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The Agreedness between Observation and Self-report Methods in Work Posture Analysis

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Abstract. *Work posture analysis plays an important role in providing safe and productive workplace through minimizing musculoskeletal symptoms or disorders. The postural analysis can be conducted through observation, direct, and self-report method, each of which has advantages and disadvantages. Purpose of this study is to compare obervation and self-report analysis in the context of degree of agreedness. One rater observes and gives rating to fifteeen work postures in an automotive service company using Rapid Entire Body Assessment (REBA) and Rapid Upper Limb Assessment (RULA). In addition, six workers in the same company also fill out the Nordic questionnaire as a self-report method of musculoskeletal symptoms or disorders. Descriptive analysis is conducted to compare the musculoskeletal symptoms using both observer and self-report analysis. Results show that RULA is slighlty better than REBA in accordance to the Nordic questionnaire' result. Implications of the result are discussed.*

Keywords: *observation, self-report, RULA, REBA, Nordic questionnaire*

I. INTRODUCTION

Work posture analysis is crucial in providing safe work posture. The issue of safe work posture is gaining attention since failure to provide safe condition lead to work musculoskeletal symptoms or work musculoskeletal disorders. The symptoms or disorders (see, for instance, Punnett and Wegman, 2004; Girish et al., 2015; Punnett et al., 2005; Smith et al., 2014) have been found in both developed and developing countries. In addition, they have been found in various industries and workplaces such as in farms (see Widyanti, 2018 for an example), among coal mining workers (see, for instance, Widanarko et al., 2016) and among homemakers (Yang et al., 2016).

The musculoskeletal symptoms or disorders might lead to various accidents and give consequences in worker' injury and economic loss of the company. The work posture analysis is therefore crucial in reducing the symptoms or the disorders. This in turn decreases incidents and accidents in the workplace and increases the productivity of the workers and the company as a whole.

Attention has been given to the development and application of the work posture analysis in various aspects such as the isue of practicability and validity. Practicability refers to the extent to which the method can be applied in different settings. Whereas validity refers to the extent to which results of measurement reflect the true condition.

There are three methods of work posture analysis: direct, observation, and self-report method. The direct measurement method's result is usually valid and objective. However, this method requires a special skill for the technical operation and data analysis. Examples of the method are goniometer and kinect (e.g., Hansson et al., 2001).

The advantage of observation method is its practicality and its cost effectiveness. The disadvantage of the method relates to inter-rater reliability, referring to agreement level among different raters in cases multiple raters are applied. Examples of observation method are Rapid Upper Limb Assessment (RULA) (McAtamney & Corlett, 1993; McAtamney et al., 2012; Dockrell et al., 2012; Chen et al., 2014) and Rapid Entire Body Assessment (REBA) (Hignett & McAtamney, 2000; Madani & Dababneh, 2016). REBA and RULA shares similar technical properties since both methods use the help of

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tables in giving rate of a work posture. Both RULA and REBA categorize work posture conditions based on risk. The differences between them are on the focus of the analysis. As reflected by its name, REBA focuses on entire body assessment, whereas RULA pays attention on upper part of the body.

The advantage of self-report method is that it can be applied in a large sample size. The disadvantage of the method is the subjectivity of the workers in relation to the process of filling out of the questionnaire. An example of the self-report method widely used in work posture analysis is the Nordic qustionnaire (Kourinka et al., 1987). The Nordic questionnaire consists of a body map. Assessment is conducted by

(a) open the back machine, (b) open the back machine on the pit, (c) assemble the motorcycle's handle using hammer, (d) change the oil, (e) inject the fuel, (f) check the chassis, (g) check the fuel injection, (h) fix the chassis, (i) fill in the water coolant, (j) open the underparts of the machine, (k) fix the chassis, (l) gain the hanging tool, (m) assemble the chassis, (n) assemble the handle of the motorcycle, (o) take off the seat

Figure 1. The fifteen postures observed

instructing the workers to fill out relevant work musculsokeletal symptoms or disorders in the intended part of the body.

Due to its practicability, the observer method and the self-report method are the most widely used methods in work posture analysis. However, it should be noted that there are different tools in the observer method (i.e., RULA, REBA, OWAS, etc) and self-report method. Sometimes the choice about which one is the best is not easy to determine, in particular in the context of validity, reliability, and practicability. Efforts have been made to compare the result of these methods (see Kee & Karwowski, 2007 on comparing the reliability of the RULA, REBA, and OWAS methods).

Considering the importance of work posture analysis and the wide use of observer and self-report methods in work posture analysis due to its practicability and cost-effectiveness, this study is aimed to analyze and compare the result of observation method and self-report method. The analysis is conducted in an automotive service company.

II. RESEARCH METHODS

One ergonomist (whose age is 42 years old, female, and an expert with qualification of more than 20 years of experience in applying ergonomic approaches in various industries) is involved in this study by conducting work posture analysis in an automotive service company. After a pilot study to observe the work posture in this workplace, fifteen postures (as can be seen in Figure 1) are determined to be further observed. The ergonomist assess the 15 work postures

Table 1. REBA analysis for the 15 work postures

Analysis	Posture															Median
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Neck position	2	2	2	1	1	1	1	1	1	2	2	2	2	2	2	2
Trunk Position	3	3	3	4	3	1	2	4	2	4	3	1	2	1	1	3
Legs	3	1	3	1	1	4	3	1	1	3	2	2	1	1	1	1
Upper Arm Position	2	1	3	3	4	2	3	1	2	2	3	2	2	3	4	2
Low Arm Position	2	1	1	1	2	1	2	1	2	2	1	1	1	2	2	1
Wrist Position	1	1	2	1	1	1	2	1	1	1	1	1	1	2	1	1
REBA SCORE	**7**	**4**	**8**	**4**	**5**	**5**	**7**	**5**	**3**	**7**	**5**	**3**	**3**	**4**	**5**	**5**

Table 2. RULA analysis for the 15 work postures

Analysis	Posture															Median
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Neck Position	3	4	2	2	2	1	2	4	2	3	4	4	1	1	4	2
Trunk Position	4	4	4	4	3	2	2	4	1	4	3	1	2	1	1	3
Legs	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Upper Arm Position	2	2	3	3	3	2	3	1	2	2	3	2	2	3	4	2
Lower Arm Position	2	2	2	2	2	1	2	1	2	2	1	1	1	2	2	2
Wrist Position	2	2	3	2	2	2	3	2	2	2	2	2	2	3	2	2
RULA SCORE	**5**	**6**	**6**	**5**	**5**	**3**	**3**	**6**	**3**	**5**	**6**	**4**	**3**	**4**	**6**	**5**

Table 3. Recapitulation of REBA and RULA corespond to the Nordic analysis

Analysis	REBA score	RULA score	Nordic*
Neck	2	2	50
Trunk	3	3	50
Leg	1	2	100
Hand **	1.5	2	50
Wrist	1	2	50
Total Score	**5**	**5**	**-**

* (% of workers who reported the symptoms)

** average of upper arm and lower arm

using REBA and RULA methods.

The self reported method by means of a Nordic questionnaire is applied and was fulfilled by 6 workers in the same company. The 6 workers were choosen by means of a convenience sampling. Permit is obtained from the owner of the company. The process of fulfilling the questionnaire is conducted during the break.

III. Result and Analysis

Result of the REBA analysis for the 15 work postures can be seen in Table 1, whereas result of the RULA implementation is provided in Table 2.

Comparison of REBA and RULA summary and the Nordic Questionnaire result can be seen in Table 3. From Table 3, it can be concluded that there is no general trend among the RULA, REBA, and Nordic score.

For further observing the agreedness between the observer and the self-report method, a graph reflecting the REBA and Nordic questionnaire comparison and another graph portraying the RULA and the Nordic questionnaire comparison are created as can be seen in Figure 2 and Figure 3. A trendline is added to the graphs to look for the best mathematical model for each of the graphs. Estimations using linear, quadratic, polynomial, and moving average regressions are applied to the graphs. Based on the value of R2 of the models (wherein the the model with R2 equals or nearly reaches 1 gives the best estimate), is is concluded that the polynomial regression level 3 are choosen as the best model for both REBA and RULA with different mathematical equation.

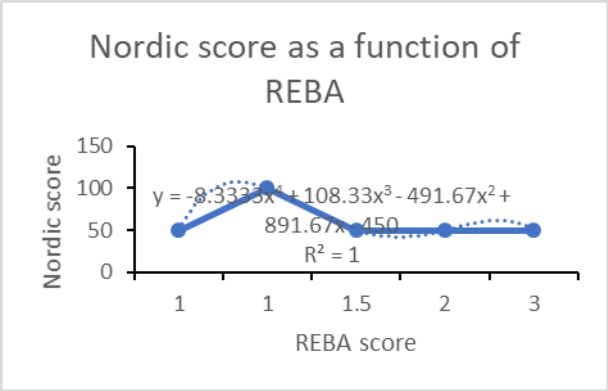

Figure 2. The Nordic score as a funtion of REBA score

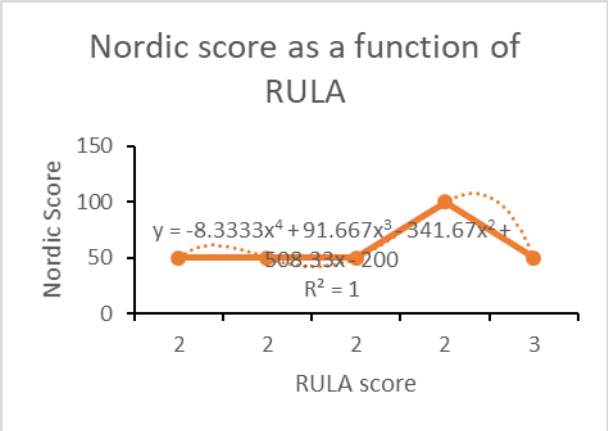

Figure 3. The Nordic score as a funtion of RULA score

Based on the mathematical equation from regression analysis, the estimated Nordic score based on the RULA and REBA value as well as the variation between the real NORDIC score and the estimated NORDIC score can be seen in Table 4. From the variations of values for each body parts in the work posture as well as the total variations, it can be concluded that RULA is better than REBA

Table 4. The estimated Nordic score based on REBA and RULA score

Analysis	REBA score	Nordic estimation as a function of REBA score	Nordic Score	RULA score	Variation	Nordic estimation as a function of RULA score	Nordic Score	Variation
Neck	2	100.0	50	2	50.0	49.98	50	-0.02
Trunk	3	49.9	50	3	-0.1	49.97	50	-0.03
Leg	1	50.0	100	2	-50.0	49.98	100	-50.02
Hand **	1.5	104.7	50	2	54.7	49.98	50	-0.02
Wrist	1	50.0	50	2	0.0	49.98	50	-0.02
		Total Variation			**54.5**			**-50.1**

in accordance to Nordic value.

This study is aimed to compare results of the REBA and RULA observer method and of the Nordic questionnaire self-report method in work posture analysis in the context of an automotive service company. Result shows that the RULA is slightly better than the REBA when they are compared to result of the Nordic questionnaire.

This study has several limitations. First, only REBA, RULA and Nordic questionnaire are observed. The use of other observer-methods such as OWAS and other selft-report methods is worthed to conduct in order to enrich the analysis. Second, only one company is involved in this study. Thus, the postures are also limited to the postures that can be found in the industry with the same characteristics. Further study with a lot more variety of companies and types of working postures are suggested to make the generalization of the result.

Despite its limitation, the present study gives a contribution in the body of literature about work posture analysis method. Since the work posture analysis has been widely used and applied in various settings, the fact that RULA is better than REBA in accordance to the Nordic result must be highlighted. This means that result of observer rating using RULA is in accordance to the voice of the worker through the Nordic result.

IV. CONCLUSION

Agreedness between REBA and RULA observer method vs. the Nordic self-report method in work posture analysis is observed in this study. The result shows that RULA is slightly better than REBA in the context of agreedness to the Nordic questionnaire' result.

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