IOSR Journal of Humanities And Social Science (IOSR-JHSS)
Volume 25, Issue 7, Series 15 (July. 2020) 26-34
e-ISSN: 2279-0837, p-ISSN: 2279-0845.
www.iosrjournals.org

Ergonomic risk factors and musculoskeletal discomfort in the upper limb in workers of a food processing company in Guadalajara

Pérez Aldrete Jorge Arturo[1], González Baltazar Raquel[2], García Hernández Luis[3], Aranda Beltrán Carolina[4]& Aldrete Rodríguez María Guadalupe[5]

[1] *(Health at work, Mexican Institute of Social Security)*
[2] *(Researcher and professor at the Department of Public Health, University of Guadalajara, Mexico)*
[3] *(Professor in the Department of Public Health, University of Guadalajara, Mexico)*
[4] *(Researcher and professor at the Department of Public Health, University of Guadalajara, Mexico)*
[5] *(University of Guadalajara, Mexico)*

Abstract
Objective: *Identify the presence of ergonomic risk factors and their relationship with upper limb musculoskeletal discomfort in workers in the packaging area of a food processing company in Guadalajara.*
Material and methods: *Observational, cross-sectional, comparative study in 39 workers who pack sausages, 21 in the T1 machine and 18 in the M2. The hypothesis raised is that there is a greater ergonomic risk and repercussion on the health of the workers of the T1 machine compared to the M2 machine. Those who were 3 months old were included and those who had another job were excluded. The data was obtained by a sociodemographic data questionnaire and labor items, the Disabilities of the Arm, Shoulder and Hand (DASH) Questionnaire and the Job Strain Index (JSI).*
Results*: 69% of the participants were men and 31% women. When evaluating repetitive movements with the Work Tension Index method, results were found outside safe ranges, being higher in T1. 42.8% of workers affected 40% of disability, being higher among T1 operators (P = 0.038). 31% reported moderate to very painful discomfort.*
Conclusion: *The hypothesis was verified by finding the relationship between upper limb disability in T1 machine operators (P 0.0294).*
Key Words: *Ergonomic risk, musculoskeletal disorders, upper limb.*

Date of Submission: 11-07-2020 Date of Acceptance: 27-07-2020

I. INTRODUCTION

Currently the workers are immersed in a world of work where changes occur every day, which can hinder or facilitate the development of work activities, these changes are given by the implementation of new work systems, the introduction of advanced technologies, automated equipment, and specialized techniques to increase the production of goods and services, sometimes cause problems for the working environment and cause the worker to be exposed to risk factors that can affect health (June and Noriega, 2004).

Among the risks to which the worker is exposed, there are ergonomic risks, which may originate from 3 factors: those resulting from manual handling of loads or by improper handling of this, the risks that come from postures forced or inadequate and finally those that can originate at least to the locomotor system to repetitive movements. It is common to find more than one of the specific factors at the same time and these can directly affect the skeletal muscular system (Escalada and González, 2013).

The International Labor Organization (ILO), in 2002, conceptualized as diseases of the musculoskeletal system those caused by labor movements or by risk factors present in the work environment: rapid or repetitive movements, excessive efforts and concentration of mechanical forces , incorrect or neutral postures, vibrations and the presence of cold in the work environment. Initially, the worker may only show tiredness and pain at the end of the work shift, but as the symptoms has evolve, it can present external periods and weakness in the affected body region, becoming a permanent injury that renders it incapable of executing its activity. (ILO, 2005).

Also the European Agency for Health and Safety at Work, defines musculoskeletal disorders (MSD) of occupational origin as "alterations suffered by body structures such as muscles, joints, tendons, ligaments,

nerves, bones and the circulatory system , caused or aggravated fundamentally by work" (OSHA The European Agency for Health and Safety at Work. FACTS 71, 2007).

The part of the body most used to carry out most activities is the upper limb; this favors it to be one of the most affected structural groups of the body. Although some musculoskeletal disorders of occupational origin present in the neck and upper extremities, result from the sudden application of extreme force, most of them originate from the repeated exercise of an apparently moderate force that lasts for a long period of time (OSHA; FACTS, 72, 2007) if we add to this the presence of ergonomic risk factors, they are capable of negatively influencing the health of the worker. In a study carried out with plant packers of industrial products, it was found that the ergonomic conditions in which the workers performed their functions in the packaging area represented a high risk of injury and appearance of MSD in upper limbs (Álvarez and Matamoros, 2015).

The socio-economic cost of MSD is high and has repercussions in several levels: for the worker it represents a decrease in his income and an increase in expenses (pharmaceutical or healthcare); for the company it can manifest itself with loss of productivity, replacement of the worker, salary supplements and compensation, economic benefits for temporary or permanent disability, expenses for hospital admissions, interventions, consultations, pharmaceutical benefits, among others; also the human cost that represents the loss of health, personal autonomy and quality of life, difficult to quantify in monetary terms (Díez de Ulzurrun, et al, 2007).

In the United States, the economic costs of MSD, in terms of days lost from work and resulting disability, were estimated at $ 215 billion a year. In the European Union, the economic costs of all occupational diseases and accidents represent 2.6 to 3.8% of the gross domestic product and between 40 to 50% of these costs are due to the EMTs (Arenas and Cantú, 2013).

In our country, Mexico, the Federal Labor Law contemplates in articles 513 and 514 muscular injuries and these are considered as damage to health and are included in the list of occupational diseases such as "Diseases caused by mechanical factors and variations in the natural elements of the work environment "(Federal Labor Law, 2012).

In addition, in Mexico, the Mexican Social Security Institute carries out the statistical registration of occupational diseases according to the nature of the injury (based on the ICD-10) of the workers affiliated to it. The Statistical Memories of 2016; reported MSD´s in second place among which were dorsopathies with 13.2%, in seventh place was carpal tunnel syndrome with 5%, Quervain's radial styloid tenosynovitis with 3.3%, synovitis tenosynovitis and bursitis 2.8 %. This same institution reported for 2017 dorsopathies in the first place with 14.9%, and for 2018 again it appears in first place with 17.4%, the other problems mentioned above were maintained with minimal differences between one year and another (Mexican Institute of Social Security (IMSS), 2016; Mexican Institute of Social Security (IMSS), 2017; Mexican Institute of Social Security (IMSS), 2018).

This research focused on identifying the presence of ergonomic risk factors and their relationship to upper limb muscle discomfort, reported by workers at a company dedicated to food production in Guadalajara.

II. MATERIAL AND METHODS

An observational, cross-sectional, comparative study was carried out in the packaging area of a cold meat company in the city of Guadalajara, Jalisco, Mexico, which has a total population of 368 employees, 39 working in the area of packaging on the T1 and M2 machines (21 on the T1 and 18 on the M2), although in their operation both are very similar, they present some differences that are worth mentioning.

The T1 is an older packaging machine with a semi-automatic system and designed for the packaging of packages of 10 sausages, it requires 7 jobs; the first 6 to place the sausage that they take from a transport channel and leave inside the pockets where the packaging is located and a seventh place to place this already packaged product in containers, which are later stowed for storage. The position that has the task of accommodating the packed product and stowing it is not taken into account for the study since this task is carried out by several workers, according to the needs and the workload, and it is not a fixed position or function of a person or group of people so the exposure is not entirely measurable (Figure 1).

The M2 machine is of a newer generation, is more automated and is designed for a different, higher capacity packaging, packing 28 sausages in each package; requires 6 workers. The work begins when the operators in position 5 and 6 place the sausage on the band, for which it is necessary to use both hands to keep the sausage aligned, giving small blows to it having a non-neutral position of the wrist and sometimes discrete trunk flexions, the sausage advances to a dispenser that drops the sausage on the band that transports the packages inside the mouthpieces, there the rest of the operators make a manual arrangement of the product using their hands on the work plane It is located 90 cm from the ground and approximately 40 cm from them, so it is necessary to flex the trunk to reach, there is also an extension of the arms that is accompanied by repeated movements of the hands in non-neutral positions of the wrist, sometimes it is necessary, due to the rhythm of work, that the operator make rotations of both the trunk and the neck, either to anticipate the movement of the

band or when it has already moved and the worker has not yet finished accommodating the product, continues his work on a plane that is not exactly in front of him (Figure 2).

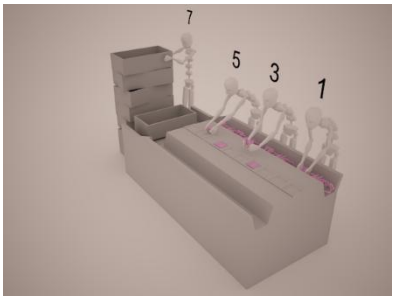

Figure 1. T1 Machine

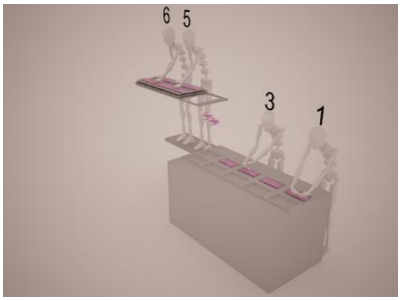

Figure 2. M2 Machine

The hypothesis proposed was that there is a greater ergonomic risk in the T1 machine with a greater presence of upper limb muscle discomfort compared to the M2.Those workers who were at least 3 months old in that job were included, considering that period as adaptation to new tasks. Those who had another job or aggregate workday in another company or institution were excluded to avoid adding risk factors.

The data was collected using three instruments, a questionnaire that contained the sociodemographic and labor data of the participants with items such as age, marital status, schooling, work shift, seniority in the company and seniority in the position; the Disabilities of the Arm, Shoulder and Hand (DASH) Questionnaire, and finally the Job Strain Index or JSI.The Disabilities of the Arm, Shoulder and Hand (DASH) Questionnaire, from which the general section and the work-related section were applied, is a questionnaire developed jointly by the Institute for Work and Health and the American Academy of Orthopedic Surgeons (AAOS). The aspects that are evaluated with this questionnaire are: Carry out physical activities, limitation of social activities, limitation of work activities, physical signs and symptoms of discomfort, sleep disturbance due to physical discomfort, perception of capacity due to pain and difficulty carrying out activities work. It is validated in Spanish and consists of 30 questions. To calculate the score, it is necessary to answer at least 27 of the 30 items that make up the instrument. The final score is obtained by calculating the arithmetic mean of the questions answered, subtracting 1 and multiplying by 25. This calculation provides a score between 0 and 100, the greater the disability the higher the score obtained, and considering variations with clinical significance those that exceed the 10 points (Castellet et al, 2010). This instrument has an internal consistency with a Cronbach's alpha = 0.96, test-retest r = 0.96 (Hervas, et al, 2006).

Another method used was the Job Strain Index, or JSI. The aspects evaluated with this method are effort intensity, effort duration, efforts per minute, hand-wrist posture, work speed and task duration. The application of the method begins with the determination of each of the tasks performed by the worker and the duration of the work cycles.

Once the tasks were assessed, the multiplying factors of the equation for each task were calculated using the corresponding tables. Once the value of the factors was known, the Strain Index of each task was calculated. For this method, scores less than and equal to 3 are considered safe, those over 7 are considered insecure (Moore and Garg, 1995).

The data were captured in the Excel program and were analyzed in the SPSS version 18 program. A descriptive analysis was performed according to the nature of the variables. Absolute and relative frequencies were obtained from the nominal and ordinal variables, and the mean and standard deviation were obtained from the quantitative variables. To compare the study groups and find the relationship between the variables, an inferential analysis was carried out. To do this, contingency tables were prepared, applying statistical tests of X2 or Fisher, depending on the case, considering significance when the p was> 0.05.The instruments were applied in a personalized way. The study adhered to the Declaration of Helsinki and the Mexican Regulations governed by the General Health Law, in its section on research in human beings, complying with the requirements set forth therein: letter of informed consent, confidentiality of results, voluntary acceptance of participation, delivery of results if requested, provide specialized care if necessary (Chamber of Deputies, Mexico, 2018).

III. Results

The study involved 39 workers with an age range of 19 to 59 years, 69% (27) were men and 31% (12) women. According to marital status, 43.6% (17) were single, 46.2% (18) married, and only 10.3% (4) had another marital status (divorced, widowed), schooling fluctuated between middle and high school. They work 40 hours a week and work in 2 types of sausage packing machines in bulk: 21 in T1 and 18 in M2, distributed

equally in the three shifts (morning, evening and night); the average length of service in the company was 4 years and 4 months, while the length of service in the job was 6 years for T1 operators and 1 year and 6 months for M2 operators (table 1).

Table 1. Frequency and percentage of sociodemographic and labor results of workers in the packaging area of a food processing company in Guadalajara

Variable		**Frequency**	**%**
Gender	Male	27	69
	Female	12	31
Age	< 20 years	3	7.7
	20-29	18	46.2
	30-39	12	30.8
	40-49	4	10.3
	50-59	2	5.1
Marital status	Single	17	43.6
	Married	18	46.2
	Divorced	3	7.7
	Widower	1	2.6
Scholarship	Secondary	19	48.8
	Highschool	20	51.2
Seniority in the company	- of a year	12	30.7
	1 to 2 years	13	33.4
	3 to 5 years	4	10.2
	5 to 7 years	3	7.7
	7 to 9 years	0	0
	10 and + years	7	18
Seniority in the work position	- of a year	25	64.1
	1 to 2 years	3	7.7
	3 to 5 years	3	7.7
	5 to 7 years	2	5.2
	7 to 9 years	0	0
	10 and + years	6	15.4

Source: Direct data / survey

The ergonomic risk factors focused on repetitive movements were assessed with the Job Strain Index (JSI) method, which takes into account, among other things, the pace of work; in this case, it was found that it depends directly on the speed of the machine and it is the worker who is forced to maintain this rate, which is why significant differences were found in both machines, but none significant between workers of the same machine. The differences between machines are mainly given by the intensity of the effort and the efforts per minute (Table 2).

Table 2. Results of the JSI method in workers in the packaging area of a food processing company in Guadalajara
(on both machines)

Evaluated Factor	**Machine T1**	**Machine M2**
Effort intensity	A little hard (Perceptible effort)	Light (Slightly noticeable, relaxed effort)
Effort duration	Efforts last between 50% and 79% of the observation period	Efforts last between 50% and 79% of the observation period
Efforts per minute	9-14 Efforts per minute	More than 20 efforts per minute
Hand-wrist posture	Regular (Flex 16 ° - 30 °, Extension 26 ° - 40 °, Deviation 16- 20 °)	Regular (Flex 16 ° - 30 °, Extension 26 ° - 40 °, Deviation 16 ° - 20 °)
Work speed	Fast (Rush but sustainable pace)	Fast (Rush but sustainable pace)
Work duration per day	Between 4 and 8 hours	Between 4 and 8 hours

Source: JSI method / Direct data

With the JSI method, it was observed that both machines had results outside the established safe ranges. For this method, scores less than and equal to 3 are considered safe, those over 7 are considered unsafe; for the M2 work machine, scores of 13.5 were found, while in T1 they reached up to 20, evaluating each factor, some similarities could be observed given the similarity that exists between the work processes, only the hand-wrist posture factor depends directly of the task (Table 3).

Table 3. Score obtained in the JSI method for workers in the packaging area of a food processing company in Guadalajara

(on both machines)

Evaluated Factor	**T1 machine**	**M2 machine**
Effort intensity	2 (a little hard)	1 (Light)
Effort duration	4 (50 to 79%)	4 (50 to 79%)
Efforts per minute	3 (from 9 to 14)	5 (> to 20)
Hand-wrist posture	3 (not neutral)	3 (not neutral)
Work speed	4 (fast-paced but sustainable)	4 (fast-paced but sustainable)
Work duration per day	4 (from 4 to 8 hours)	4 (from 4 to 8 hours)
Score JSI Total	20.2	13.5

Source: JSI method / Direct data

The Disabilities of the Arm, Shoulder and Hand (DASH) Questionnaire consists of 30 questions, plus 4 that refer to specific aspects of the job, the questions in which the most discomfort was reported were the following: 16 workers (41%) felt less able, less helpful, or less confident because of the arm, shoulder, or hand problem. When asked about the difficulty in loading a shopping bag or briefcase, 46% (18) reported a moderate to high difficulty. When questioning about the intensity of arm, shoulder or hand pain during the last week, 31% (12) reported discomfort between moderate and very painful, while 34% when questioning about pain when carrying out a specific activity(13) reported this discomfort between moderate and high.On the other hand, in the work-related area, when asked about how difficult it was to perform the tasks of their job due to arm, shoulder or hand pain, 41% (16) reported moderate to high difficulty.An analysis was carried out between seniority in the job and the disability reported, it was found that of the 8 workers with more than 5 years in the job, 4 have more than 50% disability and of the 25 with less than 1 year 10 people have less than 10% disability (Table 4).

Table 4. Results of the general DASH questionnaire and seniority in the job of personnel in the packaging area of a food processing company in Guadalajara

Seniority in the workplace	**Disability**											
	0 – 9%		10 – 19%		20 - 29%		30 - 39%		40 - 49%		More than 50%	
	#	%	#	%	#	%	#	%	#	%	#	%
Less than 1 year	10	25.6	7	17.9	5	12.8	1	2.6	2	5.1	0	0.0
From 1 to 2 years	1	2.6	0	0.0	1	2.6	1	2.6	0	0.0	0	0.0
From 2 to 3 years	0	0.0	0	0.0	1	2.6	0	0.0	0	0.0	0	0.0
From 3 to 4 years	0	0.0	0	0.0	0	0.0	1	2.6	0	0.0	0	0.0
From 4 to 5 years	1	2.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Over 5 years	2	5.1	0	0.0	1	2.6	0	0.0	1	2.6	4	10.3

Source: Self elaboration using the results of DASH Questionnaire P value = 0.0000

Similar results were obtained by applying the same criteria for work-related disabilities, finding significance in both: the DASH scores and DASH work with a p of 0.0000 (Table 5).

Table 5. Results of the DASH questionnaire in the Work Section and seniority in the job position of personnel in the packaging area of a food processing company in Guadalajara

Seniority in the workplace	**Disability**											
	0 – 9%		10 – 19%		20 - 29%		30 - 39%		40 - 49%		More than 50%	
	#	%	#	%	#	%	#	%	#	%	#	%
Less than 1 year	13	33.3	5	12.%	1	2.6	4	10.3	0	0.0	2	5.1
From 1 to 2 years	0	0.0	0	0.0	0	0.0	1	2.6	2	5.1	0	0.0
From 2 to 3 years	0	0.0	0	0.0	0	0.0	1	2.6	0	0.0	0	0.0
From 3 to 4 years	0	0.0	0	0.0	0	0.0	0	0.0	1	2.6	0	0.0
From 4 to 5 years	1	2.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Over 5 years	1	2.6	0	0.0	0	0.0	2	5.1	0	0.0	5	12.8

Source: Own elaboration using the results of DASH Questionnaire P value = 0.0000

Analyzing the disability of the upper limb and the rate of work evaluated with the results of the JSI method, depending on the speed at which the machine works, no difference was found in the same machine, but if when comparing both machines, what gives us a direct relationship between the rhythm and the percentage of disability, since with a JSI of 20.2 in machine T1 it was found that 42.8% (9) of the workers have a disability greater than 40%, while for M2 with a JSI of 13.5 only 5.5% (1) of workers have a disability greater than 40%, On the other hand, the T1 machine in which a JSI of 20.2 was reported, only 23.8% (5) of workers have less than 10 % of disability compared to the M2 machine in which the JSI result was 13.5 a disability of less than 10% was found in 55.5% (10) of the workers, statistically significant differences p 0.0383 (table 6).

Table 6. Results of the DASH questionnaire in the workers of the packaging area of a food processing company in Guadalajara
(on both machines)

DASH	T1 Machine		M2 Machine	
	Workers	%	Workers	%
0% – 9%	5	23.8%	10	55.5%
10% – 19%	1	4.7%	4	22.2%
20% - 29%	1	4.7%	0	0.0%
30% - 39%	5	23.8%	3	16.6%
More of 40%	9	42.8%	1	5.5%

Source: Direct data / DASH questionnaire P value = 0.0383

IV. DISCUSSION

The probability of developing musculoskeletal diseases (MSD) depends on the tasks performed and the presence of risk factors such as: intensity, duration of effort, repetitiveness, frequency, and time of exposure. Firstly, the musculoskeletal injury can go unnoticed or ignored until pain is presented as an initial symptom, which becomes chronic and incapacitating to perform any activity (Secretary of Occupational Health and Environment, 2014, Ríos 2018).

According to Mexican Social Security Institute (IMSS by its initials in Spanish) reports, MSD are the most frequent occupational diseases in Mexico, the working population, who carry out activities in the manufacturing industry, food producers and personnel who work in supermarkets and self-service stores, are the most affected, (IMSS, 2018). Dorsopathies, enthesopathies, carpal tunnel syndrome, shoulder injuries, radial styloid tenosynovitis as well as other synovitis and bursitis are the most frequently diagnosed conditions, which together accounted for 33% of cases of occupational diseases (IMSS, 2018), data similar to that reported in this work where 31% of the participants presented moderate to very painful pain in the upper limb and when work activities were carried out, this symptom increased to 41%, a figure higher than what was reported by Balderas (2019) that indicated a prevalence of 30%, in workers of a company dedicated to the manufacture of tires; greater data was reported by Carvajal (2019) in intensive care nurses from a hospital in Ecuador in which shoulder discomfort was 38.3% and wrist-hand discomfort 37%. Gomez (2018) in the study with area workers from sales of a department store, the participants reported discomfort in the neck (50%), upper back (33.9%) and lower back (41.9%). Fimbres, (2016) in a study with dentists, Agila et al (2014) in maintenance workers of an oil company and Ríos (2018) in patients from the Military Hospital of Matanzas found that musculoskeletal discomforts occurred in the upper limb in 60 % of the participants and where the repetitive activity was present.

The data obtained from the DASH questionnaire, which is interpreted as a percentage of upper limb disability, 38.4% of the total study population showed a disability of less than 10%. When analyzing these results for each of the machines, 42.8% of the workers who carried out the activity on machine T1 had a disability greater than 40% and only 5.5% of the participants who worked on the M2 machine presented this degree of disability, statistically significant results. The explanation for this symptomatology is due to the forced postures of the arms and the repetitive movements that the worker of the T1 machine must perform.

Another point analyzed was the length of time in the workplace, the process carried out with the M2 machine is relatively new with respect to the one carried out in T1, the maximum age for the latter is 12 years, while the maximum age for the M2 machine is of 2 years, this factor influenced the percentage of disability that the worker presents since, since it is a nuisance due to accumulated trauma, the greater the exposure time, the greater the percentage of discomfort; When analyzing these two variables, a lower disability was obtained in those workers with fewer years of seniority in the job. Workers older than 5 years have disabilities above 50%, this agrees with what was commented by Álvarez and Matamoros (2015) who mention that musculoskeletal injuries of upper limbs are present in almost all labor industries, they are Slow development, occur during the first 5 years of exposure to ergonomic risks, with slow recovery and recurrence, with a significant impact on the quality of life of workers.

This could be explained because when starting work on repetitive tasks, the discomforts appear insidious and mild, but when continuing to be exposed to this factor, the worker goes through an adaptation period in which the discomfort remains at the same level and they begin to form part of the daily life of the worker, after which they increase slightly and progressively, but when continuing with the same conditions of exposure, a more severe percentage of disability is found (OSHA, 2007, FACTS 72).

It is estimated that this problem affects the quality of life of workers and represents an economic cost in terms of lost workdays, disabilities, absenteeism, early retirement, expenses for exams, diagnosis and treatment (Jiménez, 2014).

In order to find an effective solution to this problem, it is very important to study the real situation in the workplace, since the factors vary from one place to another and in each workplace there are different situations (OSHA, FACTS 4), which is why which the discussion focuses on the results obtained in this research and the evaluation of ergonomic risk factors in the Federal Regulation of Occupational Safety and Health of November 2014 (Secretary of Labor and Social Security, 2014) which indicates that The three ergonomic risks to consider are forced postures, repetitive work, and load handling, in this particular case focused on repetitive work.

When evaluating the repeatability at work assessed under the Job Strain Index (JSI), scores of 20.2 and 13.5 were found for the machine T1 and M2 respectively, for this parameter there is no defined limit, but it is judged that tasks with a JSI score less than or equal to 3 are tasks that could be considered as safe and scores above 7 indicate that the task is probably dangerous, so both scores obtained indicate that both the tasks performed on T1 machines and M2 are potentially risky tasks.

As for speed, the task performed on both machines per minute is similar. In the T1 it is greater, this would seem an inconsistency but it can be explained by the automation in the M2 process since when the sausage is deposited in a non-manual way inside the mouthpiece, it is only proceeded to accommodate it inside the packaging, so the efforts made by the operators are mainly carried out with the hands on a single work plane, making short and rapid movements in short periods of time, while for T1 we find three work planes, the first within a channel where the sausage is deposited. without any accommodation and a second plane of approximately 50 cm from the operator, where he orders the sausages he takes with both hands, tapping them lightly on the plane and a third plane corresponding to the mouthpieces where he will proceed to deposit the sausages to accommodate them in the packaging. The efforts made in T1 involve the whole body, that is, they are larger efforts, which are carried out in a short period of time, so when evaluating the amount of efforts per minute in both machines these are greater in M2, but they are also less intense compared to those performed by T1 operators, which conditions a more difficult work rhythm to maintain, a more noticeable effort and therefore a higher score when evaluated with this method, situation that affected workers by presenting a higher degree of disability according to the results of the DASH questionnaire.

With the results of the research, the hypothesis raised at the beginning of the work was accepted, in which it was pointed out that the T1 machine presented a greater ergonomic risk for the worker with health consequences.

For this reason, the European strategy for action against MSDs at the workplace must be observed an put it on practice, based on the formulation of comprehensive prevention policies that consider the "total burden" that the body bears as the cause of MSDs, (weight handled, forces, postures, cold, heat, noise, vibrations, work organization, stress, etc.) and facilitate the maintenance, rehabilitation and reintegration into work of the affected workers (Díez de Ulzurrun M., et al, 2007).

The study of musculoskeletal problems must explain the characteristics of the organizations in which the work is carried out, since many of these establish forms of production, deadlines for carrying out tasks and productivity objectives, which directly or indirectly influence permanence. or preservation of the seated or static posture by the worker in the workplace. Studies carried out on musculoskeletal problems have shown a consistent relationship between the intensity of the work carried out and the presence of musculoskeletal disorders. Mainly there are associations between the time requirement, the workload, the pressure at work in terms of quality and efficiency, as well as with the variation in work (Castillo and Ramírez, 2009) as happened in this study.

REFERENCES

[1]. Agila Palacios E., Colunga Rodríguez C., González Muñoz E., Delgado García D., Síntomas Músculo Esqueléticos en Trabajadores Operativos del Área de Mantenimiento de una Empresa Petrolera Ecuatoriana, Ciencia y Trabajo 2014, 16 (51): 198-205. https://scielo.conicyt.cl/scielo.php?script=sci_abstract&pid=S0718-24492014000300012&lng=es&nrm=iso

[2]. Álvarez Chávez R., Matamoros Corrales A. Riesgo ergonómico asociado a movimientos repetitivos en los envasadores de una planta de productos industriales. Revista Médica de la Universidad de Costa Rica. 2015;9(10). ISSN:1659-2441 Disponible en: https://revistas.ucr.ac.cr/index.php/medica/article/view/19649/19730

[3]. Arenas-Ortiz L., Cantú-Gómez Ó. Factores de riesgo de trastornos músculoesqueléticos crónicos laborales Med Int Mex 2013; 29 (4) disponible en: http://www.medigraphic.com/cgi-bin/new/resumen.cgi?IDARTICULO=43308

[4]. Balderas-López, M., Zamora-Macorra, M., & Martínez-Alcántara, S. (2019). Trastornos musculoesqueléticos en trabajadores de la manufactura de neumáticos, análisis del proceso de trabajo y riesgo de la actividad. Acta Universitaria 29, e1913. doi. http://doi.org/10.15174.au.2019.1913

[5]. Cámara de Diputados del H. Congreso de la Unión, Secretaría General, Secretaría de Servicios Parlamentarios. Ley General de Salud, Nueva Ley publicada en el Diario Oficial de la Federación el 7 de febrero de 1984, Última Reforma DOF 12-07-2018 Disponible en: http://www.diputados.gob.mx/LeyesBiblio/pdf/142_120718.pdf
[6]. Carvajal-Vera C., Aranda-Beltrán C., González-Muñoz E., León-Cortés S., González-Baltazar R.. 2019. Desórdenes músculo esqueléticos y factores de riesgo psicosocial en el personal de enfermería de cuidados intensivos en Ecuador Revista Salud Jalisco 6 (1):162-166 Disponible en: https://imbiomed.com.mx/1/1/articulos.php?id_revista=371
[7]. Castellet Feliu ,E , Vidal ,N . Conesa X (2010) Escalas de valoración en cirugía ortopédica y traumatología. Trauma Fundación MAPFRE 21 (1):34-43
[8]. Castilla y León Manual de Trastornos Musculoesqueléticos VA-1091-2008 disponible en: http://bibliotecadigital.jcyl.es/es/catalogo_imagenes/grupo.cmd?path=10121646
[9]. Castillo JA, Ramírez BA. El análisis multifactorial del trabajo estático y repetitivo. Estudio del trabajo en actividades de servicio. Rev Cienc Salud Bogota abril 2009; 7(1). [Consulta: 5 de agosto, 2017]. Disponible en: http://www.redalyc.com/src/inicio/ArtPdfRed. jsp?iCve=56216303006>.
[10]. Díez de Ulzurrun M., Sagala A., Garasa Jiménez M.G., Macaya Zandio J., Eransus Izquierdo. Trastornos musculoesqueléticos de origen laboral, Instituto Navarro de Salud Laboral Departamento de Salud. 2007 disponible en: https://www.navarra.es/NR/rdonlyres/76DF548D-769E-4DBF-A18E-8419F3A9A5FB/145886/TrastornosME.pdf
[11]. Escalada López C., González Peón B. Trastornos musculoesqueléticos de origen laboral, Accidentes de trabajo por sobreesfuerzos y enfermedades profesionales musculoesqueléticas Cantabria Años 2011 / 2012 Instituto Cántabro de Seguridad y Salud en el Trabajo Servicio de Promoción y Planificación Preventiva Junio de 2013, disponible en:
[12]. http://www.icasst.es/archivos/documentos_contenidos/3546_3.informe_TME_2012.pdf
[13]. Fimbres Salazar K., García Puga J., Tinajero González R., Salazar Rubial R., Quintana Zavala M. Trastornos musculoesqueléticos en odontólogos, Revista de Enfermería Vol. 1 - Nº 1 - Valparaíso, Chile Julio diciembre 2016. Disponible en: https://micologia.uv.cl/index.php/Benessere/article/view/1337
[14]. Gómez Ramos M M., González Muñoz E L., Franco Chávez S A. Condiciones ergonómicas y trastornos musculoesqueléticos en personal de ventas, Revista Cubana de Salud y Trabajo 2018;19(1):15-20 Disponible en: https://www.medigraphic.com/pdfs/revcubsaltra/cst-2018/cst181c.pdf
[15]. Hervás J, Peiró M, S, Navarro C, J. Pérez, J, L. López M, P. Martínez T, I. (2006) Versión española del cuestionario DASH. Adaptación transcultural, fiabilidad, validez y sensibilidad a los cambios. Medicina Clínica 127(12) 441-447
[16]. Instituto Mexicanos del Seguro Social IMSS, Unidad de Prestaciones Económicas y Salud en el Trabajo/ Coordinación de Salud en el Trabajo (CST). 2016. Base de Riesgos de Trabajo, disponible en: http://www.imss.gob.mx/conoce-al-imss/memoria-estadistica-2016
[17]. Instituto Mexicanos de Seguridad Social IMSS, Unidad de Prestaciones Económicas y Salud en el Trabajo/ Coordinación de Salud en el Trabajo (CST), Base de Riesgos de Trabajo 2017. Disponible en: http://www.imss.gob.mx/conoce-al-imss/memoria-estadistica-2017
[18]. Instituto Mexicanos de Seguridad Social IMSS, Memorias Estadísticas 2018, Capitulo VII Salud en el Trabajo 2018. Disponible en: http://www.imss.gob.mx/conoce-al-imss/memoria-estadistica-2018
[19]. Jiménez, M. (2014). Relación con los trastornos musculoesqueléticos en miembros superiores de una empresa cordelera. Universidad de Carabobo, Venezuela. Recuperado de http://riuc.bc.uc.edu.ve/handle/123456789/962
[20]. Juno Natarén J., Noriega Elío M. Los trastornos musculoesqueléticos y la fatiga como indicadores de deficiencias ergonómicas y en la organización del trabajo. Salud de los Trabajadores. 2004; 12(2), Disponible en: http://servicio.bc.uc.edu.ve/multidisciplinarias/saldetrab/vol12n2/12-2-2.pdf
[21]. Ley Federal del Trabajo (2012), Última Reforma DOF 09-04-2012 disponible en: http://www.senado.gob.mx/comisiones/desarrollo_social/docs/marco/Ley_FT.pdf
[22]. Moore, J.S. y Garg, A., (1995), The Strain Index: A proposed method to analyze jobs for risk of distal upper extremity disorders. American Industrial Hygiene Association Journal, USA, 56:443-458. Secretaría de Salud Laboral Comisiones obreras de
[23]. Organización Internacional del Trabajo, (2005), La salud y la seguridad en el trabajo. Ergonomía
[24]. OSHA, 2007 La Agencia Europea para la Salud y la Seguridad en el Trabajo. Introducción a los trastornos musculoesqueléticos de origen laboral FACTS 71 ISSN 1681-2085 disponible en: https//osha.europa.eu/es publications/factsheets/71
[25]. OSHA La Agencia Europea para la Salud y la Seguridad en el Trabajo FACTS 4 disponible en: https://osha.europa.eu/es/tools-and-publications/publications/factsheets/4

[26]. OSHA, 2007 Agencia Europea para la seguridad y salud en el trabajo FACTS, 72, 2007 ISSN 1681-2085 disponible en: https://osha.europa.eu/es/tools-and-publications/publications/factsheets/72
[27]. Ríos García, Marilia. (2018). Trastornos musculoesqueléticos del miembro superior en el Hospital Militar de Matanzas. Revista Médica Electrónica,40(6), 1819-1834. Disponible en: http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S1684-18242018000601819&lng=es&tlng=es.
[28]. Secretaría de Salud Laboral y Medio Ambiente Comisiones obreras de Asturias, Lesiones músculo esqueléticas de origen laboral, AS-6941/08 disponible en: http://tusaludnoestaennomina.com/wp-content/uploads/2014/06/Lesiones-musculoesquel%C3%A9ticas-de-origen-laboral.pdf
[29]. Secretaría del Trabajo y Previsión Social, Reglamento Federal de Seguridad y Salud en el Trabajo. Diario oficial, Nov 2014 disponible en: http://www.diputados.gob.mx/LeyesBiblio/regla/n152.pdf

Pérez Aldrete Jorge Arturo, et. al. "Ergonomic risk factors and musculoskeletal discomfort in the upper limb in workers of a food processing company in Guadalajara." *IOSR Journal of Humanities and Social Science (IOSR-JHSS)*, 25(7), 2020, pp. 26-34.