Evaluation of Students' Working Postures in School Workshop

Adila Md Hashim *adilamdhashim@yahoo.com.my*
Department of Engineering Design and Manufacture
Engineering Faculty, University of Malaya
Kuala Lumpur, 50603, Malaysia

Siti Zawiah Md Dawal *sitizawiahmd@um.edu.my*
Associate Professor, Centre of Product Design and Manufacture (CPDM)
Department of Engineering Design and Manufacture
Engineering Faculty, University of Malaya
Kuala Lumpur, 50603, Malaysia

Abstract

Awkward postures are one of the major causes of musculoskeletal problems to be prevented at an early stage. Tackling this problem at the initial stage in schools would be of great importance. Tasks should be designed to avoid strain and damage to any part of the body such as the tendons, muscles, ligaments, and especially the back. Musculoskeletal disorder and back pain problems in adults was partly contributed by having such symptoms in their childhood. It is important to understand the symptoms of low back pain in children and design early interventions to prevent chronic symptoms that they may experience when they are adults. Musculoskeletal disorder and back pain problems in children and adolescent may give great implications in future workforce. The objective of this study was to compare working postures among students 13 to 15 years old while performing tasks in school workshop, therefore problems of musculoskeletal pain among students can be identified. Ergonomic assessments used for this study were the RULA and REBA methods. This cross-sectional study was conducted at a secondary school in Malaysia. Ninety-three working postures were evaluated to find out the posture risk level. Analysis result showed the average score are 4.87 and 5.87 for RULA and REBA methods respectively, which indicate medium risk and need for further action. The results also informed that 13-year old students had higher scores for both methods. Comparison using Kruskal-Wallis rank test showed there were significant differences among age groups for both scores and action levels. 13-year old students have the highest mean rank indicating bigger potential risks of awkward postures. In conclusion, both methods proved the workstation is mismatched for students' body size especially for younger students. An ergonomic intervention is needed to improve students' working posture, work performance and level of comfort.

Keywords: School Workshop, RULA, REBA, Working Posture, Student.

1. INTRODUCTION

Safety in school programs in Malaysia was started in 2002 to improve safety awareness for schoolchildren, teachers, parents and general population [3, 13]. Unfortunately, ergonomics issues among students are not documented widely compared to other safety issues such as air and water pollution, sports activities and other hazards in school.

In recent years, students in Malaysia has been suffering from musculoskeletal disorder symptoms because of furniture mismatch in schools [1, 27]. According to A. Sachdeva et al [28], musculoskeletal disorder is a condition which a part of musculoskeletal system get traumatized over a period of time. Mohd Azuan et al [17] also indicated that school-related factors such as backpack and school furniture had been identified as a common risk of musculoskeletal disorder and back pain. However, there is still lacking in ergonomic intervention in school environment and facilities. S. Murphy et al [17] revealed that specifications of school furniture have the highest prevalence of inducing pain. Conventional workstations that are currently used in school are often described as incompatible for students.

It is agreed by many researchers that school furniture is one of the factors that may contribute to musculoskeletal pain (MP) among schoolchildren [6, 7, 17, 27]. Researchers claimed that ergonomically designed school furniture might reduce the risks of early symptoms of musculoskeletal disorders [8, 14, 25]. Besides ergonomic furniture in classrooms, ergonomic factors in other locations such as science laboratories and workshops should also be taken into consideration for designing ergonomic furniture. Children and adolescents should've been introduced to ergonomic and correct posture habits for them to take care of themselves, especially their back [2, 9].

Secondary school students spend at least five hours in school and their activities circulates in classrooms, laboratories, workshops, and sports lessons as part of their learning processes. School furniture gives a high impact on their posture habit. They can develop musculoskeletal disorder and back pain if mismatch occurs [4, 26]. Bad posture was among the risk factors associated with discomfort while doing these activities. Pain is usually related with static posture, sitting arrangement and loads carried. Students tend to show a variety of postures while seated and performing tasks regardless of the furniture [15]. Different postures may contribute to different sites of discomfort. On the other hand, they are prone to adopt flexed postures when working at the desk. To conclude, it is important to investigate all relevant risk factors in order to identify the postural stress among students [22].

2. METHODOLOGY

This study was done at a secondary school in Klang district, Selangor. Subjects were among students' ages 13 to 15 years old. All subjects were in voluntary basis and have been notified about the purpose of the study. All of them have had the experience of using the school workshop's workstation for at least five hours to complete the woodworking project. Activities for evaluation were materials cutting and assembly tasks. These activities were recorded and ninety-three working postures were selected to calculate the scores.

Figures 1 and 2 show how assembly and cutting tasks were performed in a school workshop. Students use the workshop to complete a woodworking project for one hour and 45 minutes per week. Besides coursework project, some of them also use the workshop as classroom for living skills subject. All tasks were observed by a trained researcher. Task specifications was informed to ensure the completion of the assessment which are RULA and REBA methods.

Rapid Upper Limb Assessment (RULA) is a method to identify postural stress of upper limbs that was originally developed by McAtamney & Corlett [16]. The risk is calculated into scores and classified into four action levels. A RULA sheet consists of body posture diagrams and scoring tables. Based on the RULA method, the human body is divided into two parts, which are part A for Arm and Wrist analysis while part B for Neck, Trunk and Leg Analysis. A scoring system is used to assign scores at every step, depending on the body position, with the higher scores for more awkward postures. RULA method is widely used in ergonomic field.

Hignett & McAtamney [10] developed the Rapid Entire Body Assessment (REBA) method. Unlike RULA method that focused on sedentary tasks, REBA method assesses the whole body. The risk calculates into the score with five action levels. A REBA sheet consists of body posture diagrams and three scoring tables. The human body is divided into two parts, which are part A for Neck, Trunk and Leg analysis while part B is for Arm and Wrist Analysis. A scoring system is used to assign scores at every step. The process depends on the specific body position, showing higher scores for more awkward postures. Both methods have categorized action levels to indicate action requirement. Table 1 and 2 show the action levels for each score.

FIGURE 1: Cutting Task.

FIGURE 2: Assembly Task.

Statistical analysis was conducted using SPSS Version 17.0 software. A Kruskal-Wallis test was done to justify significant differences among students' age. A Pearson correlation test was also done to compare the relationship of the risk assessment scores between applied methods. *P* value < 0.05 was considered statistically significant.

Score	Indication
1 and 2	Acceptable posture
3 and 4	Changes are recommended
5 and 6	Changes are soon required
7	Changes are immediately required

TABLE 1: RULA: Score and Indication.

Score	Indication	Action
1	None	Not necessary
2 to 3	Low	May be necessary
4 to 7	Medium	It is necessary
8 to 10	High	Very necessary
11 to 15	Very high	It is urgent

TABLE 2: REBA: Score and Indication.

3. RESULTS

The analysis results reveal that average posture score for RULA method is 4.87 which mean deeper investigation is needed and changes may be required while the score using REBA method is 5.87 which indicate medium risk, and that action is necessary. Comparison among age groups showed that 13 year-old students have the highest risk in posture scores. Table 3 explains the scores obtained from both methods. The table showed that students age 13 years old have the highest average RULA and REBA posture score by 5.31, which means changes are required soon and 6.66, which categorized under medium risk level, respectively. This result shows that the current workstation is more suitable for older students that are more likely to have bigger and taller body sizes.

Age	N	RULA (Average)	REBA (Average)
13	29	5.31	6.66
14	36	4.81	5.72
15	28	4.50	5.25
Average score		4.87	5.88

TABLE 3: Average Scores Among Age Groups.

According to RULA method results, 48.38% posture scores indicate changes might be required, 39.78% required changes soon and 11.82% needed changes immediately. As for the REBA method analysis 12.9%, 77.41% and 9.68% postures were classified under high risk, medium risk and low risk respectively.

Age	N	RULA (%)		
		Changes are recommended	Changes are soon required	Changes are immediately required
13	29	31	55	14
14	36	50	39	11
15	28	64	25	11

TABLE 4: Percentage of Action Levels of RULA Outputs from 93 Posture Analyses.

Age	N	REBA (%)		
		Low risk	Medium risk	High risk
13	29	7	65	28
14	36	6	88	6
15	28	18	75	7

TABLE 5: Percentage of Action Levels of REBA Outputs from 93 Posture Analyses.

The Kruskal-Wallis rank test in table 6 showed that RULA and REBA scores have significant differences among students' age groups. Further analysis was done and the results in table 7 showed significant differences between RULA and REBA action levels among different age groups.

Age	N	Mean rank	
		RULA scores	REBA scores
13	29	56.84	59.16
14	36	45.63	44.88
15	28	38.57	37.14
P value		0.027	0.006
95% CI		0.000, 0.051	0.000, 0.032

TABLE 6: Kruskal-Wallis Test for RULA and REBA Scores Among Age Groups.

Age	N	Mean rank	
		RULA scores	REBA scores
13	29	54.59	54.29
14	36	46.17	45.58
15	28	40.21	41.27
P value		0.083	0.038
95% CI		0.053, 0.184	0.008, 0.100

TABLE 7: Kruskal-Wallis Test for RULA and REBA Action Levels Among Age Groups.

The Pearson correlation test was conducted between RULA and REBA scores and action levels. Results in table 8 and 9 showed a significant correlation for both methods. The correlation coefficients for scores and action levels between RULA and REBA methods were r = 0.480 and r = 0.305, respectively.

		RULA	REBA
RULA	Pearson correlation	1	0.480*
	Sig. (2-tailed)		0.000
	N	93	93
REBA	Pearson correlation	0.480*	1
	Sig. (2-tailed)	0.000	
	N	93	93

*Correlation is significant at the 0.01 level (2-tailed)

TABLE 8: Correlation Test between RULA and REBA Scores.

		RULA	REBA
RULA	Pearson correlation	1	0.305*
	Sig. (2-tailed)		0.003
	N	93	93
REBA	Pearson correlation	0.305*	1
	Sig. (2-tailed)	0.003	
	N	93	93

*Correlation is significant at the 0.01 level (2-tailed)

TABLE 9: Correlation Test Between RULA and REBA Action Levels.

4. DISCUSSION

The main purpose of the study was to compare working postures of 13–15 years old students in school workshop. An additional objective was to relate Rapid Upper Limb Assessment (RULA) method to Rapid Entire Body Assessment (REBA) method as evaluation tools for students' working postures.

The results of percentages and statistical analyses indicated that younger students' aged 13 year old faced higher potential risk of musculoskeletal pain compared to older students aged 14 and 15 years old. The 13 year old students have higher risk level in which deeper investigations were required to improve students' working postures. The results of both methods showed that younger students which generally have smaller body sizes have more difficulties while using the workstation. In a study of designing classroom furniture, the authors indicated that younger students have smaller body sizes as compared to older students. Therefore, furniture design criteria should be provided for three age groups for secondary schools which are 10-11 years, 12-13 years and 14 – 15 years old [12].

In this study, it was suggested that most likely the current workshop furniture is more suitable for bigger sized students. The school's management might have equipped the school workshop with adult size furniture that is mismatched for growing adolescents. The size of school workstation should be based on students' stature, rather than any other body segments [19]. In addition, Kruskal-Wallis test showed significant differences among age groups in both assessment methods for scores and action levels. Thus, it can be justified that each age group faced different risk levels while performing tasks in school workshop. 13-year old students having the highest mean rank means they tend to have bigger potential risk of awkward postures. An ergonomically designed workbench and stool should be provided to improve the working conditions of the students and reduce the potential risk of MSD.

The results of the correlation test between RULA and REBA scores showed that they were highly correlated [14]. This result agreed with a study conducted by Nasl Saraji et al [14], which indicated that final scores and action level of RULA and REBA methods were correlated to evaluate WMSDs risk factor and poor working postures in workplaces. Therefore, it is possible to interchangeably apply both methods to assess postural risk in appropriate working condition. Furthermore, RULA and REBA methods were recommended for evaluation in similar environments.

5. CONCLUSION

Based on the findings, there are significant differences among students in three different ages. The 13 year old students group faced the highest WMSD risk while using the school workshop. School furniture and workstations should suit the students' body sizes and anthropometric body dimensions [3, 5, 11, 12]. A study by Murphy et al [13] indicated that school furniture characteristics have the highest prevalence of relationship to pain among schoolchildren.

In order to improve working posture and reduce factors that are associated with back pain, participatory ergonomic programs should be introduced in schools in terms of posture training or furniture modification. Considering children today are adults of tomorrow, this makes ergonomic education essential in their early stage of life to develop a good posture habit and maintain their physical health [7, 8].

Further research on the ergonomics potential of students' working postures will investigate the effects of ergonomics interventions of ergonomically designed workstation to decrease the MSD and improve their work performance. In order to meet these positive results, the measures which are reviewed in this paper can be applied to evaluate ergonomics conditions of the workstation.

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