Research Article
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Effects of physical load on the health of workers of a Colombian company

Abstract

Evaluate the physical load derived from the workers of a Colombian company in the city of Cartagena. The type of investigation is descriptive as a technique; direct observations were used in the workplace, and interviews with the 30 workers were conducted during the operational process of civil and mechanical activities. The data collection instruments used were the Nordic survey and the OWAS method. Of the 30 employees in the study were found in 3% found the possibility of causing damage to the skeletal muscle system; in 11%, there are postures with harmful effects on the musculoskeletal system; finally, the load caused by postures with harmful effects on the musculoskeletal system is more frequent in 83%; thus, the mechanical activity predominates with the greatest physical load during the execution; of which 40% presents discomfort in the lumbar spine.

Keywords: evaluate, OWAS, mechanical activity, civil activity

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Introduction

Taking into account the indicators between 2011 and 2015 of the General System of Occupational Risk of Colombia issued by the Ministry of Labor in its 2016 publication, which refers to an increase in workers affiliated to the general risk system by 20% from 7,951,917 to 9,546,636 workers; of which occupational diseases have been reported in this same time from 8982 to 9614 workers, observing a notable increase of 7%; also having an increase in work accidents from 555,479 to 723,836, with an increase of 30%.[1] According to the Colombian Federation of Insurers, the evolution of occupational risk indicators, segmented by economic sectors between 2011 and 2015, indicates that the construction sector has the highest accident rate.[2]

There is documented evidence that points to biomechanical hazards as factors that violate the integrity of workers, generating absences from work.[3] The company under study belongs to the construction sector and is at risk level V. It gives relevance to the identification and control of biomechanical hazards due to a lack of a history of absenteeism,[4] the types of short-term employment contracts of no more than 3 months on average, the lack of investment of resources, and the silence of workers in providing the required information on their health status for fear of losing their jobs.[5] These have led to the identification of hazards, specifically those concerning hygienic hazards, being undervalued. The intervention measures proposed by this type of employer are observed to be basic and without significant impact. Although biomechanical hazards are the main sources of disability due to injuries or musculoskeletal disorders, this demonstrates the deficiency in physical load assessments in these manual activities that negatively impact the health of workers.[6]

Therefore, the importance of identifying biomechanical hazards in a methodological and objective manner reaffirms the importance of providing a specific analysis of these alterations through the appropriate selection of a tool;[7] authors versed in the subject reaffirm that ergonomic assessment should be carried out using more representative existing methods such as OWAS;[8] others affirm that the importance of evaluating physical load at work can prevent occupational diseases.[4]

For the detection of musculoskeletal symptoms, instruments have been applied to workers in the form of a questionnaire that uses a map of the body divided into regions;[5] these symptoms have been identified in the workers, being clear about the cause and the effect that is generating it.[8] The importance of developing intervention programs that solve the problems dictated is mentioned.[9] In order to comprehensively evaluate the activities of the jobs, a cross-sectional and descriptive research is used, which aims to investigate the working conditions that seek to evaluate the physical load derived from the civil and mechanical engineering activities in a company to determine the physical load conditions present in the operational processes under study through process characterization,[10] the presence of musculoskeletal symptoms that indicate the need to apply an ergonomic assessment instrument is detected through the Nordic survey,[11] the biomechanical alterations present in the workers participating in the production process are analyzed using the OWAS method and ideal intervention strategies are proposed to minimize the biomechanical risk[12] present in the tasks of the company process, which shows that the active breaks program has a positive effect on the prevention and reduction of musculoskeletal disorders of the forearm and dominant hand in workers, because it helps reduce the perception of pain, increase the pain threshold to pressure and improve the functionality of the upper limb.[13]

Methods

Just like the methodology used by Rondón and Márquez in 2010,[13] this research is descriptive,[14] referring to the knowledge of the tasks, for the execution of the same the characterization of the processes was taken into account as a first measure to determine in each of the tasks present the physical load to which the workers were exposed; having clear each one of the activities and tasks present in the process,[15] as well as the application of the questionnaire to the workers in which a map of the body divided into regions is used, the Nordic survey

was carried out in this project with the consent of each one of the workers of the selected process, in order to detect musculoskeletal symptoms.[16]

The sample used was 30 workers who work with the company, the collection being in the form of a census, since it was applied to the entire population; In this survey, 7 questions were asked which identified the different parts of the body such as: neck, thoracic spine, lumbar spine, shoulder, hand, wrist, forearm, leg, ankle and knee. The presentation of discomfort was investigated. To collect this information, the following questions were asked:

1. Have you had any discomfort?
2. Have you needed to change jobs?
3. Have you received treatment for these complaints?
4. Indicate how long the discomfort has been present
5. Indicate the time that these pains occur and persist.
6. Indicate the time that these discomforts have prevented you from working
7. Rate your discomfort between 1 (no discomfort) and 5 (very strong discomfort).

Once the information was obtained, a tabulation was carried out through a characterization in which all the variables included in the survey were captured and served as a starting point for a good analysis. The result indicated the need to apply an ergonomic evaluation instrument such as the OWAS method, which defined and codified the postures collected. For each posture, an identification code was assigned that was used to designate said relationship according to the risk or discomfort of a posture for the worker.[7] In turn, four risk levels were distinguished in ascending order, with 1 being the lowest and 4 the highest value. For each risk category, the method established a proposal for action, indicating in each case the need for intervention over time. After data collection, the respective tabulation was carried out in a characterization taking into account the variables provided, making the analysis easier by cross-referencing the information.

Results

In order to determine the physical load conditions present in the operational processes, a characterization is carried out as shown in Table 1, from which the operational process was identified, branched into 2 main activities for the execution of the assembly of a pipeline in a large company in Cartagena; of which the first civil activity could be identified with manual excavation tasks, using minor tools, materials such as sand, cement, among others; with the participation of an officer and 3 civil assistants, with a daily work schedule from 6:00 a.m. to 4:00 p.m. with a break within the daily work day from 12:00 to 1:00 p.m.; thus identifying in this civil activity the biomechanical danger in its dynamic load due to effort and the static load due to forced postures.

Table 1 Process characterization

Activities	Tasks	#Workers	Biomechanical hazard
Civilians	Dig	4	Forced Postures
	Weld	10	Forced Postures
	Assemble pipe	4	Forced Postures
Mechanics	Install Pipe	9	Forced Postures Effort
	Maintain pipeline	3	Forced Postures

Similarly, the second activity classified as mechanical was observed with tasks such as welding, assembly, launching and maintenance of pipes, for the execution of these tasks there are tools and materials such as welding machine, polisher, electrodes, cutting and polishing discs, oxycutting equipment, differentials, tirfor, slings, cables, skates, crane, scaffolding among others; There was the participation of 5 welders, 9 assistants, 4 assembly officers, 3 mechanics, 1 instrumentalist, 2 pipe fitters, 1 electrician and 1 supervisor, with a work schedule from 6:00 am to 4:00 pm, rest within the daily work day from 12:00 to 1:00 pm; thus identifying in these mechanical activities the biomechanical danger in its dynamic load due to effort and the static load due to forced postures, due to the location of the pipes to be assembled that are 40 centimeters from the floor level.

For the detection of musculoskeletal symptoms, the Nordic survey was conducted on the total of 30 workers who worked for the company, being the collection in the form of a census, since it was applied to the entire population; Of the variables filled out by them, a characterization was made, of which it was analyzed that the participating workers had 17% the position of welder equivalent to five workers, 40% assistants equivalent to thirteen workers, 13%, to assembly officer equivalent to four workers, 10% mechanics equivalent to three workers, 7% pipe fitters equivalent to two workers, 3% to the positions of instrumentalist, electrician, supervisor and assembly officer equivalent to one worker.

It was also noted that the average age of the surveyed workers was between 20 and 29 years old, 30%, between 30 and 39 years old, 40%, between 40 and 49 years old, 7%, between 50 and 59 years old, 20%, over 60 years old, 3%; these workers have a work experience of between 1 and 2 years, 7%, equivalent to two assistants; from 3 to 5 years, 20%, equivalent to four assistants and two welders; from 6 to 10 years, 40%, equivalent to 5 assistants, 2 assembly officers, 2 pipe fitters, an electrician, a welder, a mechanic; from 11 to 19 years old, 20%, equivalent to an instrumentalist, two assembly officers, a civil officer, an assistant, a welder; over 20 years old, 13%, equivalent to a supervisor, a welder, and two mechanics. In the workplace, 100% of the workers had a fixed-term contract, none of them had a permanent contract. 50% had worked with the company on a non-continuous basis on some projects, and the other 50% had been with the company at the time of the survey.

Likewise, the musculoskeletal symptoms that are affected were described in the surveyed people, of which the most common were: lumbar spine discomfort in 40%, equivalent to three welders, of which one has type I obesity; there are also 7 assistants, of which one has grade II obesity; there are also 2 assembly officers, of which he has grade II obesity and is overweight; there are also an electrician and a supervisor. There is also 23%, equivalent to 8 workers, who have not presented symptoms, they only refer to the normal fatigue of the work day; in 17% there is shoulder discomfort, equivalent to three assistants who performed painting and excavation tasks, an assembly officer who performs tasks with differential and tirfor, a welder and a mechanic who uses torque as his main tool; neck discomfort was also obtained in 11% in an assembly officer, a pipe fitter, an assistant, a static mechanic.

A 6% of workers reported knee pain, which was the same as for a welder and an assembly worker. These two workers had a common origin in their knee pain, as they both played soccer and both underwent surgery. Finally, a 3% reported elbow pain, which was the result of a plumber.

It was obtained from the respondents that only two people have received medical treatment and they are the workers with the knee

discomfort. The rest of the surveyed personnel report that they have not had medical treatment for the discomfort they have experienced, they report that they self-medicate, that the discomfort has not prevented them from carrying out their work despite the fact that their level of pain is between mild and moderate. They also comment that these episodes of discomfort last less than 24 hours and that they have been present for between one week and three months. Only four cases report it for twelve months and they are the discomfort in the knees of a welder, the neck of an assembly officer, the shoulder of an assistant who performs painting work and the elbow of a pipe worker.

In order to carry out the analysis using the OWAS method for the biomechanical alterations present in the workers participating in the production process, the following result was obtained from the observations of the different postures adopted by the worker during the development of the task, of the 60% of the working day in which they are executing the tasks inherent to the task: 3% of the population is in a normal posture with no harmful effects on the musculoskeletal system, equivalent to the position of supervisor; 3% are in a posture with the possibility of causing damage to the musculoskeletal system, for which corrective actions are required in the near future, equivalent to the position of instrumentalist; 11% are in postures with harmful effects on the musculoskeletal system for which corrective actions are required as soon as possible, equivalent to an assembly officer, a civil officer, an electrician who reports discomfort in the lumbar spine; finally, it is most frequent in 83%. The load caused by bent back postures with twist combined with low, raised arms and squatting feet with both legs bent and the unbalanced weight between them has extremely damaging effects on the musculoskeletal system, which requires immediate corrective action. This is due to the location of the pipe; in this type of tasks, the worker has to adapt to the conditions, due to the location of the pipe, which is on pedestals with a height already stipulated and which cannot be redesigned at the time of assembly; therefore, immediate corrective action is required.

Having as intervention proposals to minimize the biomechanical risk present in the tasks of the company's process, taking into account the characteristics of the work in which the person has to adapt to the conditions, due to the location of the pipe that is on pedestals with a height already stipulated and that cannot be redesigned at the time that the assembly is being carried out, and that there are no reported occupational diseases within the company's statistics; the following can be proposed to the person as: occupational medical evaluations with emphasis on musculoskeletal examination, active break program, training in postural hygiene, training in work techniques specific to the task to be performed, healthy lifestyle program, and the implementation of an osteomuscular epidemiological surveillance system.

OWAS questionnaire.

Possible effect:

- The load caused by this posture has extremely damaging effects on the musculoskeletal system.
- Postures with harmful effects on the musculoskeletal system.
- Normal posture without harmful effects on the musculoskeletal system.
- Posture with the possibility of causing damage to the musculoskeletal system

Interpretation:

- No action required.
- Corrective actions are required in the near future.
- Corrective actions are required as soon as possible.
- Corrective action is required immediately.

Discussion

Reference obtained as a result, that the highest prevalence of exposure to forced postures, handling of loads, repeated movements occurred in bricklayers,[12] of which in this study the predominance was obtained by mechanical activities in positions of welders, assemblers, pipe fitters, due to the load caused in postures of bent back with twist combined with low, raised arms and squatting feet with both legs flexed and the unbalanced weight between both that has extremely harmful effects on the musculoskeletal system.

According to the information provided by reports on the assessment of postural overload of musculoskeletal risks in the workplace in metalworking companies, there are few;[14] taking into account the results of this project, mechanical activities are those that have the greatest impact on the worker because through the adoption of forced postures, sudden movements, which when performing specific tasks produce greater discomfort, hence the reason for carrying out the study in this sector.

Regarding other studies taken into account such as Linares et al ., it reaffirms the validation of a scale to measure ergonomics in the workplace[6] and the realization of a documentary, descriptive and analytical study, through the search for electronic publications in journals, books, theses and dissemination in congresses and unpublished presentations, obtaining as a result, the OWAS method, used in various populations of workers, such as those related to the construction industry,[9] this article takes as a reference the importance of evaluating physical load through an objective method that helps to work on the prevention of work diseases due to musculoskeletal disorders derived from physical load.

Ardila, et al.,[7] concluded that the ergonomic risk profile in the manufacturing sector is incipient, considering it to be influenced by factors such as lack of knowledge of the subject and lack of management commitment in the implementation of programs that help minimize diseases derived from the activities carried out in each of the sectors. This is reaffirmed in this study despite the fact that the study is not carried out in the same sector.

While Marrero et al.,[11] in 2013 determined that the evaluation of ergonomic demand is a key step for the development of intervention programs in work systems coinciding with the methodological structure and concepts that structurally supported the results of this research project.

Conclusion

The biomechanical dangers found in the risk assessment are acceptable, with specific controls, which were only carried out through training in postural hygiene and when monitoring, no positive impact on the worker was evident.

The results of these evaluations demonstrate that the load caused by forced postures can have harmful effects on the musculoskeletal system, generating some type of musculoskeletal damage or pathologies.

Mechanical activities are those that have the greatest impact on the worker because, through the adoption of forced postures and sudden movements, they are the ones that cause the greatest discomfort when performing specific tasks.

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By performing objective evaluation methods, guidelines are achieved to determine which body segments are most involved when performing the task, the degree of severity of the task with respect to posture, and the body segment involved in the action. It is pertinent to implement intervention plans in the workplace and in people, to achieve a balance in the man-object system and environment, thus improving the quality of life of the worker on a daily basis.

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Conflicts of interest

The authors declare there is no conflict of interest.

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