An approach to identify jobs for ergonomic analysis

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Abstract

An important part of initiating a site-wide ergonomics evaluation process is prioritizing jobs to be analyzed. While injury data is important, other factors such as worker discomfort and physical exertion requirements, should be considered. This paper describes the use of four sources of data (injury records, the Nordic Standardized Musculoskeletal Questionnaire, supervisor interviews, and management concerns) to prioritize jobs for ergonomic analysis. The approach described integrates the four sources using a decision matrix to prioritize jobs for ergonomics analysis.

Keywords

ergonomics, musculoskeletal disorders, risk factors

1. Introduction

Three main risk factors contribute to musculoskeletal disorders (MSDs): force, repetition, and awkward postures. Any one or combination of these may contribute to the development of MSDs [1]. The design of equipment, environment, and workplace layout in conjunction with the required tasks should be evaluated when attempting to reduce these risk factors. Subsequent development and implementation of effective ergonomics interventions reduces workers' exposure to these risk factors and the likelihood of developing an MSD [2].

To prioritize jobs for ergonomics evaluation, injury records should be examined to identify jobs with high injury rates. This is a good quantitative measure, but it does not give the whole picture, especially for MSDs. Often MSDs develop over time and injury records may not accurately reflect the aches and pains being experienced by the workforce. Relying on injury information alone is a reactive approach. A pro-active approach is to identify jobs which have MSD risk factors and to develop and implement interventions before injuries occur. Thus, it is useful to obtain qualitative input from all available sources such as the workers, first-line supervisors, safety personnel, and upper levels of management. This data is a little more difficult to measure and interpret, however, there are tools available to aid in its collection and analysis.

Initiating an ergonomics study is often a straightforward process of examining jobs associated with recurring injuries, reported problems, high turnover, high absenteeism, or poor productivity. In these cases, the starting point for evaluation may be obvious. When the starting point is not clear, the ergonomist should examine a wide range of information concerning work activities at the facility. During a National Institute for Occupational Safety and Health (NIOSH) ergonomics study aimed at identifying risk factors associated with MSDs at various mining facilities, a method was developed to collect information about work activities and integrate this information to prioritize jobs for ergonomics evaluation. Because this information is both quantitative and qualitative data, it can be difficult to integrate. This paper will describe a decision matrix that was developed by the Ergonomics Intervention Team (EIT) during a NIOSH study to weight and score information obtained from several data sources and to prioritize jobs for ergonomic analysis.

2. Approach

2.1 Tools Used

For this study a number of tools were used to gain input from a variety of perspectives at the work site. Each perspective has a stake in the job. A body part discomfort questionnaire, the Nordic Standardized Musculoskeletal Questionnaire, was distributed site-wide. An interview guide was developed by the EIT and administered to first line supervisors. The mines provided access to their injury databases. Finally, meetings were held with the management team to collect their perspective on jobs which they believed may put workers at higher risk of developing MSDs. The EIT used the results of each to assign ratings to jobs and to develop a decision matrix.

2.1.1 Nordic Questionnaire

One tool for measuring musculoskeletal distress is the Nordic Questionnaire. This instrument can be used to assess a general level of discomfort across the workforce, regardless of the source of pain. The general form of the Nordic Questionnaire was designed by the Institutes of Occupational Health in the Nordic countries [3], figure 1. This tool has been widely tested and used in Denmark, Finland, Norway, Sweden, and the UK [4]. Results of this questionnaire can be presented in a variety of ways. We chose to evaluate work groups by the number of body parts reported and the number of reports of discomfort in similar body parts. These numbers were compared with the average number of body parts per person site-wide to assign ratings of low, medium, and high for the decision matrix.

The goal was to have as much of the work force as possible fill out a questionnaire. A copy of the questionnaire was sent in advance to the mine contact. When possible, a member of the EIT gave an overview of the questionnaire to the workers and then the workers completed the form. At other times, mine safety personnel distributed and discussed them with the employees prior to completing the form. An analysis of musculoskeletal discomfort was performed to determine each work area's report of discomfort.

2.1.2 Injury data

The mine was requested to provide at least a three-year period in injury reports. The injury data provided by the mine was reviewed and analyzed. This included incidents involving (1) near misses, (2) medical treatment, and (3) lost work time. Incident data were summarized by the type of incident (e.g., struck by / struck against, contact with a hot object, jolt / jar, overexertion) and incident outcome (e.g., cut, bruise, burn, sprain / strain). An incident ratio was calculated for each work group. This ratio was based on the number of incidents over the period examined per the number employees that perform that job. The relative incident ratio by workgroup was compared to the incident ratio of the facility overall to develop ratings for the decision matrix.

The reporting of incident data is influenced by many factors. The number or type of incident does not often reflect the degree of injury risk. This is especially the case for jobs where the number of workers is relatively small. A small increase or decrease in the number or injuries can markedly change the implied risk. However, the occurrence of injury is still a useful decision point to identify jobs that can benefit from ergonomic evaluation.

2.1.3 Supervisor Interview Guide

The evaluation team developed an interview guide for first-line supervisors. The goal of this interview was to learn about jobs performed at the facility as well as to gain insight into which jobs first-line supervisors felt were the most physically demanding. The interviews took approximately 30-40 minutes. The primary questions asked during this interview were:

- Please describe the jobs, title and brief description, performed by your work crew/group:
- For these jobs, which ones seem to be the most physically demanding? Why?
- Are there any tasks or activities within these jobs that are especially difficult or physically demanding?

The degree of physical stress was assessed based on the description of common physical risk factors which include: forceful exertions, heavy lifting, awkward postures, repetitive motions, and jolting or jarring. For each task identified by the supervisors a ranking of low, medium, or high was assigned to characterize the degree of physical stress identified.

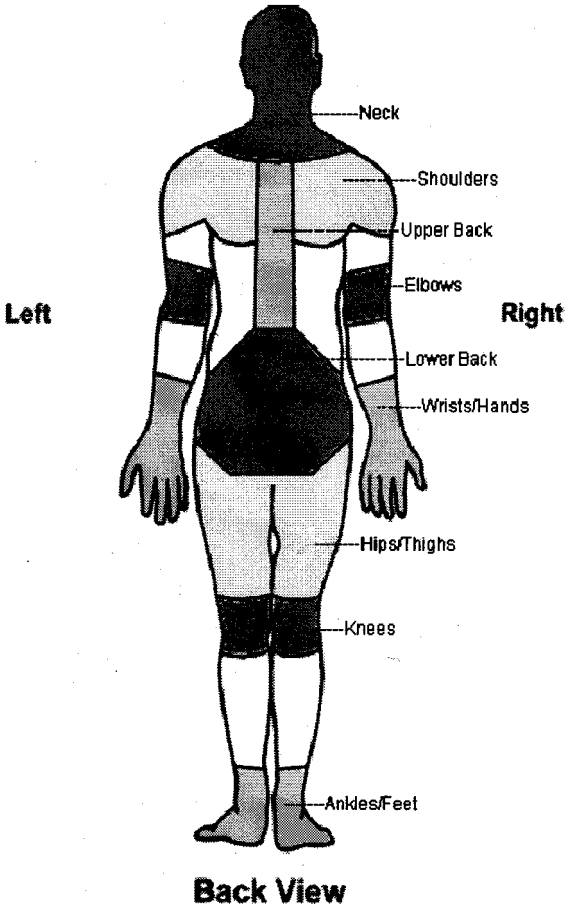

Figure 1. Sample Nordic Questionnaire.

To be answered by everyone:	**If Yes to first question...**	**If Yes to first question...**
Have you at any time during the last 12 months had trouble (ache, pain, discomfort) in:	Have you at any time during the last 12 months been prevented from doing your normal work (at home or away from home) because of the trouble?	Have you had trouble at any time during the last 7 days?
Neck ¡ No ¡ Yes	¡ No ¡ Yes	¡ No ¡ Yes
Shoulders ¡ No ¡ Yes, right shoulder ¡ Yes, left shoulder ¡ Yes, both shoulders	¡ No ¡ Yes	¡ No ¡ Yes
Elbows ¡ No ¡ Yes, right elbow ¡ Yes, left elbow ¡ Yes, both elbows	¡ No ¡ Yes	¡ No ¡ Yes
Wrists/Hands ¡ No ¡ Yes, right wrist/hand ¡ Yes, left wrist/hand ¡ Yes, both wrists/hands	¡ No ¡ Yes	¡ No ¡ Yes
Upper Back ¡ No ¡ Yes	¡ No ¡ Yes	¡ No ¡ Yes
Lower Back (small of back) ¡ No ¡ Yes	¡ No ¡ Yes	¡ No ¡ Yes
One or both hips/thighs ¡ No ¡ Yes	¡ No ¡ Yes	¡ No ¡ Yes
One or both knees ¡ No ¡ Yes	¡ No ¡ Yes	¡ No ¡ Yes
One or both ankles/feet ¡ No ¡ Yes	¡ No ¡ Yes	¡ No ¡ Yes

2.2 Decision Matrix

Utilizing results from mine injury data, the Nordic Questionnaire, and Supervisory Interviews, a Decision Matrix was constructed to identify work groups from which target tasks would be selected. Each of the three sources of data were equally weighted and a ranking of Low, Medium, or High was given by consensus of the evaluation team. For scoring purposes, a rating of High was given three points, Medium given two points, and a Low rating given one point. One additional point was awarded if management expressed concern regarding a work area. The Final Score was calculated as the sum of the ratings for three data sources plus the additional point if management expressed concern. An example of what a decision matrix might look like is illustrated in table 1.

Table 1. Decision Matrix

Work Group	# of Employees	Incident Data	Nordic Questionnaire	Supv. Interviews	Mgmt. Concern	Final Score
Scaling Machine Operators	6	Medium	Low	Medium		5
Drillers	4	High	High	High	✔	10
Blasting Crew	4	Low	Medium	Medium		5
Truck Drivers	8	Medium	High	Medium		7
Loader Operators	6	Low	Medium	Low		4
Mechanics	4	Medium	High	Medium	✔	8

The work groups which obtained the highest scores were given priority. Through subsequent discussions with the mine management, a final set of jobs were selected for initial evaluation. Once the initial work groups to be evaluated were determined, specific tasks which were most likely to expose workers to MSD risk factors were identified to be the focus of the ergonomics evaluation.

Work groups with the highest final score were not always selected for initial evaluation. For example, a work group that did not perform routine work activities such as maintenance and repair work may not have been selected. This does not mean that these types of work groups should not be evaluated. Due to time constraints associated with the NIOSH study, it was decided that they would not be considered. Work groups that consist of routine tasks lead to more straightforward evaluations. When conducting a comprehensive site-wide evaluation process, it would be appropriate to take on more complex ergonomics issues associated with jobs with non-routine tasks.

In the example given in table 1, the three highest scoring groups are the Drillers, Mechanics, and Truck Drivers. The tasks performed by the Drillers and the Truck Drivers are routine, whereas, the Mechanics' tasks are less predictable. An ergonomics evaluation of the Mechanics would be time intensive and could be reserved for a site-wide evaluation. The initial study in this situation could be to evaluate tasks performed by the Drillers and Truck Drivers. These evaluations could be completed more quickly and build confidence in the ergonomics process before examining more complex work activities as part of a comprehensive evaluation.

3. Discussion

It is frequently the case that injury data alone is used to prioritize jobs for an ergonomics analysis. The prioritization process can be better if qualitative data is considered as well. The tools used to help profile pain and discomfort and physically demanding tasks can provide for a broader look at safety and health. This can help to reduce reliance on managing the "number of injuries" as the main measure of organizational performance within the domain of safety and loss control.

It can be difficult to integrate the results of quantitative and qualitative data. The goal of the decision matrix was to develop a simple, easy-to-use method that includes information from multiple data sources. The decision matrix allows one to consider and integrate ergonomic aspects from several different perspectives. Thus, it can build ownership in the process and offer a means for organizations to incorporate a variety of perspectives.

This technique can be used to assess and rate data that would be difficult to assign outcome probabilities. The data represents major stakeholders at the work site – those that do the work and use the technology (workers), those that direct the work and provide resources for people to accomplish the work in a safe and efficient manner (supervisors), and those that have financial responsibility for investing in both people and technology to make a reasonable return on

the shareholder investment (upper management).

While the outcome of involving multiple stakeholders and perspectives can be positive, it is more time consuming and costly. It takes time to actively involve the workers to provide information and plan for interventions. It could be less costly in the short term for a decision to be made based on any one of the four dimensions studied. However, building ownership in the study and teaching problem solving skills is a key aspect of quality work life. These results can be more effective and prevent injuries before they occur which will pay off in the long term.

The method used to integrate the four data sources could be conducted easily by someone at a facility or someone from the outside coming into a facility to perform an evaluation. The goal is to encourage the use of multiple data sources and allow for a simple means to integrate the information obtained. Simplicity is its value and it is not suggested that these are the only dimensions.

4. Summary

When a decision is made to do an ergonomic analysis at a facility, often reported injuries are the criteria used to prioritize jobs for evaluation. While this is a valid starting point, it is important to take other information into consideration. By incorporating worker feedback on body part discomfort and supervisory feedback on jobs that are physically demanding, a more complete picture of the problem jobs can be obtained. The matrix described in this paper is one example of a simple and straightforward means to include several criteria into the decision process. Ergonomics is an iterative process. Once jobs are evaluated and solutions are implemented, it is important to reevaluate the activities to ensure that there are no unintended consequences [5] and the effectiveness of the changes implemented. The process described in this paper is one approach to select the initial jobs to be analyzed. It is not to say that these are the only jobs that should be assessed. All jobs eventually should be screened for risk factors. It may be necessary to go back and repeat the process to select additional jobs.

The decision matrix used to integrate the data examined to prioritize jobs for ergonomics evaluation is just one example of how this can be accomplished. Regardless of how the information is integrated, it is important that several forms of information are taken into consideration, both quantitative and qualitative. It is important to obtain a variety of perspectives (management, worker, and front-line supervisor) on the issues. Also, by soliciting input from the involved parties, it provides them with a sense ownership. This can contribute to the success of ergonomics interventions developed and implemented. For the majority of interventions to enhance safety or reduce the risk of injury and illness, one needs all parties to take an active role in defining the issues, developing ideas, and implementing interventions.

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