



**UNIVERSITI PUTRA MALAYSIA**

***ASSOCIATION BETWEEN ERGONOMIC RISK FACTORS AND  
MUSCULOSKELETAL DISCOMFORT AMONG THE HOSTEL'S  
RESIDENCE OF UNIVERSITY PUTRA MALAYSIA***

**FATIN NASUHA ABDUL RAHIM**

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**BY**

**FATIN NASUHA BINTI ABDUL RAHIM**

**Thesis submitted in fulfilment of the requirement for the degree of Bachelor  
Science (Environmental and Occupational Health) from the Faculty of Medicine  
and Health Sciences, Universiti Putra Malaysia.**

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In the name of ALLAH, the Most Gracious and the Most Merciful.

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## ABSTRAK

### HUBUNGAN DI ANTARA FAKTOR RISIKO ERGONOMIC DAN KETIDAKSELESAAN OTOT RANGKA DALAM KALANGAN PELAJAR DI ASRAMA UNIVERSITI PUTRA MALAYSIA

FATIN NASUHA BINTI ABDUL RAHIM

**PENGENALAN:** Banyak kajian telah dijalankan untuk mengkaji factor-faktor risiko ergonomic dalam kalangan pelajar sekolah dan pekerja pejabat. Namun tiada kajian yang pernah dijalankan dalam kalangan pelajar universiti di Malaysia. **OBJEKTIF:** Tujuan kajian ini dijalankan ialah untuk mengkaji factor-faktor risiko berkaitan dengan ketidakselesaan ototrangka dalam kalangan pelajar universiti. **METHODOLOGI:** Ini adalah satu kajian keratin rentas. Responden dipilih dengan menggunakan kaedah persampelan rawak mudah. Ketidakselesaan ototrangka telah direkodkan menggunakan borang soal selidik MSD. "Rapid Upper Limb Assessment" (RULA) telah digunakan untuk menilai postur janggal pelajar iaitu membongkok ke hadapan, bersandar, duduk dan berpusing. "Rapid Office Strain Assessment" (ROSA) telah digunakan untuk mengukur risiko yang berkaitan dengan stesen kerja pelajar dengan aktiviti-aktiviti yang berkaitan dengan komputer. Pengukuran antropometri yang terdiri daripada berat badan dan ukuran duduk daripada responden telah dilakukan dengan menggunakan set antropometri yang bertujuan untuk mengenalpasti ketidaksepadanan di antara dimensi badan pelajar dan perabot. Empat ketidaksepadanan yang dikira ialah ketinggian popliteal dan ketinggian tempat duduk; panjang punggung-popliteal dan kedalaman tempat duduk; ketinggian lutut dan pelepasan meja; dan ketinggian siku dan ketinggian meja. **KEPUTUSAN:** Keputusan menunjukkan bahawa kelaziman ketidakselesaan dalam kalangan pelajar adalah 76.7%. Keputusan ujian Chi Square menunjukkan bahawa tidak ada kaitan antara ketidakselesaan ototrangka dengan factor-faktor sociodemografi untuk jantina, umur, BMI dan etnik. Selain itu, kajian menunjukkan sebarang perkaitan antara ketidakselesaan ototrangka dengan factor-faktor risiko ergonomik termasuk ROSA ( $\chi^2 = 2.635$ , nilai-p = 0.105), RULA ( $\chi^2 = 4.634$ , nilai-p = 0.099), aduan MSD ( $\chi^2 = 0.032$ , nilai-p = 0.857) and ketidaksepadanan ( $\chi^2 = 0.332$ , nilai-p = 0.564). **KESIMPULAN:** Prevalens ketidakselesaan ototrangka adalah tinggi dalam kalangan para pelajar. Oleh itu, ukuran kerusi dan meja yang sesuai telah dicadangkan supaya ia dapat dilaksanakan bagi mengelakkan peningkatan risiko dalam kalangan pelajar di universiti.

**Katakunci:** Ketidakselesaan ototrangka, Rapid Upper Limb Assessment (RULA), Rapid Office Strain Assessment (ROSA),

## ABSTRACT

### ASSOCIATION BETWEEN ERGONOMIC RISK FACTORS AND MUSCULOSKELETAL DISCOMFORT AMONG THE HOSTEL'S RESIDENCE OF UNIVERSITY PUTRA MALAYSIA

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**INTRODUCTION:** Numerous studies are conducted to study the ergonomics risk factors among schoolchildren and office workers. No study had been conducted yet on the ergonomic risk factors for university students in Malaysia. **OBJECTIVE:** The aim of this study was to investigate the risk factors associated with musculoskeletal discomfort among the university students. **METHODOLOGY:** This is a cross-sectional study. The respondents were selected using a simple random sampling method. Musculoskeletal discomfort (MSD) was recorded using MSD Questionnaire. Rapid Upper Limb Assessment (RULA) was used to assess awkward posture of student's torso namely bending forward movement, leaning, sitting and twisting. Rapid Office Strain Assessment (ROSA) was used to quantify risk associated with the work station of the students with computer related activities. Anthropometric measurement which consist of weight and sitting measurement of a respondents using anthropometry set to measure the possible mismatch between the body dimension of the students and furniture dimension. Four possible mismatch that measured were popliteal height and seat height; buttock-popliteal length and seat depth; knee height and table clearance; and elbow rest height and table height. **RESULTS:** Results showed that the prevalence of discomfort among the students was 76.7%. Results of Chi Square test showed that there was no association between discomfort and sociodemographic factors for gender, age, BMI and ethnicity. There was no association between discomfort and ergonomic factors including ROSA ( $\chi^2 = 2.635$ , p-value = 0.105), RULA ( $\chi^2 = 4.634$ , p-value = 0.099), MSD complain ( $\chi^2 = 0.032$ , p-value = 0.857) and mismatch ( $\chi^2 = 0.332$  p-value = 0.564). **CONCLUSION:** The prevalence of discomfort was high among the students. Therefore, a recommended chair and table dimension was recommended so that it can be implemented to avoid the increasing of risks among the students at the university.

**Keywords:** Musculoskeletal Discomfort (MSD), Rapid Upper Limb Assessment (RULA), Rapid Office Strain Assessment (ROSA), Mismatch

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## LIST OF ABBREVIATIONS

BMI	Body Mass Index
BPL	Buttock-popliteal Height
KH	Knee Height
MSD	Musculoskeletal Discomfort
PH	Popliteal Height
ROSA	Rapid Office Strain Assessment
RULA	Rapid Upper Limb Assessment
SEH	Sitting Elbow Height
SSH	Sitting Shoulder Height

## CHAPTER 1

### INTRODUCTION

#### 1.1 Background

Musculoskeletal disorders are injuries and disorders that affect the human body's movement or musculoskeletal system, which include bones, nerves, tendons, ligament, joints, cartilage, blood vessels and spinal discs. While musculoskeletal discomfort (MSD) includes musculoskeletal aches and pains and these symptoms are self-assessed (Hamberg-van Reenen et al, 2008 as cited by Scuffham et al., 2010). It also stated that, MSD are the precursor to clinically characterized health events. Since there is no specific definition for MSD, the MSD define musculoskeletal aches, pains and discomfort that affecting an identified body site (Scuffham et al., 2010).

In work-related MSD, many physical and physiological factors are related to the musculoskeletal discomfort. The factors are prolonged static posture, repetitive task, prolonged periods of exposure to a given task, job satisfaction, stress and organizational structure. However, the risk factors that influence the prevalence of MSD among students are student posture, anthropometrics and furniture, computer use and vision (Grimes and Legg, 2004). This is a review

article which discuss about multiple factors affecting postures, comfort and health in classroom environments. The incidence of musculoskeletal discomfort increase with the muscular strain. Besides, the static muscular effort can also cause short term lumbar and dorsal pain (Vergara and Page, 2002).

## **1.2 Problem Statement**

The problems of musculoskeletal discomfort or disorder is a common case among school students and workers whether in the office or industrial fields. But the study related to musculoskeletal discomfort among university student at hostels in the university in Malaysia is not yet conducted. The study furniture available at hostels in the university has a potential of being in the research. This is due to the emerging issues related to health that need to be research.

The following factors are the issues identified as the problem that need to be tackled. First, the problem of the design of the study furniture used at the hostels. Second, the problem with the posture of the student while studying or sitting at the study furniture at their hostels. The outcome of the above issues may cause musculoskeletal discomfort among the students.

From the previous study, the prevalence of muscular discomfort among workers and school children was quite high, thus it is not possible to have high

prevalence of musculoskeletal among the university student. Extensive exposure to risk factors of musculoskeletal discomfort can lead to musculoskeletal disorder (Grimes and Legg, 2004).

A survey among the final year students in the study group had been conducted to survey the student's experiences of discomfort when using the study furniture provided at the hostel. These students stayed at the hostels for almost 3 years. Most of the students choose uncomfortable with 56.1% for comfort rate for the study furniture and 7.3% of the students choose very uncomfortable.

Thus, the purpose of this study to be carried out is to determine association between risk factors and musculoskeletal discomfort among residence of UPM's hostel.

### 1.3 Study Justification

Currently there is no study has been conducted on risk factors and musculoskeletal discomfort among the hostel residence in UPM. This study was important to determine the prevalence of discomfort among the university student so that people will aware of the importance of ergonomic consideration in study environment.

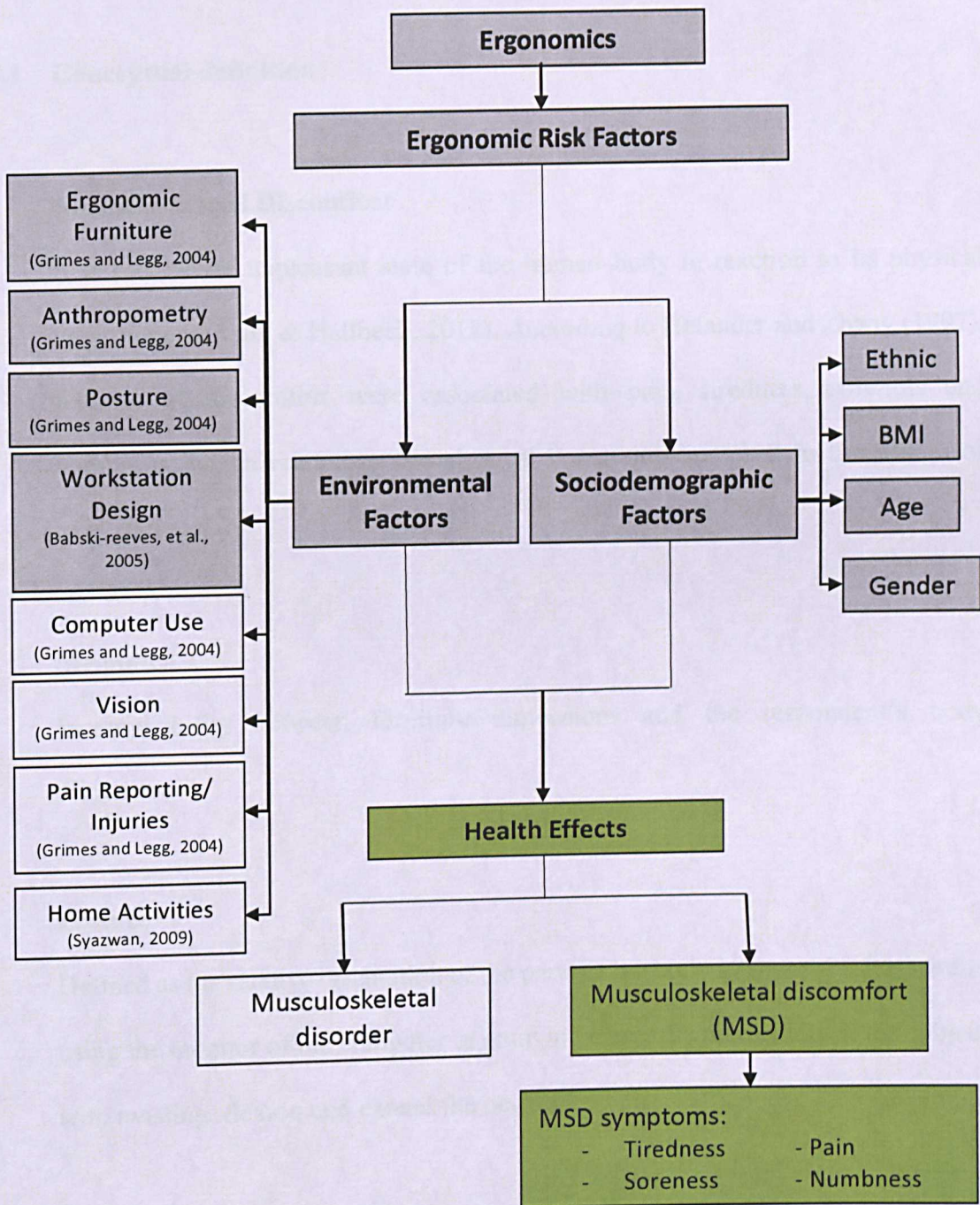
Besides, this study aim to determine the possible mismatch of the body dimension of subjects and furniture dimension used in the hostels. If the percentage of mismatch is high among the subjects, the data obtain from this study can be used to redesign the furniture so as to conform to the student's physiological measurement.

According to Odunaiya *et al.*, (2014), fitting execution of classroom ergonomics may be required to those upkeep for beneficial health, enhance academic performance, learning and motivation. Ill-fitted and improper design to the body dimension of the students can result in quicker fatigue, faulty posture and the station of obsessive states which might influence their performance in studying (Odunaiya *et al.*, 2014).

Students spend a lot of time at their room after the classes at the faculty finished. They spend hours doing their assignments using a computer and studying. This prolonged seating postures can make them susceptible to have musculoskeletal discomfort from a bad design of study furniture.

Many research that had been done concluded that the awkward postures and mismatch of body dimension to the furniture dimension were the factors that contribute to the development of musculoskeletal discomfort (MSD) among workers and school children. This can also be concluded to the group of young adults especially university students. Therefore, this study was aim to determine the prevalence of MSD, prevalence of MSD complaints, mismatch and posture scores.

## 1.4 Conceptual Framework



**Figure 1.1: Conceptual Framework**

Independent variable: Posture, Workstation, Anthropometry and Furniture.

Dependent variable: Musculoskeletal Discomfort

## **1.5 Variable Definition**

### **1.5.1 Conceptual definition**

#### **Musculoskeletal Discomfort**

It is seen as an unpleasant state of the human body in reaction to its physical environment (Vink & Hallbeck, 2012). According to Helander and Zhang (1997), feelings of discomfort were associated with pain, tiredness, soreness and numbness, which related to the physical constraints imposed in the design of workstation.

#### **Mismatch**

Incompatibility between furniture dimensions and the respondent's body dimension.

#### **Posture**

Defined as the relative orientation of the parts of the body in space. Position while using the monitor of the computer or studying effect the discomfort of the subject with twisting, flexion and extend the neck.

#### **Workstation Design**

Computer setup such as position of keyboard, mouse and monitor height placement, table and chair design has a significant relationship with the ergonomics suitability of a person.

## **1.5.2 Operational definition**

### **Musculoskeletal Discomfort**

Musculoskeletal discomfort (MSD) includes musculoskeletal aches and pains which are self-assessed (Hamberg-van Reenen et al, 2008).

### **Mismatch**

Anthropometric mismatch are the number and percentage of the students where body match and mismatch with furniture, that calculated based on rules adopted from Parcels (1999), Chaffin and Anderson (1991), Panagiotopoulou et al., (2004) and Mandal (1982).

### **Posture**

Body posture is evaluate based on the position of body region for arm and wrist, and neck and trunk. Rapid Upper Limb Assessment (RULA) was used to assess awkward posture of student's torso namely bending forward movement, leaning, sitting and twisting.

### **Workstation Design**

Rapid Office Strain Assessment (ROSA) was used to quantify risk associated with the work station of the students with computer related activities.

## **1.6 OBJECTIVE**

### **1.6.1 General objective**

To investigate the association between ergonomic risk factors and musculoskeletal discomfort among residence of UPM hostels.

### **1.6.2 Specific objective**

1. To determine the possible mismatch between the student's body dimensions and the dimensions of the study furniture used in the hostel.
2. To determine the prevalence of discomfort among the respondents.
3. To determine the musculoskeletal complaints among the respondents.
4. To determine the association between ergonomic risk factors and discomfort in the study group.
5. To determine the association between sociodemographic background and discomfort in the study group.
6. To recommend the suitable chair and table height for the students in the study group.

## 1.7 Hypothesis

**Table 1.1: Hypothesis of this study.**

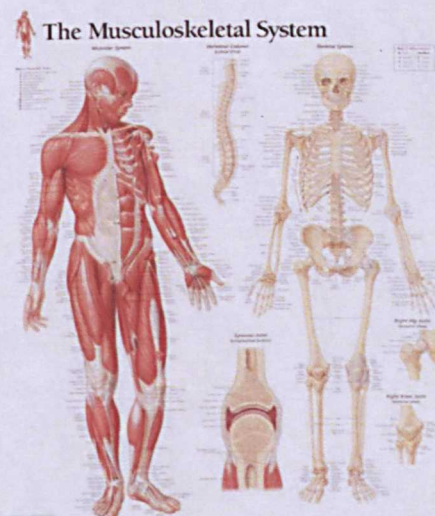
Variables	Hypothesis
To determine the association between ergonomics risk factors and musculoskeletal discomfort in the study group.	There is no significant association between ergonomics risk factors and musculoskeletal discomfort among hostel residence of UPM.
To determine the association between sociodemographic background to the musculoskeletal discomfort in the study group.	There is no significant association of sociodemographic background to the musculoskeletal discomfort among hostel residence of UPM.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Anatomy of musculoskeletal system

The musculoskeletal system is an organ system enabling an organism to move, support itself and maintain stability during locomotion. This system gives human the ability to move using the combined actions of the muscular and skeletal systems. The musculoskeletal system is made up of bones, muscles, cartilage, tendons, ligaments, joint and other connective tissue that supports and binds tissue and organs together. This system function to support the weight of the body by which the bones work together with muscles to maintain body position and control the precise movements of the body.



**Figure 2.1:**  
**The musculoskeletal system.**

## **2.2 Musculoskeletal Discomfort**

### **2.2.1 Definition of discomfort**

No widely accepted definition of comfort has been agreed upon in the ergonomics literature, but it is beyond dispute that comfort and discomfort are feelings or emotion that are subjective in nature (de Looze et al., 2003). According to Helander and Zhang (1997), feelings of discomfort were associated with pain, tiredness, soreness and numbness, which assumed to be imposed by physical constraints in the design of workstation.

### **2.2.2 Prevalence in young adults/university student**

The study conducted by Dockrell *et al.*, (2015), the prevalence of musculoskeletal symptoms among undergraduate students was 52.8%.

## **2.3 Ergonomic Risk Factors**

### **2.3.1 Anthropometric and furniture**

Human health was significantly affected by furniture and the anthropometric body dimension of human. Mismatch between the study furniture and anthropometry of the subject was responsible for discomfort, pain and disorders in neck, back, shoulder, hands, arm, wrist which can lead to musculoskeletal disease.

The perception of comfort can also be significantly influenced by the anthropometric dimensions of the student (Agarwal, 2006). Anthropometric dimensions of the student determines the fit of the chair and table dimension. According to Agarwal (2006), attention to chair design can reduce the occurrence of static muscular effort which result in increased overall comfort.

### **2.3.2 Posture**

According to Murphy (2003), pupil's typical classroom tasks of reading, writing, listening and computer use are performed in sitting, this typically being static. This position are often adopted for prolonged period of time which can result in fatigue, discomfort and pain as the maintenance of muscles in a tense (Agarwal, 2006). Subject may exposed to static postures when they sit for a prolonged period on the chairs that do not provide adequate lumbar support, thus

it can primarily affect lumbar area of the back and also affect the upper back, neck and legs. As the lumbar support is not adequate and the subject start to bend forward, the muscle of the back are trying to force the lumbar region out of it natural curve, in which it applies pressures on the discs and reduces the blood supply to the spinal tissues and this leads to muscle fatigue.

### 2.3.3 Workstation Design

University students has a lot of assignment that needs them to use computer. The amount of computer work increase when they participate co-curriculum activities and outside job. Thus, a good workstation design may help in reducing the probability of musculoskeletal discomfort. Musculoskeletal disorders associated with occupational computer use are related to head and neck, upper limb (Gerr et al., 2002) and back. From the usage of keyboard and mouse, repetitive motion of hands and wrist, prolong awkward posture of forearm and wrist and contact pressure in the wrist is said to be a possible mechanism for injury among the workers (Village *et al.*, 2005).

According to Thariq et al., (2010), deciding the right position for the desktop may be a critical aspect in design process, which it might influence the comfort and wellbeing of the students. Most of the desktop are position where the

armrest is fitted, which 95% of the desktops is on the right side and only 5% on the left side of the person (Thariq et al., 2010).

Practically all the available research recommend to position the desktop right in front of the subjects. Keyboard and mouse also affect the comfort of the subjects. Arms of a person are supported on the desk in a horizontal surface for high percentages of time and sometime the mouse is position at a different level of the keyboard.

## **2.4 Other Factors**

### **Sex Differences**

Sex differences can be seen from the variation of body proportions and variation in strength. Generally, the lengths of upper and lower limbs are greater in men while the length of buttock-knee are greater in women (Pheasant, 2006). In variation of strength, women strength is said to be two-thirds as strong as men with average value of F/M ratio is 61% (Pheasant, 1983).

## **Ethnicity Differences**

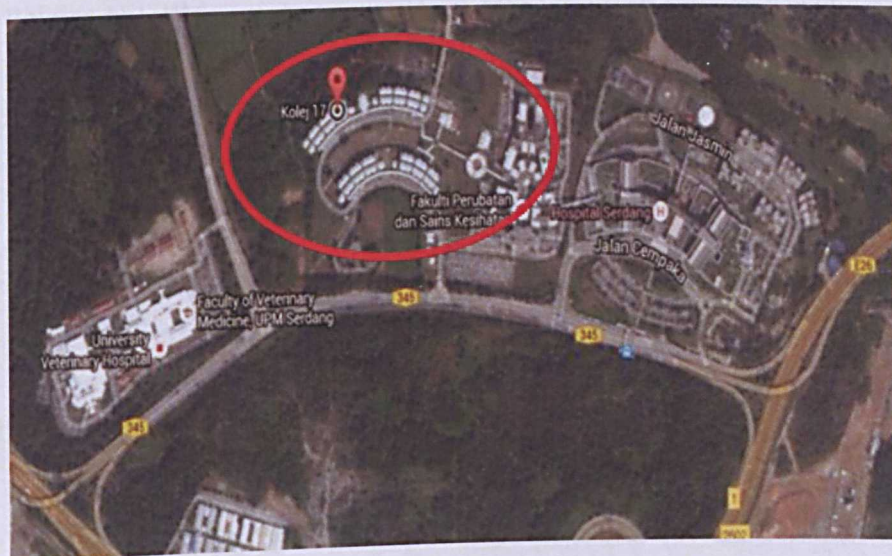
Ethnic group is a population of peoples that inhabit a specified geographical distribution and have certain physical characteristics in common. One product may not be suitable for different ethnic groups due to difference in anthropometrics differences among them (Pheasant, 2006).

## CHAPTER 3

### METHODOLOGY

#### 3.1 Study Location

This study was conducted at hostel of University Putra Malaysia. This hostel are occupied by the students of Faculty Veterinary and Faculty Medicine and Health Science. The occupants of the hostel are among the degree and master student. This hostel have four building and it is near the Hospital Serdang, Selangor. Below is the map showed the study location where the study will be conducted:



**Figure 3.1: Map of the study location.**

Source: Adopted from Google Maps.

### 3.2 Study design

A cross sectional study design was chosen to assess the association between ergonomic risk factors and discomfort among residence of hostel in UPM.

### 3.3 Sampling

#### 3.3.1 Sampling Population

The study population of this project are residence of UPM's hostel.

#### 3.3.2 Sampling Frame

The total of the residence of this hostel was obtained from Bahagian Hal Ehwal Pelajar of UPM.

College	Gender		Total
	Male	Female	
College 17	296	1066	1362

#### 3.3.3 Sampling Method

The respondents were randomly selected among males and females students who stayed at the hostel.

### 3.3.4 Sampling Unit

The students from this study location have the criteria of:

- 1) Both male and female students,
- 2) Undergraduate students
- 3) Age around 19 to 26 years old.

### 3.3.5 Study Sample

The sample size calculation by Kirkwood (2009) for sample size estimation, is shown below:

$$N = P(1 - P) / 0.05^2$$

Where,

N = Sample size

P = expected prevalence of proportion

e = standard error = 5%

Study conducted by Dockwell (2015), prevalence of Musculoskeletal Symptoms among university students was 52.8%
--

Hence, the sample size needed is:

$$N = 0.528(1 - 0.528) / 0.05^2$$

$$= 99.67$$

$$= 100 \text{ respondents}$$

So, 20% of 100 respondents are  
= 20

Thus, the total respondents are 120.

### 3.4 Sample Instrumentation

#### 3.4.1 Questionnaire survey

Students from hostel in UPM had been choose to participate in this questionnaire survey. A set of questionnaire namely Musculoskeletal Discomfort (MSD) Questionnaire was used in this study. It consists of four parts. Part A was used to determine the respondent's background such as age, gender, ethnic and BMI. Part B was used to obtain information on the musculoskeletal discomfort experienced by the students when using the study furniture provided at the hostel. Part C was used to obtain the MSD complaint of the students. This part was adopted from Body Part Discomfort (BPD) Scale published by Corlett and Bishop (1976). This part contained a diagram of 9 body parts which are neck, shoulder, upper arms, lower arms, wrist/hands, upper back, lower back, hips/buttocks and tight that assist the respondents to answer the questions for correct body parts. Part D was for a respondent's feedback. The questionnaire is in **Appendix D**.

### 3.4.2 Anthropometric Measurement

Seven anthropometric dimensions identified were measured using the measuring equipment such as anthropometry set, metal tape and weighing scale.

a. Height measurement

b. Weight measurement

c. Sitting measurement:

1. Shoulder height
2. Elbow-rest height
3. Buttock-popliteal Length
4. Popliteal height
5. Knee height

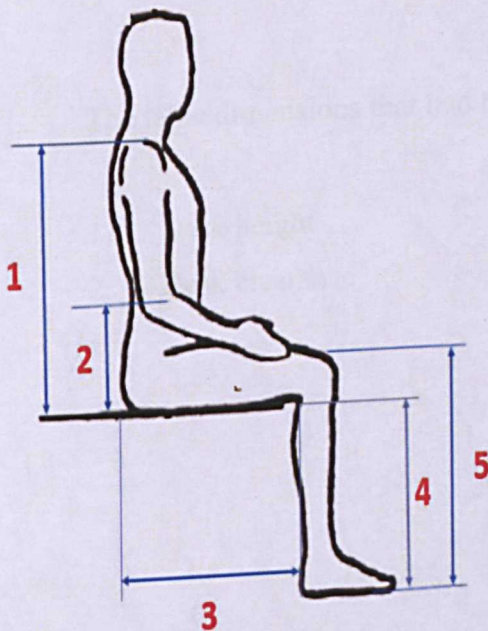


Figure 3.2:

The measurement taken for body dimension.

### 3.4.3 Furniture Measurement

The dimensions of the chair and table were measured. The chair dimensions that had been measured are:

1. Seat height - Distance from the highest point of the seat to the floor
2. Seat depth - Back of the sitting surface of the seat to its front

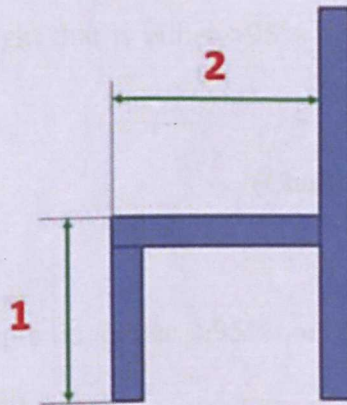


Figure 3.3: The measurement taken for seat dimension.

The table dimensions that had been measured are:

1. Desk height - From the floor to the front edge of the shelf
2. Desk clearance - From the floor to the front edge of the shelf

## Anthropometric Mismatch

In order to determine incompatibility of the body dimension of subjects and furniture dimension, four rules were determined:

**Table 3.1: Types of mismatch and its rule.**

Type of Mismatch	Equation
Popliteal height and seat height mismatch:	<p>Seat height that is either &gt;95% or &lt;88% of the popliteal height.</p> <p>(Chaffin and Anderson, 1991)</p>
Buttock-popliteal length and seat depth mismatch:	<p>Seat depth is either &gt;95% or &lt;80% of the buttock-popliteal height.</p> <p>(Panagiotopoulou et al., 2004)</p>
Knee height and table clearance mismatch:	<p>Occurring when the table is &lt;2cm higher than the knee height.</p> <p><math>A = \text{Desk clearance} - \text{Knee height}</math></p> <p>(Mandal, 1982)</p>
Elbow rest height and table height mismatch:	<p>Elbow rest height and table height mismatch occurred when the desk height was either lower than minimum desk</p>

Type of Mismatch	Equation
height or higher than the maximum desk height calculated from the formula.	Acceptable desk height is determine by the equation :
	$hE = hEv + \mu [(1 - \cos \theta) + \cos \theta (1 - \cos \beta)]$
	where,
	hE = vertical distance from the top of the desk to the student's sitting surface
	hS = shoulder height
	hEv = elbow height
	U = hS – hEv = upper arm length shoulder flexion
	(Parcells et al., 1999)

### 3.4.4 Rapid Upper Limb Assessment (RULA)

RULA was used to evaluate the awkward posture of the respondents while using the study furniture at their hostel. RULA was developed by Mc Atamney and Corlett (1993) from University of Nottingham's Institute of Occupational Ergonomics. Observations that had been conducted were expressed in numeric scores which then recorded in RULA form. The final scores for RULA was determined through the matrix of scoring. The score was classified into one of four categories which are posture is acceptable, further investigation is needed and

change may be required, investigation and changes are required soon and investigation and changes are required immediately.

The posture of the student was assessed in two analysis which are:

1. Arm and Wrist Analysis
2. Neck, Trunk and Leg Analysis

RULA checklist form that was used for the observations of the posture was in **Appendix E**.

### **3.4.5 Rapid Office Strain Assessment (ROSA)**

ROSA was a picture based posture checklist which designed to quantify exposure to risk factors associated with the work station of the students with computer related activities. ROSA method has been developed by Sonne et al., (2012).

The checklist of the assessment have 3 section, which are:

- |           |                                  |
|-----------|----------------------------------|
| Section A | - The chair height and pan depth |
|           | - Arm rest, back support         |
| Section B | - Monitor                        |
| Section C | - Keyboard and mouse             |

Scores of greater than 5 are deemed to be “high risk” and the workstation should be assessed further.

### **3.5 Data Collection Procedure**

#### **3.5.1 Phase 1 – Preliminary**

Conducted a pre-testing of the methods. The questionnaire was tested to 10% of the same potential study participants. It was then computed in Cronbach alpha where it is consider adequate or good when it is between 0.75 to 0.85.

#### **3.5.2 Phase 2 – Preparatory**

All the sets of questionnaire was updated and corrected to allow the data collection tools to suit with the design of the study.

#### **3.5.3 Phase 3 – Questionnaire Survey and Personal Data Collection**

Questionnaire was distributed to the students to answer, and interview was conducted throughout the questionnaire filing.

### **Anthropometric measurement**

The measurement of the body dimension was taken each of the respondents. The measuring equipment used for anthropometric data collections are anthropometry set, metal tape and weighing scale.

### **Furniture measurement**

The measurement of the furniture will be taken using a metal tape.

### **Rapid Upper Limb Assessment (RULA)**

A single page of RULA checklist form was used to evaluate required body posture, force and repetition. Evaluation was made from the observations and score for each body region in Section A for arm and wrist and section B for neck and trunk were entered. After data for each region was collected and scored, tables on the form are then used to compile the risk factor variables, generating a single score that represents the level of MSD risk. The RULA checklist form was attached at **Appendix E**.

### **Rapid Office Strain Assessment (ROSA)**

A ROSA checklist sheet was used during the assessment. Evaluation was made based on the postures that were observed and duration that are reported by the person that are being assessing was recorded. The ROSA checklist sheet was attached at **Appendix F**.

### 3.5.4 Phase 4 – Measurement Evaluation

Some of the data obtained was undergo some mathematics calculation to obtain the reading for possible mismatch. Some of the data which are from RULA and ROSA will be drawn in a matrix form. All the data obtained from data collection will be compiled together and key in the Statistical Package for Social Science (SPSS) version 22.0.

### 3.6 DATA ANALYSIS

All the statistical analysis was conducted using Statistical Package for Social Science (SPSS) version 22.0. Descriptive analysis was performed for sociodemographic of respondents, number of mismatch case, prevalence of musculoskeletal discomfort and prevalence of body parts complaints. Chi square test was performed for ergonomics risk factors and sociodemographic background with musculoskeletal discomfort.

**Table 3.2: Specific objectives and its statistical analysis.**

Specific Objectives	Statistical Analysis
To determine the possible mismatch between the student's body dimensions and the dimensions of the study furniture used in the college.	Descriptive
To determine the musculoskeletal complaints among the respondents.	Descriptive
To determine the prevalence of discomfort among the respondent.	Descriptive

---

**Specific Objectives****Statistical Analysis**

---

To determine the association between risk factors to discomfort among respondents.

Chi Square

- Anthropometry and furniture (mismatch)

- ROSA

- RULA

To determine the association between sociodemographic background to the discomfort among respondents.

- Age

Chi Square

- Gender

- BMI

- Ethnicity

---

### 3.7 Quality Control

#### Pre-test

A pre-test was conducted prior to actual data collection for this research. The respondents was tested on the adopted questionnaire to evaluate their level of understanding or perception of the questionnaire. This aim to ensure that the question is suitable and understood by the respondents, so that any mistakes could be rectify before the actual data collection. This also help in preventing bias limitation and help strengthen the result when the actual respondents answer the questionnaires.

The questionnaire will be given to the 10% of the same potential study participants for pre-test. The computed Cronbach alpha is adequate or good when it is in between 0.75 to 0.85. For this study, the MSD Questionnaire was validated with 0.835 Cronbach alpha.

### 3.8 Study Ethic

This study obtained an approval from University Ethics Committee for researches involving human of University Putra Malaysia. Reference item of Ethical Approval was UPM/TNCPI/RMC/1.4.18.1 (JKEUPM)/F2. Permission from college management to conduct this study was also obtained. Permission from respondents that took part in this study were obtained from written consents of the respondents before the data collection process was conducted. Besides, the privacy of information and confidential of the respondents were protected.

## CHAPTER 4

### RESULTS AND DISCUSSION

#### 4.1 Background

This study was mainly to study the association between ergonomic risk factors and musculoskeletal discomfort among students of University Putra Malaysia. The respondents for this study were collected among the female and male students from the residence of UPM hostel.

The total number of students involved in this study were 120 with 33 male and 87 female students. The respondents were randomly selected from the population which fulfill all the inclusion criteria that has been stated before. The respondents are from undergraduate program that age between 19 to 26 years old and stay at the hostels of UPM.

## 4.2 Descriptive Analysis

### 4.2.1 Sociodemographic of Respondents

Table 4.1 showed the distribution of the subjects according to the sociodemographic characteristics. Majority of the respondents are female (72.5%) and the remaining 27.5% are male respondents. The age ranged between 20 to 26 years old with the mean age of  $22.41 \pm 1.260$ . 50% of the respondents were ranged in the age of 20 to 23 years old range and another 50% were ranged in the age of 24 to 26 years old range. Nearly 70% of the respondents are having a normal BMI.

Majority of the respondents were Malay with 84.2% and only a few of them were India, Chinese and others. The academic level for all of the respondents were undergraduate. Nearly 30% of the respondents were the students of Environmental and Occupational Health course followed by the Biomedical, Nutrition, Medic, Dietetic, Veterinary and Nursing course. The mean for year of study of the respondents were  $3.23 \pm 0.950$ , ranging from first year students to 5<sup>th</sup> year students. Most of the respondents (45.8%) were 4<sup>th</sup> year students. This showed that most of the respondents have more than 3 years of experienced of using the study furniture provided at the hostel.

**Table 4.1: Socio demographic characteristics of the respondent.**

<b>Variable</b>	<b>Frequency</b>	<b>Percentage (%)</b>	<b>Mean ± S.D</b>
<b>Gender</b>			
Male	33	27.5	
Female	87	72.5	
<b>Age</b>			
≤ 23	60	50	22.41 ± 1.260
≥ 24	60	50	
<b>BMI</b>			
Normal	84	70	
Abnormal	36	30	
<b>Ethnicity</b>			
Malay	101	84.2	
India	6	5	
Chinese	5	4.2	
Others	8	6.7	
<b>Academic Level</b>			
Undergraduate	120	100	
Postgraduate	0	0	
<b>Course</b>			
KPP	36	30	
PKK	18	15	

<b>Variable</b>	<b>Frequency</b>	<b>Percentage (%)</b>	<b>Mean ± S.D</b>
Biomedical	26	21.7	
Nursing	8	6.7	
Medic	12	10	
Dietetic	10	8.3	
Veterinary	10	8.3	
<b>Year of Study</b>			
1 <sup>st</sup> Year	7	5.8	
2 <sup>nd</sup> Year	19	15.8	
3 <sup>rd</sup> Year	36	30	3.23 ± 0.950
4 <sup>th</sup> Year	55	45.8	
5 <sup>th</sup> Year	3	2.5	

#### 4.2.2 Mismatch between Anthropometry Measurements of the Respondents and the Furniture

Table 4.3 illustrated the number and percentage of the respondents that have mismatch between their body anthropometry measurement and the furniture measurement. Anthropometric data taken from the respondents were used to calculate the mismatch. A total of five anthropometric data were taken for all of the respondents involved in this study. The anthropometric data of the respondents

are presented in Table 4.2. The mean, standard deviation, minimum, maximum and 5<sup>th</sup>, 50<sup>th</sup>, and 95<sup>th</sup> percentile were calculated for all the anthropometric measurements taken as illustrated in Table 4.2. The values that are calculated were combined male and female respondents. The data of elbow height, shoulder height, knee height, popliteal height and buttock-popliteal height were used to calculate the possible mismatch between body dimension and the furniture dimension.

**Table 4.2: Summary of anthropometric dimension among the respondents. (n= 120)**

<b>Anthropometric Dimension</b>	<b>Mean</b>	<b>SD</b>	<b>Min</b>	<b>Max</b>	<b>5<sup>th</sup> percentile</b>	<b>50<sup>th</sup> percentile</b>	<b>95<sup>th</sup> percentile</b>
<b>Age (years)</b>	22.41	1.260	20	26	20	23	24
<b>Elbow Height (cm)</b>	22.59	2.559	15.00	31.00	18.00	23	26
<b>Shoulder Height (cm)</b>	58.38	3.476	50.00	67.00	53.00	58	64
<b>Knee Height (cm)</b>	50.08	2.917	44	58	45	50	57
<b>Popliteal Height (cm)</b>	42.33	2.381	34	49	39	42	47
<b>Buttock-popliteal Height (cm)</b>	45.07	3.392	37	56	40	45	51.95

There are four mismatch that are calculated from the data collection which are knee height and table clearance mismatch, buttock-popliteal and seat depth mismatch, popliteal height and seat height mismatch and elbow rest height and table height mismatch. There were 113 (94.2%) of the respondents had a popliteal height and seat height mismatch problems. There were 23 (19.2%) of the respondents had a buttock-popliteal and seat depth mismatch problems. There were no cases of mismatch for knee height and table clearance mismatch and elbow rest height and table height mismatch. Thus, the prevalence of overall mismatch that occurred among the respondents in the hostels was 95%. From this, it can be concluded that the furniture provided at the hostels was not match with the student's anthropometry dimension. From this study, popliteal height and seat height mismatch was the highest mismatch cases (94.2%). It is reported that popliteal height was the important design factor for seat height (Legg *et al.*, 2003 as cited in Grimes & Legg, 2004). Recent study conducted by Ismaila *et al.*, (2013), a total of 93.75% of the respondents complained of neck, shoulder, upper and lower back pain that they attributed to the furniture they utilized.

**Table 4.3: Mismatch between anthropometry measurements of the respondents and the furniture.**

Variable	Frequency	Percentage (%)
<b>Mismatch</b>		
Knee Height and Table Clearance Mismatch		
Yes	0	0
No	120	100
Buttock-popliteal and Seat Depth Mismatch		
Yes	23	19.2
No	97	80.8
Popliteal Height and Seat Height Mismatch		
Yes	113	94.2
No	7	5.8
Elbow Rest Height and Table Height Mismatch		
Yes	0	0
No	120	100
<b>Overall Mismatch</b>	<b>114</b>	<b>95</b>

#### 4.2.3 The Prevalence of Musculoskeletal Discomfort among the Respondents

As illustrated in Table 4.4, the musculoskeletal discomfort scales of the respondents were obtained from part B of the questionnaire which consist of six items which are the comfort with sitting on the chair, comfort with height of the chair, comfort with the length of seat pan, comfort with the angle of back support, comfort with the level of monitor and comfort with the position of keyboard and mouse. There are two level of discomfort which are experienced a discomfort and not experienced a discomfort. There were 93 (77.5%) of the respondents had a discomfort while sitting on the chair. There were 80 (66.7%) of the respondents had a discomfort with the height of the chair and length of the seat pan. There were 70 (58.3%) of the respondents had a discomfort with the level of monitor of the laptop while putting it on the table provided at the hostel. There were 83 (69.2%) of the respondents had a discomfort with the position of the keyboard and mouse. Thus, the prevalence of discomfort among the respondents were high with 76.7%.

This study showed a high prevalence of musculoskeletal discomfort among the students (76.7%). The data for the prevalence of musculoskeletal discomfort was in Table 3. The study conducted by Dockwell *et al.*, (2015), the prevalence of musculoskeletal symptoms among undergraduate students was 52.8%. Prolong seating may cause discomfort for the students like muscle fatigue, soreness, numbness and feeling pain. According to Vergara and Page (2002), the main reason for increase in general discomfort in seated position was discomfort from

lumbar region. Low back pain cases are rare among young people (Turner et al., 1989, as cited in Murphy et al., 2004).

**Table 4.4: The prevalence of musculoskeletal discomfort among the respondents.**

Variable	Frequency	Percentage (%)
<b>Discomfort with Sitting on the Chair</b>		
Yes	93	77.5
No	27	22.5
<b>Discomfort with Height of the Chair</b>		
Yes	80	66.7
No	40	33.3
<b>Discomfort with the Length of Seat Pan</b>		
Yes	80	66.7
No	40	33.3
<b>Discomfort with the Angle of Back Support</b>		
Yes	90	75
No	30	25
<b>Discomfort with the Level of Monitor</b>		
Yes	70	58.3
No	50	41.7
<b>Discomfort with the Position of Keyboard and Mouse</b>		
Yes	83	69.2
No	37	30.8
<b>Overall Discomfort</b>	<b>92</b>	<b>76.7</b>

#### 4.2.4 The Prevalence of Body Parts Complaints

The prevalence of body parts complaint was determined from the questionnaire in part C. The body parts that being asked are head/neck, shoulders, upper arms, lower arms, wrists/hands, upper back, lower back, hips/buttocks and tight. As illustrated in table 4.5, the study showed that from 9 body parts, the prevalence of body parts complaints showed the highest complained was shoulders (85.8%). The high number of complaints were followed by lower back pain (82.5%). The overall complaint received was more than the number of respondents, this means that there are certain respondents that have more than one parts of their body experienced discomfort.

More than 95.8% of the students complained that they are suffering from body aches while using the study furniture provided at their hostel. In Table 4.5, among all the 9 body parts that being asked, shoulders, lower back, hips/buttocks and neck having as the most pain areas. In this study, the average duration of the respondents sitting on the chair was one to four hours per day. A study from Pope et al., (2002) suggested that the fixed postures and prolonged seating are the risk factors for the development of low back pain.

**Table 4.5: The prevalence of body parts complaints among the respondents.**

<b>Body Parts</b>	<b>Frequency</b>	<b>Percentage (%)</b>
Head/neck	94	78.3
Shoulders	103	85.8
Upper Arms	63	52.5
Lower Arms	59	49.2
Wrist/hands	72	60
Upper Back	89	74.2
Lower Back	99	82.5
Hips/buttocks	96	78.3
Tight	62	51.7
<b>Overall Complaint</b>	<b>737</b>	

N = 120

### 4.3 Bivariate Analysis (Chi Square)

#### 4.3.1 Association between Sociodemographic Background and Musculoskeletal Discomfort

From table 4.6, it showed that the sociodemographic background of the respondents were not shown to be significantly associated to the musculoskeletal discomfort including age ( $\chi^2 = 0.000$  with p-value = 1.000), gender ( $\chi^2 = 0.108$  with p-value = 0.743), BMI ( $\chi^2 = 0.033$  with p-value = 0.855) and ethnicity ( $\chi^2 = 3.106$  with p-value = 0.376). According to Woolf & Pfleger (2003), the cases of low back pain increase with age and it also affected by lifestyle factors such as obesity. It stated that aged between 25 to 64 years has the highest incidence of low back pain. A study conducted by Gerr et al., (2002) found that the nonwhite workers had a lower occurrence of neck pain than whites workers.

**Table 4.6: Association of sociodemographic background and discomfort.**

Variable (N)	Discomfort (%)		$\chi^2$	p-value
	Yes	No		
<b>Age</b>				
≤ 22	57	3	0.000	1.000
≥ 23	57	3		
<b>Gender</b>				
Male	31	2	0.108	0.743
Female	83	4		
<b>BMI</b>				
Normal	80	4	0.033	0.855
Abnormal	34	2		
<b>Ethnicity</b>				
Malay	96	5	3.106	0.376
India	6	0		
Chinese	4	1		
Others	8	0		

Statistical Test – Chi Square

#### 4.3.2 Association of Ergonomic Risk Factors and Musculoskeletal Discomfort

From Table 4.7, it showed that the ergonomics risk factors for ROSA, RULA and mismatch were not shown to be significantly associated to the overall musculoskeletal discomfort of the respondents.

#### **Association between Rapid Office Strain Assessment (ROSA) and Musculoskeletal Discomfort**

ROSA was used to quantify the risks associated of work station of the students with computer related activities. ROSA final scores ranged from 1 to 10, it was then transformed into two level which are high risk and low risk. Students have a lot of assignment that needs them to use computer. Computer use have a potential risk for development of musculoskeletal disorder through the hands and wrist, head and neck, shoulder, elbow and lower back. From this study, there was no significant association between ROSA and musculoskeletal discomfort among the respondents ( $\chi^2 = 2.635$ , p-value = 0.105). However, study conducted by Harris and Straker (2000) been reported that number of students that needs treatment for musculoskeletal injuries and discomfort associated with computer use was increasing. Chair design was emphasized in ROSA where the pan depth, chair height, back support and armrest were needed to be scored. According to Oxford (1969) as cited in Grimes & Legg, (2004), the ill-fitted furniture will impact the

students, such as when they sit on chair that are too low, there is a probability for them to slouch and adopt a bad posture. Also if the chairs are too high, they tend to perch to the front of the seat, thus they will not lean back to the back support.

### **Association between Rapid Upper Limb Assessment (RULA) and Musculoskeletal Discomfort**

RULA was conducted through an observation of the student's posture while doing their work using the study furniture. This techniques was used to assess postural health of the students as they tend to sit in a long period of time and perform an awkward postures. The outcome for this study, there was no significant association between musculoskeletal discomfort and RULA score ( $\chi^2 = 4.634$ , p-value= 0.099). Murphy et al., (2004) cited a study conducted by Lee and Chiou (1994) poor sitting habits were statistically associated to low back pain. It also reported that, a lot of adult who suffered low back pain had their first onset of back pain in their 20s. Since the subject that are involved in this study was young adults, it is possible not to have any association between RULA score and musculoskeletal discomfort.

## **Association between Mismatch and Musculoskeletal Discomfort**

There was no significant association between musculoskeletal discomfort and mismatch between anthropometry measurement of the respondents and the furniture dimension ( $\chi^2 = 0.194$  with p-value = 0.660). However, improper design of the furniture and ill-fitted to the student's anthropometry can result in fatigue and awkward posture which could affect their focus in doing their works. Study conducted by Benjamin et al., (2003) stated that, an ill-fitted furniture has been shown to lead to increase of musculoskeletal strains and loads, decrease productivity and health of the respondents.

**Table 4.7: Association of ergonomics risk factors and discomfort.**

Variable (N)	Discomfort (%)		$\chi^2$	p-value
	Yes	No		
<b>ROSA Assessment</b>				
High risk	73	6	3.278	0.070
Low Risk	41	0		
<b>RULA Assessment</b>				
Posture acceptable if not maintained or repeated for long periods	0	0	0.260	0.878
Further Investigation is needed and changes may be required	47	3		
Investigation and changes are required soon	65	3		
Investigation and changes are required immediately	2	0		
<b>Mismatch</b>				
Yes	86	5	0.194	0.660
No	28	1		

The previous discussion had mention that the ergonomic risk factors and musculoskeletal discomfort was not shown to be significantly associated. So, the independent variable for this study was break into a small fragments to see a deeper review of the association between musculoskeletal discomfort and ergonomic risk factors. The musculoskeletal discomfort was broke into three fragments which are

discomfort of chair, the level of monitor and the position of mouse and keyboard. In Table 4.8, Table 4.9 and Table 4.10 showed the results of the analysis. From Table 4.8, it showed that the ROSA and RULA scores of the respondents were not shown to be significantly associated to the musculoskeletal discomfort which specifically for chair that are provided at the hostel.

**Table 4.8: Association of ergonomic risk factors and musculoskeletal discomfort (Chair).**

	Variable (N)	Discomfort (%)		$\chi^2$	p-value
		Yes	No		
<b>CHAIR</b>	<b>ROSA Assessment</b>				
	High risk	103	10		
	Low Risk	7	0	0.676	0.411
	<b>RULA Assessment</b>				
	Posture acceptable if not maintained or repeated for long periods	0	0		
	Further Investigation is needed and changes may be required	46	4		
	Investigation and changes are required soon	62	6		
Investigation and changes are required immediately	2	0	0.210	0.900	

As illustrated in Table 4.9, ROSA and RULA scores of the respondents showed no significant association to the musculoskeletal discomfort which specifically for level of the monitor of the laptop when putting it on the table provided at the hostel.

**Table 4.9: Association of ergonomic risk factors and musculoskeletal discomfort (Level of Monitor).**

	Variable (N)	Discomfort (%)		$\chi^2$	p-value
		Yes	No		
<b>LEVEL OF MONITOR</b>	<b>ROSA Assessment</b>				
	High risk	12	58		
	Low Risk	7	43	0.216	0.642
	<b>RULA Assessment</b>				
	Posture acceptable if not maintained or repeated for long periods	0	0		
	Further Investigation is needed and changes may be required	29	21		
	Investigation and changes are required soon	40	28		
Investigation and changes are required immediately	1	1	0.066	0.967	

From Table 4.10, the study showed that the ROSA and RULA scores of the respondents were not shown to be significantly associated to the musculoskeletal discomfort which specifically for position of the keyboard and mouse of the computer.

**Table 4.10: Association of ergonomic risk factors and musculoskeletal discomfort (Position of mouse and keyboard).**

	Variable (N)	Discomfort (%)		$\chi^2$	p-value
		Yes	No		
<b>POSITION OF MOUSE AND KEYBOARD</b>	<b>ROSA Assessment</b>				
	High risk	23	12	0.276	0.599
	Low Risk	60	25		
	<b>RULA Assessment</b>				
	Posture acceptable if not maintained or repeated for long periods	0	0	2.074	0.355
	Further Investigation is needed and changes may be required	38	12		
	Investigation and changes are required soon	44	24		
Investigation and changes are required immediately	1	1			

## **CHAPTER 5**

### **CONCLUSION AND RECOMMENDATIONS**

#### **5.1 Conclusion**

This study had shown that there was a high prevalence of musculoskeletal discomfort (76.7%) among the university students. Most of the students are facing a musculoskeletal discomfort whenever they use the study furniture provided at the hostel. The prevalence of mismatch (95%) shown that the current study furniture available at the hostels was not match with the student's anthropometry dimension. Therefore, suitable furniture that fit to the body dimension of the students should be used to avoid the increasing of risks among the students at the university. The ergonomic risk factors of musculoskeletal discomfort can be avoided through the approach of ergonomic interventions programs such as ergonomically design furniture.

## 5.2 Recommendation

There are some recommendations that would like to suggest to the college management of University Putra Malaysia to help to reduce and control the incidence of musculoskeletal discomfort among the students who stay at the hostels. Table 5.1 illustrate the summary of anthropometry dimension among the respondents. Based on the anthropometry data measurements taken from the respondents, a new dimension of the chair can be produced from the data received. Thus, Table 5.2 showed the recommendation for the dimensions of chair that suit the anthropometric dimensions of the students.

**Table 5.1. Summary of anthropometric dimension among the respondents. (n= 120)**

<b>Anthropometric Dimension</b>	<b>Mean</b>	<b>SD</b>	<b>Min</b>	<b>Max</b>	<b>5<sup>th</sup> percentile</b>	<b>50<sup>th</sup> percentile</b>	<b>95<sup>th</sup> percentile</b>
<b>Age (years)</b>	22.41	1.260	20	26	20	23	24
<b>Elbow Height (cm)</b>	22.59	2.559	15	31	18	23	26
<b>Shoulder Height (cm)</b>	58.38	3.476	50	67	53	58	64
<b>Knee Height (cm)</b>	50.08	2.917	44	58	45	50	57
<b>Popliteal Height (cm)</b>	42.33	2.381	34	49	39	42	47
<b>Buttock-popliteal Height (cm)</b>	45.07	3.392	37	56	40	45	52

The new table and chair dimension was obtained from the a few determinant that were taken from the anthropometry data of the respondents. Seat surface height, seat depth, back rest height, back rest angle and table height that are suggested was 39cm, 40cm, 53cm, 110° and 67cm respectively. This new dimension of chair and table might reduce the number of mismatch between the student's anthropometry and furniture dimension and therefore it will reduce the incidence of musculoskeletal discomfort among the students.

**Table 5.2: Recommended dimensions for chair and table for use in the hostels.**

<b>Features</b>	<b>Anthropometric measure</b>	<b>Design Dimension</b>	<b>Criteria/Determinant</b>
<b>Seat surface height</b>	Popliteal height (PH)	39cm	5 <sup>th</sup> percentile of popliteal height
<b>Seat depth</b>	Buttock-popliteal length (BPL)	40cm	5 <sup>th</sup> percentile of buttock-popliteal length
<b>Back rest height (upper) above seat</b>	Sitting shoulder height (SSH)	53cm	5 <sup>th</sup> percentile of sitting shoulder height
<b>Back rest angle to horizontal</b>	-	110°	-
<b>Table height</b>	-	68cm	Max acceptable height = (SEH + 7.5cm) + (PH - 5cm) + shoes allowance

### 5.3 Study Limitation

The main limitation of the study is it was a cross sectional study which not all risk factors related to musculoskeletal discomfort were studied in this study. The risk variables in this study were predictive and seen as exploratory rather than an examination of pain and causal factors.

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## **APPENDICES**

Medical Clearance

**APPENDIX A:**

**Ethical Clearance**

**JKEUPM Ref No. : FPSK(EXP15-OSH)U014**

a) Members of the JKEUPM who reviewed the documents:  
Prof Dr Zamberi Sekawi

b) Date of approval: 31/12/2015

Endorsed at JKEUPM Meeting on 8/1/2016, attended by:

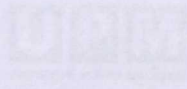
NAME	DESIGNATION	GENDER	TICK IF PRESENT
Prof. Dato' Dr. Abdul Jalil Nordin	Nuclear Radiologist & Dean, Faculty of Medicine and Health Sciences	Male	√
Prof. Dr Zamberi Sekawi	Medical Microbiologist & Deputy Dean of Research and Internationalization, Faculty of Medicine and Health Sciences	Male	√
Prof. Dato' Dr. Lye Munn Sann	Medical Statistician, Dept of Community Health, Faculty of Medicine and Health Sciences	Male	
Prof. Dr. Tengku Aizan Abd Hamid	Gerontologist & Director, Institute of Gerontology	Female	
Prof. Dr. Lekhraj Rampal	Medical Statistician, Dept of Community Health, Faculty of Medicine and Health Sciences	Male	√
Prof. Dr. Lim Thiam Aun	Anesthesiologist, Dept of Surgery, Faculty of Medicine and Health Sciences	Male	√
Prof. Dr. Patimah Ismail	Professor of Biomedicine, Dept of Biomedical Sciences, Faculty of Medicine and Health Sciences	Female	√
Prof. Dr. Johnson Stanslas	Pharmacologist, Dept of Medicine, Faculty of Medicine and Health Sciences	Male	
Prof. Dr. Sherina Mohd.Sidik	Professor of Medical, Department of Psychiatry, Faculty of Medicine and Health Sciences	Female	√
Prof Dr. M. Iqbal Saripan	Professor of Department of Computer and Communication Systems Engineering	Male	
Assoc. Prof. Dr. Mansor Abu Talib	Assoc. Professor of Guidance and Counselling, Dept of Human Development and Family Studies, Faculty of Human Ecology	Male	
Assoc. Prof. Dr. Hejar Abd.Rahman	Assoc. Professor of Public Health / Head Of Unit, Department of Community Health, Faculty of Medicine and Health Sciences	Female	√
Assoc. Prof. Dr. Normala Ibrahim	Assoc. Professor of Psychiatry, Department of Psychiatry, Faculty of Medicine and Health Sciences	Female	√

Assoc Prof Dr Sharmala Paramasivam	Assoc Prof of Department English, Faculty of Modern Languages and Communication	Female	
Assoc Prof Dr Arshad Abdul Samad	Assoc Prof of Department Language and Humanities Education, Faculty of Educational Studies	Male	√
Assoc Prof Dr Muhamamd Najib Mohamad Alwi (Independent Member)	Psychiatric Consultant, Cyberjaya University College of Medical Sciences ( CUCMS)	Male	√
Dr. Salmiah Md. Said	Lecturer of Epidemiology, Medical Statistics, Department of Community Health, Faculty of Medicine and Health Sciences	Female	√
Assoc. Prof. Dr. Noritah Omar (Lay Person)	Assoc. Professor of English Language, Dept of English Language, Faculty of Communication and Modern Languages	Female	√
Dr. Rojanah Kahar (Lay Person)	Senior Lecturer of Dept of Human Development and Family Studies, Faculty of Human Ecology	Female	
Tan Sri Dato' Napsiah Omar (Independent Member)	Chairman, National Population and Family Development Board	Female	√
En John Posko Anthony (Lay Person)	Headmaster of Sekolah Jenis Kebangsaan (Tamil) Kajang	Male	√

Permission Letter to Study Location

**APPENDIX B:**

**Permission Letter to Study Location**



**FORM B1: RESPONDENT'S INFORMATION SHEET AND CONSENT**

Please read the following information carefully and do not hesitate to discuss any concerns you may have with the researcher.

**1. STUDY TITLE**

The relationship between Organisational Commitment and Organizational Citizenship Behaviors (OCB) in public

**2. INTRODUCTION**

You are being invited to participate in a research project. The study is a research on the relationship between  
 Organizational Commitment and Organizational Citizenship Behaviors (OCB) in public  
 employees. We are looking for individuals who are currently employed in a public sector organization.  
 We are looking for individuals who are currently employed in a public sector organization.

**APPENDIX C:**

**FORM B1: Respondent's Information Sheet and Consent  
 Letter**

**3. WHAT WILL YOU HAVE TO DO?**

You will be asked to complete a questionnaire to answer the research questions. It will take about 15 minutes to complete.

**4. WHO SHOULD NOT PARTICIPATE IN THE STUDY?**

Individuals who are not currently employed in a public sector organization should not participate in the study.

**5. WHAT WILL BE THE BENEFITS OF THE STUDY?**

**6. AM I TO BE THE SUBJECT?**

The research will be conducted in a public sector organization. The findings of the study may benefit public sector organizations in general.

**7. AM I TO BE INVOLVED?**

Participation in the study is voluntary. You may withdraw from the study at any time without any penalty or loss of benefits to which you are entitled.



**FORM B1: RESPONDENT'S INFORMATION SHEET AND CONSENT**

Please read the following information carefully and do not hesitate to discuss any questions you may have with the researcher.

**1. STUDY TITLE :**

The Association between Ergonomic Risk Factors and Discomfort among Residence of UPM's hostel.

**2. INTRODUCTION:**

You are being invited to take part in a research study. This study is aim to study the association between ergonomic risk factors and discomfort among the students. Please take time to read the following information carefully and ask us if there is anything that is not clear or if you would like more information.

All information you provide for this study is confidential and anonymous. Names are not recorded anywhere, and nothing can be attributed to you personally.

**3. WHAT WILL YOU HAVE TO DO?**

You will be provided a set of questionnaire to answer and be asked to sign a consent form.

**4. WHO SHOULD NOT PARTICIPATE IN THE STUDY?**

Every students that are residence of College 17 have the same chances to be a respondents.

**5. WHAT WILL BE THE BENEFITS OF THE STUDY:**

**(a) TO YOU AS THE SUBJECT?**

You are able to contribute towards the aims of the study. The findings of this study may benefit you or the other residence of 17 College in future.

**(b) TO THE INVESTIGATOR?**

**9. CONSENT**

I ..... Identity Card No. ....  
address.....

.....hereby voluntarily agree to take part in the research stated above \*(clinical /drug trial/video recording/ focus group/interview-based/ questionnaire-based).

I have been informed about the nature of the research in terms of methodology, possible adverse effects and complications (as written in the Respondent's Information Sheet). I understand that I have the right to withdraw from this research at any time without giving any reason whatsoever. I also understand that this study is confidential and all information provided with regard to my identity will remain private and confidential.

I\* wish / do not wish to know the results related to my participation in the research

I agree/do not agree that the images/photos/video recordings/voice recordings related to me be used in any form of publication or presentation (if applicable)

\* delete where necessary

Signature .....  
(Respondent)

Signature .....  
(Witness)

Date :.....

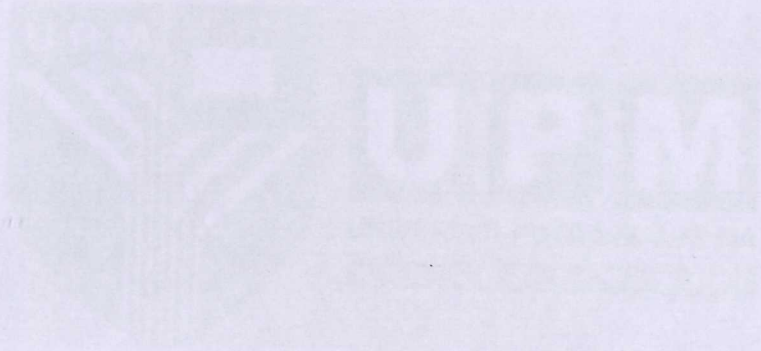
Name :.....

I/C No. :.....

I confirm that I have explained to the respondent the nature and purpose of the above-mentioned research.

Date .....

Signature .....  
(Researcher)



FACULTY OF MEDICINE AND  
HEALTH SCIENCE  
UNIVERSITY PUTRA MALAYA  
43000 SERDANG, SELANGOR  
MALAYSIA

**APPENDIX D:**

**QUESTIONNAIRE FORM**  
**MSD Questionnaire**

RESEARCH TITLE: THE ASSOCIATION  
BETWEEN ECONOMIC RISK  
FACTORS AND DISCOMFORT AMONG  
RESIDENCE OF COLLEGE 17 OF  
UNIVERSITY PUTRA MALAYSIA

PART A: BACKGROUND INFORMATION OF

RESPONDENT NO.



FACULTY OF MEDICINE AND  
HEALTH SCIENCES

UNIVERSITY PUTRA MALAYSIA,  
43400 SERDANG, SELANGOR,  
MALAYSIA.

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# QUESTIONNAIRE FORM

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**RESEARCH TITLE: THE ASSOCIATION  
BETWEEN ERGONOMIC RISK  
FACTORS AND DISCOMFORT AMONG  
RESIDENCE OF COLLEGE 17 OF  
UNIVERSITY PUTRA MALAYSIA**

## PART A: BACKGROUND INFORMATION OF THE RESPONDENT

1. Gender : Female  Male
2. Age : .....
3. Body Weight : ..... kg
4. Height : ..... cm
5. BMI : .....
6. Ethnicity : Malay  India  Chinese   
Others  State:.....
7. Academic level : Undergraduate  Post Graduate
8. Course : KPP  PKK  BioMedic   
Nursing  Medic  Others   
State:.....
9. Year of Study : 1<sup>st</sup> year   
2<sup>nd</sup> year   
3<sup>rd</sup> year   
4<sup>th</sup> year   
5<sup>th</sup> year

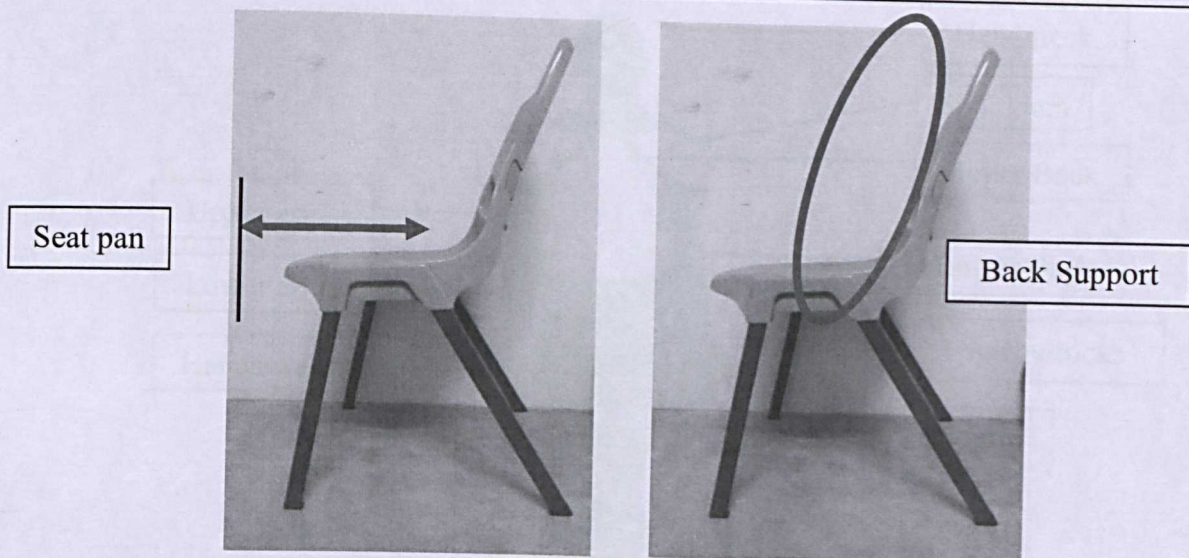
## PART B: GENERAL COMFORT RATING

Questions on this part aim to know students' experiences of **discomfort** when using the study furniture (table and chair) provided at the hostel for doing work, study or using the computer. A picture of a chair and the labels below the table will help you to answer the questions.

Please tick the point that best describes your feelings.

- 1 = Very comfortable
- 2 = Comfortable
- 3 = Uncomfortable
- 4 = Very uncomfortable

		Comfort Rate			
<b>Study Furniture</b>					
1	Do you feel comfortable with the overall study furniture (table and chair)?	1	2	3	4
2	Do you feel comfortable sitting on the chair?	1	2	3	4
3	Do you feel comfortable with the height of the chair?	1	2	3	4
4	Do you feel comfortable with the length of the seat pan of the chair?	1	2	3	4
5	Do you feel comfortable with the angle of the back support of the chair?	1	2	3	4
<b>Computer Use</b>					
6	Do you feel comfortable with the level of the monitor when putting the computer on the table?	1	2	3	4
7	Do you feel comfortable with the position of the keyboard and mouse?	1	2	3	4



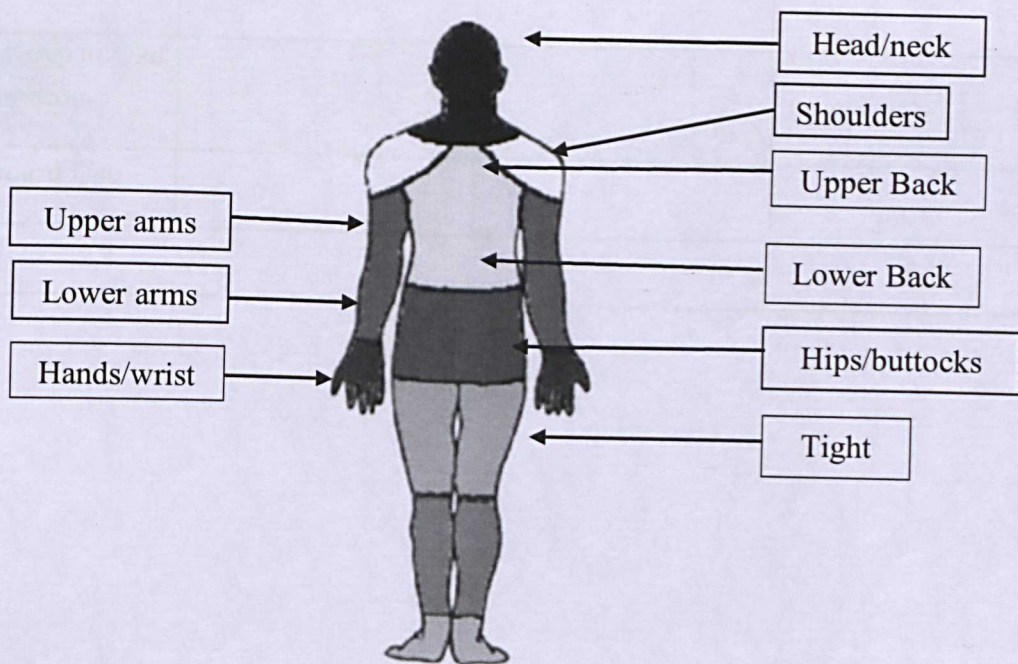
## PART C: BODY PART DISCOMFORT (BPD)

This part aim to know the location of pain that you might feel when you are using the study furniture (table and chair) for doing your work, study or using the computer for a few hours. Remember, pain, includes aches, numbness, tingling, stiffness or burning sensation.

Please tick the point that best describes your feelings.

- 1 = No Pain
- 2 = Mild Pain
- 3 = Moderate Pain
- 4 = Severe Pain

	Pain Scale			
Head/neck	1	2	3	4
Shoulders	1	2	3	4
Upper Arms	1	2	3	4
Lower Arms	1	2	3	4
Wrist/hands	1	2	3	4
Upper Back	1	2	3	4
Lower Back	1	2	3	4
Hips/buttocks	1	2	3	4
Tight	1	2	3	4



**PART D: RESPONDENT'S FEEDBACK**

1. Do you have any suggestion(s) to improve the comfort level of the study furniture in the hostel?

.....

.....

.....

**Additional Information:**

This part aim to know your **duration of use** of chair, monitor, hand phone, mouse and keyboard at your hostel. Please tick the answers according to your daily duration of use.

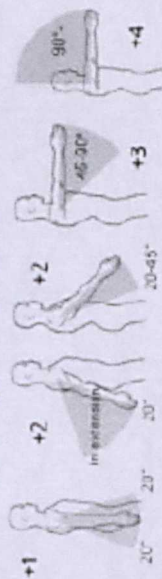
	Duration of Use		
	Less than 1 hour per day	Between 1 to 4 hours per day	More than 4 hours per day
Chair Use Duration			
Monitor Duration			
Hand phone Duration			
Mouse/ Keypad Use Duration			
Keyboard Use			

**APPENDIX E:**

**Rapid Upper Limb Assessment (RULA) Form**

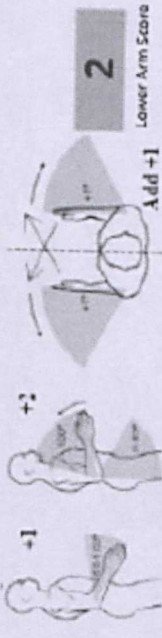
**A. Arm and Wrist Analysis**

**Step 1: Locate Upper Arm Position:**



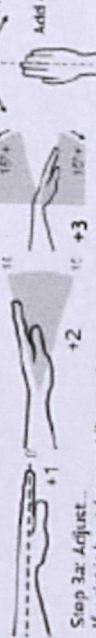
**Step 1a: Adjust...**  
If shoulder is raised: +1  
If upper arm is abducted: +1  
If arm is supported or person is leaning: -1

**Step 2: Locate Lower Arm Position:**



**Step 2a: Adjust...**  
If either arm is working across midline or out. to side of body: Add +1

**Step 3: Locate Wrist Position:**



**Step 3a: Adjust...**  
If wrist is bent from midline: Add +1

**Step 4: Wrist Twist:**

If wrist is twisted in mid-range: +1  
If wrist is at or near end of range: +2

**Step 5: Look-up Posture Score in Table A:**

Using values from steps 1-4 above, locate score in Table A

**Step 6: Add Muscle Use Score**

If posture mainly static (i.e. held > 10 minutes), Or if action repeated occurs 4x per minute: +1

**Step 7: Add Force/Load Score**

If load < 4.4 lbs. (intermittent): +0  
If load 4.4 to 22 lbs. (intermittent): +1  
If load 4.4 to 22 lbs. (static or repeated): +2  
If more than 22 lbs. or repeated or shocks: +3

**Step 8: Find Row in Table C**

Add values from steps 5-7 to obtain Wrist and Arm Score. Find row in Table C.

**Scores**

Table A		Wrist Score			
Upper Arm	Lower Arm	Wrist Twist	Wrist Twist	Wrist Twist	Wrist Twist
		1	2	3	4
1	1	1	2	2	3
1	2	2	2	2	3
1	3	2	2	2	3
2	1	2	3	3	4
2	2	3	3	3	4
2	3	3	3	3	4
3	1	3	4	4	5
3	2	3	4	4	5
3	3	4	4	4	5
4	1	4	4	4	5
4	2	4	4	4	5
4	3	4	4	4	5
5	1	5	5	5	6
5	2	5	5	5	6
5	3	5	5	5	6
6	1	6	6	6	7
6	2	6	6	6	7
6	3	6	6	6	7

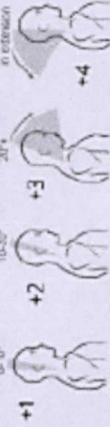
**Table C**

Wrist / Arm Score	Neck, Trunk, Leg Score						
	1	2	3	4	5	6	7
1	1	2	3	4	5	6	7
2	2	3	4	5	6	7	8
3	3	4	5	6	7	8	9
4	4	5	6	7	8	9	9
5	5	6	7	8	9	9	9
6	6	7	8	9	9	9	9
7	7	8	9	9	9	9	9

Scoring: (final score from Table C)  
1-2 = acceptable posture  
3-4 = further investigation, change may be needed  
5-6 = further investigation, change soon  
7 = investigate and implement change

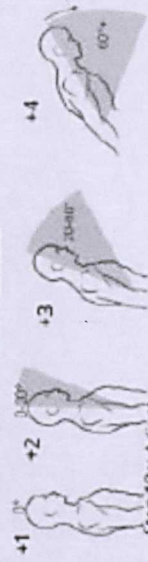
**B. Neck, Trunk and Leg Analysis**

**Step 9: Locate Neck Position:**



**Step 9a: Adjust...**  
If neck is twisted: +1  
If neck is side bending: +1

**Step 10: Locate Trunk Position:**



**Step 10a: Adjust...**  
If trunk is twisted: +1  
If trunk is side bending: +1

**Step 11: Legs:**

If legs and feet are supported: +1  
If not: +2

Neck Posture Score	Table B: Trunk Posture Score					
	1	2	3	4	5	6
1	1	2	3	4	5	6
2	2	3	4	5	6	7
3	3	4	5	6	7	7
4	4	5	6	7	7	7
5	5	6	7	7	7	7
6	6	7	7	7	7	7

**Step 12: Look-up Posture Score in Table B:**

Using values from steps 9-11 above, locate score in Table B

**Step 13: Add Muscle Use Score**

If posture mainly static (i.e. held > 10 minutes), Or if action repeated occurs 4x per minute: +1

**Step 14: Add Force/Load Score**

If load < 4.4 lbs. (intermittent): +0  
If load 4.4 to 22 lbs. (intermittent): +1  
If load 4.4 to 22 lbs. (static or repeated): +2  
If more than 22 lbs. or repeated or shocks: +3

**Step 15: Find Column in Table C**

Add values from steps 12-14 to obtain Neck, Trunk and Leg Score. Find Column in Table C.

Neck, Trunk, Leg Score

Posture B Score + Muscle Use Score + Force / Load Score =

5

RULA Score

7

**APPENDIX F:**

**Rapid Office Strain Assessment (ROSA) Form**



# RAPID OFFICE STRAIN ASSESSMENT

## ROSA SCORING INSTRUCTIONS

1. Add Seat Pan and Seat Depth scores together to receive Section A vertical Axis Score. Add Arm Rest and Back Rest scores together to receive the vertical axis score. Using these scores, follow the scoring chart to receive the Chair Score. Add the appropriate duration score based on the amount of time the worker spends in the chair per day.
2. Add the score for the Monitor with the appropriate duration score to receive the value for the horizontal axis in Section B. Add the telephone score together plus the appropriate duration score to receive the vertical axis for Section B. Using these scores, follow the scoring chart to receive the Section B score.
3. Add the score for the keyboard to the appropriate duration score to receive the value for the horizontal axis in Section C. Add the score of the mouse to the appropriate duration score to receive the vertical axis for Section C. Using these scores, follow the scoring chart to receive the Section C score.
4. Use the score from step 2 to receive the score for the vertical axis in the peripheral and monitor section. Use the score from step 3 to receive the score for the horizontal axis in the peripheral and monitor section.
5. Use the score from Step 1 (Section A) to receive the value for the vertical axis in the grand score chart. Use the score from step 4 to receive the score for the horizontal axis in the grand score chart. Using these two scores, find the corresponding Grand ROSA score.

		SECTION A SCORE									
		Arm Rest and Back Support									
		2	3	4	5	6	7	8	9		
seat pan height / depth	2	2	2	3	4	5	6	7	8		
	3	2	2	3	4	5	6	7	8		
	4	3	3	3	4	5	6	7	8		
	5	4	4	4	4	5	6	7	8		
	6	5	5	5	5	6	7	8	9		
	7	6	6	6	7	7	8	8	9		
	8	7	7	7	7	8	8	9	9		

		SECTION B SCORE									
		Monitor									
		0	1	2	3	4	5	6	7		
Phone	0	1	1	1	2	3	4	5	6		
	1	1	1	2	2	3	4	5	6		
	2	1	2	2	3	3	4	6	7		
	3	2	2	3	3	4	5	6	8		
	4	3	3	4	4	5	6	7	8		
	5	4	4	5	5	6	7	8	9		
	6	5	5	6	7	8	8	9	9		

		SECTION C SCORE									
		Keyboard									
		0	1	2	3	4	5	6	7		
Mouse	0	1	1	1	2	3	4	5	6		
	1	1	1	2	3	4	5	6	7		
	2	1	2	2	3	4	5	6	7		
	3	2	3	3	3	4	5	6	7		
	4	3	4	4	5	5	6	7	8		
	5	4	5	5	6	6	7	8	9		
	6	5	6	6	7	7	8	8	9		

		Peripherals and Monitor										ROSA FINAL SCORE	
		Chair											
		1	2	3	4	5	6	7	8	9	10		
Chair	1	1	2	3	4	5	6	7	8	9	10		
	2	1	2	3	4	5	6	7	8	9	10		
	3	2	3	4	5	6	7	8	9	10			
	4	3	3	4	5	6	7	8	9	10			
	5	4	4	4	5	6	7	8	9	10			
	6	5	5	5	6	7	8	9	10				
	7	6	6	6	6	7	8	9	10				
	8	7	7	7	7	7	8	9	10				
	9	8	8	8	8	8	8	8	9	10			
	10	9	9	9	9	9	9	9	9	10			

		MONITOR AND PERIPHERALS SCORE												
		Monitor and Telephone					Mouse and Keyboard							
		1	2	3	4	5	6	7	8	9				
Monitor and Telephone	1	1	2	3	4	5	6	7	8	9				
	2	1	2	3	4	5	6	7	8	9				
	3	2	2	3	4	5	6	7	8	9				
	4	3	3	3	4	5	6	7	8	9				
	5	4	4	4	4	5	6	7	8	9				
	6	5	5	5	5	5	6	7	8	9				
	7	6	6	6	6	6	6	6	7	8	9			
	8	7	7	7	7	7	7	7	7	7	8	9		
	9	8	8	8	8	8	8	8	8	8	8	9		
	10	9	9	9	9	9	9	9	9	9	9	9		

		MONITOR AND PERIPHERALS SCORE												
		Monitor and Telephone					Mouse and Keyboard							
		1	2	3	4	5	6	7	8	9				
Monitor and Telephone	1	1	2	3	4	5	6	7	8	9				
	2	1	2	3	4	5	6	7	8	9				
	3	2	2	3	4	5	6	7	8	9				
	4	3	3	3	4	5	6	7	8	9				
	5	4	4	4	4	5	6	7	8	9				
	6	5	5	5	5	5	6	7	8	9				
	7	6	6	6	6	6	6	6	7	8	9			
	8	7	7	7	7	7	7	7	7	7	8	9		
	9	8	8	8	8	8	8	8	8	8	8	9		
	10	9	9	9	9	9	9	9	9	9	9	9		