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Short Communication

A Method for Non-experts in Assessing Exposure to Risk Factors for Work-related Musculoskeletal Disorders—ERIN

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Abstract: A practical method for non-experts in assessing exposure to risk factors for work-related musculoskeletal disorders (WMSDs) is presented. Evaluación del Riesgo Individual (Individual Risk Assessment) (ERIN) is based on available ergonomic tools, epidemiological evidence and the joint IEA-WHO project for developing WMSDs risk management in developing countries. ERIN focuses primarily on the interaction of some physical workplace factors but also includes the workers' assessment. A scoring system has been proposed to indicate the level of intervention required to reduce the risk of injury. A worksheet has also been designed for increasing the usability of the method. Preliminary tests show that it is easy and quick to use, but further work is needed to establish its reliability and validity. The use of ERIN can contribute to the prevention of WMSDs in Cuba and other developing countries.

Key words: Exposure assessment, Work-related musculoskeletal disorders, Observational method, Ergonomic tool, Posture

Work-related musculoskeletal disorders (WMSDs) are a common health problem and a major cause of disability[1)]. These injuries which include disorders of the back, trunk, upper extremity, neck, and lower extremity are one of the 10 leading work-related illnesses and injuries in the United States[1)]. Currently, these disorders have become one of the main focuses in the area of occupational disease prevention[2)].

In Cuba, WMSDs are not recognized in law as an occupational illness, nor are statistics kept on them. However, in studies carried out by the National Institute of Workers' Health (INSAT), WMSDs accounted for the second highest rate of total permanent disability in the Cuban work force in 2005, with 180 cases for every 10,000 workers—exceeded only by vascular-brain diseases, which had 186.9 cases for every 10,000 workers[3)].

There is a need to promote the prevention of WMSDs, in which the development of a method for assessing risks at a workplace is a very important step, as is recognized by several authors[4, 5)].

Even though the methods used for quantitative and qualitative assessment of working conditions and outcomes have been refined gradually[6)], limitations have been identified[4, 7, 8)]. Only 2 of the 30 methods reviewed by Takala and his colleagues can be used by workers and supervisors, while 6 others may be so used[8)]. In order to generalize the assessment of exposure to risk of WMSDs, one easily used method is needed. In developing countries,

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such as Cuba, the potential users of the method have little knowledge about WMSDs. As a result, they have little training in using tools for assessing their exposure to risk of WMSDs.

In this paper is presented the ERIN ergonomic method, which was designed for used by non-experts with minimal training and few resources, to enable them to carry out large-scale assessments of individuals exposed to WMSD risk factors in static and dynamic tasks. The assessors can measure the effects of interventions aimed at reducing the global risk. Its use can contribute to the management and prevention of WMSDs in Cuba and other developing countries. The development of this observational method follows the guidelines of the International Ergonomics Association (IEA) and World Health Organization (WHO) initiative for developing toolkits which non-experts can use at the workplace level to assess the risk of WMSD injuries.

ERIN has been developed taking into account experiences in field studies using such available ergonomic tools as Rapid Upper Limb Assessment (RULA), Rapid Entire Body Assessment (REBA), Strain Index (SI), Quick Exposure Check (QEC), the Occupational Repetitive Actions (OCRA) checklist and Ovako Working Posture Analyzing System (OWAS); literature research in state-of-the-art studies concerning work-related musculoskeletal disorders and risk factors; critical studies of current methods for assessing exposure to WMSDs; and feedback from ergonomists, experts in occupational health and safety, industrial engineers and specialists in human resources.

The proposed method involves the measurement or assessment of the following seven variables: posture and frequency of movement of the trunk, shoulder/arm, hand/wrist and neck; the rhythm resulting from the interaction of work speed and the duration of each task; intensity of effort (which includes both the intensity and frequency of the perceived effort); and self-assessment (workers are asked about their perception of how stressful they find their work to be).

ERIN worksheet is shown in Fig. 1. The representation of each variable follows four criteria:

1. In order to assess the postural load, ERIN uses a predefined posture categorization system similar to RULA. This system of scoring each body part posture provides a sequence of numbers which is logical and easy to remember[9].
2. In order to make posture identification easier, ERIN combines images and descriptive words.
3. The categorization posture system is divided into a few levels to increase the reliability and validity[10].
4. The categorization of movement of body parts takes into account the risk model for health associated to posture and movement[11].

The steps for determining the ERIN score using the ERIN worksheet (Fig. 1):

(1) Observe the task.
(2) Score the risk values per variable.
(3) Add all the risk values to obtain the global risk.
(4) Determine the corresponding risk level, based on the global risk.

Additional considerations are the follows:

- Due to the limitation of selective attention, the number of body joints and number of posture categories that can be observed simultaneously are limited when real-time posture categorization decisions are required[12]. For the above reasons the observer should select the worst posture for each body part assessed. This facilitates observation for non-experts. When the purpose is to detect small changes that improve working conditions and the working postures have few variations over time, it can also be useful to select the most common posture for each body part assessed.
- If there are several types of effort, the effort with the greatest intensity of effort should be selected. This variable combines the intensity of the worker's exertion-which, as defined by Moore and Garg, is an estimate of the force requirements of a task, reflecting the magnitude of muscular effort required to perform the task one time[13]—and frequency of effort—which is divided into three categories. The intensity of effort can be evaluated using the criteria of the observer (the efficacy of vicarious perception by non-experts has been reported by Drury)[14] and by asking the observed worker, encouraging worker participation.
- Frequency of movement is determined by the number of times the body part moves and is not related to the number of times the worst posture occurs.

Most scoring systems used in existing methods have been largely hypothetical[7]. ERIN's scoring system has a hypothetical base and was designed to provide non-experts with a tool for carrying out interventions based on "before and after" comparisons of global risk levels. This scoring system will need further development and refinement based on future epidemiological research.

The global risk is obtained by adding the values for all of the seven variables assessed in ERIN. The model used for calculating the global risk permit to easily identify the influence of each factor and to address the change needs

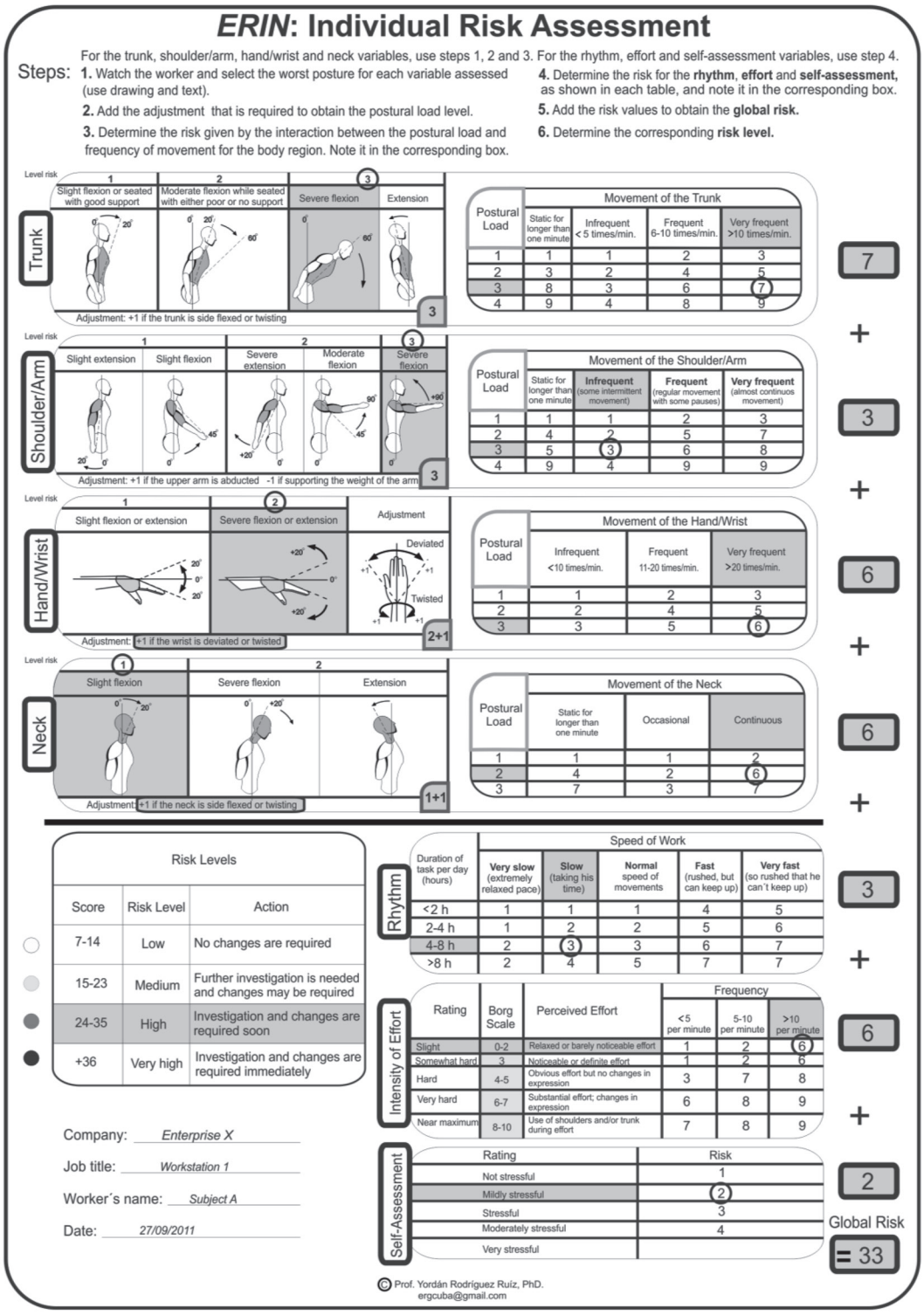

Fig. 1. Completed ERIN worksheet for an operator placing foodstuffs on trays.

for diminishing the global risk.

When the global risk is between 7 and 14—that is, a *low level—n*o changes are required. When the global risk is between 15 and 23—that is, a *medium level*—further investigation is needed/and changes may be required. When the global risk is between 24 and 35—that is, a *high level*—investigation and changes are required soon. When the global risk is more than 36—that is, a *very high level*—

investigation and changes are required immediately.

Most of the available observational methods were designed to be used by skilled assessors[8]. ERIN was developed to be easy to use by non-experts and seeks to overcome some of the limitations presented by such methods.

OWAS is very good for classifying which jobs potentially affect workers but focuses primarily on posture assessment and does not include the rate of movement of the body parts. In RULA, the movement of the body parts has little impact on the final score. ERIN quantifies the interaction of postural load with the frequency of movement of each body part assessed, giving the movement of the body parts a greater impact on final scores. ERIN considers time of exposure and the evaluation of psychosocial risk factors (self-assessment) in consultation with workers, aspects not considered in other methods (e.g. RULA, REBA and OWAS). In ERIN it is very easy to identify what variable (s) (the focus of future interventions) the observer should modify in order to decrease the final score. In other methods, such as RULA and REBA, the use of tables makes it difficult to identify which variable (s) the observer should modify in order to decrease the final score. Although use of the ERIN posture categorization system is similar to that of RULA and REBA methods, in most cases ERIN uses wider width angle intervals. This approach has resulted in better inter/intra-rater reliability[10]. QEC offers only a total score for each body part, which makes it difficult to assess the global risk of exposure. ERIN gives a global risk assessment using a simple procedure.

The following example illustrates the use of ERIN at the workplace level. Here, an operator is placing foodstuffs on trays. Figure 1 shows the completed ERIN worksheet.

As explained above, the observer must decide which is the worst posture adopted for each body part. Figure 2A shows that, even though the trunk is not bent to the side or twisted, it is flexed more than 60° (3). The movement of the trunk is very frequent (>10 times/min.). Figure 2B shows that the left shoulder/arm is flexed more than 90° and is neither supported nor abducted (3+0). The movement of the arm is infrequent (some intermittent movement).

Figure 2C shows that the right wrist is flexed more than 20° and deviated (2+1). The movement of the wrist is very frequent (>20 times/min.). Figure 2D shows that the neck is flexed less than 20° and bent to the side (2+1). The movement of the neck is continuous, occasioned by the different heights of the work planes.

The operator spends between 4 and 8 h in this task during the working day and performs it at a slow speed of work. The intensity of effort is considered "slight," with a frequency (>10 per minute), and the worker has assessed the task as mildly stressful.

Fig. 2. Worst postures assessed.

The global risk score is 33, corresponding to a high risk level, indicating that investigation and changes are required soon.

ERIN was developed in line with the IEA and WHO's initiative for developing toolkits which non-experts can use at the workplace level to assess the risk of WMSDs. The proposed method can be used by non-experts with minimal training in dynamic and static tasks, without the need for any equipment. ERIN can be used as instrument to determine in which cases interventions should be instituted to reduce the worker's exposure to WMSD factors and to measure the effects of those measures.

Although experience to date shows that it will be a valuable method for the prevention of WMSDs, further studies are needed to establish the reliability and validity of the tool.

Finally, it should be stressed that ERIN is only one tool in a comprehensive effort to prevent WMSD. Some examples of other approaches are described elsewhere.

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