that in which region pains occurs, how uncomfortable is that pain and does the pains, aches and discomfort interfere in their work ability. So, it is really important to get preventive measures accordingly. The Ovako Working Posture Assessment System (OWAS) was used to analyze specific postures like Bending, kneeling, standing which eventually differed for various activities like cooking, and lifting or moving heavy equipment and thus recommend corrective actions. These postures were most commonly seen in the chefs while doing these activities. OWAS identifies the most habitual back postures in workers' arm, legs and weight of the load handled. All this implies up to 252 possible combinations. The procedure to apply OWAS is consistent with making observations of the work task, codifying the postures, assigning risk categories and proposing corrective action. Even when a person stands, it is not necessary that he may stand properly. There can be a bend in his back which may then be a reason for pain in his lower back. His 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 the load of force which a person may use while performing a job, all these may hence affect the working posture of a person and this is evaluated by OWAS Posture assessment technique. Figure 7 focuses on Posture assessed while cooking. Two kinds of posture were adopted for the task of cooking. When analyzed with OWAS it was seen that around 69(57%) chefs who used to bend and cook had an OWAS scoring 2 which means they may need corrective measure in the near future. When the chef used to stand and cook around 48(40%) had an OWAS scoring as 1 which means no corrective measure is needed 27(22%) used to bend and cook; 18(15%) used to stand and cook 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 right manner which means proper balance in both the legs and not applying pressure only in one leg. 17(14%) chefs rated 4 as OWAS score used to stand while cooking, whereas 21(17%) used to bend a lot. OWAS score 4 implied Corrective measure should be taken immediately, if not taken then permanent damage in the Musculoskeletal system may occur which is indeed not a good sign. 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 load on their lower back. Whereas figure 8 focuses on posture assessment observed while lifting or moving heavy equipment. Three kinds of posture were observed namely 1 Bending from back, 2 Kneeling and 3 Standing. When these postures were analyzed with OWAS it was seen that majority of the chef who used to stand, had OWAS scoring 1 while having same posture no one had OWAS score of 4. Which means when they stand for using heavy equipments not much problems is seen in their posture. It can be concluded that among the three postures; Kneeling is the one where the most pressure comes and so the person needs to have corrective measures immediately or as soon as possible. This may be because when they kneel, they don't kneel properly. Due to lack of time or working under pressure they won't realize that they are putting pressure on a single leg while kneeling because of which they have a problem in their knees. While bending from the back comes as a painful task, this may be because in a hurry they don't bend properly. One should not bend at waist but they should bend from knees but in a

proper manner. This will hence reduce the load in the back which can be caused due to bending. Standing is the least painful for this task. It was also observed that younger people below the age of 30 years are more vulnerable, as they don't report due to job insecurity. Older people have more problems as they have had a long experience doing the same job over and over again. Reports of near misses and accidents should be reported to the authorities. Because through this the organization can have the record of what are the chances for any accidents. According to F. E Bird's Accidents triangle; it is said that for every 600 near miss accidents, 30 damages occur for which 10 minor injuries (first aid injuries) are seen of which there is 1 serious or disabling injury which may occur. (<https://risk-engineering.org/concept/Heinrich-Bird-accident-pyramid>) So, reporting near miss accidents is very important. Proper corrective measure depending upon the OWAS score is essential, if not, then musculoskeletal disorders will occur which will then cause the worker in this case chef unable to do his work properly due to which the productivity of the company/ hotel will reduce. Which is why proper corrective measures have to be taken, proper rest breaks should be taken by the chefs. Adapting correct posture while working is equally important so that the chef will be more proficient in his job which can then improve the productivity and efficiency of the hotel.

5. RECOMMENDATION: Ergonomics is a study of people's efficiency in their working environment (from oxford). It focuses on helping people with their ability to work with no or minimal interference. The suggestions and control methods for this research study are as follows –

Engineering Controls: Engineering controls are built to design equipments so as to eliminate or reduce awkward postures and prevent injuries and accidents at the workplace. These are the most effective of all the three as it focuses on the principle of fitting the job to the man. This is the best control method for reducing the risk of injuries. So implementing these will be the best way to reduce the risk of any accidents or mishap happening in kitchen.

- Proper workstation design modification -This may help chefs to not adopt awkward postures while working like bending or stretching out of the power zone. This will result in not applying pressure in any part of their body and thus reducing the risk of musculoskeletal problems which would have happened if the workstation design is not proper.
- Full range of motion is equally important- The work space of the chefs should be clear. This is important to avoid stretching and causing problem in upper arm or shoulder area. Chef should be able to do his work without any problem. (<https://www.osha.gov/SLTC/ergonomics/controlhazards.html>)

Administrative Controls: To prevent fatigue and stress, action 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 PPE but not effective than engineering control. It includes:

- Rest breaks and job rotation- Giving proper rest breaks in between is very important so that they can relax from the work they do. They can probably stretch and relax so that their body may get rest and muscles may be relaxed, this will help in preventing onset to musculoskeletal disorders. One might get bored by performing the same tasks over and over again so job rotation is really important. This will also help them not cause any problem in one specific part in the body.
- Ergonomic training and development- Training and development is essential in each and every organization. But training related to ergonomics will help the workers related their problem well and so they can easily find solution. For example: teaching them exercises to reveal the pains if caused, at managerial level teach the management about implementing all the control methods in their working method etc.
- Breaking down of complex tasks –This follows Foyal's principle of division of labor wherein one big task gets divided into many smaller tasks. (<https://www.osha.gov/SLTC/ergonomics/controlhazards.html>)

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

- Robotic hands – these are mechanical hands which help in bringing the equipment to the kitchen counter and thus saving time and energy. It also helps in cooking tasks like stirring, chopping.
- Anti-fatigue insoles- This will help to decrease the loss of time due to foot and back problems. They stand for longer hours so this will be of a great benefit.
- Physical exercises – Stretching exercises that includes
 1. Flexor compartment stretching of the forearm
 2. Hamstring muscle stretching and back isometric exercises.
 3. Plantar fascia release for heel pain.(<https://www.osha.gov/SLTC/ergonomics/controlhazards.html>)

6. CONCLUSION:

There are many problems faced by chefs such as pain in lower back because of frequent bending and continuous lifting of heavy equipment, pain in shoulder which can happen due to various tasks performed in the kitchen like stirring, chopping etc., without adequate break so the continuous repetitive movement can cause pain in the shoulder and upper arm region, Pain in the foot region can be due to long standing hours. Almost all chefs have to stand for a long period without rest breaks this is the reason the chefs have reported pain in foot region. These problems interfere their work ability which means these pains and discomfort interfere the work/ task performed by them hence lowering the productivity of the hotel. Many of the chefs had mentioned that because of performing the same job regularly it has been their habit due to which they don't feel any pain but some still complain that they do find difficulty while performing the task. Some of them even mentioned that due to working in heat for long hours, the sweat goes in their eyes and accidents can also occur due to this. The implementation of three levels of control methods: Engineering controls, Administrative controls and Personal Controls, will surely help reduce the discomfort experienced by the chefs. Among these engineering control though is the most expensive of all but it is also the most effective. Personal controls are the least effective but the easiest to implement. The study must be taken forward to include many related aspects which due to time constraints could not be explored such as ergonomic redesigning of the commercial kitchens, occupational stress faced by the chefs of varying hierarchy, Job satisfaction and life work balance, cardiac cost of tasks and ergonomic tool design for chefs.

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REFERENCES:

1. Bernard BP, editor. U.S. Department of Health and Human Services, Centers for Disease control and Prevention, National Institute of Occupational Safety and Health. Musculoskeletal disorders and workplace factors: a critical review of epidemiologic evidence for work-related musculoskeletal disorders of the neck, upper extremity, and lower back. July 1997. DHHS (NIOSH) Publication No. 97-141.
2. Bridger, R. S. (2003). Introduction to Ergonomics (Third Edition).
3. Delleman, N. J., C, M, Haslegrave, and D. B. Chaffin (2004). Working postures and movements: CRC Press.
4. International Association for the Study of Pain
5. Irish Society of Chartered Physiotherapists (1997) Back Care Programmes: Guidelines for assessment of moving and handling training, Dublin: Irish Society of Chartered Physiotherapists.
6. Krause, N. M. and Jay, G. M. (1994) . What do global self-rated health items measure? Medical care, 930-942.
7. Mogul, M. (2019). Improving Ergonomic Conditions at Hosp. Industry. International journal of Business and Social Science.
8. Murray, R. Gibbons, C. (2019). Awkward analysis at food production activity using RULA, Journal of Fundamental and Applied Science.
9. Pheasant, S. (2003). Bodyspace (Third Edition).
10. Rao, R. (2018). Introduction to Ergonomics.

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