Research Paper: Ergonomic Assessment of Posture Risk Factors Among Iranian Workers: An Alternative to Conventional Methods

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ABSTRACT

Objectives: Work-related musculoskeletal disorders are a global problem which evolves at different workplaces such as industries, administrative, and agriculture sectors. In various studies, such disorders were assessed through multiple methods. It is necessary to evaluate different tools to use them in diverse communities. The aim of this study was to assess the validity of the new ergonomic evaluating method of Novel Ergonomic Postural Assessment (NERPA) method in Iran.

Methods: The employees (n=455) of operational units of four companies (drug producers, printing and publishing houses, dairy, and drinks producers) were assessed in 2014. It was a cross-sectional and descriptive-analytical study. One of the researchers developed a questionnaire that was applied to collect demographic data. The NERPA, Rapid Upper Limb Assessment (RULA), and Rapid Entire Body Assessment (REBA) methods were utilized to analyze posture risk factors. Spearman correlation and Kappa agreement were used to analyze the collected data through SPSS V22.

Results: Findings indicated that printing company had the best and pharmaceutical industries had the worst state regarding RULA's results. The risk levels between NERPA and REBA were not statistically significant (P>0.05), however, that was significant with RULA's outcome. Also, the results of NERPA and other two methods were correlated significantly (P<0.05). Pain in the lumbar area was implied to be the most prevalent problem (35.1%).

Discussion: Data of the present study suggest that NERPA method was a valid tool compared to RULA. The NERPA method could be used to evaluate standing tasks among industrial workers. However, the concurrent validity of NERPA method compared with results of REBA, as a widely used method, were not verified.

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1. Introduction

Inadequate body postures related to workstations is the primary cause of Musculoskeletal Disorders (MSDs) [1, 2]. American Bureau of Labor Statistics announced that in the United States of America, 44% of all reported occupational diseases were related to MSDs [3]. In Iran, studies are limited in this area [4]. In 1998, according to the Medical Commission of Tehran Social Security Organization, 14.4% of diseases that caused disabilities were MSDs [5]. Nouri et al., quoted Choobineh (2004) that the cost of MSDs in Iran in 2000 was 13.1% of Iranian government budget [6].

MSDs often engage multi-risk factors. The most important risk factors include vibration [7], poor posture, repetitive and excessive force, lifting and carrying [8-11]. The awkward posture is most important among various risk factors [12, 13]. Various studies have shown that the best strategy for the prevention of WMSDs is intervention aided by Multiple-Criteria Decision-Making (MCDM) techniques to reduce exposure to risk factors such as repetitive motions, excessive force, awkward postures, vibration and static activities [14-17]. This suggests that risk factors for MSDs must be considered and evaluated in the workstations [18, 19]. Also, risk assessment, training, consultation with workers, and prevention of fatigue must be noted [12, 20].

There are various tools to analyze risk factors or identify potentially hazardous jobs. These include observational methods, direct methods, self-declarations, and other psycho-physiological methods [21]. The objective measurement may result in the best description, but these methods are time-consuming, and also the evaluation of large groups is expensive. The tool must be user-friendly and flexible for a wide range of tasks with different complexities. On the other hand, studies demonstrated that experts tend to use descriptive words or use numbers only to describe situations, rather than an exact angle of body posture [21]. There are various methods such as QEC, OWAS, SI, OCRA, HAMA, and PLIBEL to assess the load/stress on body parts. However, Rapid Entire Body Assessment (REBA) and Rapid Upper Limb Assessment (RULA) are two other commonly used techniques to assess postures at work regards to economic reasons and ease of use. Also, Novel Ergonomic Postural Assessment (NERPA) method is one of the newest methods of postural assessment [22].

It is important to note that many variables between different countries, such as language, culture, and geography can change the output of the methods used [23]. In addition to variables such as gender, age, economic status, and body mass index, factors such as genetic, environmental, and cultural differences influence such disorders. MSDs are widespread among minority ethnic groups in the UK; this may reflect psychological, cultural, and social differences [24].

As another example, the Egyptian-born Americans are more prone to low back pain [25]. It can be hypothesized that the development of MSDs may be different in various populations. Therefore, it is necessary to evaluate the instruments prior to use in other communities. For instance, a tool like NERPA that is designed and tested in Spain needs to be validated in other countries. The aim of the current study was to validate NERPA by comparing it with two conventional methods of RULA and REBA. The results could be useful for occupational health experts, ergonomists and occupational medicine specialists in job assessment and prevention of MSDs.

2. Methods

The aim of this cross-sectional and descriptive-analytical study was to assess the validity of NERPA as a postural assessment method in industries of Iran within the year 2014. All operational staff (n=502) working in four industries including pharmaceutical, the publishing industry, drinks producer, and dairy were included. People with joint problems like arthritis, herniated disc, disc infection, and fracture in the spine, and other musculoskeletal problems and pains in various parts of the body were excluded from the current study. Finally, 455 workers were selected and enrolled in the study. Three posture evaluating methods named RULA, REBA and NERPA were used. NERPA was reported by Sanchez et al. in 2013 and is one of the latest postural assessment methods that try to make a better assessment of the situation. This method like many other pen-paper-based postural assessment methods uses a scoring system to express body states and reports them by numbers. Finally, it offers them in the form of four levels of corrective action [22].

At the first stage, working cycle was defined, and a cycle was captured in different directions by a camera. The videos/images were investigated further, and the various tasks have been analyzed. The tasks with higher frequencies were assessed by three mentioned methods. Furthermore, a demographic questionnaire was used to gather data about age, gender, and work experience.

The results were collected and reported based on the approved ethical code of Qom University of medical sci-

ences. Informed consent was prepared for all the participants as well as they were informed that inclusion and exclusion from the study were voluntary. All the information of participants kept confidential. Finally, the data were analyzed using kappa coefficient of the agreement through SPSS software version 20. Also, Spearman's correlation test was used.

3. Results

General description

A total of 455 workers participated in this study, and 51.5% of them were aged 36-50 years (n=234), and 9.7% of them were >50 years. Majority of subjects had <10 years of work experience. Men represented 56.7% of participants and 43.3% (n=197) were women. Furthermore, only 2% of respondents have been working over 20 years at the same place. From the perspective of the industries, highest number of employees was in the dairy industry (38.02%) and lowest number of employees was in the drink production industry (10.99%). Detailed information on the numbers and percentages of the variables are presented in Table 1.

Comparing results of NERPA and RULA

Comparison between the level of risk assessed by RULA and NERPA has been tested using Spearman correlation coefficient and Kappa coefficient. Correlation between two methods with regards to corrective action levels was analyzed, and statistically significant (P<0.01) coefficient of 0.93 was obtained. Agreement between corrective actions levels of methods was also significant (P<0.01). Details of correlation and agreement coefficients are specified in Table 2. The highest agreement between two methods was achieved in the printing industry (coefficient 0.93) and the highest correlation was observed in the drink production industry. All coefficients were significant (P<0.01).

NERPA and REBA comparison

Comparison between levels of risk carried out by two methods of NERPA and REBA was performed by Spearman correlation and Kappa agreement coefficients. The correlation between outcomes of two methods was 0.744 (P<0.05). The agreement of corrective action levels of two methods was analyzed by kappa coefficient, however, no significant relationship was established. Also, the highest correlation was resulted in the drink production industry (0.78) and the lowest correlation was resulted in the dairy industry (0.50) (P<0.05).

4. Discussion

Currently, MSDs as a global challenge for occupational health and ergonomics specialists have crossed geographical boundaries and have become an international issue [26]. It should be noted that MSDs as the most severe consequences caused by work load, will lead to job restriction, loss of work time, reduced productivity and quality, poor quality of work life, and reduction in the retirement age [27-29]. These problems are prevalent among people in various occupations for e.g. in industries, organizations, healthcare sectors, and agricultural fields. Muscle pains as well as their related fatigue, can affect postural control and increase the risk of human er-

Table 1. Number and percentage of subjects in different industries and in terms of age and experience (n=455)

Variable	Options	Number	Percent
Industry	Producer of drinks	50	10.99
	Pharmacy	135	29.67
	Dairy production	173	38.02
	Print	97	21.32
Age	20-35 years	177	38.8
	36-50 years	234	51.5
	More than 50 years	44	9.7
Job experience	Less than 10 years	246	54.0
	10-15 years	59	13.0
	15-20 years	141	31.0
	More than 20 years	9	2.0

Table 2. Correlation and agreement between results of RULA and NERPA risk levels and the total for each industry

Industry Parameter	Print	Pharmacy	Producer of Drinks	Dairy Production	Total
Spearman	0.943	0.817	0.991	0.924	0.928
Kappa	0.929	0.817	0.605	0.793	0.856

* P<0.01

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rors [30, 31] . Similar to other chronic diseases, MSDs have both occupational and non-occupational risk factors. Daily activities such as sports, driving, and work-family conflict, as well as smoking and obesity could influence ergonomic disorders [30]. Also age, sex, socio-economic status, and ethnicity can effect risk of injury. Therefore, it is crucial to apply best assessment method.

In this study, a comparison between the levels of risks involved was perfomed using the three methods (RULA and REBA as two reliable methods against NERPA as a novel method) aided by Spearman correlation and Kappa coefficients. Based on the statistical analysis, Spearman coefficient has demonstrated that the correlation between the assessed postures by NERPA and RULA in the investigated industries was significant. Our result revealed that the studied sectors had an excellent coefficient (0.92). Outcomes of REBA and NERPA methods demonstrated an acceptable correlation between the two methods (0.74). The correlation coefficient in four industries ranges from 0.78 to 0.51 that belong to drink production and dairy industries, respectively. Postures evaluated in the drink production industry by both RULA and REBA and comparing the results with NERPA had the highest correlation. The RULA method was in better correlation with NERPA which corroborates with the study conducted by Sanchez [22]. Some studies have been performed about comparison, correlation, or agreement of different postural evaluating methods such as RULA [32, 33], REBA [34], or both [3, 33, 35]. However, none of the studies compared NERPA with other evaluating methods.

Correlation between the results of two methods of REBA and RULA was tested and there a high correlation was observed between the final scores and the levels of corrective action of the two methods (0.871 and 0.821), respectively [3]. Chiasson et al. compared methods of QEC, FIOH, RULA, HAL, SI, REBA, OCRA, and EN1005-3 standard in various industries. The agreement of evaluation results at high-risk stations was reported for these methods [33]. In another study, Jones and Kumar evaluated the REBA, RULA, OCRA, HAL, and SI methods in the wood industry and found a complete agreement [35]. In a study performed in automobile assembly companies, outcomes of RULA and SI methods were compared and suggested a little agreement between results of the two methods, with a kappa coefficient of 0.11 [13].

5. Conclusion

Based on the results of the present study, it can be concluded that the correlation between corrective actions levels of NERPA and RULA is desirable. On the other hand, correlation between NERPA and REBA was acceptable. However, concurrent validity of NERPA comparing with REBA's result, as a widely used method, has not been verified in the present study. For the establishment of NERPA inplace of REBA method to use in the industrial fields, further studies in larger populations as well as in more industries are essential. In summary, this study illustrated that applying a new NERPA method instead of RULA for the posture analysis of workers in manufacturing industries is possible.

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Conflict of Interest

There is no conflicts of interest to be declared.

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