



Laptop Use and Upper Extremities Musculoskeletal Disorders Among Higher Learning Students

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Abstract

Background: In recent years, laptop was very popular among university students for the purpose of education. However, due to its physical characteristics, users may find difficulties in maintaining a good posture especially after prolonged use. This circumstance can lead to awkward posture that eventually cause musculoskeletal discomforts. **Objective:** To determine ergonomic practices and musculoskeletal related problems among university students when using a laptop. **Methods:** The cross-sectional study was conducted among (n=240) respondents from June to October 2015 in Faculty of Biomedical and Health Sciences, Universiti Selangor. Inclusion and exclusion criteria were determined for the selection of respondents. Self-administered questionnaire was used for data collection. **Results:** Results showed that there were significant association between practices and use of laptop causing shoulder, elbow, wrist and upper back discomfort of the body. Lower back (59.6%) is the highest discomfort complaint by the respondents followed by neck (55.4%) and shoulder (45.8%). **Conclusion:** Laptop is not designed for prolonged use and may lead to musculoskeletal discomfort among users. However, with proper guide in ergonomic education and practices, the magnitude of the problems can be minimized effectively.

Keywords: Laptop; ergonomics; musculoskeletal disorders

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INTRODUCTION

Nowadays, the use of laptop or notebook computers is essential for everybody regardless the types of activities and tasks involved. This is because laptop provide convenient and portability to the user and it can be carried almost anywhere. Due to these two special features, it is always been preferred over desktop computers. Laptop has been used for varieties of activities such as working, entertainment, education and other activities, which required data input or processing information. Along with the advancement in information and communication technology, the use of laptops in the education industry began to grow.

It is crucial for any learning institution to keep abreast with current technological development. The new technology creates a new learning environment, which is more flexible in terms of time, place, method and learning materials. For instance, most of the students used a computer or laptop as a device to complete task such as assignment and presentation.

When new technologies emerges in a university, one of an important dimensions that is often overlooked is ergonomics practice. Ergonomic is defined as the science of studying people at work and then designing tasks, jobs, information, tools, equipment, facilities and the working environment so people can be safe and healthy, effective, productive and comfortable (Auburn Engineers, 1997). Although the use of laptop facilitates the work, but improper practices will cause harm to the users. In addition, without appropriate workstation setup, it

contributes to musculoskeletal discomfort or even worse chronic musculoskeletal disorders.

Many studies has been conducted focusing on the relationship between personal computer usages and musculoskeletal disorders. The prevalence is not only in adults, but also among students, including those in college (Jacobs et al., 2009; Noack-Cooper, Sommerich, & Mirka, 2009; Katz et al., 2000). For example, notebook users have tendency involves in hunched posture, repetitive movement, and prolonged sitting (Mahmud, Bahari, & Zainudin, 2014; Chavda, Parmar, & Parmar, 2013; Cooper, Sommerich, & Campbell-Kyureghyan, 2008).

It also had been reported that the prevalence of musculoskeletal disorders among university students was exceeding 30% and showed increasing trend of musculoskeletal disorders related to occupational visual display unit (How, Bahri, & Tamrin, 2012). The purpose of this study is to determine ergonomic practices and musculoskeletal related problems among university students when using a laptop.

METHODOLOGY

Study Population

A cross-sectional study has been conducted among Faculty of Engineering and Life Sciences students from Universiti Selangor (UNISEL) starting from June 2015 to October 2015. Two hundred and

forty undergraduate students (72.1% females; 27.9% males) were selected. Only students who own and use notebook computers were invited to participate in the study. Selection criteria were based on purposive sampling with established inclusion and exclusion criteria.

Study Questionnaire

Pre-designed and validated self-reporting questionnaire have been used to evaluate user practices when using a laptop and upper extremities musculoskeletal discomfort complaints from the respondents. The questionnaire has three main sections. Section A addressed the demographic information of the respondents such as gender, sex, educational level body mass index (BMI), age, race etc. Section B is concerned with the practice of respondents when operating the laptop. The questions covered hours per day spent using laptop, position of the laptop, portion of time using laptop for different kind of activities (social media, website surfing), break duration taken by the user, posture of the body while using a laptop, and the use of external devices when operating the laptop such as mouse, and keyboard. These questions were adapted from several sources such as from Department of Occupational Safety and Health guidelines for working with video display units (DOSH, 2003), German VDU questionnaire (Mitarbeiterbefragung, 2008), UNISON: Health and safety and the use of laptop computers, and Contract research report: health and safety of portable display screen equipment produce by Heasman, Brooks, Stewart, & Heasman, 2000. All questions from this section is a dichotomous and respondents were required to answer whether “Yes” or “No” only. Meanwhile, section C comprises of body discomfort chart which were used to measure the body discomfort areas among the respondents. The respondents marked the area(s) of the discomfort on the chart provided. This chart is a subjective survey tool for evaluating the discomfort experience at different body parts (Corlett & Bishop, 1976).

The questionnaire were paper-based that required respondent to complete within time given. On average, the completion of the questionnaire roughly about was five to ten minutes. Any incompleteness in questionnaires was excluded from the study.

RESULTS

Demographic of respondents

Table 1 shows the demographic and characteristics of the students in UNISEL. The response rate of the study was 100%.

Variables		n	%
Age	18 – 19	101	42.1
	20 – 21	92	38.3
	22 – 23	35	14.6
	>23	12	5
Gender	Male	67	27.9
	Female	173	72.1
Race	Malay	182	75.8
	Chinese	5	2.1
	Indian	47	19.6
	Others	6	2.5
Education level	Diploma	200	83.3
	Degree	40	16.7
Smoking status	Yes	11	4.6
	No	218	90.8
	Ex-smoker	11	4.6
Hand dominant	Right	210	87.5

	Left	30	12.5
Marital status	Single	235	97.9
	Married	5	2.1
Height	<140 cm	2	0.8
	140 - 159 cm	127	52.9
	160 - 179 cm	105	43.8
	>180 cm	6	2.5
Weight	<49 kg	73	30.4
	50 – 69 kg	109	45.4
	70 – 89 kg	49	20.4
	>90 kg	9	3.8
BMI	Underweight	53	22.1
	Ideal	118	49.2
	Overweight	50	20.8
	Obesity	19	7.9

Majority of the respondents were in age of 18 to 19 (n=101, 42.1%) and others in age 20 to 21 (n=92, 38.3%), age 22 to 23 (n=35, 14.6%) and age >23 (n=12, 5%). Malay is more dominant among participants (n=182, 75.8%) and followed by Indian (n=47, 19.6%), Chinese (n=5, 2.1%) and others (n=6, 2.5%). In addition, respondents were mainly from diploma level (n=200, 83.3%) and others were from degree level (n=40, 16.7%).

Moreover, 90.8% of the students were non-smokers and others were both smokers and ex-smokers (n=11, 4.6%) respectively. Meanwhile, respondents height in the range of 140 to 159 cm (n=127, 52.9%), followed by 160 cm to 179cm (n=105, 43.8%), more than 180 cm (n=6, 2.5%) and less than 140cm (n=2, 0.8%) respectively. Most of the respondents weight is around 50 kg to 69 kg (n=109, 45.4%), followed by less than 49 kg (n=73, 30.4%), 70 kg to 89 kg (n=49, 20.4%) and more than 90 kg (n=9, 3.8%) respectively.

In addition, most respondents had an ideal body mass index (n=118, 49.2%), followed by underweight (n=53, 22.1%), overweight (n=50, 20.8%) and obesity (n=19, 7.9%) correspondingly.

Respondents Practices

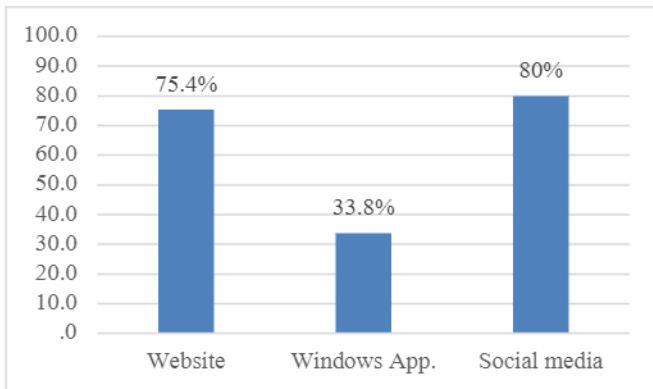
Table 2 describes the amount of time spent by the students with laptop.

Table 2. Duration of Time Spent with Laptop

Frequency	Percent (%)	Cumulative Percent (%)	
Less 1 Hour	61	25.4	25.4
1-2 Hour	62	25.8	51.3
2-3 Hour	45	18.8	70.0
> 3 Hour	72	30.0	100.0
Total	240	100.0	

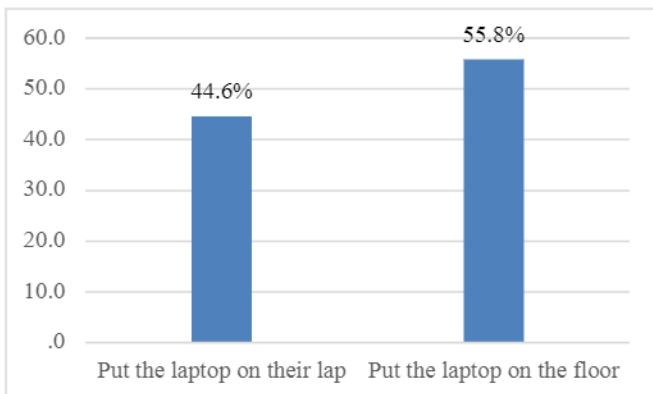
Most of the respondents (30%) spent time more than three hours per day in front of the laptop whereby 80% their time spend in surfing social media followed by surfing websites looking for the news, sports and entertainments. However, less time was spent using Windows applications such as MS Word, MS PowerPoint, Adobe Photoshop and others.

FIGURE 1. Percentage of laptop used for several activities



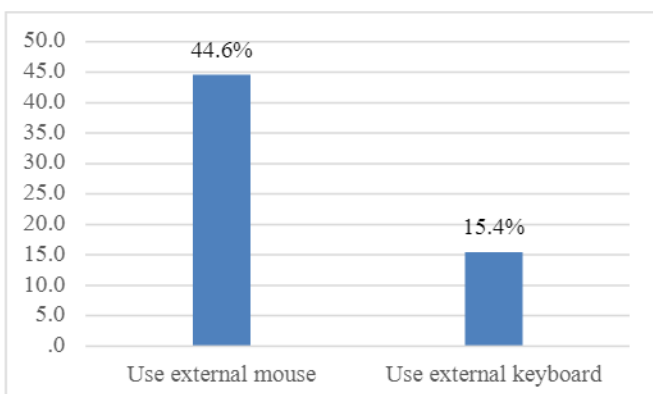
Besides, data also showed 76% of respondents took enough rest while operating the laptop. Among the activities carried out while resting are walking and stretching.

FIGURE 2. Preference selection in positioning the laptop.



Referring to figure 2, respondents have a tendency to put the laptop on the floor (55.8%) compared to place on their laps (44.6%) when no desk facilities available. Meanwhile over half of the respondent (55% to 59%) will adjust the height of the laptop to get suitable or comfortable view. 66.3% of the respondents have to bow or bent down their neck slightly when looking at a laptop screen.

FIGURE 3. The use of external devices



As in Figure 3 for the use of external devices, 44.6% of respondents used mouse to control cursor movement. However, still the majority of respondents depends on the built-in touchpad. Beside mouses, the use of external keyboard was also very low among respondents, only

15.4% from total users. Related to the keyboard, only 38.8% of respondents practice appropriate techniques while typing where the wrist in awkward postures (bending the wrist and stressful motions) and do not rest on any supports. In addition, they also require moving the head forward (extreme flexion) when using a laptop (60.4%).

From Table 3, lower back was the highest discomfort reported (59.6%) and least reported was lower arms (5.8%).

TABLE 3. Body Discomfort Report

Body Region	Frequency	Percentage (%)
Lower back	143	59.6
Neck	133	55.4
Shoulder	110	45.8
Wrist	74	30.8
Upper back	67	27.9
Elbow	32	13.3
Fingers	31	12.9
Upper arms	15	6.8
Lower arms	14	5.8

Table 4 shows the relationship between the use of laptop and musculoskeletal discomfort reported by respondents.

TABLE 4. Association of the practice and musculoskeletal discomfort.

Body Region	Practice	χ^2	p-value
Elbow	A4	4.36	*0.03
Upper Back	A9	6.19	*0.01
Wrist	A15	6.51	*0.01
Shoulder	A16	5.26	*0.02

*p < 0.05 = statistical significant

There was significant relationship between elbow discomfort and question A4 (social media surfing); p < 0.05. Meanwhile, there was significant relationship between upper back and question A9 that linked to laptop position selection (put on the floor); p < 0.05. Question A15 (use external keyboard) also have a significant relationship with wrist discomfort; p < 0.05. Finally, shoulder discomfort has a significant relationship with A16 (correct posture of the wrist when typing); p < 0.05.

DISCUSSION

Ergonomic Practices

This study shows that the use of laptops among students is practically not ergonomic. One of the main reason was the laptop design characteristics (e.g., small display monitor and built-in keyboard) that leads to awkward body postures (Hamilton, Jacobs & Orsmond, 2005; Raps & Nanthavanij, 2008). Thus, laptop user may experience musculoskeletal symptoms due to the variety of non-traditional laptop workstation setups that may place their body into awkward postures (Harris & Straker, 2000).

In the perspective of the duration of use, majority of respondents consumed more than three hours per day with frequent interval time for rest. Spending a lot of time in front of laptop may contribute to the awkward body posture which will lead to other ergonomic issues. This condition was also seen among medical students where prolonged awkward body posture has created various musculoskeletal problems (Chavda et al., 2013). Therefore, even though students take regular

break time, but due to incorrect body posture, they would still experience body discomfort.

For the laptop position preference, students are more likely to put the laptop on the floor than on their lap. Because of this position, they need to seat and flexes their head or neck to look into the screen. They also need to move their head forward because the position of the laptop is below the eye level. This position may generate addition load to posterior neck muscles. A study by Mechelen, Bongers, Arie, Bouter, & Wal (2001) found a significant relationship between neck symptoms and prolonged neck flexion of over 20°.

The use of external devices such as a mouse and keyboard are still low. Because of this practice, students only rely on the touchpad and built in keyboard on the laptop. This condition make them to place their palms on the surface or on the edge of the laptop. Contact stress on the hard surface putting pressure on the median nerve that lead to carpal tunnel syndrome. Moreover, the built-in keyboard is not ergonomically design leads to the students having the tendency to practice inappropriate typing techniques. Joint deviation (ulnar or radial) on the wrist may cause stress on the tendon subsequently pressing on the median nerve. Furthermore, laptop design promotes constrained body postures during typing because of small display monitors, flat keyboards, and the lack of a separate keyboard and monitor position adjustment (Shin, 2010).

Musculoskeletal Discomfort

Chavda et al. (2013) mentioned that approximately up to 20% of the students suffered from one of the musculoskeletal problems every time they work with laptop computer. This study found that females are more dominant in experiencing body discomfort than males. This finding has been supported by Mechelen et al. (2001) which mentioned females have a greater tendency in reporting discomforts or pain than males.

The lower back discomfort was the highest body discomfort regions reported by the students. However, through statistical analysis, there were no significant association between any practices with lower back discomfort. Body regions that have a significant association with the practices are elbow, upper back, wrist, and shoulder. It could be explained that through various body movement such as trunk flexion, neck flexion, head-down tilt, inward rotation of shoulder, and ulnar deviation of the wrist (Szeto & Lee, 2002), duration spent time, and lack use of external devices among users while handling the laptop.

Thus, it is important for the higher learning institutes to develop or adapt an appropriate guideline for the students or even to the whole staff about the ergonomic practices while using a laptop. Beside, continuous education and awareness should be implemented to improve the knowledge and practice among this community regarding laptop ergonomics.

CONCLUSION

There were high prevalence of upper extremities musculoskeletal discomfort complaints among university students who are using a laptop. Number of hours spent, laptop position and use an external keyboard shows a significant relationship to musculoskeletal discomfort. It was suggested that students should learn about ergonomic practices, schedule their break and stretching exercise in between tasks to avoid overuse of muscle activity. The university also should inculcate the awareness on ergonomics aspect to provide the students with appropriate knowledge.

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REFERENCES

- Auburn Engineers, 1997. Ergonomic Design Guidelines, (Auburn, AL: Auburn Engineers, Inc.)
- Chavda, E., Parmar, S., & Parmar, M. (2013). Current Practice of Laptop Computer and Related Health Problems : A Survey Based on Ergonomics. *International Journal of Medical Science and Public Health*, 2(4), 1024–1026.
- Cooper, K. N., Sommerich, C. M., & Campbell-Kyureghyan, N. H. (2008). Computer Usage and Ergonomic Risk Factors Among College Students. *The 9th Southeast Asian Ergonomics Society Conference*, (October), 1–9.
- Corlett, E. N., & Bishop, R. P. (1976). A Technique for Assessing Postural Discomfort. *Ergonomics*, 19(2), 175–182.
- Department of Occupational Safety and Health Malaysia. 2003. Guidelines for Occupational Safety And Health For Working With Video Display Units.
- Hamilton, A. G., Jacobs, K., Orsmond, G. (2005). The Prevalence of Computer-Related Musculoskeletal Complaints in Female College Students. *Journal of Prevention, Assessment & Rehabilitation*, 24(4), 387–394.
- Harris, C., & Straker, L. (2000). Survey of Physical Ergonomics Issues Associated With School Childrens' Use of Laptop Computers. *International Journal of Industrial Ergonomics*, 6(3), 337–346.
- Heasman, T., Brooks, A., Stewart, T., & Heasman, T. (2000). *Health and Safety of Portable Display Screen Equipment*. London.
- How, V., Bahri, S., & Tamrin, M. (2012). Effect of Notebook Computer Display Tilt Angle on Muscle Activity among Notebook User. In *Southeast Asian Network of Ergonomics Societies Conference (SEANES)*. Malaysia.
- Jacobs K., Johnson P., Dennerlein J., Peterson D., Kaufman J., Gold J., Williams S., Richmond N., Karban S., Firm E., Ansong E., Hudak S., Tung K., Hall V., Pencina K., Pencina M. (2009). University Students' Notebook Computer Use. *Applied Ergonomics*, 40(3), 404–409.
- Katz, J. N., Amick, B. C., Carroll, B. B., Hollis, C., Fossel, A. H., & Coley, C. M. (2000). Prevalence of upper extremity musculoskeletal disorders in college students. *The American Journal of Medicine*, 109(7), 586–588.
- Mahmud, N., Bahari, S. F., & Zainudin, N. F. (2014). Psychosocial and Ergonomics Risk Factors Related to Neck, Shoulder and Back Complaints among Malaysia Office Workers. *International Journal of Social Science and Humanity*, 4(4), 260–263.
- Mechelen, A. W. Van, Bongers, P. M., Arie, G. A. M., Bouter, L. M., & Wal, G. Van Der. (2001). Psychosocial Risk Factors for Neck Pain : A Systematic Review. *American Journal of Industrial Medicine*, 193(39), 180–193.
- Mitarbeiterbefragung, B. (2008). Procedures for The Assessment and Design of Office and Screen Work as Well as Mobile work (BBM). Retrieved June 14, 2014, from <http://www.institut-aser.de/out.php?idart=485&lang=de>
- Noack-Cooper, K. L., Sommerich, C. M., & Mirka, G. A. (2009). College students and computers: assessment of usage patterns and musculoskeletal discomfort. *Work (Reading, Mass.)*, 32(3), 285–298.
- Raps, T., & Nanthavanij, S. (2008). Survey Study of Notebook Computer Use and Preferred Work Postures Among Thai University Students. *Thammasat International Journal of Science and Technology*, 13(4), 62–75.
- Shin, H. (2010). Musculoskeletal Symptoms and Laptop Computer Use Among College Students. Retrieved from <http://d-scholarship.pitt.edu/10166/>
- Szeto, G. P., & Lee, R. (2002). An Ergonomic Evaluation Comparing Desktop, Notebook, and Subnotebook Computers. *Physical Medicine and Rehabilitation*, 83(4), 527–32.