

Improvement Plan for the Prevention of Musculoskeletal Disorders to Minimize the Rate of Medical Leave in the Overhaul Operations Workshop

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Abstract - Due to the medical leaves reported in the overhaul workshop in Lima, this study investigated the causes of occupational risks and the incidence of medical interruptions in the overhaul workshop located in Lima. Over a 12-month period, the study analyzed productivity before and after the implementation of an ergonomic risk control program in the areas of body assembly, body repair, electrical workshop, and differential axles, with the objective of assessing occupational risks and providing training to the workers. The study followed a pre-experimental design with a phased methodological approach. The sample consisted of 10 workers, selected through non-probability sampling. Data collection was conducted using the Nordic Musculoskeletal Questionnaire and the OWAS method to evaluate working postures. The percentage of absenteeism decreased after the implementation of the improvement plan, reaching a reduction of 0,11%.

Based on the results obtained, conclusions can be drawn to support the development of ergonomic studies aimed at improving workplace health and safety, increasing company productivity, and reducing medical leaves among workers.

Keywords: occupational risks, ergonomics, symptoms-disorders, musculoskeletal injuries and OWAS Method.

1. Introduction

Currently, musculoskeletal disorders (MSDs) represent a highly relevant occupational health issue worldwide, as they can lead to temporary or permanent disabilities [1], affecting both workers' quality of life and companies' productivity. According to the World Health Organization (WHO), approximately 1.71 billion people suffer from MSDs, of whom 568 million suffer from lower back pain. This condition is expected to increase in the coming years due to occupational factors such as repetitive movements, intense physical exertion, and prolonged postures during the workday, among other combinations [1, 2]; Leading to staff shortages, declines in work productivity and temporary or, in major cases, permanent ailments, it is crucial to evaluate the impact of musculoskeletal injuries, since they not only affect the health of the worker and, if the conditions arise, they can generate absenteeism, decreased work performance and economic losses for companies and countries [3, 4, 5].

This study is carried out in a mechanical workshop where a high rate of sick leave and absences from work has been identified, which negatively impacts operational efficiency, causing delays in production and affecting business profitability [5]. Since the beginning of the quarter, these activities have seen an increase in sick leave, resulting in delays in machinery deliveries.

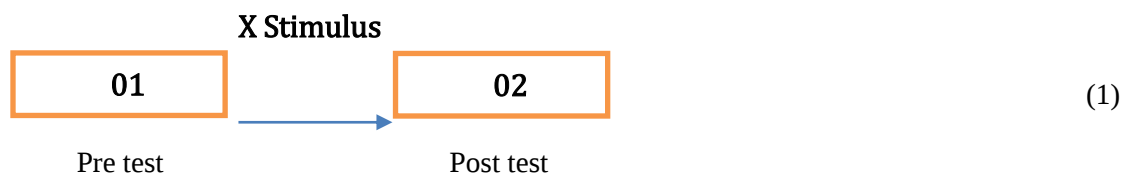
Workshop activities such as engine repair, axle repair, electrical workshop repair, and transmission case repair require sustained postures and prolonged physical exertion, which contribute to the development of MSDs and increased work absences.

Given this context, the research question arises: What are the factors that contribute to the high incidence of MSDs among mechanical workshop workers, and what strategies can be implemented to reduce their impact?

To answer this question, the study will use scientific methodologies and ergonomic approaches to identify the main risks associated with MSDs and develop an improvement plan for the prevention of these conditions. The results are expected to reduce absenteeism and optimize the company's productive performance, promoting a safer and more efficient work environment.

2. Methodology

The type of research is applied because it is based on the knowledge generated [6]. The scope of the research was descriptive and cross-sectional. A phased methodological approach was adopted [3], The instruments used were the Nordic Musculoskeletal Questionnaire (NMQ), which allows the analysis, understanding, and evaluation of processes and tasks to confirm the presence of musculoskeletal symptoms [7] and the OWAS method. This combination allowed us to obtain precise data on the symptoms of the collaborators [8]. [6], with a pre-experimental design (single-group pre-test/post-test). That is, a test will be administered before the experimental stimulus or treatment, then the treatment will be administered, and finally, a post-stimulus test or study group will be administered (p. 199), In addition, ergonomic software is used to verify the current diagnosis.



Where:

O1: Data observed on the working conditions of employees.

X: Conduct a study to prevent musculoskeletal disorders.

O2: Data observed the working conditions of employees after conducting the study to prevent musculoskeletal disorders.

The sample consisted of 10 workers from a company that performs overhaul in machinery maintenance, who were selected using non-probability sampling.

In the initial stage, an Ishikawa diagram was created, followed by a questionnaire to diagnose the presence of musculoskeletal disorders.

The Ishikawa diagram is represented below, identifying the causes that will determine improvements in MSD prevention in the overhaul workshop.

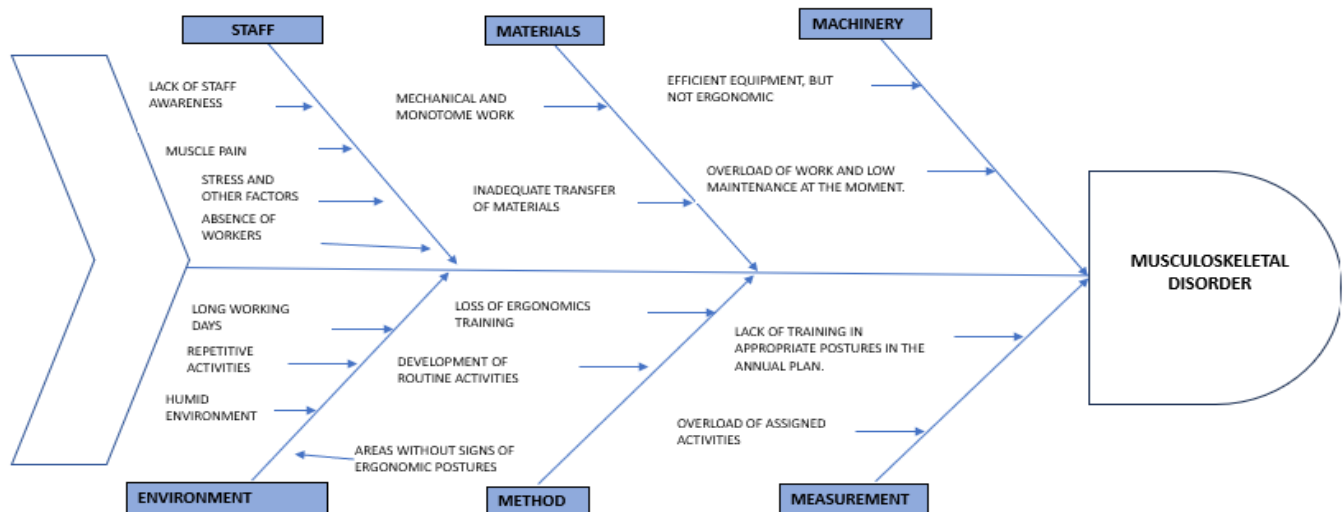


Fig. 1: Ishikawa diagram for musculoskeletal disorders.

- To evaluate the company's sick leave, documentary analysis will be used, using the 2023 Incident Record (SHEQ) as a tool. Workplace absenteeism will also be assessed, using documentary analysis and taking into account the sick leave report as a tool.

- To determine the causes of musculoskeletal disorders, the Nordic Questionnaire was administered at the beginning of the workday to 10 randomly selected workers. Observational techniques were also employed, using the Ergoniza program as a tool to identify employees' awkward postures at their workplaces.

- To develop the improvement plan for the prevention of musculoskeletal disorders, the results were used to improve ergonomic postures in the workplace [9]

- A post-productivity evaluation was conducted to determine whether the improvement plan for the prevention of musculoskeletal disorders (MSDs) contributed to a reduction in work absences, by calculating the absenteeism rate. This indicator is obtained by dividing the total number of days lost due to absences associated with MSDs by the total number of theoretical workdays and multiplying the result by 100.

- In the OWAS method study,

Postural frequency recordings were taken among workers in the area for 40 minutes every four hours during a work shift, capturing frontal and side views of the worker to accurately estimate the angle formed by the arms and trunk.

- «Each observed posture is classified by assigning a code. From the code of each posture, an assessment of the risk or discomfort involved in its adoption is obtained, assigning it a risk category» [8] (p. 1).

2.1. Development

The method began with the systematic observation of the tasks performed by workers. When the activities are homogeneous, the analysis is more agile and precise. To this end, a 40-minute observation period was defined, with the aim of ensuring that the sample of postures analyzed was representative of the total postures adopted during the workday [10, 11]. Once the phases of the process were established, critical postures and their frequency were identified through photographic and video recordings. Subsequently, the percentages corresponding to each position were calculated, which allowed for a more detailed and objective ergonomic evaluation.

The risk category is calculated based on relative frequency. This will determine which limbs present the greatest risks and the need for redesign and then apply corrective measures [10] [11].

1. Back posture is analyzed and given a score of 1, 2, 3, or 4, depending on whether the back is straight, curved, etc.

2. Arm posture is analyzed and given a score of 1, 2, or 3, depending on whether the worker is sitting, standing, crouching, etc.

3. The load the worker will be handling is considered, assigning a number from 1 to 3.

4. Posture codes are entered into a table to determine the risk level, classified from 1 to 4, where 1 represents low risk and 4 indicates high risk.

5. Depending on the risk level, the need for corrective measures increases or decreases.

Staff awareness training was planned, relevant information was gathered, and the Safety, Occupational Health, Environment, and Quality Training Program was reviewed. Based on the identified recommendations and observations, improvements were made to the content of the annual program documentation, implementation procedures were harmonized, and supplementary sessions were incorporated into the workshop schedule to strengthen staff commitment to prevention and good work practices.

- Training Induction

Step 1: The agreements reached by the OSH Committee were taken into account, based on the initial assessment.

Step 2: Priorities were established, which included fostering a sense of responsibility through frequent training for operators, raising their awareness of the need to collaborate closely with the OSH Committee.

Step 3: The purpose of the training was defined, aimed at generating a predictable and consistent synchronization routine with operators, with the goal of reducing negative behaviors or anxiety at the end of the workday and improving their perception skills.

Step 4: The training program was incorporated into the Safety, Occupational Health, Environment, and Quality Program. Sessions were scheduled every two weeks for a period of 7 months, adjusting dates when they coincided with holidays.

Step 5: Training began, considering aspects that required improvement, such as the issue related to proper postures in each work area.

Step 6: Staff participation was recognized, highlighting their contribution to personal and professional growth, through a quarterly evaluation of the activities carried out in their respective areas [12].

3. Results

3.1. Results of the musculoskeletal symptoms questionnaire (Nordic questionnaire)

The results of the survey conducted with the 10 workers are shown. An average pain level of 5.98 at the knee has been established, exceeding the tolerance level of 5.0; followed by muscle pain: lower back and fingers (4.84), upper back (4.66), arms and thighs (4.34), hip (4.26), wrist (4.24), forearm (4.16), hand (4.06), shoulders (3.72), elbow (3.7), and neck (3.12).

3.2. Result of the OWAS Method

The image of the engine repair shows the posture of the back without any damage, since the back is straight, with grade 1 supporting the weight of < 40 kg.



Fig. 2: Critical position 1 "engine repair"

The image of the axle repair shows the posture of the straight back without damage effect, with grade 1 supporting the weight of < 40 Kg.

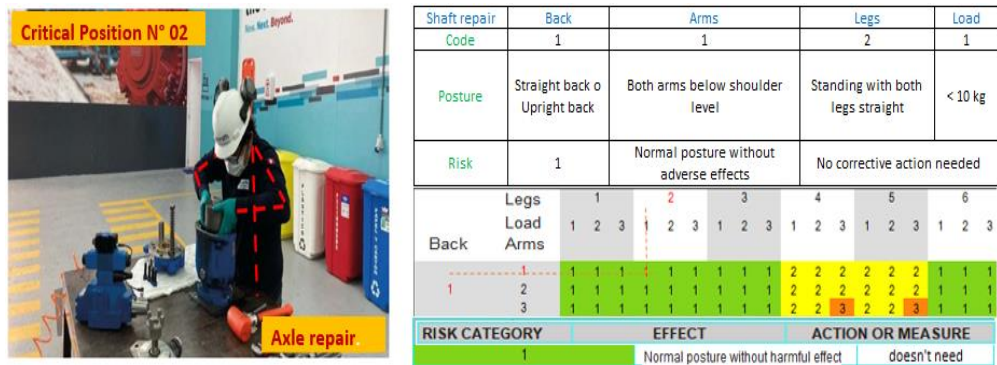


Fig. 3: Critical position 2 "axle repair"

The electrical workshop repair image shows the posture of the back bent forward, with damage to the musculoskeletal system, grade 2, supporting a weight of < 40 kg. Corrective action is required.

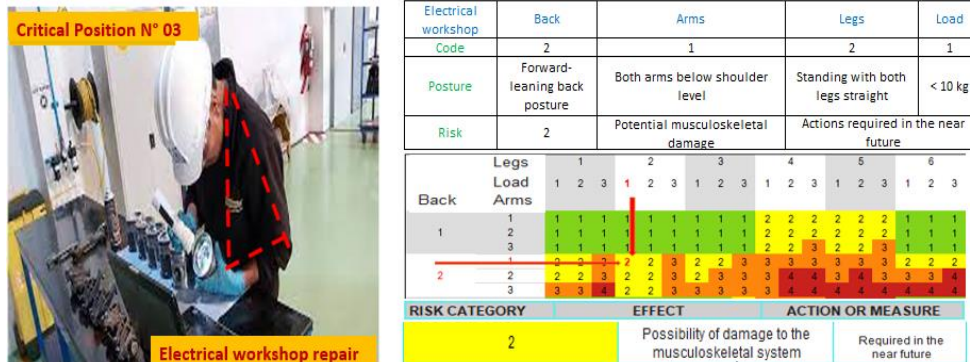


Fig. 4: Critical Position 3 "Electrical Workshop Repair"

The transmission box repair image shows the posture of the stiff back leaning slowly without any damage, given that the back is straight, with grade 1 supporting the weight of < 40 kg.



Fig. 5: Critical Position 4 "Transmission Case Repair"

3.3. Development of an improvement plan for the prevention of musculoskeletal disorders.

The results of the research study obtained by the OWAS method, the evaluation of the Nordic questionnaire allowed the development of 30-minute talks before the workday once a month, considering the critical positions of the OWAS method and the highest level questions of the Nordic questionnaire, complementing the care of the work area in safety, personal protective equipment, order and cleanliness, within the annual training schedule.

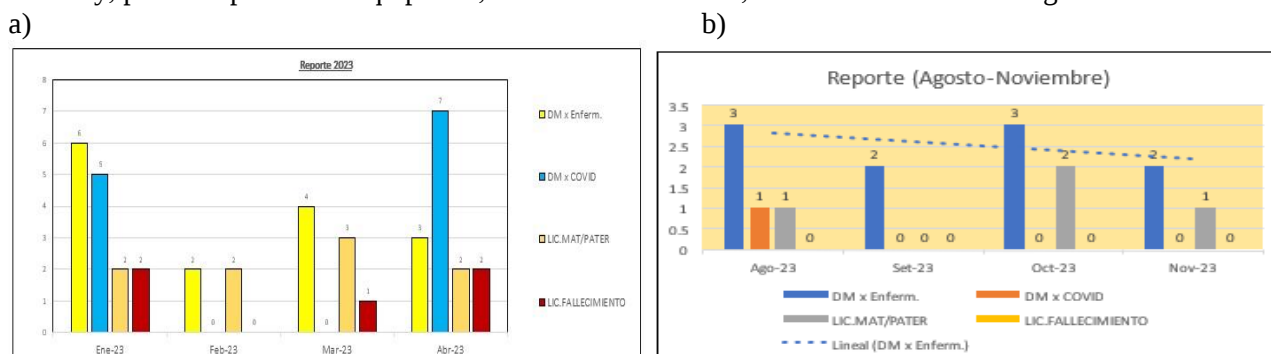


Fig. 6: Medical leave report 2023

- a) Report for the months of January, February, March and April.
b) Post-improvement report for the months of August, September, October, and November.

Table 1. Comparative table of medical leaves.

REASON	BEFORE AMOUNT	AFTER AMOUNT
DM*Illness (Musculoskeletal Disorder)	15	10
DM*COVID	12	1
Maternity/Paternity License	9	4
Death License	5	0
Absenteeism	0.34%	0.23%

Table 1 shows the percentage of absenteeism due to TME before and after, which decreased by 0.23% of the total work absences.

$$\begin{aligned} \% \text{ Absenteeism} &= \frac{\text{Days lost due to absence}}{\text{Total theoretical days}} * 100 = 0.227\% \\ \% \text{ Absenteeism} &= \frac{10}{4400} * 100 = 0.227\% \end{aligned} \quad (2)$$

Data for calculating theoretical working days: 50 workers × 22 days/month × 4 months = 4,400

Table 2. Economic savings.

Amount	Estimated monthly workday	Average cost per day	Total theoretical workdays 4 months - (50 × 88)	Savings from improvement plan (US\$) - (0.11% × 4,400)	Estimated financial savings (US\$) - (5 × US\$ 21.62)
50 collaborators	22 workdays	US\$ 21.62	4400 workdays	4.84 (approximately 5 days)	US\$ 108.11

4. Discussion

Based on the results obtained, the following reflections are proposed. The analysis of work absenteeism recorded over the past 120 days revealed a significant frequency of persistent complaints, justifying the application of the Nordic Questionnaire. The findings of this instrument revealed an average level of knee pain above the tolerance threshold, underscoring the need to implement preventive strategies to mitigate the risk of musculoskeletal disorders.

1.- The implementation of ergonomic risk control plans has proven to be an effective strategy for improving organizational productivity. In the study developed by Contreras [13], a 16.59% reduction in absenteeism was observed, which represented tangible benefits in terms of operational efficiency and a reduction in losses associated with sick leave. Additionally, Salinas [14] supports the usefulness of using tools such as the Nordic Questionnaire to identify musculoskeletal symptoms and guide preventive measures. In line with these approaches, in the present study, this questionnaire was applied as a basis for the design of an improvement plan, achieving a 0.11% reduction in absenteeism, which represented a direct savings of US\$ 108.11 over a four-month period. Although the reduction was modest compared to other studies, the results confirm the effectiveness of ergonomic preventive strategies in improving operational continuity and employee well-being.

2.- It was proposed that the application of direct observation techniques would allow the analysis and evaluation of biomechanical risks, as indicated by Zorrilla [15], In the surveyed sample, composed of 10 workers, it was identified that 5.98% reported knee pain above the tolerance threshold (5.0), while 3.12% indicated cervical discomfort. These results showed that the use of direct observation techniques significantly contributed to the diagnosis of ergonomic risk factors in the work environment.

3.- It was also suggested that the implementation of an epidemiological surveillance system would contribute to the prevention of musculoskeletal disorders, in accordance with the provisions as stated in Guerrero's thesis [8]. The implementation of this system depended, to a large extent, on the training of staff in preventive measures, which was reflected in a decrease in sick leave and greater risk awareness among employees.

5. Conclusion

For this study, the Nordic questionnaire, the OWAS method, and training were used to present a musculoskeletal disorder improvement plan to the company, aiming to reduce the number of sick leave days resulting from workers' activities. In conclusion, this study provided a comprehensive assessment of the company's work situation, highlighting critical areas requiring immediate attention. The lack of proper posture signage in certain areas was identified as a significant finding during the situational walkthrough. The results of the musculoskeletal symptom questionnaire (Nordic questionnaire) revealed an average level of knee pain that exceeded the established tolerance threshold. This suggests the existence of musculoskeletal health problems among workers, especially in the electrical workshop area, where a significant risk has been identified. Detailed analysis using the OWAS method highlights that postures in the electrical workshop pose a risk of musculoskeletal damage, indicating an urgent need to implement corrective actions in this specific area. In contrast, other areas, such as axle and transmission case repair, show safer postures with a lower risk of damage. The discussion of the results underscores the importance of proactively addressing the identified conditions. The improvement matrix, based on the findings, will serve as a guide for implementing corrective measures and improving working conditions, especially in the electrical workshop, where the highest incidence of musculoskeletal health risks has been identified. Ultimately, this study provides a solid basis for making informed decisions aimed at improving the health and safety of workers in the company.

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