Inter- and intra- observer reliability of the offera method for assessing exposure risk of computer work-related to wmsds

M N A Rahman1, S S Mohamad1, O M F Marwah1, I Masood1, M F Hassan1, A M T Arifin1, R H A Haq1, S Ahmad1, H F Haw1 and H Abdullah1

1Department of Manufacturing Industrial Engineering, Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia (UTHM) 86400 Parit Raja, Batu Pahat, Johor, Malaysia.

Abstract. The purpose of this study was to evaluate inter- and intra- observer reliability of the observers assessing office workers performing their jobs using the Office Ergonomic Risk Assessment (OFFERA) method. 44 Industrial Engineering students at UTHM participated in a training session on inter- and intra- observer reliability. The period interval between inter- and intra- observer training session was 1 week. Three different jobs were assessed by observer using the OFFERA method. Through the three different tasks, the average of inter- and intra- observer reliability ranged between good to very good agreement. Meanwhile, the level of agreement for the intra-observer (K=0.68-0.96) was higher than the inter-observer (K=0.62-0.94). Items with the strongest agreement (K=0.96) were related to armrest, document holder and keyboard wrist rest. The OFFERA method has both good and very good agreement in terms of reliability. The observers stated that it was easy to evaluate the ergonomic risk at office using this simple tool.

1. Introduction

Work-related musculoskeletal disorders (WMSDs) are common health problems experienced by industrial workers and haves long been a major cause of suffering in many industrialised countries [1-4]. Over the past few years, work-related musculoskeletal disorders (WMSDs) at offices haves increased mainly due to the frequent use of computers at workstation [5-7]. In fact, the reported presence WMSDs increased especially in the neck and upper limbs [7-9]. The main factors that lead to MSDs for office workers include prolonged static sitting posture for a long time, awkward posture of the head, neck and upper limbs, repetitive movement of the wrist and fingers [10-12], increased muscular activity in the upper back and shoulder, as well as the duration of work and time pressure [13-14].

Various methods have been developed to assess posture in order to assess risk factors for WMSDs [15]. An ergonomic risk assessment tool is the one of the methods that is commonly used for assessing WMSDs [16]. Seven of the ergonomic risk assessment tools haves been widely used for WMSDs related to office workstation include Rapid Upper Limb Assessment17, Rapid Entire Body Assessment [18], Computer Workstation e-Tool [19], Quick Exposure Checklist [20], Assessment of Repetitive Task [21], Office Ergonomic Assessment [22], and Rapid Office Strain Assessment [11]. The Office Ergonomic Risk Assessment (OFFERA) method was developed to assess the exposure of office risk factors associated with work-related musculoskeletal disorders (WMSDs). This method involves the assessment of office component (chairs, desks, input devices, monitor, and accessories) and the office environment. The psychometric properties of outcome measures include level of
measurement such as reliability, validity, and responsiveness [23]. Reliability is a property of an instrument that comes up with a true score or number that is equivalent to the true value [24]. Reliability is the most important part in developing a tool that is used to validate exposure assessment techniques. However, most of the observational methods which have been developed have not been tested in term of their reliability [15]. From a reviewed of the reliability results available, only five tools was found to have examined all tests which include RULA, REBA, QEC, ART and ROSA. The lack of studies on reliability generally leads to the poor performance of an exposure assessment tool [25, 26]. The aim of the study was to evaluate the inter- and intra- observer reliability of the observers assessing office workers performing their jobs using the Office Ergonomic Risk Assessment (OFFERA) Method.

2. Method

2.1. Study Design

The reliability of the prototype tool has been assessed through inter- and intra- observer reliability. The aim of the study was to determine the percentage of level agreement between observers, during the analysis on the same job/tasks using the OFFERA method. Besides that, this test aimed to establish whether the OFFERA method can be used at office workstation for conducting risk assessment of the workplace. 44 participants who were involved in this training were Industrial Ergonomics student (fourth year Mechanical Engineering student) whereas the study was conducted at Universiti Tun Hussein Onn Malaysia (UTHM) as shown in figure 1 and 2. The training session were conducted by the researchers. All the participants involved in risk assessment were trained to conduct the OFFERA (prototype) method. Intra-observer is a type of reliability assessment in which the same assessment is completed by the same observers on two or more occasions. A week after the first training session, the second training conducted with same participants and the same video film (with the same procedure) for intra-observer reliability. Cohen’s Kappa coefficient was used to assess the level of agreement between inter- and intra- observer reliability on the 18 items of risk factors in the OFFERA assessment.

Figure 1. Inter- observer reliability training session
2.2. Data Collection

All participants who had undertaken risk assessment were trained (inter-observer reliability) to conduct the OFFERA method. This involved a trial assessment of the three jobs captured in the videos to familiarize the participants with the OFFERA process. A video and picture of the three jobs were recorded at office workstations; the job involved include admin counter, an accountant, and a research assistant [27]. The three recorded jobs were assessed by observer at the same time during the day. The observer attended a briefing on the purpose of the tool, instructions, scorings system and the introduction of the OFFERA method. The researchers later showed the video to the observers. The observers assessed each recorded task using the OFFERA method. They completed each task in about 10 to 15 minutes. The total time used to complete all three task was 45 minutes. One week after the first training session, the second training session was conducted with same participants and the same video film (with the same procedures) for intra-observer reliability.

2.3. Data Analysis

The reliability of the OFFERA method was assessed using the inter- and intra-observer reliability. For the analysis of the inter-observer reliability and the intra-observer reliability of the OFFERA tool Cohen’s Kappa coefficient were calculated for the assessment of the 44 observers (Industrial Engineering students) who evaluated the recorded tasks. Cohen’s Kappa coefficient was used to assess the level of agreement from the inter- and intra-observer reliability on the 18 items of risk factors found in the OFFERA assessment. The percentage of agreement was also calculated for the observer group (Industrial Engineering students).

3. Results

In the development of the OFFERA Method, the reliability tests involving 44 undergraduate students (Industrial Engineering student) from the Faculty of Mechanical and Manufacturing Engineering, UTHM. The participants (students) involved in the training session of the OFFERA Method acted as observers. There was in total observers were 32 male students (72.7%) and 12 female students (27.3%). The mean age of the observer (N=44) was 23.14 years (SD=1.622) in the range between the ages of 22 to 29 years old. Table 1 shows the demographic data for inter- and intra-observer reliability. The results of the inter-observer reliability and the intra-observer reliability testing have been divided into three jobs: 1) Job A (Admin Counter), 2) Job B (Accountant), and 3) Job C
(Research Assistant). From the Kappa analysis, the results show the level of agreement for the intra-observer reliability was higher than the level of agreement for the inter-observer reliability.

### Table 1. Demographic data of the observers in training session (N=44)

| Group of observer | Gender N (%) | Age (year) |
|-------------------|--------------|------------|
|                   | Male         | Female     | Mean (SD) | Range |
| Diploma/STPM      |              |            |           |       |
| (N=14)            | 12 (85.7%)   | 2 (14.3%)  | 24.50 (1.829) | 23-29 |
| Matric (N=30)     | 20 (66.7%)   | 10 (33.3%) | 22.50 (1.042) | 22-26 |
| Total (N=44)      | 32 (72.7%)   | 12 (27.3%) | 23.14 (1.622) | 22-29 |

### 3.1. Inter – Observer reliability

The results of the inter-observer reliability for Job A, Job B, and Job C are shown in Table 2. The Cohen’s Kappa coefficient for Job A ranged between of 0.53-0.95, whereas the Cohen’s Kappa coefficient Job B and Job C ranged between of 0.58-0.98 which indicated that “moderate” to “very good” reliability existed among the observers who used the OFFERA method for inter-observer reliability. In addition, the percentage of agreement for the three tasks was more than 50% and from the study the range from 68.18% to 97.73%.

### 3.2. Intra – Observer reliability

The result of the intra-observer reliability test for Job A, Job B, and Job C are shown in Table 3. The Cohen’s Kappa coefficient ranged between 0.53-0.95 for Job A, 0.67-0.98 for Job B and 0.71-0.98 for Job C. All these results indicated that “moderate” to “very good” reliability existed among observers who used the OFFERA method for intra-observer reliability. In addition, the percentage of agreement for the three tasks in terms of intra-observer reliability was more than 50% and from the study, the range from 68.18% to 97.73% respectively.

### 4. Discussions

The results for inter- and intra-observer reliability of the OFFERA method are shown in Table 2 and 3. From the results, it was found that the level of agreement between the observers for the telephone, desk depth, monitor angle, keyboard, seat pan height, and the mouse position was generally lower than others. However, in term of intra-observer reliability, only the desk depth, monitor angle and telephone scored have the lower Kappa analysis value compared to others with a Kappa analysis ranging between K=0.68-0.75. According to Altman [28], the strength of agreement for these items can be regarded as “good agreement” (K=0.60-0.79).

Besides that, the results showed the lowest values of inter- and intra-observer reliability for the three tasks involved the item on desk depth (K= 0.53-0.63). This is because the observers found that it was difficult to observe and define the range of desk depth when they assess a worker’s activity at the desk. Other than that, the observers stated the instructions and illustrations of the desk depth, monitor and telephone were difficult to understand and therefore caused confusion during the assessment. In addition, the observers found it difficult to observe and define the angular ranges when assessing the neck posture for items such as the monitor angle and the telephone item through the OFFERA method [27].

A study by David et al. [20] in the QEC assessment has found that it was very difficult to determine the worker’s posture angle based on observation only. Besides that Li and Buckle [29] mentioned the same issues and found that the observers preferred to use descriptive terms instead of angle during the assessment. The observers had difficulty differentiating between wrist postures, for example, above or
below as well as the angle when assessing the wrist posture using the OFFERA method especially for keyboard items. Besides that, assessing the wrist posture during keying and clicking activity has been reported as being more difficult to assess than other joint [30]

Table 2. Inter-observer reliability for Job A, Job B, and Job C (N=44 observer)

| OFFERA Items       | Job A    |     | Job B    |     | Job C    |     | Overall  |     |
|--------------------|----------|-----|----------|-----|----------|-----|----------|-----|
|                    | K^a      | %b  | K^a      | %b  | K^a      | %b  | K^a      | %b  |
| Seat Pan Height    | 0.78     | 81.82 | 0.90     | 90.91 | 0.63     | 72.73 | 0.77     | 81.82 |
| Seat Pan Depth     | 0.78     | 81.82 | 0.84     | 86.36 | 0.95     | 95.45 | 0.86     | 87.88 |
| Backrest           | 0.84     | 86.36 | 0.95     | 95.45 | 0.67     | 75.00 | 0.82     | 85.60 |
| Armrest            | 0.84     | 86.36 | 0.95     | 95.45 | 0.95     | 95.45 | 0.91     | 92.42 |
| Desk Height        | 0.81     | 84.09 | 0.87     | 81.82 | 0.74     | 79.55 | 0.81     | 81.82 |
| Desk Depth         | 0.53     | 68.18 | 0.74     | 79.55 | 0.63     | 72.73 | 0.63     | 73.49 |
| Keyboard           | 0.58     | 70.45 | 0.63     | 72.73 | 0.93     | 93.18 | 0.71     | 78.79 |
| Mouse Positioned   | 0.87     | 88.64 | 0.67     | 75.00 | 0.81     | 84.09 | 0.78     | 82.58 |
| Mouse Size         | 0.84     | 86.36 | 0.98     | 97.73 | 0.93     | 93.18 | 0.92     | 92.42 |
| Monitor Angle      | 0.67     | 75.00 | 0.58     | 70.45 | 0.74     | 79.55 | 0.66     | 78.03 |
| Monitor Distance   | 0.81     | 84.09 | 0.95     | 95.45 | 0.87     | 88.64 | 0.88     | 89.39 |
| Telephone          | 0.53     | 68.18 | 0.74     | 79.55 | 0.58     | 70.45 | 0.62     | 72.73 |
| Document Holder    | 0.95     | 95.45 | 0.95     | 95.45 | 0.95     | 95.45 | 0.95     | 95.45 |
| Keyboard Wrist rest| 0.95     | 95.45 | 0.93     | 93.18 | 0.95     | 95.45 | 0.94     | 94.69 |
| Mouse Wrist rest   | 0.90     | 90.91 | 0.87     | 88.64 | 0.90     | 90.91 | 0.89     | 90.15 |
| Lighting           | 0.95     | 95.45 | 0.98     | 97.73 | 0.90     | 90.91 | 0.94     | 94.70 |
| Temperature        | 0.87     | 88.64 | 0.95     | 95.45 | 0.87     | 88.64 | 0.90     | 90.91 |
| Noise              | 0.84     | 86.36 | 0.71     | 77.27 | 0.98     | 97.73 | 0.84     | 87.12 |

^aK – Cohen’s kappa coefficient was used to evaluate the inter-observer reliability and intra-observer reliability. The value K: 0.0-0.19 are poor level agreement, 0.2-0.39 are fair level agreement, 0.4-0.59 are moderate level agreement, 0.6-0.79 are good level agreement and 0.8-1.0 are very good level agreement.

^b% – Percentage agreement

Other than that, the results of the seat pan height, seat pan depth, backrest and armrest show good and very good level agreement for both inter-observer reliability (K=0.77-0.91) and intra-observer reliability (K=0.83-0.96). Dockrell et al. [31] concluded that a static posture such as sitting was easier to assess than a dynamic posture with observational methods because there is repetitive movement. Furthermore, the observer stated that this method was easier to understand and not confusing. The 44 observers’ assessment on the other OFFERA items resulted in a higher Kappa value (K=0.81-0.95) for inter-observer reliability (12 items) and (K=0.81-0.96) for intra-observer reliability (16 items). Besides that, the results shows the level of agreement (Kappa values) for intra-observer reliability (K=0.68-0.96) was higher than inter-observer reliability (K=0.62-0.95). Other studies showed that the value for the intra-observer reliability (ICC=0.80-0.95) was higher than the inter-observer reliability (ICC=0.51-0.91) [11]. It also showed that the observers had a better understanding of conducting assessment using the OFFERA method after using it for the second time. In addition, the comment from the observers’ shows the OFFERA method was simple and easier to use.
Table 3. Intra-observer reliability for Job A, Job B, Job C, and Job C (N=44 observer)

| OFFERA Items         | Job A   | Job B   | Job C   | Overall |
|----------------------|---------|---------|---------|---------|
|                      | $K^a$   | %b      | $K^a$   | %b      | $K^a$   | %b      | $K^a$   | %b      |
| Seat Pan Height      | 0.81    | 84.09   | 0.93    | 93.18   | 0.74    | 79.55   | 0.83    | 85.61   |
| Seat Pan Depth       | 0.81    | 84.09   | 0.95    | 95.45   | 0.95    | 95.45   | 0.90    | 91.66   |
| Backrest             | 0.95    | 95.45   | 0.95    | 95.45   | 0.87    | 88.64   | 0.92    | 93.18   |
| Armrest              | 0.95    | 95.45   | 0.95    | 95.45   | 0.98    | 97.73   | 0.96    | 96.21   |
| Desk Height          | 0.81    | 84.09   | 0.84    | 86.36   | 0.78    | 81.82   | 0.81    | 84.09   |
| Desk Depth           | 0.53    | 68.18   | 0.81    | 84.09   | 0.71    | 77.27   | 0.68    | 76.51   |
| Keyboard             | 0.81    | 77.27   | 0.74    | 79.55   | 0.95    | 95.45   | 0.83    | 84.09   |
| Mouse Positioned     | 0.90    | 90.91   | 0.81    | 84.09   | 0.90    | 90.91   | 0.87    | 88.64   |
| Mouse Size           | 0.90    | 90.91   | 0.95    | 95.45   | 0.98    | 97.73   | 0.94    | 94.50   |
| Monitor Angle        | 0.71    | 77.27   | 0.67    | 75.00   | 0.78    | 81.82   | 0.72    | 78.04   |
| Monitor Distance     | 0.87    | 88.64   | 0.95    | 95.45   | 0.95    | 95.45   | 0.92    | 93.18   |
| Telephone            | 0.71    | 77.27   | 0.84    | 86.36   | 0.71    | 77.27   | 0.75    | 80.30   |
| Document Holder      | 0.95    | 95.45   | 0.98    | 97.73   | 0.95    | 95.45   | 0.96    | 96.21   |
| Keyboard Wrist rest  | 0.95    | 95.45   | 0.98    | 97.73   | 0.95    | 95.45   | 0.96    | 96.21   |
| Mouse Wrist rest     | 0.90    | 90.91   | 0.93    | 93.18   | 0.95    | 95.45   | 0.93    | 93.18   |
| Lighting             | 0.93    | 93.18   | 0.98    | 97.73   | 0.93    | 93.18   | 0.95    | 94.70   |
| Temperature          | 0.90    | 90.91   | 0.95    | 95.45   | 0.95    | 95.45   | 0.93    | 93.94   |
| Noise                | 0.84    | 86.36   | 0.95    | 81.81   | 0.93    | 93.18   | 0.91    | 87.12   |

*K – Cohen’s kappa coefficient was used to evaluate the inter-observer reliability and intra-observer reliability.

The value $K$: 0.0-0.19 are poor level agreement, 0.2-0.39 are fair level agreement, 0.4-0.59 are moderate level agreement, 0.6-0.79 are good level agreement and 0.8-1.0 are very good level agreement.

%b – Percentage agreement

5. Conclusions

In conclusion, the level of agreement for the OFFERA method arranged between good ($K$=0.62-0.78) to very good ($K$=0.81-0.96) for inter- and intra- observer reliability respectively. Besides that, the result shows that the level of agreement (Kappa values) for the intra-observer reliability was higher than the inter-observer reliability. The results showed, the observer had a better understanding on how to conduct assessment using the OFFERA method after doing it for the second time. From the training session, the observer found that the OFFERA method can be easily used to assess and understand the ergonomic risks at office workstations. However, it was found that the level of agreement for the telephone, desk depth, and monitor angle was generally lower than others. The observer stated that the instruction and illustration of those items were confusing to assess and therefore made the observation difficult. After inter- and intra- observer reliability already tested, the OFFERA method has been revised based on the results as well as the observers’ comments.
References

[1] Kuorinka, I., Jonsson, B., Kilbom, A., Vinterberg, H., Biering-Sorensen, F., Andersson, G. and Jorgensen, K., 1987. Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. *Applied ergonomics*, 18(3), pp.233-237.

[2] B. P. Bernard, 1997. Musculoskeletal disorders and workplace factors: critical review of epidemiologic evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back. National Institute for Occupational Safety and Health (NIOSH). Cincinnati, OH.

[3] Chiasson, M.É., Imbou, D., Aubry, K. and Delisle, A., 2012. Comparing the results of eight methods used to evaluate risk factors associated with musculoskeletal disorders. *International Journal of Industrial Ergonomics*, 42(5), pp.478-488.

[4] Rahman, M.N.A., Rani, M.R.A. and Rohani, J.M., 2012. Investigation of work-related musculoskeletal disorders in wall plastering jobs within the construction industry. *Work*, 43(4), pp.507-514.

[5] Tittiranonda, P., Burastero, S. and Rempel, D., 1999. Risk factors for musculoskeletal disorders among computer users. *OCCUPATIONAL MEDICINE-PHILADELPHIA*, 14, pp.17-38.

[6] Buckle, P.W. and Devereux, J.J., 2002. The nature of work-related neck and upper limb musculoskeletal disorders. *Applied ergonomics*, 33(3), pp.207-217.

[7] Gerr, F., Marcus, M. and Monteilh, C., 2004. Epidemiology of musculoskeletal disorders among computer users: lesson learned from the role of posture and keyboard use. *Journal of Electromyography and Kinesiology*, 14(1), pp.25-31.

[8] Wahlström, J., 2005. Ergonomics, musculoskeletal disorders and computer work. *Occupational Medicine*, 55(3), pp.168-176.

[9] Larsson, B., Søgaard, K. and Rosendal, L., 2007. Work related neck–shoulder pain: a review on magnitude, risk factors, biochemical characteristics, clinical picture and preventive interventions. *Best Practice & Research Clinical Rheumatology*, 21(3), pp.447-463.

[10] Village, J., Rempel, D. and Teschke, K., 2005. Musculoskeletal disorders of the upper extremity associated with computer work: a systematic review. *Occupational Ergonomics*, 5(4), pp.205-218.

[11] Sonne, M., Villalta, D.L. and Andrews, D.M., 2012. Development and evaluation of an office ergonomic risk checklist: ROSA–Rapid office strain assessment. *Applied ergonomics*, 43(1), pp.98-108.

[12] Loghmani, A., Golshiri, P., Zamani, A., Kheirmand, M. and Jafari, N., 2013. Musculoskeletal symptoms and job satisfaction among office-workers: A Cross-sectional study from Iran. *Acta medica academica*, 42(1), pp.46-54.

[13] Punnett, L. and Wegman, D.H., 2004. Work-related musculoskeletal disorders: the epidemiologic evidence and the debate. *Journal of electromyography and kinesiology*, 14(1), pp.13-23.

[14] Punnett, L. and Bergqvist, U., 1997. Visual display unit work and upper extremity musculoskeletal disorders. *Stockholm: National Institute for Working Life*, 997.

[15] Rahman, M.N.A. and Mohamad, S.S., 2017. Review on pen-and-paper-based observational methods for assessing ergonomic risk factors of computer work. *Work*, 57(1), pp.69-77.

[16] Eyal, L., Ribak, J. and Badihi, Y., 2012. Remote online ergonomic assessment in the office environment as compared to face-to-face ergonomic assessment. *Work*, 41(Supplement 1), pp.516-523.

[17] McAtamney, L. and Corlett, E.N., 1993. RULA: a survey method for the investigation of work-related upper limb disorders. *Applied ergonomics*, 24(2), p.91-99.

[18] Hignett, S. and McAtamney, L. 2000. Rapid entire body assessment (REBA). *Applied Ergonomics*, 31(2), pp.201-205.

[19] Occupation Safety & Health Administration, 2003. Computer Workstation e-Tool Checklist, United State Department of Labor. Available from [https://www.osha.gov](https://www.osha.gov).

[20] David, G., Woods, V., Li, G. and Buckle, P., 2008. The development of the Quick Exposure Check (QEC) for assessing exposure to risk factors for work-related musculoskeletal disorders. *Applied ergonomics*, 39(1), pp.57-69.

[21] Ferreira, J.G., Hunter, M. Birtles, L.M., Riley, D., 2009. Development of an assessment tool for repetitive tasks of the upper limbs (ART). Derbyshire: Health and Safety Executive
[22] Robertson, M., Amick III, B.C., DeRango, K., Rooney, T., Bazzani, L., Harrist, R. and Moore, A., 2009. The effects of an office ergonomics training and chair intervention on worker knowledge, behavior and musculoskeletal risk. *Applied ergonomics, 40*(1), pp.124-135.

[23] Drost, E.A., 2011. Validity and reliability in social science research. *Education Research and perspectives, 38*(1), pp.105.

[24] Fagarasanu, M. and Kumar, S., 2002. Measurement instruments and data collection: a consideration of constructs and biases in ergonomics research. *International journal of industrial ergonomics, 30*(6), pp.355-369.

[25] David, G., Buckle, P. and Woods, V., 2005. *Further development of the usability and validity of the Quick Exposure Check (QEC)*. Health & Safety Executive.

[26] Takala, E.P., Pehkonen, I., Forsman, M., Hansson, G.A., Mathiassen, S.E., Neumann, W.P., Sjøgaard, G., Veiersted, K.B., Westgaard, R.H. and Winkel, J., 2010. Systematic evaluation of observational methods assessing biomechanical exposures at work. *Scandinavian journal of work, environment & health*, pp.3-24.

[27] Rahman, M.N.A., Mohamad, S.S., Salleh, S.M., Mahzan, S. and Ahmad, S., 2017. Feedback Survey on the Usability of the OFFERA Method for Assessing an Exposure Risks of Computer Work Related to WMSDs. In *MATEC Web of Conferences* (Vol. 135, p. 00025). EDP Sciences.

[28] Altman, D. G., 1990. *Practical statistics for medical research*. CRC press.

[29] Li, G. and Buckle, P., 1999. Current techniques for assessing physical exposure to work-related musculoskeletal risks, with emphasis on posture-based methods. *Ergonomics, 42*(5), pp.674-695.

[30] Dartt, A., Rosecrance, J., Gerr, F., Chen, P., Anton, D. and Merlino, L., 2009. Reliability of assessing upper limb postures among workers performing manufacturing tasks. *Applied Ergonomics, 40*(3), pp.371-378.

[31] Dockrell, S., O'Grady, E., Bennett, K., Mullarkey, C., McConnell, R., Ruddy, R., Twomey, S., Flannery, C., 2012. An investigation of the reliability of Rapid Upper Limb Assessment (RULA) as a method of assessment of children's computing posture. *Applied Ergonomics, 43*(3) pp 632-636.

**Acknowledgments**

This research is funded by Ministry of Higher Education of Malaysia (MOHE) and Universiti Tun Hussein Onn Malaysia (UTHM) under Fundamental Research Grant Scheme (FRGS, Vot 1495).