

LAPTOP USE AND UPPER EXTREMITIES MUSCULOSKELETAL DISORDERS AMONG FACULTY OF BIOMEDICAL AND HEALTH SCIENCES STUDENTS, UNIVERSITI SELANGOR

Mohd Amir Arshad, Mohd Zubairy Shamsudin, Mohd Jamalil Azam Mustafa

*Faculty of Biomedical and Health Sciences, Department of Environmental Health and Occupational Safety,
Universiti Selangor, Malaysia
E-mail: m.amir@unisel.edu.my*

Abstract

Background: In recent years, laptops were 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 the Faculty of Biomedical and Health Sciences, Universiti Selangor. Inclusion and exclusion criteria's have been setup for sampling of the respondents. Self-administered questionnaire was used for data collection.

Results: Results showed that there were significant association between practices on the 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: Laptops have not been designed for prolong use that might lead to musculoskeletal discomfort among users. However, with proper guide in ergonomic education and practices, the magnitude of the problems can be minimize effectively.

Keywords: Laptop; Ergonomics; Musculoskeletal Disorders; Discomfort

1 INTRODUCTION

Nowadays, the used of laptop is essential for everybody regardless of what types of industries they belong to. This is because the laptop provides convenient and portability to the user and it can be carried almost anywhere. Due to these two special features, it has always been preferred over desktop computers.

Laptops have 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 (ICT), the use of laptops in the education industry has begun to grow. Learning settings must maintain pace with technology in order to prepare students for their futures. This approach has created a new learning environment which is more flexible in terms of time, place, method and learning materials. At universities, laptops have been used as a key tool to complete lecture task such as assignments and presentation by students.

When new technologies are introduced in a university setting, one of an important dimension that is often overlooked is ergonomics. Ergonomic is define 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, 1998). Although the use of laptop will facilitate the work or task, but with improper practices will bring harm to the

users. In addition, without appropriate setup of the workstation, it also contribute to musculoskeletal discomfort or even worst chronic disorders. Many studies have been conducted about the relationship between the use of personal computer such as laptop or notebook and musculoskeletal disorders and the prevalent not only in adults, but in students, including those in college (Jacobs K. et al., 2009; Noack KL et al., 2004; Katz JN et al., 2000).

For example, notebook users have a tendency to involve in hunched posture, repetitive movement, and prolonged sitting (Norashikin M. et al., 2014; Ekta Chavda et al., 2013; Cooper K.N. et al., 2008). It also had been reported that the prevalence of musculoskeletal disorders among university students is exceeding 30% and showed a trend of occupational visual display unit related musculoskeletal disorders (How V. and Tamrin, 2012). The purpose of this study is to understand the ergonomic practices of the student who are using a laptop computer and it relationship with upper extremities musculoskeletal discomfort.

2 METHODOLOGY

2.1 Study Population

A cross-sectional study have been conducted among Faculty of Biomedical and Health Sciences students from Universiti Selangor 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 using notebook computers were invited to participate in the study. Selection criteria was based on purposive sampling with established inclusions and exclusions criteria.

2.2 Study Instrument

Pre-design and validated self-reporting questionnaire have been used to evaluate user practices when using a laptop and upper extremities musculoskeletal discomfort complaint from the respondents. The questionnaire have 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 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 used 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 (BiFra, 1998), UNISON: Health and safety and the use of laptop computers, and Contract research report: health and safety of portable display screen equipment produce by Health and Safety Executive (2003). All question from this section is a dichotomous and respondents was require to answer whether “Yes” or “No” only. Meanwhile, section C comprise of body discomfort chart which were used in order to measure the body discomfort areas among the respondents. The respondents will marked the area(s) of the discomfort on the chat provided. This chart is a subjective survey tool for evaluating the discomfort experience at different body parts (Corlett and Bishop’s, 1976).

The questionnaire were paper-based and completed after distributed. On average, the completion of the questionnaire roughly about was five to ten minutes. Any incompleteness in questionnaires were excluded from the study.

3 RESULTS

3.1 Demographic of respondents

Table 1.0 shows the demographic and characteristics among 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 - 69kg	109	45.4
	70 - 89kg	49	20.4
	>90kg	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%). Next, respondents were mainly from diploma level (n=200, 83.3%) and others were 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 is around 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 50kg to 69kg (n=109, 45.4%), followed by less than 49 kg (n=73, 30.4%), 70 kg to 89kg (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.

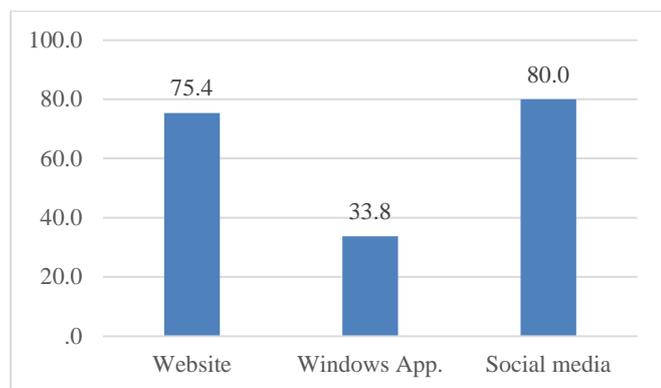
3.2 Respondents Practice

TABLE 2. Duration Time Spent with Laptop

Frequency	Percent	Cumulative Percent
Less 1 Hour	61	25.4
1-2 Hour	62	51.3
2-3 Hour	45	70.0
More than 3 Hour	72	100.0
Total	240	100.0

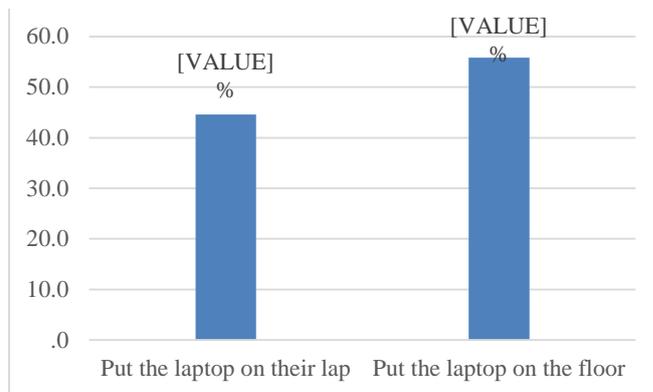
From this study, most of respondents (30%) spent time more than three hours per day in front of the laptop whereby 80% their time spend in surfing social media such as Facebook, YouTube and others followed by surfing a websites looking for the news, sports and entertainments. However, they was less frequently spend time for using windows applications such as Photoshop, PowerPoint and others.

FIGURE 1. Percentage of laptop used for several activities



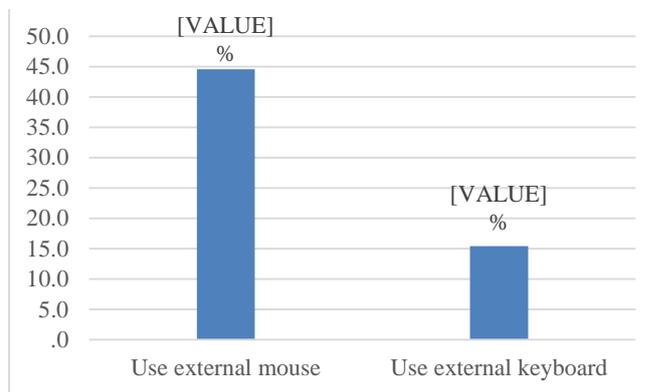
Beside, data also showed that 76% of respondents practice enough rest when operating the laptop. This is done by walking or stretching movement in order to avoid discomfort on body parts such as hands, wrists and arms.

FIGURE 2. Preference selection to position the laptop.



Referring to figure 2, respondents have a tendency to put the laptop on the floor (55.8%) compare on their lap (44.6%) when no desk facilities available. However, only 55% to 59% of them will adjust the height of the laptop to get suitable or comfortable view. Consequently, 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



Regarding the use of external devices, 44.6% of respondents have used the mouse to control the movement of a pointer or cursor on the display screen. However, still the majority of respondents do not use it and only depends on the touchpad attached to the laptop. Beside mouse, the use of external keyboard was also very little among respondents when only 15.4% from total users. Related to the use of the keyboard, only 38.8% of respondents practice appropriate techniques while typing where the wrist in a straight line and do not rest on any surface. In addition, they also require to move the head forward when using a laptop (60.4%).

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 arm	14	5.8

From the table 3 above, lower back is the highest degree of discomfort reported by respondents (59.6%) and the least reported is lower arm discomfort (5.8%).

TABLE 4. Association of the practice and musculoskeletal discomfort.

Body Region	Practice	X 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

Table 4 shows the relationship between the use of laptop and musculoskeletal discomfort reported by respondents. There was significant relationship between elbow discomfort and question A4 (social media surfing) with the p-value of 0.03. Meanwhile, there were significant relationship between upper back and question A9 which linked to laptop position selection (put on the floor) with p-value of 0.01. Question A15 (use external keyboard) also have a significant relationship with wrist discomfort (p-value=0.01). Finally, shoulder discomfort have a significant relationship with A16 (correct posture of the wrist when typing) with the p-value of 0.02.

4 DISCUSSION

Ergonomic Practices

In this study, practice of laptop usage among students was ergonomically improper. This could be so because the design of laptop (e.g., small monitor and keyboard and lack of a separate keyboard and monitor position adjustment) can promote awkward body postures (Hamilton, Jacobs, & Orsmond, 2005; Raps & Nanthavanij, 2008). In addition, according to Harris and Straker (2000), laptop user may experience musculoskeletal symptoms due to the variety of non-traditional laptop workstation setups that may place their body into awkward postures.

When we look into the duration spent with the laptop, majority of them consumed more than three hours per day with frequent interval time for rest. By spending a lot of time in front of the laptop may contribute to the awkward body posture that will lead to other ergonomic problems. This statement also supported by one study conducted among medical students, shows that prolonged usage with improper body posture has created various musculoskeletal problems (Chavda EM. Et al, 2013). That is why even though students take regular break time, but due to incorrect body posture, they 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 sit and lower their head or neck in order to look at the laptop screen. They also need to move their head forward because the position of the laptop is

below the eye level. This position may create muscle spasms on the neck due to over flexion. This statement is supported by Ariens et al. (2001) who found a significant relationship between neck symptoms and prolonged neck flexion of over 20°.

The use of external devices such as 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 makes them place their palms on the surface or on the edge of the laptop. Contact stress on the hard surface will put pressure on the median nerve that can lead into carpal tunnel syndrome. Moreover, because the built-in keyboard is not ergonomically designed, the students have a tendency to practice inappropriate typing techniques that are unsafe for their wrist muscle. Joint deviation on the wrist may cause stress on the tendon subsequently pressing on the median nerve. Furthermore, the laptop design promotes constrained body postures during typing because of small monitors, flat keyboards, and the lack of separate keyboard and monitor position adjustment (Shin H. (2010).

Musculoskeletal Discomfort

Previous study conducted by Chavda EM, Parmar SB, Parmar MB. (2013) mention that approximately up to 20% of the students suffered from one of the musculoskeletal problems every time when they worked with laptop computer. Through this study, it is found that females are more dominant in experiencing body discomfort than males. This is also supported by Ariens *et al.*, 2001 and Hoogendoorn *et al.*, 2000, which mentioned that females have a greater tendency in reporting pain than males.

The lower back discomfort is the top of the list for body discomfort region reported by the students. However, through statistical analysis study, there is no significant association between any practices with lower back discomfort. The body regions that have a significant association only in the elbow, upper back, wrist, and shoulder. This is due to more 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 of external devices usage among users while handling the laptop.

Thus, it is important for the university to develop or adapt an appropriate guideline for the students or even the whole staff about the ergonomic practices while using laptops. Moreover, continuous education and awareness should be implement in order to improve the knowledge and practice among this community regarding laptop ergonomics.

5 CONCLUSION

There was as high prevalence of upper extremities musculoskeletal discomfort complaints among university students who use laptops. Number of hours spent, laptop position and usage of external keyboards show a significant relationship to musculoskeletal discomfort. It was suggested that students should learn about ergonomic practices,

schedule their break and perform stretching exercises in between task to avoid overuse of muscle activity. The university also should inculcate the awareness on ergonomics aspect to provide them with appropriate knowledge.

ACKNOWLEDGMENTS

First, we thank Allah SWT for His guidance that we are able to successfully complete this project on time. Thanks also to our management especially dean of the faculty and head of program for showing us continuous support in conducting this study. Last but not the least; we sincerely thank our students who participated in this study.

REFERENCES

- Ariens, G.A.M., W.V. Mechelen, P.M. Bongers, L.M. Bouter and G.V.D. Wal, 2001. Psychosocial risk factors for neck pain: A systematic review. *Am. J. Ind. Med.*, 39: 180-193. DOI: 10.1002/1097-0274(200102)
- Chavda EM, Parmar SB, Parmar MB. (2013). Current practice of laptop computer and related health problems: A survey based on ergonomics. *International Journal of Medical Science and Public Health* 2013; 2:1024-1026.
- Department of Occupational Safety and Health, Malaysia (DOSH, 2003). Guidelines on Occupational Safety and Health for Working with Video Display Units (VDU's). First Edition, June 2003.
- Hamilton, A. G., Jacobs, K., & Orsmond, G. (2005). The prevalence of computer-related musculoskeletal complaints in female college students. *Work*, 24, 387-394.
- Harris, C., & Straker, L. (2000). Survey of physical ergonomics issues associated with school children's use of laptop computers. *International Journal of Industrial Ergonomics*, 26, 337-346.
- Health and Safety Executive (2003). Work with display screen. Retrieved from http://www.hseni.gov.uk/126_work_with_display_screen_equipment.pdf
- Hoogendoorn, W.E., M.N.M. van Poppel, P.M. Bongers, B.W. Koes and L.M. Bouter, 2000. Systematic review of psychosocial factors at work and private life as risk factors for back pain. *Spine*, 25: 2114-2125.
- How. V & Tamrin SBM (2012). Effect of notebook computer display tilt angle on muscle activity among notebook user. Conference paper from 2012 Southeast Asian Network of Ergonomics Societies Conference (SEANES)
- Institute A. BiFra Mitarbeiterbefragung: Display Questionnaire Translation of the German Version. 2008.
- 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, 62-75.
- Shin H. (2010). Musculoskeletal symptoms and laptop computer use among college students. Phd Thesis from University of Pittsburgh.
- Szeto, G. P., & Lee, R. (2002). An ergonomic evaluation comparing desktop, notebook, and subnotebook computers. *Archives of Physical Medicine and Rehabilitation*, 83, 527-532.