ORIGINAL ARTICLE

MUSCULOSKELETAL DISORDERS AMONG CLEANERS IN COLLEGE WORKPLACE

*Mohd Raziff MAT HASSAN[1], Muhamad Husaini HARIS[2], Muhammad Naqib OSMAN[3], Ammar ADNAN[4], Radin Zaid RADIN UMAR[5], Siby SAMUEL[6], Mohd Hanafi ANI[2], Malek HAMID[2, *]*

[1]Faculty of Science & Technology Open University Malaysia, Kuala Lumpur, Malaysia
[2]Department of Manufacturing and Materials Engineering, Faculty of Engineering, International Islamic University Malaysia, Kuala Lumpur, Malaysia
[3]Department of Mechanical Engineering, Faculty of Engineering, International Islamic University Malaysia, Kuala Lumpur, Malaysia
[4]SimplyErgo Consultancy, Kedah, Malaysia
[5]Faculty of Manufacturing Engineering, Universiti Teknikal Malaysia Melaka, Melaka, Malaysia
[6]Department of System Design Engineering, University of Waterloo, Ontario, N2L 3G1, Canada

[*] *Corresponding Author: abdmalek@iium.edu.my*

ABSTRACT

Cleaners are suffering from musculoskeletal disorders symptoms, which is contributed mainly by awkward postures, forceful exertion, and repetitive tasks. However, very few studies have been done on cleaners at college workplace. Thus, the objectives of the study are: (i) to evaluate working postures among the cleaners using REBA analysis; (ii) to evaluate discomfort level among cleaners using MSS body symptoms; (iii) to compare working postures among cleaners by task; (iv) to compare working postures among cleaners by workplace setting; and (v) to evaluate the relationship between REBA score and MSS body symptoms survey. Thirty IIUM cleaners between 27 to 63 years old of age [mean = 45.64; SD = 9.7] participated in this study. Four video clips were taken while the participants were doing four different tasks (one clip per task). From each video clip, three postures were selected and analyzed by using REBA analysis. In total, twelve postures were analyzed for each participant. In addition, participants were also asked to rate their discomfort level by using MSS body symptoms survey. The results showed that: (i) cleaners at college are exposed to a high risk for MSDs [REBA mean score = 7.86; SD = 0.861]; (ii) cleaners reported a high number of discomfort level [MSS mean score = 4.47; SD = 3.79]; (iii) the REBA score between the tasks are significantly different, $F(3,356) = 26.282$, $p < 0.001$; (iv) the REBA score between the academic building and dormitory are not significantly different; and (v) there is no correlation between the REBA score (measured) and MSS score (self-reported). These findings show that cleaners at college workplace indeed expose to risk for musculoskeletal disorders, thus, awareness programs and proper training on ergonomics should be provided.

Keywords: *Musculoskeletal Disorders, Cleaners, REBA Analysis, Posture, Ergonomics*

INTRODUCTION

Musculoskeletal disorders are a pain or injury that affect human's musculoskeletal system such as muscles, ligament, tendon, nerve, and joint (Bridger, 2018). Its contributing factors includes adaptation of an awkward posture, repetitive action, extreme force exertion, and contact stress (Toivanen, Helin & Hanninen, 1993). Musculoskeletal disorders have been shown to affect workers from numerous workplaces such as manufacturing company. Beside the workplace related tasks, daily activities can also expose an individual to the risk for musculoskeletal disorders.

Cleaners are group of workers who focus on maintaining the cleanliness and tidiness of a workplace. The cleaning process is important to reduce the risk of exposure to irritant that might cause problems such as allergic and respiratory problems. Example of task involved in working routines of cleaners are cleaning the restroom, emptying trash bins, sweeping and mopping hallway. The task involved can lead to musculoskeletal disorders as the task adapt the awkward posture, repetitive action, extreme force exertion and contact stress that considered as contributing factors toward musculoskeletal disorders (Bridger, 2018)

Despite the knowledge of human factors and ergonomics available, there has been relatively few studies made regarding the importance of the application of this science to cleaners in industry. Among the studies that have been done were in hospital settings (Toivanen, Helin & Hanninen, 1993; Lasrado et al., 2017) and hotel settings (Burgel et al., 2010; Hatzudis, 2014). However, very few studies have been done on the cleaners in academic workplace setting. Thus, there is a need to investigate this environment of workplace.

The aim of the study is to evaluate the effect of working postures among cleaners on the risk for musculoskeletal disorders. In order to achieve this aim, several objectives have been determined, and they are; (i) to evaluate working postures among cleaners on the risk for

musculoskeletal disorders by using REBA analysis; (ii) to evaluate discomfort level among cleaners by using self-reported Musculoskeletal symptoms (MSS body symptoms); (iii) to compare working postures among cleaners by task (cleaning bathroom, sweeping/mopping corridor, sweeping/mopping stairs, and emptying trash bin) by using REBA analysis; (iv) to compare working postures among cleaners by workplace setting (academic building and dormitory) by using REBA analysis; and (v) to evaluate the relationship between the REBA score and MSS body symptoms survey obtained from the experiment.

METHODS

Participants

Thirty participants were recruited for the study. All participants were required to fulfill the eligibility criteria for the study which is fulltime workers in IIUM. This criterion was set so that all participants will have a similar daily routine activity. This is because, daily routine i.e. physical job demands (Bridger, 2018) are among the contributing factors for the risk for musculoskeletal disorders. Thirty participants were recruited to fulfill the minimum requirement of the number of participants for general human subject studies so that the data collected can be safely assumed will be normally distributed (Morgan et al., 2012).

Apparatus & Stimuli

The apparatus and stimuli are classified into five categories: (i) Data collection equipment; (ii) Scoring form; (iii) REBA form; (iv) Modified ERA form; (v) Administrative form

Data Collection Equipment: A video recorder - Panasonic HC-V210 (Figure 1) was used for the experiment. The video recorder was hold by the experimenter and followed the movement of participant to record from the side of the body of participant. Illustrates the video recorder tripod used in the experiment.

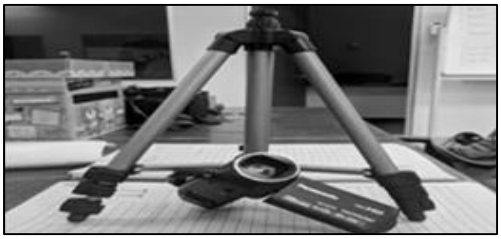

Figure 1 Video Recorder (Panasonic HC-V210)

The experimenter followed the participant with video recorder and record all the activities done by the participant. In addition, the experiment's recording covered the full body of participant. A few clearances were considered in assumption that a participant may move out from the mentioned area. This is to ensure that participant's posture will be able to be scored during the scoring processes. Four video clips were taken while cleaners doing different task. During the playback, a data analyst can see all the video output (just like any other regular video recorder systems) and produce a snapshot at any particular time frame. For each video, three snapshots were taken to be used in analyzation process.

Scoring Forms: The scoring forms used in the study were: (i) REBA form and (ii) Modified ERA body symptoms survey form.

REBA Form: The body posture analyses were adopted from one of the reliable postural analysis tools that is widely used in musculoskeletal disorders studies called Rapid Entire Body Assessment (REBA) tool (Burgel et al., 2010) Basically, the form consists of two boxes (Figure 2 shows the partial the form): (i) a box to paste the snapshot taken from the video (left part of the form: i.e. in here, a data analyst took a snapshot from the video data and pasted it on this part of the form); and (ii) a box to score the posture (right part of the form: i.e. a data analyst will have to score the snapshot pasted above it). The complete form would have multiple scoring sheet for every posture for each task (up to 12 postures).

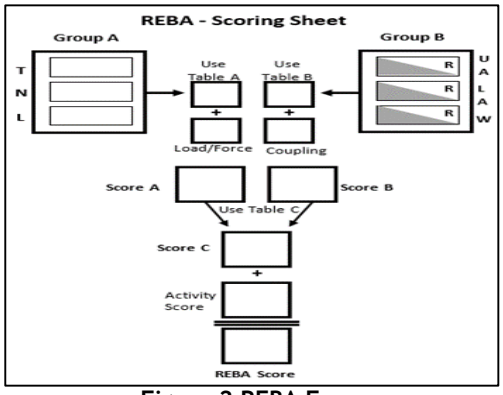

Figure 2 REBA Form

Modified ERA Body Symptom Survey: The body symptom survey used in the study was Ergonomic Risk Assessment (ERA). However, because a short time to do the survey, the survey is simplified and only focused on the symptom in the meantime.

Figure 3 below illustrates the body diagram that is used to assess postural discomfort. This subjective scale required the participant to evaluate if she feels discomfort on a part of his body regions.

If a participant feel discomfort at that particular region, he was asked to label "X" on the number that represent his body region, and more than one "X" can be labelled. Participant needs to circle the "X" if she feels that the discomfort

came from the work routine. This scale was chosen among other similar symptom surveys (Hatzudis, 2014) because of its simplicity yet reliable. This decision was made in order to reduce the load that a participant will have to spend on the study.

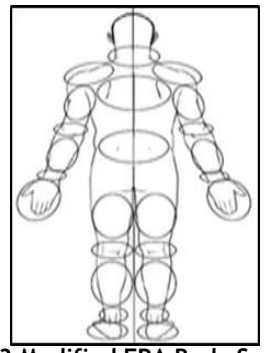

Figure 3 Modified ERA Body Symptoms

Administration Forms: In this study, three types of administrative form – (i) Informed consent form (ii) Participant form and (iii) Payment voucher were used to the scoring of the trunk and neck posture throughout the gaming session.

The Informed consent form was used to obtain participants' approval before the experiment started. For the participant form, it was used to record the demographic data of the participant – age, gender and nationality. Lastly, the payment voucher was used to record all the details regarding the payment made to the participants.

Experimental Design

Baseline posture setup: At the beginning of the experiment, participant was asked to stand in the condition that her posture were straight (Bridger, 2017) as this is the ergonomic posture for human. This step is to ensure that a participant start the experiment session with an ergonomic posture. Thus, it somehow would be the baseline to the scoring.

Experiment Duration: The study is to evaluate the effect of working posture. Thus, the experimental session was from 7.30 am to 4.30 am based on regular working hours.

Rest-time: Because the experiment session based on regular working hours, the rest time also follow the same regular rest time, which is 10.00 am to 11.30 am and 1.00 pm to 2.00 pm. There is no restriction for participant to follow the task requested by experimenter and participants can follow their own working schedule.

Procedure

The procedure for the study was classified into three phases. These are: (i) pre-experimental session; (ii) experimental session; (iii) post-experimental session. Pre-experimental Session

Screening: Participants' eligibility was checked in which she must be fulltime workers in IIUM, with healthy current condition at the time of the study (e.g. no sign of fever, sinus, etc.). If participant did not fulfill all the recruitment criteria, she will be dismissed, else, she will proceed to the next step.

Informed Consent Form: Before the experiment starts, a participant was briefed about the safety of the premises i.e. the fire exit, nearest fire assembly point, and the restroom. Then, a participant was asked to read this form for a better understanding of the study in general so that he can have his consent in participating in the study. Then, the experimenter briefed the participant on the important information of the form – experiment purposes in general, the task that she must do, voluntary condition of the experimental session, confidentiality of the collected data, and the risk & benefit of the study. Then, a participant was asked to sign two copies of the form that given her consent in participating in the study. One copy was given to the participant for their reference, and the other was kept in the study's file and placed in the lock cabinet at the Ergonomics Laboratory.

Data Form: Then participants' demographic information – age, and gender – was obtained. After that, several questionnaires related to the study was asked to the participants. These included the participant's record of medical leave.

Modified ERA Body Symptom Survey Form: A participant was asked to fill in the Modified ERA for Body Symptom Survey Form, and was asked to place an 'X' at the region of body diagram that she feels discomfort of herself and circle the "X" if the discomfort came from their working activities.

Experimental Session

For experiment control purposes, participants were always asked to turn off her cell phone during the experiment or hand-in it to the experimenter to monitor the incoming calls and messages as an emergency precaution. After that, a participant was asked to start their working activities.

Post Experimental Session

Compensation and Thanking Session: A participant was given a hamper from experimenter after completed her task. Lastly, the participants were thanked for their volunteering to participate in the study.

Data Scoring & Analysis Method

There were two analysis have been done for this research; (i) REBA analysis and (ii) Modified ERA for body symptoms survey.

REBA Analysis
Scoring method: If the REBA score is 1, the risk level is negligible, for 2-3 score the risk level is low, for 4-7 score the risk level is medium, for score 8-10 the risk level is high and for 11-15 score the risk level is very high. The REBA score will be 1-15 and the risk level will start with negligible and the highest will be very high. In scoring this analysis, a protractor was used to measure the angle of the participant's postures.
Dependent variable 1: The mean value of the REBA score. The mean value for each data group and task was calculated and compared.

Hypothesis 1: The mean value for task 4 will be the highest followed by task 3, task 1 and task 2($mean_{task4} > mean_{task3} > mean_{task1} > mean_{task2}$). In this analysis, the more the mean score indicates the more the risk for the musculoskeletal disorders that an individual may have, resulting from his or her posture. This is because whenever a position of human body is away from the neutral (or anatomical) position, the muscle that span the joint are stretched to more possible extend, and the bone's disks are disrupted and result in greater stress (Bridger, 2018).

Modified ERA for Body Symptoms Survey
Dependent variable 2: The mean value (number of 'X') of the Modified ERA. The mean value for each data group was calculated and compared.

Hypothesis 2: The mean value for dormitory will be greater than the academic building ($mean_{dormitory} > mean_{academic}$). In this analysis, the more the mean score indicates the more discomfort the participant felt after finished the working session. This is because, increasing amount of workload is known to cause the feeling of discomfort and increase the risk for musculoskeletal disorders (Bridger, 2017; The American Academy of Orthopaedic Surgeons, 1965; Bardin, King, & Maher, 2017; Li et al., 2017).

RESULTS & DISCUSSION

The raw data from the experiment was transferred into the SPSS statistical package software (version 23). The data was then analyzed in order to compute the mean of the variable. From the output, descriptive statistic graph (average mean score) was plotted. In order to analyze this finding, the One-way ANOVA model was applied. This model was utilized because there are two data groups being compared (Bridger, 2018).

Thirty IIUM cleaners participated in this study, and their age range is from 27 to 63 years old [mean = 45.64; SD 9.70]. The level of education of participant was divided into four categories, which are no academic background, primary school, secondary school and high institution education. However, there is no participant in fourth group, which is high institution, and the highest group is secondary school. Total medical leave for each participant varies from 0 to 3 and mostly participant having 0 medical leave last month.

Objective 1: From the raw data, the mean of REBA analysis score for each participant were calculated. In overall, the mean value of REBA score is 7.86 [SD = 0.861].In order to check the normality, Shapiro-Wilk test was used to analyze the 30 samples. This test was used because it can be used to analyze data with sample of 50 and below (Morgan, 2012). To consider the data is normal, the significant value should be greater than 0.05. From the SPSS output the significant value is 0.773, hence the data can be considered as normally distributed.

Objective 2: From the raw data, the mean of MSS score for each participant were calculated. In overall, the mean values of MSS score are 4.47 [SD = 3.79].Next, in order to check the normality, Shapiro-Wilk test was used to analyze the sample. From the SPSS output, the significant value is 0.005, hence the data can be considered as not normally distributed.

Objective 3: From the raw data, the average REBA analysis score for each task 1, task 2, task 3 and task 4 were calculated, and the graph for the averages was plotted. Figure 4 illustrates the average REBA analysis score for each task. The mean values of the REBA score of task 1, task 2, task 3 and task 4 are 7.41 [SD = 1.88], 6.74 [SD = 1.74], 8.54 [SD = 1.88] and 8.76 [SD = 1.52] respectively. The graph shows that the average REBA score for task 4 is the highest followed by task 3, task 1 and task 2. However, it can be seen from the graph that the average for the task 4 and task 3 are quite close in comparison to the task 2 and task 1 score. This means that the effect of task 4 and task 3 are similar, whilst effect of task 2 and task 1 is low compared to the other two tasks.

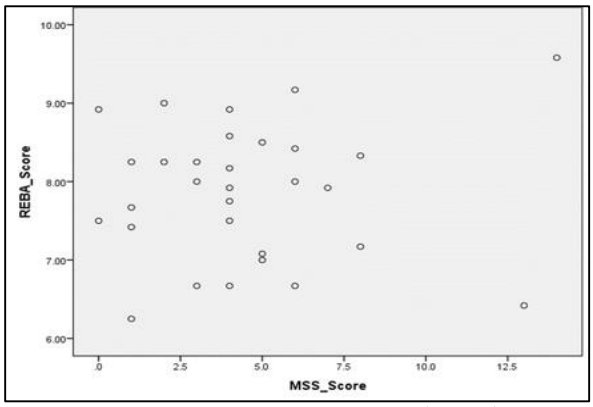

Figure 4 Average REBA score by task

In order to check the differences, one-way ANOVA analysis model was utilized. One-way ANOVA analysis is the best model to analyze this type of data because, this data consists of only one independent variable (REBA analysis score) and has four dependent variables (task 1, task 2, task 3 and task 4). One-way ANOVA is suited to be used when there is only one independent variable involves and consists of three or more dependent variables (Bridger, 2018). The null hypothesis is that the means values are all same (H0: μtask 1 = μtask2 = μtask 3 = μtask 4), and the alternative hypothesis is that at least one mean is differs from the other (Ha = at least one mean is differs from the other). Utilizing the one-way ANOVA, it was found that there was a significant effect for the four condition, $F(3,356) = 26.282$, $p < 0.001$. Thus, the null hypothesis was rejected.

Objective 4: From the raw data, the average REBA analysis score for each workplace setting (academic building and dormitory) were calculated, and the graph for the averages was plotted. Figure 5 illustrates the average REBA analysis score for each workplace. The mean values of the REBA score of academic building and dormitory are 7.83 [SD = 1.86] and 7.90 [SD = 2.02] respectively (the error bar in Figure 5 shows the standard deviation range of the data). The graph shows that the average REBA score for academic building and dormitory is similar. This means that there is no significant between the workplace settings.

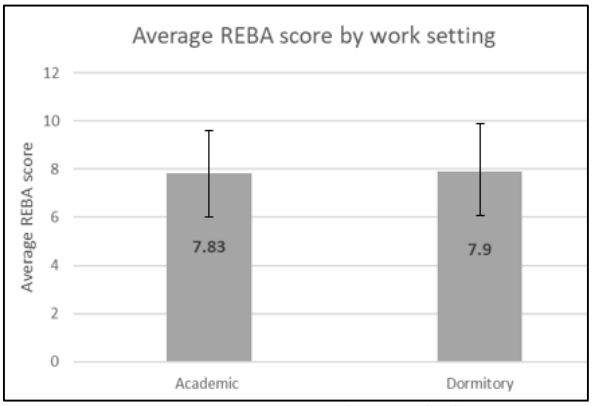

Figure 5 Average REBA Score by Workplace Setting

Objective 5: The analysis is to check if there is any correlation among the data. In explanation, it is to investigate the relationship between REBA score and MSS score. To do this, Correlation under one-way ANOVA was analyzed. The graph for correlation is plotted as in Figure 6.

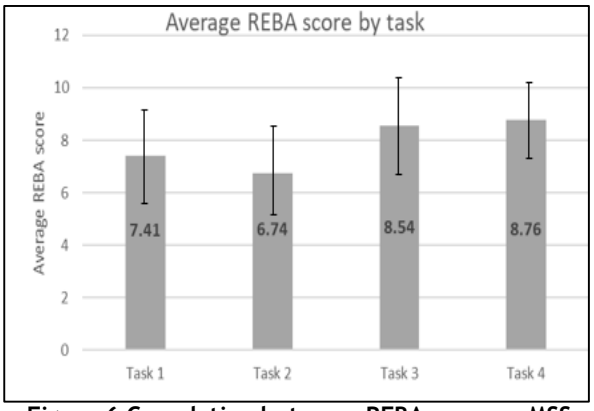

Figure 6 Correlation between REBA score vs MSS score

The analysis revealed that: the comparisons do not have a strong correlation because the data below 10%. The correlation is categorized as strong only if the r-value is > 0.7 (or more than 70%) (Bridger, 2018). This shows that, the uniqueness between the participants do exist. In explanation, because the data were not directly proportional between REBA score and MSS score, the correlations were mixed up with some lower, some higher, and some equal.

CONCLUSION

The analysis revealed that: the comparisons do not have a strong correlation because the data below 10%. The correlation is categorized as strong only if the r-value is > 0.7 (or more than 70%) (Bridger, 2018). This shows that, the uniqueness between the participants do exist. In explanation, because the data were not directly proportional between REBA score and MSS score, the correlations were mixed up with some lower, some higher, and some equal.

The first objective is to evaluate working postures among the cleaners using REBA analysis. It was found that, the mean of REBA score is 7.86 [SD = 0.861]. The highest mean score by participant is 9.17. The mean REBA score can be rounded off to 8 and based on REBA guideline, the action level is 8, the risk level is high, and the action needed is necessary soon. In conclusion, the working postures among cleaners can contribute to musculoskeletal disorders.

The second objective to evaluate working postures among cleaners using MSS body symptoms. In overall, the mean of MSS score is 4.47 [SD = 3.79]. The highest score by participant is 14. There is might be bias when answering the MSS body symptoms form due to participant behaviour – i.e. social desirability bias. In conclusion, the MSS data does not normally distributed and there is no relation between MSS score and musculoskeletal disorders.

The third objective is to compare the REBA score among the cleaners by task. The mean values of

the REBA score of task 1, task 2, task 3 and task 4 are 7.41 [SD = 1.88], 6.74 [SD = 1.74], 8.54 [SD = 1.88] and 8.76 [SD = 1.52] respectively. The average REBA score for task 4 is the highest followed by task 3, task 1 and task 2. However, it can be seen from the graph that the average for the task 4 and task 3 are quite close in comparison to the task 2 and task 1 score. This means that the effect of task 4 and task 3 are similar, whilst effect of task 2 and task 1 is low compared to the other two tasks.

The fourth objective is to compare the REBA score among the cleaners by workplace setting. The mean values of the REBA score of academic building and dormitory are 7.83 [SD = 1.86] and 7.90 [SD = 2.02] respectively. The average REBA score for academic building and dormitory is similar. This means that there is no significant between the workplace settings.

The fifth objective is to evaluate the relationship between REBA score and MSS body symptoms survey. The analysis revealed that: the comparisons do not have a strong correlation because the data below 10%. The correlation is categorized as strong only if the r-value is > 0.7 (or more than 70%). This shows that, the uniqueness between the participants do exist. In explanation, because the data were not directly proportional between REBA score and MSS score, the correlations were mixed up with some lower, some higher, and some equal. In conclusion, there is no correlation between REBA score and MSS score.

As mentioned above, attire of participant gives huge differences in term of easy to analyse. In addition, different task such as cleaning laboratory and additional work can be observed.

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