



UNIVERSITI PUTRA MALAYSIA

***SURFACE ELECTROMYOGRAPHY BASED MUSCLE ACTIVITY
ANALYSIS FOR PROLONGED MOTORCYCLE RIDING***

NUR FARHANA BT ABD JAIZ

**Ip
FPSK4 2015 2**

**SURFACE ELECTROMYOGRAPHY BASED MUSCLE
ACTIVITY ANALYSIS FOR PROLONGED MOTORCYCLE
RIDING**



**BY
NUR FARHANA BT ABD JAIZ**

**This 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.**

ABSTRACT

Surface Electromyography (EMG) Based Muscle Activity Analysis for Prolonged Motorcycle Riding

Nur Farhana bt Abd Jaiz

Introduction: Motorcyclist faced more ergonomic hazard that related to the human body especially to the lower back. **Objective:** The main objective of this study is to determine the effectiveness of lumbar support. The main issues were approached in ergonomics based on the supportive of back pain which include 1) the analysis of muscle activation and 2) the analysis of muscle fatigue. **Methodology:** One hundred and twenty motorcyclists have participated in this study. All motorcyclists should in good physical condition and do not have musculoskeletal disorder symptoms. The subjects have divided into two groups which are control group and experimental group. Each participant was asked to sit for 2 hours on motorcycle in two different sessions in controlled room environment. This study is carried out by electromyography (EMG) to evaluation of muscular strain for each participant in each session and Borg 'Scale questionnaire to identify the rating of discomfort at interval 15 minutes in every session. The statistical analysis will find out by paired t-test by identifying the relationship between back support, muscle activation and muscle fatigue. **Result:** There is significant ($t= 6.81, p = <0.001$) when using lumbar support in muscle activity evaluation because the protection of staining back muscle helps to avoid putting too much strain on the lumbar area. There is also significant in Borg' Scale questionnaire evaluation ($t = 4.82, p= <0.001$) because by using a lumbar support improved posture because it trained the body to seated and stand upright in good posture. **Conclusion:** The intervention (lumbar support) is engineering improvement that gives the effectiveness and relaxation riding for motorcyclist. There is a significant different between pre evaluation without an intervention and post evaluation without an intervention.

Keyword: Musculoskeletal Disorder, Surface Electromyography (sEMG), Borg' Scale and Lumbar Support

ABSTRAK

Analisis Aktiviti Otot berdasarkan Permukaan Electromyography (EMG) untuk Pengguna Motorsikal Secara Berpanjangan

Nur Farhana bt Abd Jaiz

Pengenalan: Motorsikal menghadapi risiko yang tinggi terutamanya pada ergonomik. **Objektif:** Objektif utama kajian ini adalah untuk menentukan keberkesanan sokongan lumbar. Antara isu utama untuk pendekatan dalam ergonomic dalam sokongan belakang ini adalah 1) analisi pengaktifan otot dan 2) analisis keletihan otot. **Metodologi:** Seratus dua puluh orang penunggang motorsikal telah mengambil bahagian dalam kajian ini, semua pelajar mestilah dalam keadaan fizikal yang baik dan tidak mempunyai symptom musculoskeletal. Penunggang motorsikal akan terbahagi kepada dua kumpulan iaitu kumpulan kawalan dan kumpulan eksperimen. Setiap pelajar diminta untuk duduk selama 2 jam di atas motorsikal pada dua sesi yang berbeza di dalam persekitaran bilik yang dikawal. Kajian ini dijalankan menggunakan permukaan electromyography (EMG) untuk penilaian ketegangan otot untuk setiap peserta dalam setiap sesi dan borang soal selidik Skala Borg' untuk mengenal pasti kedudukan yang tidak selesa pada setiap 15 minit bagi setiap sesi. Analisis statistic akan diketahui dengan menggunakan bepasangan ujian-t untuk mengenal pasti hubungan antara sokongan belakang, pengaktifan otot dan keletihan otot. **Keputusan dan Perbincangan:** Keputusan menunjukkan signifikan ($t=6.81, p<0.001$) apabila menggunakan sokongan lumbar dalam menilai aktiviti otot kerana apabila member perlindungan kepada otot yg tegang terutama pada kawasan lumbar. Keputusan untuk borang soal selidik Borg' juga menunjukkan signifikan ($t=4.82, p<0.001$) kerana dengan menggunakan sokongan lumbar akan memperbaiki kedudukan dan melatih tubuh untuk duduk tegak dalam kedudukan yang baik. **Kesimpulan:** Intervensi (sokongan lumbar) adalah peningkatan teknik yang berkesan dan member keselesaan kepada penunggang untuk menunggang motorsikal. Terdapat perbezaan yang signifikan antara pra penilaian intervensi dan pos penilaian tanpa intervensi.

Kata kunci: Gangguan Otot Serangka, Permukaan Electromyography (EMG), Skala Borg' dan Sokongan Lumbar.

TABLE OF CONTENTS

	Page
DECLARATION	ii
SIGNATURE OF SUPEVISOR/ INTERNAL EXAMINER	iii
ACKNOLEDGEMENT	iv
ABSTRACT	v
ABSTRAK	vi
CONTENTS	vii
LIST OF TABLES	xii
LIST OF FIGURES	xiii
LIST OF ABBREVIATIONS	xv
CHAPTER 1: INTRODUCTION	
1.1 Background	1
1.2 Research Justification	3
1.3 Problem Statement	4
1.4 Objectives	7

1.5	Hypothesis	8
1.6	Definition and term	9
1.6.1	Conceptual Definition	9
1.6.2	Operational Definition	10
1.7	Conceptual Framework	12
CHATER 2: LITERATURE REVIEW		27
2.1	Motorcycle	14
2.2	Musculoskeletal Disorder	16
2.3	Electromyography and Borg 'Scale	18
2.4	Lumbar Support	20
CHAPTER 3: METHDOLOGY		35
3.1	Study Design	21
3.2	Study Location	22
3.3	Sampling	37
3.3.1	Sampling Population	23
3.3.2	Sampling Frame	23

3.3.3	Inclusion and Exclusion Criteria	24
3.3.4	Sampling Method	25
3.3.5	Sample Size	25
3.4	Instrumentation and Data Collection Technique	
3.4.1	Instruments	27
3.4.1.1	Questionnaire	27
3.4.1.2	Measuring Tape and Weighing Scale	30
3.4.1.3	Electromyography	30
3.4.2	Data Collection Procedure	31
3.5	Validity and Reliability	33
3.6	Data Analysis	35
3.7	Quality Control	
3.7.1	Pre Test	36
3.7.2	Standard Operating Procedure (SOP)	37
3.8	Study Limitation	
3.8.1	Electromyography	38

3.9	Ethical Consideration	38
CHAPTER 4: RESULTS		
4.1	Study Background	40
4.2	Descriptive Data	
4.2.1	Socio demographic data for respondent	41
4.2.2	Discomfort Information	43
4.3	Comparison of Borg Scale of Discomfort Rating	
4.3.1	Comparison of Borg Scale of Discomfort Rating between Pre and Post Control group	45
4.3.2	Comparison of Borg Scale of Discomfort Rating between Pre and Post Experimental group	46
4.3.3	Comparison of Borg Scale of Discomfort Rating between Pre Control and Pre Experimental group	47
4.3.4	Comparison of Borg Scale of Discomfort Rating between Post Control and Post Experimental group	48
4.4	Comparison of Electromyography with Muscle Activity	
4.4.1	Comparison of Electromyography with Muscle Activity between Pre and Post Control group	51
4.4.2	Comparison of Electromyography with Muscle Activity between Pre and Post Experimental group	52
4.4.3	Comparison of Electromyography with Muscle Activity between Post Control group and Experimental group	53
CHAPTER 5: DISCUSSION, CONCLUSION AND RECOMMENDATION		

5.1	DISCUSSION	
5.1.1	Subject and Methods	55
5.1.2	Discomfort Information	57
5.1.3	Comparison of Electromyography with Muscle Activity between Pre and Post Experimental group	57
5.1.4	Comparison of Borg Scale of Discomfort Rating between Pre and Post Experimental group	60
5.1.5	Comparison of Electromyography with Muscle Activity between Post Control group and Experimental group	62
5.1.6	Comparison of Borg Scale of Discomfort Rating between Post Control and Post Experimental group	63
5.2	Conclusion	64
5.9	Recommendation	65
	REFERENCES	68
	APPENDICES	

LIST OF TABLES

		Page
Table 4.1	Socio demographic of the workers who participated in the study (N=120)	41
Table 4.2	Discomfort 'Break Point' data distribution at lower back (Borg Scale rating ≥ 5)	49
Table 4.3	Paired Sample t-test for both group	50
Table 4.4	Mann- Whitney U test for both groups	50
Table 4.5	Paired Sample t-test for both group	54
Table 4.6	Independent t-test for Post Control and Experimental Group	54
Figure 3.2	The recommend conceptual design. Complete seat	6
Figure 3.3	The recommend conceptual design. Complete seat with backrest support in 45 degree	7
Figure 3.4	Schematic diagram of the experimental setup. The total period of 15 min of Borg scale rating is every 15 min time period. In Control group	12
Figure 3.5	Data Collection	33
Figure 4.1	Part of body that feel pain, numb, burning or discomfort	44
Figure 4.2	Part of body that feel pain when riding a motor cycle	44
Figure 4.3	Graph of Borg Scale of Discomfort Rating between Pre Control and Post Control group	45
Figure 4.4	Graph of Borg Scale of Discomfort Rating between Pre Post Experimental group	46
Figure 4.5	Graph of Borg Scale of Discomfort Rating between Pre Control and Pre Experimental group	47
Figure 4.6	Graph of Borg Scale of Discomfort Rating between Post Control and Post Experimental group	48
Figure 4.7	Graph of Electromyography with Muscle Activity between Pre and Post Control group	51

LIST OF FIGURES

		Page
Figure 1.1	General Motorcyclist riding posture	3
Figure 1.2	The recommend conceptual design. Complete seat without built in lumbar support in fold close.	6
Figure 1.3	The recommend conceptual design. Complete seat with built in lumbar support in fold close	6
Figure 1.4	Conceptual Framework	13
Figure 3.1	Motorcycle with Lumbar Support (Prototype)	22
Figure 3.2	Borg CR-10 scale	29
Figure 3.3	The body chart discomfort using Borg CR-10 scale	29
Figure 3.4	Schematic schedule measurement including: 1) The total period of time, 2) Borg's scale recording at every 15 min time period, 3) Continuous EMG recording	32
Figure 3.5	Data Collection Procedure	33
Figure 4.1	Part of body that feel pain, aches, burning or discomfort	44
Figure 4.2	Part of the body that feel pain when riding a motorcycle	44
Figure 4.3	Graph of Borg Scale of Discomfort Rating between Pre and Post Control group.	45
Figure 4.4	Graph of Borg Scale of Discomfort Rating between Pre and Post Experimental group	46
Figure 4.5	Graph of Borg Scale of Discomfort Rating between Pre Control and Pre Experimental group	47
Figure 4.6	Graph of Borg Scale of Discomfort Rating between Post Control and Post Experimental group	48
Figure 4.7	Graph of Electromyography with Muscle Activity between Pre and Post Control group	51

Figure 4.8	Graph of Electromyography with Muscle Activity between Pre and Post Experimental group	52
Figure 4.9	Graph of Electromyography with Muscle Activity between Post Control Group and Post Experimental group	53
Figure 5.1	Wavelength recorded from the electromyography	59
Figure 5.2	The control group subject without intervention	59
Figure 5.3:	The experimental subject with an intervention	60
Figure 5.4	Seat without intervention during pre evaluation	61
Figure 5.5	Seat with intervention during post evaluation	62
Figure 5.6	Recommendation on lower back support sitting posture	66
Figure 5.7	Recommendation on seating material	66

LIST OF ABBREVIATIONS

%	Percentage
MIROS	Malaysian Institute of Road Safety
MSD	Musculoskeletal Disorder
LBP	Low Back Pain
EMG	Electromyography
WT	Wavelet or wavelength
MAV	Mean Absolute Value
ZC	Zero Crossing
AR	Autoregressive coefficient
RMS	Root mean square
SPSS	Statistical Packaging for Social Science
MF	Mean Frequency

CHAPTER 1

INTRODUCTION

1.1 Background

Motorcycle are one of the transport that always choose by Malaysian to move from one another place because it is cheaper, compact, agile, consume less fuel and using less maintenance compare to car. Therefore, the numbers of motorcycle on the roads are increasing every year (Karmegam et al., 2012). Unfortunately, the high number of motorcycle may leads to high numbers of accidents involving motorcycle. The Malaysian Institute of Road Safety Research (MIROS) 2011, state that the new registered motorcycle until 2010 is about 9 million and the amount of motorcycle accident about 120,156, and the ratio of motorcycle accident to motorcycle user is 1:1.52. The result also shows that about 113,962 involved in road accident have 3,640 riders that cause accidental fatalities and another 430 are pillions.

Then, motorcycles are regarded as first choice of transportation for Malaysian in urban area. The transportation are continue to grow and may contribute traffic congestion every year. Thus, the motorcycle is chosen because the smaller size and high manoeuvrability that will reduce the stress of rider during traffic jam happened. Other than that, the prices are suitable for lower income group to get the motorcycles as daily transportation. Then, the advantages that attract people to use motorcycle are about parking. The parking spaces are easier to find compare to cars as well as it free of charges. For the fuel price in Malaysia, the motorcycle is safer cheaper compared to the car because the fuel consumption by car is more than motorcycle (Dorothy & Edmund, 2013). From the Royal Malaysia Police data has shows the percentage of death by road user category is highest for motorcycle user (58%) and follow with car user (26%) and the others user such as heavy trucks, buses, pedestrians (16%). Therefore, the risk of death when motorcycling is 4 to 5 times compare to driving (World Health Organization, 2013).

There are several reasons for people choosing motorcycle even they knew it give higher risk compare to car. One of the reasons is job responsibilities such as postman, police traffic and more have to choose motorcycle to complete their duties to move one another place. Motorcyclists are subjected to several hazards such as physical, biological, chemical, psychosocial and ergonomic. Among this, the ergonomic hazards such as musculoskeletal disorder are one of critical effect to motorcyclist (Alperovitch-Najenson et.al, 2010). The musculoskeletal disorder develops when there is pressure on the lower back because there is no support

especially in prolonged riding that show in figure 1.1 for a normal motorcycle that always used by motorcyclist.



Figure 1.1: General Motorcyclist riding posture (Karmegam et al,2011)

1.2 Research Justification

There are a lot of studies about driving comfortability especially for car driver and buses compare to motorcyclists. However, research and sources information regarding motorcyclists' comfortability is a small chance to find it and it is also limited. This study is important because riding a motorcycle are facing more physically and mentally demanding compare to driving especially in air and

ergonomic hazard. From the Start online, 5 March 2014 state that the number of motorcycles and cars are equal and it takes concern by MIROS director general Professor Wong Shaw Voon because the limited engineering space in motorcycle that make the number of accident among motorcyclist increasing (Dina,M, 2014).

The purpose of this study was to reduce motorcyclist discomfort. This is because, motorcyclist are more exposed to sitting hazard during riding compare to car drivers because the motorcycle seat design do not have any backrest support. Therefore, this study will be identify the effectiveness of lumbar support can stabilize the pressure in the body of motorcyclist by comparing the comfortability of the subject when have the lumbar support and do not have the lumbar support. This is because, a good posture will make riding comfortable and less induces of muscle fatigue when having a lumbar support (Karmegam et.al, 2012; Giusepper et al, 2002).

1.3 Problem Statement

Drivers' and riders comfort are one of important factor to reduce the amount of accident that has been increasing lately. The high factors that cause muscular and skeletal disorders such as pain in the lower back (LB), neck and shoulder is seated posture especially in a long journey user. Sitting with poor posture

will also develop discomfort and musculoskeletal disorders to human body (Karmegam et al, 2011). When the motorcyclist have seated for a long time, the chain of metabolic, structural and energetic muscle will be changes because of insufficient oxygen and nutritive substance that supply through blood circulation will gives changes the efficiency of the nervous system. Therefore, it will give muscle fatigue and give discomfort to motorcyclist. It also might give the post stroke to the motorcyclist if the activities happen frequently (Mario et.al, 2009; Soraia et.al, 2014).

There are studies done by Karmegam et al, (2011) in Malaysia had proposed one of ergonomic improvement which is lumbar support as improve level of discomfort among motorcyclist that show in figure 1.3 in complete design where as it can built without lumbar support as shown in figure 1.2. The recommended design is intended to provide back support for motorcyclist and his pillion during riding process. However, the researcher stated that this recommended design required some further field testing to enhance the ability in providing support to lumbar region during riding process. Therefore, this research permission was obtained from the previous researcher for assessing the Surface Electromyography Based Muscle Activity Analysis for Prolonged Motorcycle Riding when sitting in a trial section.

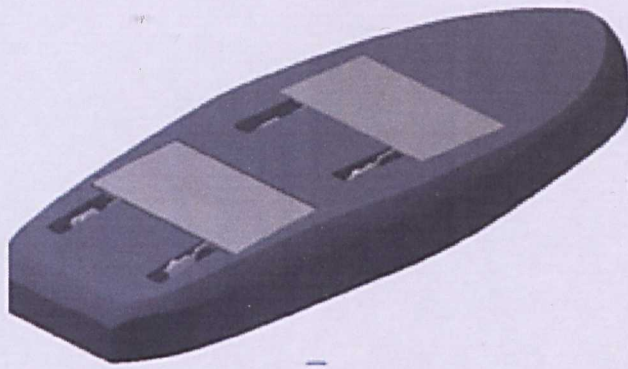


Figure 1.2: The recommend conceptual design. Complete seat without built in lumbar support in fold close (Karmegam et al, 2011)



Figure 1.3: The recommend conceptual design. Complete seat with built in lumbar support in fold close (Karmegam et al, 2011)

1.4 Objectives

1.4.1 General Objectives

To analyze the effectiveness of lumbar support on muscle in prolongs riding among motorcyclist.

1.4.1 Specific Objectives

1.1.1.1 To compare the muscle activation in mean frequency (MF) between pre and post evaluation of experimental group by using electromyography.

1.1.1.2 To compare the rating in Borg' Scale of discomfort between pre and post evaluation of experimental group.

1.1.1.3 To compare the muscle activation in mean frequency (MF) when post evaluation between control and experimental group by using electromyography.

1.1.1.4 To compare the rating in Borg' Scale of discomfort in post evaluation of control and experimental group.

1.5 Hypothesis

The hypothesis will be tested are shows in the null form:

- 1.5.1 There are no differences in muscle activation in mean frequency (MF) between pre and post evaluation in experimental group by using electromyography.
- 1.5.2 There are no differences in rating in Borg' Scale of discomfort between pre and post evaluation in experimental group.
- 1.5.3 There are no differences in muscle activation in mean frequency (MF) when post evaluation between control and experimental group in mean frequency (MF).
- 1.5.4 There are no differences in rating in Borg' Scale of discomfort in post evaluation between control and experimental group.

1.6 Definition of term

1.6.1 Conceptual definition

1.6.1.1 Muscle Contraction

Muscle contraction is a muscle that undergoes when increase in tension or force. The contraction of muscle will be substitute with action or activation because when the load is greater than muscle force, the stretch produces a reversal in the force generating working stroke is reduced. (Faulkner, 2003)

1.6.1.2 Awkward Posture

Awkward posture are the posture that caused fatigue, pain, or injury when do some activities repeatedly or for prolonged period because of the contraction of muscle, tendon or ligaments. It is because of less sufficient blood supply to the body that leads to muscle fatigue. (Keyserling, Brouwer & Silverstein, 1992)

1.6.1.3 Muscle Fatigue

Muscle fatigue happens because of insufficient of blood that contain of oxygen that supply through blood circulation and effect to the nervous system.

(Cifrek, Medved, Tonkovic, & Ostojic, 2009)

1.6.2 Operational definition

1.6.2.1 Discomfort

Discomfort is happen when an individual have a repetitively or long period of force happened to the body. Therefore, the borg' scale are use to analyse by ratter or numbered scales for the comfortability with written language.

(Spielholz, 2006)

1.6.2.2 Muscle Activity

Muscle activity is identify when there is movement pattern that we can observe by using electromyography from the interaction between external forces (joint reaction and ground reaction) and internal forces (produce by muscles and other soft tissue) used whether during moving position or static position such as walking or grip on load by hand (Piia,H et.al, 2013). The patterns appear that show the activity of muscle to be different for each muscle and between the age and physical activity of the subject (Laughton et.al, 2003).

1.6.2.3 Muscle Fatigue

Muscle fatigue is described as a feel of weakness and muscle pain because of the contraction of muscle with the force activities. When the muscle contraction, there is many biological changes occur such as increase in metabolite. It can be measure by using electromyographic recording that produce electrical activity of nearby muscle from the surface electrode. This interference signal may be recorded to the surface electromyography signal of

the muscle even when the muscle is relaxed. (González-Izal, Malanda, Gorostiaga, & Izquierdo, 2012)

1.7 Conceptual Framework

Motorcycle are exposed more hazard compare to car such as chemical hazard, physical hazard and through ergonomic (Giusepper et.al, 2002). The main hazard for motorcycle that exposed to a user is ergonomic (Karmegam et.al, 2009), while ergonomic is related to the human body such as neck or head, arm and hand, lower back and many more. The statement from MIROS director general Prof Wong Shaw Voon also concern about limit in engineering space in motorcycle to improve the safety (Dina, 2014).

The effect to motorcyclist if the engineering limitation is not overcome, the number of cases accident among motorcycle is increasing because of discomfort. This is because, sitting with poor posture will develop musculoskeletal disorder and tend to lack of concentration during riding. (Mario et.al, 2009; Soraia et.al, 2014) Meanwhile, this muscle activity also will give muscle pain and muscle fatigue other than muscle discomfort and induced motorcyclist to have mental stress and reduce in working performance. (Figure 1.4)

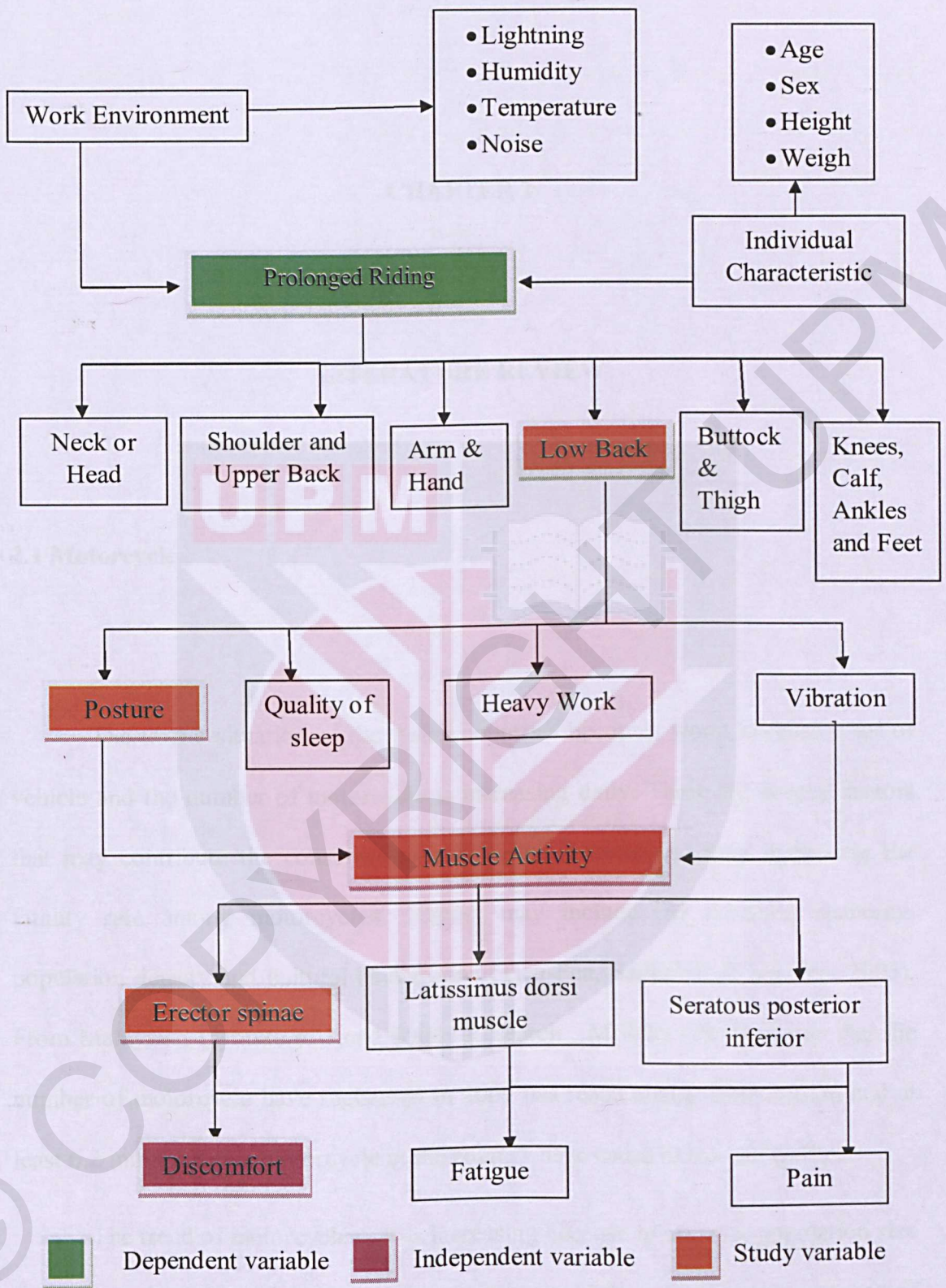


Figure 1.4: Conceptual Framework

CHAPTER 2

LITERATURE REVIEW

2.1 Motorcycle

The traffic situation of the Asian countries becomes worst because a lot of vehicle and the number of motorcycle is increasing daily. There are several factors that may contribute the consumer to buy the motorcycle and may increasing the fatality rate among motorcyclist. Factors may include the weather, economy, population density and cultural background (Tien-Pen, Sadlullah & Nguyen, 2003). From Malaysian Institute of Road Safety Research , MIROS (2011), stated that the number of motorcycle have registered in 2009 has reach almost nine million and at least 6.2 million active motorcycle in the country have cause of the bad traffic.

The trend of motorcycle user is increasing because of increase population size and economic status. If the area or country has a high population, the amount of vehicle is also high and gives the difficulty to a people for travelling. Therefore,

almost people want to choose motorcycle as daily transportation and can pass easily through congested area. Other than that, motorcycle is preferred to a low and middle income (Shivakumara BS & Sridhar V, 2010) because they are compact, agile, consume less fuel, cheaper to buy and required less maintenance compare to car (Karmegam et. al, 2012). However, motorcycle facing more hazards which are noise, lighting, air and ergonomic compared to car.

There are many type of motorcycle in Malaysia with a certain function and design need by the riders. Based on study by Malaysian Riders, there are a lot of types of motorcycle use which are Superbike with 250 -1300CC, Tourer or touring bike with 1000CC, Motorcross, Motard, Moped with 50CC-125CC and Skuter with 250CC -900CC. The most rider choose because of smaller in size and fuel using is lesser is Moped or (Motorcycle with Pedal) motorcycle. This motorcycle is design with centrifugal automatic clutch for riders easily exchange the gear without trouble will attract the user.

Therefore, the ergonomics of facility for motorcycle that always has been choose by community due to its impact on safety, health, productivity and economy of the user. Most of the motorcycle in Malaysia especially Moped motorcycle is not ergonomic to the user when sitting position. This is because, the sitting position during riding give awkward and poor posture because it is limited body movement, static and seat without any back support. Ma'arof et.al (2012) mentioned in the study,

the awkward and poor posture will develop musculoskeletal disorders (MSD) and discomfort for whole body. This is because, the rider cannot lean their back that required the rider to use high energy to hold their body in straight position. At the end, it will develop musculoskeletal disorder (MSD) because of discomfort during riding process. (Karmegam,2009).

2.2 Musculoskeletal Disorder (MSD)

Discomfort is frequent issue among motorcyclist. Comfortable is subjective and it is very challenging to interpret, measure and specifically to define due to its psychophysical nature. One of factor that effect discomfort on motorcyclists is body parts such as arm, foot and lumbar. The discomfort at body parts mostly related to the lack of ergonomically interaction of human and machine (motorcycle) in the riding environment (Karmegam et. al, 2008). In the motorcycle, seating parts are the main activities when riding. The posture, size and density could give potential that introduce zones at the high pressure during riding. Therefore, balance and control of posture rider with a backrest and literal support may give comfort ability to rider (Giuseppe et.al, 2002).

2.3.7. The comfort and discomfort term is unmeasured term in the ergonomic field because it is based on human perception of the machine and work system environment and it integrates a sense of well being with health and safety (Karmegam et. al, 2011; Giuseppe et. al, 2002). Therefore, muscle impairment is a common finding associated with low back pain and frequently describe with strength, fatigue and muscle activity. (Serge.HR et.al,1995). Low back pain (LBP) is one of the effects that cause from sitting in prolong riding. At the end, low back pain will cause muscle fatigue because of expected force that contract the muscle with a long time that facing to the rider especially in prolonged riding with an unsupported posture (Asa et. al, 1999). When discomfort from prolonged sitting increase, it cause muscle fatigue, it will decrease intervertebral disc nutrition, reduced blood flow in muscles and increased risk of disc herniation (Durkin, Harvey, Hughon & Callaghan, 2006 ; Donna.A, 2007).

Therefore, to examine the abnormalities in muscle activity contribute to development of low back pain, the researcher often use surface electromyography (SEMG). Surface electromyography can be collected during static posture and different dynamic movement (Micheal.EG, 2007). There is correlation between the number and intensity increases with muscle contraction. The EMGs can also measure of external load, body postures or joint movements to aid interpretation (Stanton et.al, 2005).

2.3 Electromyography and Borg' Scale

The physiological signals from electromyography are important especially for clinical and engineering purposes (Phinyomark.A, Limsakul, & Phukpattaranont, 2011) Electromyography (EMG) is useful for analysing the muscle function through electrical signals that produce during muscle contraction whether voluntary or involuntary contraction. There are two main types of electromyography that use for kinesiological purposes which are surface EMG and intramuscular EMG. Surface EMG is divide into two groups which is active which have built-in amplifiers at the electrode site to improve impedance and the other one is passive which detect EMG signal without a built-in amplifier. While, intramuscular EMG used a needle for insertion into the muscle. (Bouisset, et. al, 1972)

The advantage when using surface EMG is the respondent will have minimal pain when applications while the disadvantage is the electrode for the EMG have a large pick up area, therefore there are more potential for cross talk from adjacent muscle. While for intramuscular EMG are an increased band width and have more specific pick-up area. It is also able to test deep muscles, isolate specific muscle parts from large muscle and able to test small muscles which would be impossible to detect with surface EMG because of cross-talk. However, the disadvantage for this type of EMG, it will give discomfort when needle insertion and will give effect for

the result. This is because, when respondent is uncomfortable, the muscle use will be tightness and sometimes, the muscle cramping will be occurring. Other than that, it is very difficult to place a needle in the same area of the muscle each time and the electrode is less repeatable (Gregory S.Rash)

There are many purposes for EMG application, such as study for combat sport and martial art (Neto,O.P, et.al, 2009) and low back pain ((V.Balasubramanian & M. Jagannath, 2014). Wavelet transform (WT) is a time-frequency analysis method that will identify in EMG signal. There are various types that approach for the transformation method. The transformation method are mean absolute value (MAV), energy, variance and zero crossing (ZC), mean and median frequency, and autoregressive coefficient (AR). The successful and popular that always used for clinical an engineering application is root mean square (RMS) and MAV (Oskoei, et. al , 2007 & Naik, et.al, 2010).

The other measurement for identify the discomfort level is Borg' Scale. Borg' Scale is a subjective measure by rating for estimating the level of physical activity based on the feel of subject during riding including the heart rate, respiration, sweating and muscle fatigue (Spielholz, 2006).

2.4 Lumbar Support

The engineering improvement design in motorcycle is important to maintain comfort ability to motorcycle users. The purpose of engineering design is to devise system, component or process with combination of basic knowledge (basic science, mathematics and engineering science) and interaction between human and other element to system performance (Karmegam et.al, 2011). Based on Mike Kolich (2003) stated that, ergonomic criteria and make a user comfortable accommodation is comfortable seating or adjustable in lumbar region. This is because, during riding process motorcyclist will keep changing their posture to avoid the mechanical load and ischemia of tissue which will contribute to discomfort effect on body parts (Karmegam et.al, 2011).

Therefore, one previous study from karmegam et. al 2012 found that there is a positive effect on the body part's comfort when use a lumbar support. The backrest or lumbar support will contribute the stress on the lower body can be reduced and ideal sitting posture can be obtained because the backrest will supported seated person to transfer part of their upper body load to the lower part of the body, which decreases the intradiscal pressure and enhance the relaxation of the supporting back muscles. There was a higher comfort change in the upper back, low back and buttock.

CHAPTER 3

METHODOLOGY

3.1 Study Design

The design of this study is True experimental study. The subject will be divided into two groups. In the first group, they will be receiving the lumbar support intervention as shown in figure 3.1 while the other group will not be required lumbar support intervention. This study will be required pre and post intervention. Pre intervention will be considered as a baseline data and post intervention study will be the effect of the intervention given. There will be difference outcome between pre and post studies that would be shown the effect of lumbar support intervention.

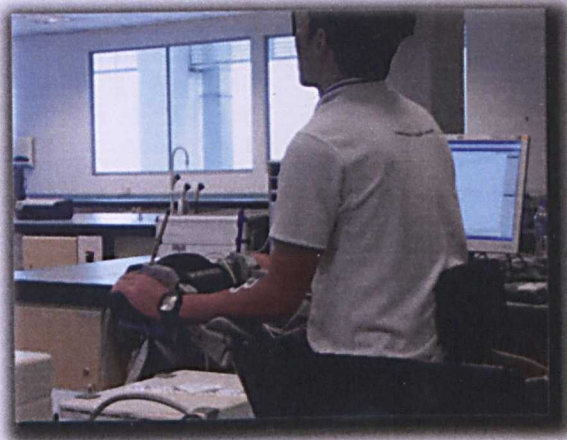


Figure 3.1: Motorcycle with Lumbar Support (Prototype).

3.2 Study Location

This study will be conducted at Occupational Health and Safety Laboratory which located at Faculty of Medicine and Health Science, Universiti Putra Malaysia

3.3 Sampling

3.3.1 Sampling Population

Study population in this study conducted among male students at Faculty of Medicine and Health Science, Universiti Putra Malaysia.

3.3.2 Sampling Frame

The sampling frame obtained from a list of all male students at Faculty of Medicine and Health Science, Universiti Putra Malaysia. The name lists will be obtained from Student Affairs Division and Dean's Office at Faculty of Medicine and Health Science, Universiti Putra Malaysia.

3.3.3 Inclusion and Exclusion Criteria

For the inclusion criteria, the respondent will be chosen at Universiti Putra Malaysia. The selection of the respondents will be based on the purposive sampling, which is all of them should fulfil the inclusion criteria as listed below:

1. Male
2. Age between 18-35 years old
3. Normal body mass index (BMI) 18.5-24.9
4. Motorcyclists for a motorcycle of 150cc and below.
5. Have more than one year riding experience.
6. Have no history of accident or injury in the past one year.
7. No immediate complaint of low back pain.

For exclusion criteria, the respondent will be excluding in this study if:

1. Inadequate sleep prior to experiment
2. Taking medication prior to experiment

3.3.4 Sampling Method

The sampling method in this study is purposive sampling where all male students of Faculty of Medicine and Health Science, Universiti Putra Malaysia will be selected based on the inclusion criteria's. The respondents will then be randomly assigned to be enrolled in the intervention group or control group.

3.3.5 Sample Size

Group comparison (2 groups) sample calculation is used,

$$\text{Formula } n = \frac{2\sigma^2 (Z_{1-\alpha/2} + Z_{1-\beta})^2}{(\mu_1 - \mu_2)^2}$$

Where σ = estimated standard deviation (assumed to be equal to each group)

μ_1 = estimated mean of first population

μ_2 = estimated mean of second population

$Z_{1-\alpha}$ = Standard error associated with confidential interval

(Here we decide to choose 95% confidential interval = 1.96)

$Z_{1-\beta}$ = Standard error associated with power

(Here we decide to choose 80% of power = 1.28)

Thus, to test the hypothesis about this study on the studied population based on the literature review, the calculation estimate is made:

$$n = \frac{2(0.65)^2 (1.96 + 1.28)^2}{(1.13 - 1.54)^2}$$

$$= \frac{2 (0.42) (10.5)}{(0.41)^2}$$

$$= \frac{8.82}{0.17}$$

$$= 52$$

$$n = 52 + 20\% \text{ dropout rate}$$

Therefore, the sample will be 62 subjects for each group.

This study will be using 1 control per interventional subjects. From Durkin, Harvey, Hughson & Callaghan (2006) who is done previous study stated that, the standard deviation was 0.65. If the difference in the intervention and control means is 0.41, the study needs 52 intervention subjects and 52 control subjects to be able to reject the null hypothesis that the population means of the intervention and control group are equal with power of 0.8. Sample of 52 subjects should be added with 20% dropout rate. So, total sample will be 124 subjects, with 62 subjects for each group.

3.4 Instrumentation and Data Collection Technique

3.4.1 Instruments

3.4.1.1 Questionnaire

The questionnaire will be distributed among male student at Faculty of Medicine and Health Science, Universiti Putra Malaysia. Each of the students will be

briefed about the questionnaire and consent will be obtained from them. There are two parts in the questionnaire which include:

I Pre-Survey Questionnaire

This questionnaire is to determine the personal information of the motorcyclist which consists of four sections as Section A: Background Information, Section B: Daily Activities, Section C: Health Information and Section D: Discomfort Information. All respondents have to answer the pre-survey questionnaire before they decide to voluntarily participate in the study.

II Borg Scale Measurement

In the second part, a body chart of discomfort using the Borg's CR10 scale will be used. The subject will rate the degree of subjective discomfort (figure 3.2) on the body parts (figure 3.3) with number supported by written expression.

0	Nothing at all
0.5	Very, very slight (just noticeable)
1	Very slight
2	Slight (light)
3	Moderate
4	Somewhat severe
5	Severe (heavy)
6	
7	Very severe
8	
9	
10	Very, very severe

Figure 3.2: Borg CR-10 scale (Borg, 1982)

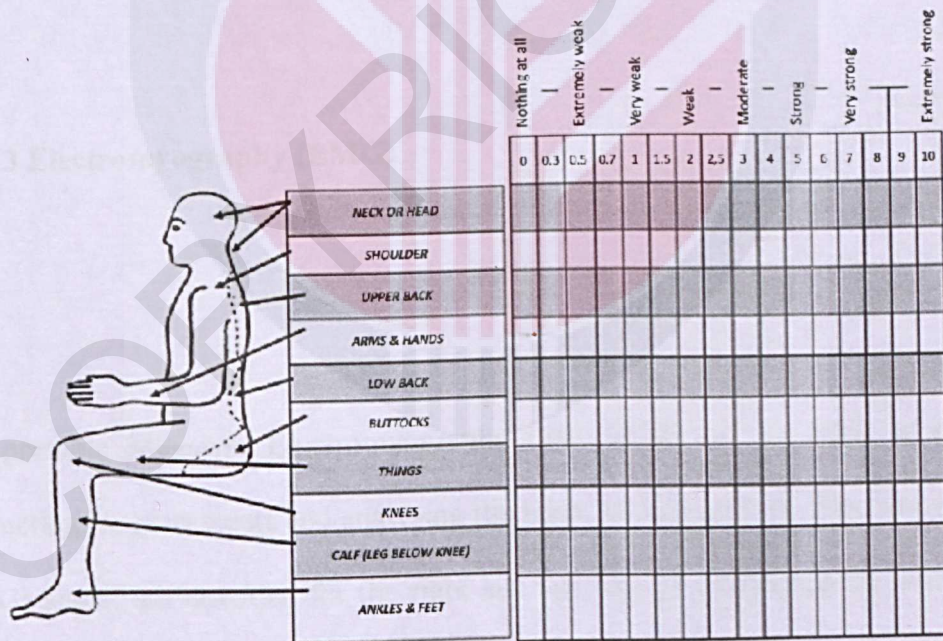


Figure 3.3: The body chart discomfort using Borg CR-10 scale (Karmegam et.al, 2011)

3.4.1.2 Measuring Tape and Weighing Scale

The respondent will be undergoing a physical examination to identify their height and weight to ensure that the respondent will be fulfilling in the criteria of the study. Measuring tape will be used to measure the height while weighing scale is used to measure the body weight of respondents. This is important to determine the body mass index (BMI) status of respondents. The measuring tape that will be used is SECA Bodymeter and the weighing scale that will be used is TANITA Digital Weighing Scale.

3.4.1.3 Electromyography (EMG)

The portable Megawin Electromyography (ME 6000) will be used as tools for conducting measurements and analysing the body muscle activity. Electromyography (EMG) signal are recorded for the right and left erector spinae muscle with surface electrode will be attached on lumbar region. The data of electromyography has taken the mean frequency (MF) value for every 15 minutes.

3.4.2 Data Collection Procedure

After getting the student name list from Student Affairs Division and Dean's Office at Faculty of Medicine and Health Science, Universiti Putra Malaysia, data collection will begin with the answering of pre-survey questionnaire before the respondents will be decide to voluntary participate in the study. The respondents have to undergoing in physical examination (measure height and weight) to ensure the respondent will be fulfilled the criteria of the study. Finally, the procedure will be explained and informed consent letter will be distributed.

Every respondent is required to attend experimental session on two different days (with minimum three day interval between them). During the session, each respondent will be asked to sit on the static motorcycle in a controlled room environment for two hours. Each respondent in intervention groups will be attend pre and post intervention (with and without lumbar support) while the control group will be attend pre and post intervention without lumbar support. At 15 minute intervals, respondents are required to evaluate their discomfort level on the Borg's CR10 questionnaire (Figure 3,3). At the same time, the electromyography (EMG) signal will be used to monitor recorded muscle activity for the lumbar region that has been attached by surface of the electrode. As a means of distraction and entertainment a movie will be played during each session.

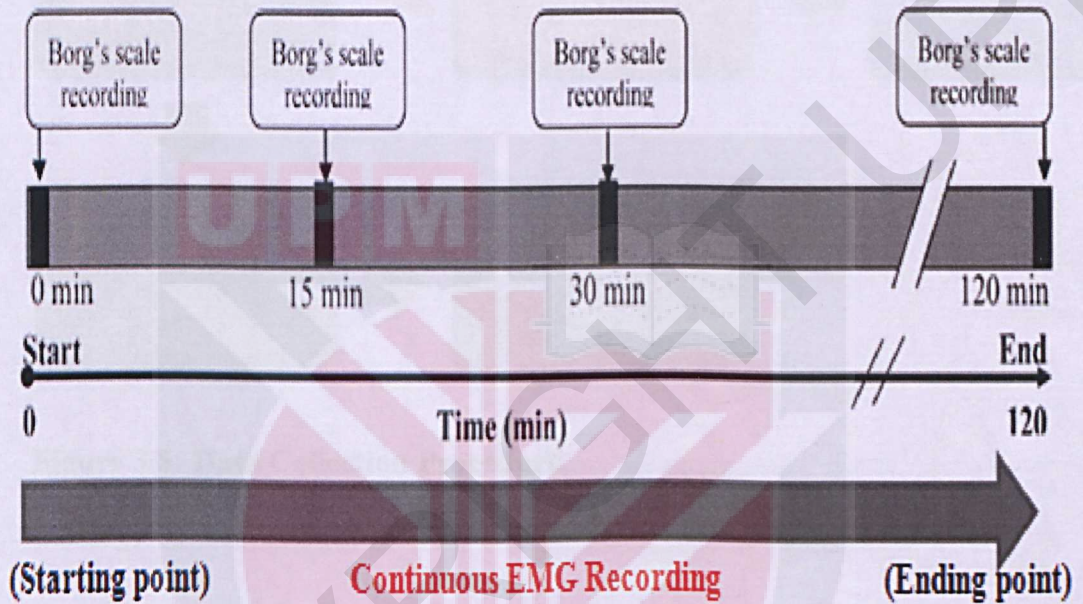


Figure 3.4: Schematic schedule measurement including: 1) The total period of time, 2) Borg's scale recording at every 15 min time period, 3) Continuous EMG recording.

(Karmegam et.al, 2011)

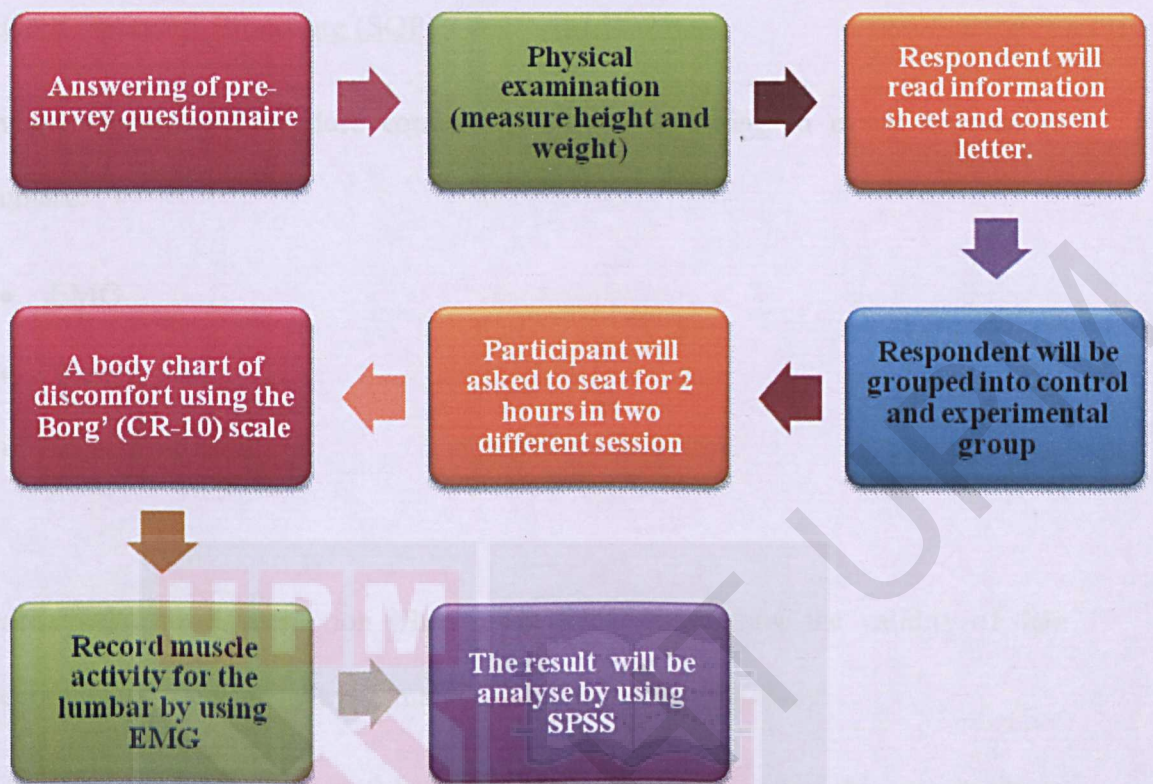


Figure 3.5: Data Collection Procedure

3.5 Validity and Reliability

Pre-test

The sample will be taken about 10% from a population sample to ensure the validity and reliability when conducting pre-test for the entire experimental study.

Standard Operating Procedure (SOP)

Standard Operating Procedure conducted will be including in every instrument, which are:

- EMG
- Weight Scale
- Measuring tape

These are the basic instruction when using EMG to increase the validity of data collection since the EMG plays a major character role in this study:

1. Potential respondent will be asked if he is allergic or has skin sensitivity to ethanol. If he is allergic, he will be informed that the study will be used an ethanol in placement of electrodes and he cannot participate in the study.
2. Potential respondent will be advice should wear a loose fitting t-shirt.
3. Respondent will be reminded to ask any question based on the procedure.
4. All instrumentation will be attached to respondent is electrically isolated.
5. Once the session complete, the electrode will be removed.

3.6 Data Analysis

The Electromyography raw data are collected and analysed by using Megawin Electromyography (ME 6000) software through personal computer (PC). Electromyography data and Borg' Scale data will be analysed by using 'Statistical Package for Social Science' (SPSS Windows Version 21.0).

For descriptive data which is univariate analysis will be used to determine mean value, standard deviation, median, frequency and the percentage. Kolmogorov-Smirnov test will be used to run the normality of data distribution.

The type of data will be used:

Objectives	Test
1. To compare the muscle activation in mean frequency between pre and post evaluation of experimental group by using electromyography.	Paired t-test
2. To compare the rating in Borg' Scale of discomfort between pre and post evaluation of experimental group.	Paired t-test

3. To compare the muscle activation in mean frequency (MF) when post evaluation between control and experimental group by using electromyography.

Independent t- test

4. To compare the rating in Borg' Scale of discomfort in post evaluation of control and experimental group.

Mann-Whitney U test

3.7 Quality Control

3.7.1 Pre Test

To make sure the validity of the test, 10% of study sample was recruited from other sample population in order to conduct pre test for the entire experimental study.

3.7.2 Standard Operating Procedure (SOP)

The Standard Operating Procedure for every instrument tools which include:

- Surface electromyography (SEMG)
- Borg' Scale

Before the test conducted to the respondent, this is the basic requirement to respondent should be known:

- I. The subjects have been asked if they have any allergic to alcohol.
- II. The reminder to respondent before comes as respondent, they should wear loose t-shirt.
- III. They also have been asked any question related to science or the experiment procedure.
- IV. They also have been informed, all instrumentation attach to the respondent was electrically isolated.
- V. When completion for every session, the electrode were removed.

3.8 Study Limitation

3.8.1 Electromyography

Surface electromyography has potential cross talk from adjacent muscle because the reading pick up in large surface. The reading of the muscle is not specific compare to intramuscular EMG.

3.9 Ethical Consideration

The approval of the study will be gained from Ethic Committee, Universiti Putra Malaysia with the JKEUPM reference number FPSK(EXP14-OSH)U048.

Furthermore, before the questionnaire distribute to the respondent, the respondent will be asked to sign a participation consent form which includes the following information:

- The respondent is willing to participate in the study.
- The nature and purpose of the study will be explained to the respondent.
- The likely involvement, in terms of time of the respondent.
- The respondent has the opportunity to question the researcher.

The information and data gained are confidential and not be revealed to others who are not part of the research team. The data obtained in the research study only used in the purposed of research study. No part of it will be sold to or reused by people for other research or non-research purposes unless the participants have agreed to this.

CHAPTER 4

RESULT

4.1 Study Background

. This study conducted in Faculty of Medicine and Health Science. The sample size for this study was 120 male students who included 60 people for control group and 60 people for experimental group in this faculty. Mostly student in this study were a bachelor and master student in this faculty with the range of age between 18 to 35 years old. The study subject were included the Body Mass Index with Normal range which 18.5 to 24.9 and had been riding experience at least one year.

4.2 Descriptive Data

4.2.1 Socio demographic data for respondent

Most of respondent that volunteer in this study were Malaysian, Malay (73.3%) in the range of age 18-23 years old (73.3%). The detail background information of the respondents was presented in Table 4.1.

Table 4.1: Socio demographic of the workers who participated in the study (N=120)

Variable	Frequency (%)	Mean±SD
Age		
18-23	88 (73.3%)	
24-29	28 (23.3%)	
30-35	4(3.3%)	
Race		
Malay	88(73.3%)	

Chinese	26 (21.7%)	
Indian	2 (1.7%)	
Other	4 (3.3%)	
Average Sleep		6.59±1.70
Average Riding		1.91±2.95
Heavy work		
Yes	30(25%)	
No	90(75%)	
Hour Heavy Work		4.22±4.05
Play Sport		
Yes	96(80%)	
No	24(20%)	
Hour Play Sport		4.72±4.92

In this study, we were also identified most of respondent have enough sleep with average sleep for 7 hours per day (6.59 ± 1.70) and physically active when they were frequently playing sport (4.72 ± 4.92). Other than that, we were only recruited the respondent have an experience riding any motorcycle at least for 1 hours. This information had show that most of respondent have an experience riding motorcycle at least 2 hours per day (1.91 ± 2.95).

4.2.2 Discomfort Information

From the musculoskeletal disorder information, most of respondent had an experience of musculoskeletal disorder (MSD). This information had shown the highest body part that they ($n=24$) have feel pain, aches, burning or discomfort at the lower back in the figure 4.1. Other than that, this study was also identified lower back ($n=24$) is the most body part that they feel pain when riding a motorcycle in the figure 4.2.

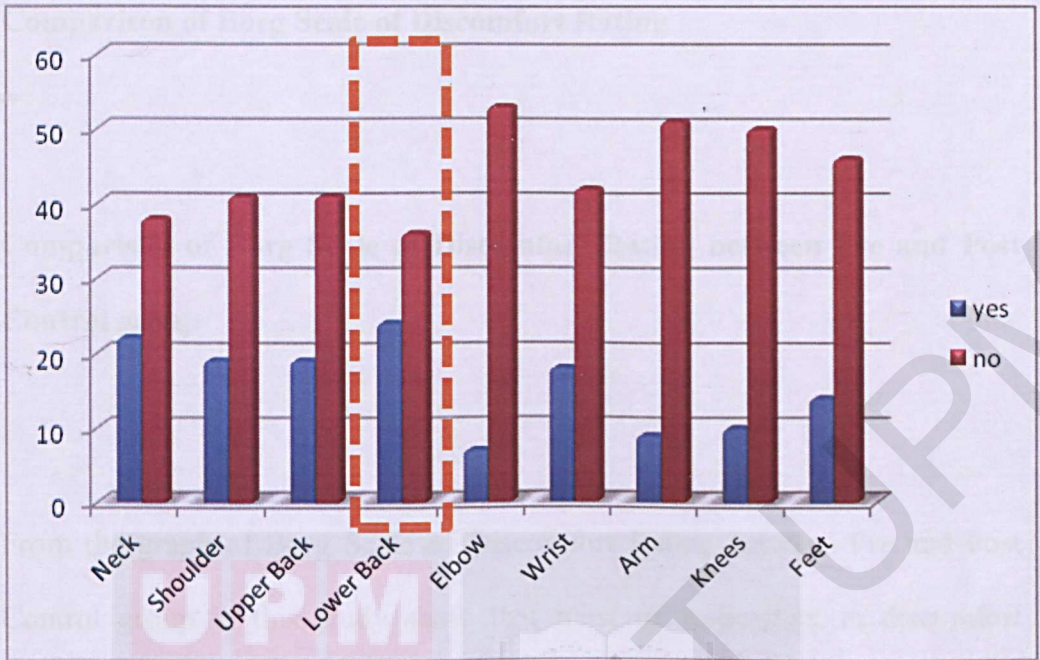


Figure 4.1: Part of body that feel pain, aches, burning or discomfort.

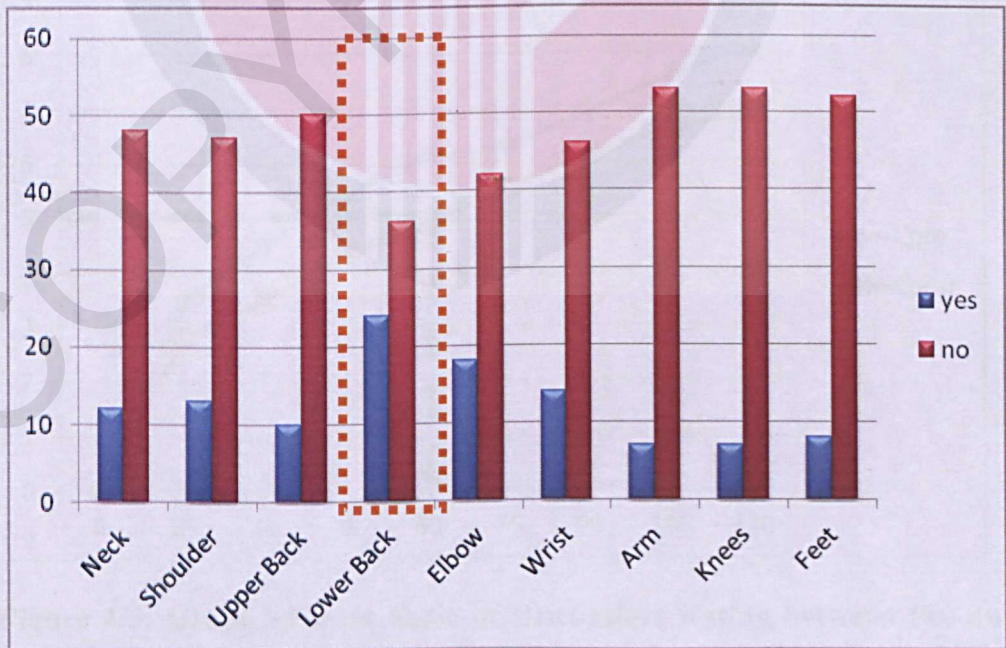


Figure 4.2: Part of the body that feel pain when riding a motorcycle.

4.3 Comparison of Borg Scale of Discomfort Rating

4.3.1 Comparison of Borg Scale of Discomfort Rating between Pre and Post Control group

From the graph of Borg Scale of Discomfort Rating between Pre and Post Control group in this study show that most of respondent in discomfort condition between minutes 30 and 45 for pre test and minutes 60 for post test with the 'break point' of discomfort ≥ 5 .

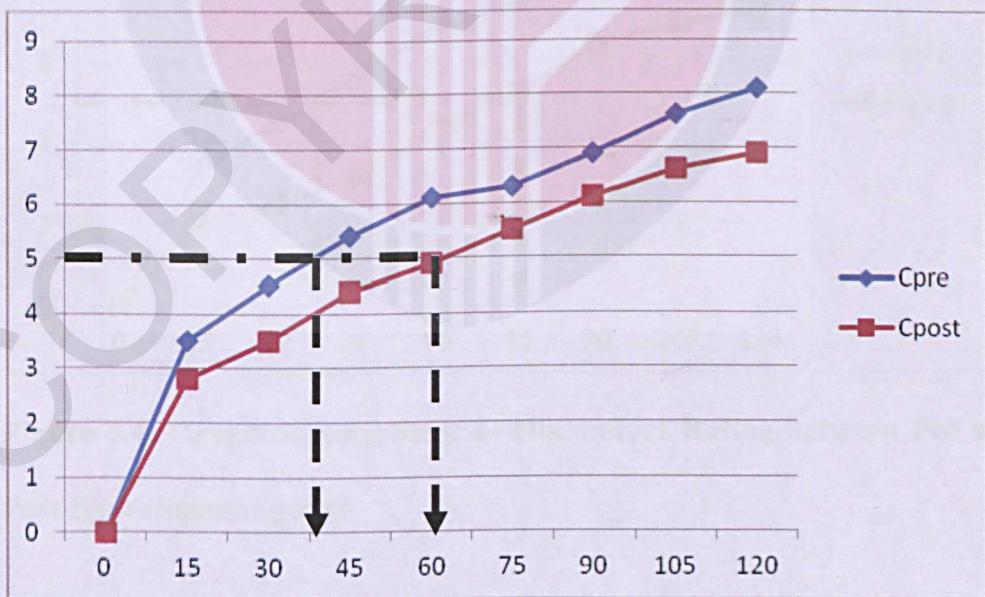


Figure 4.3: Graph of Borg Scale of Discomfort Rating between Pre and Post Control group

4.3.2 Comparison of Borg Scale of Discomfort Rating between Pre and Post Experimental group

From the graph of Borg Scale of Discomfort Rating between Pre and Post Experimental group in this study show that most of respondent in discomfort condition between minutes 30 and 45 for pre and 75 for post with the 'break point' of discomfort ≥ 5 .

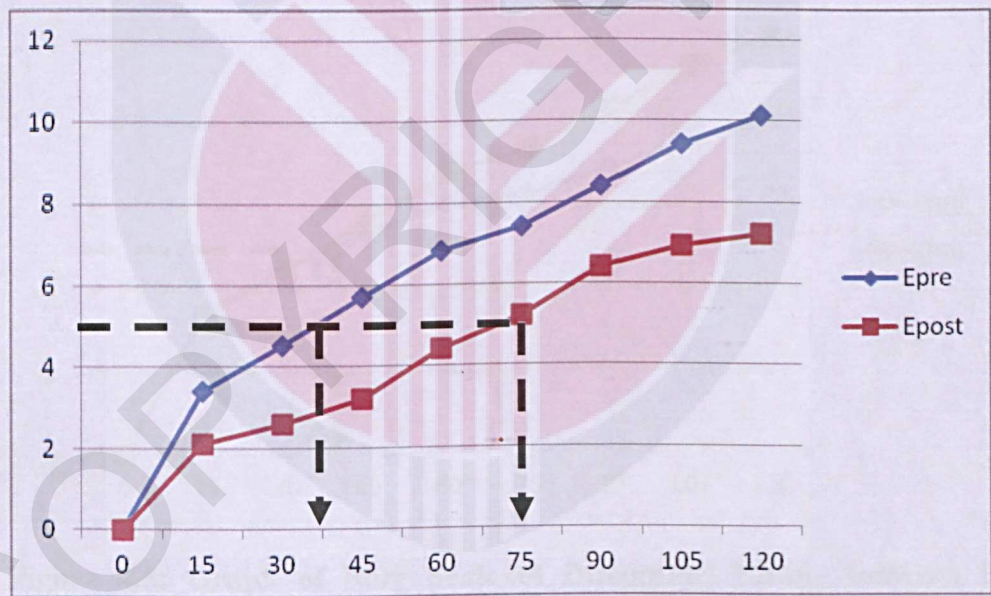


Figure 4.4: Graph of Borg Scale of Discomfort Rating between Pre and Post Experimental group

4.3.3 Comparison of Borg Scale of Discomfort Rating between Pre Control and Pre Experimental group

From the graph of Borg Scale of Discomfort Rating between Pre Control and Pre Experimental group in this study show that most of respondent in discomfort condition between minutes 30 and 45 with the 'break point' of discomfort ≥ 5 .

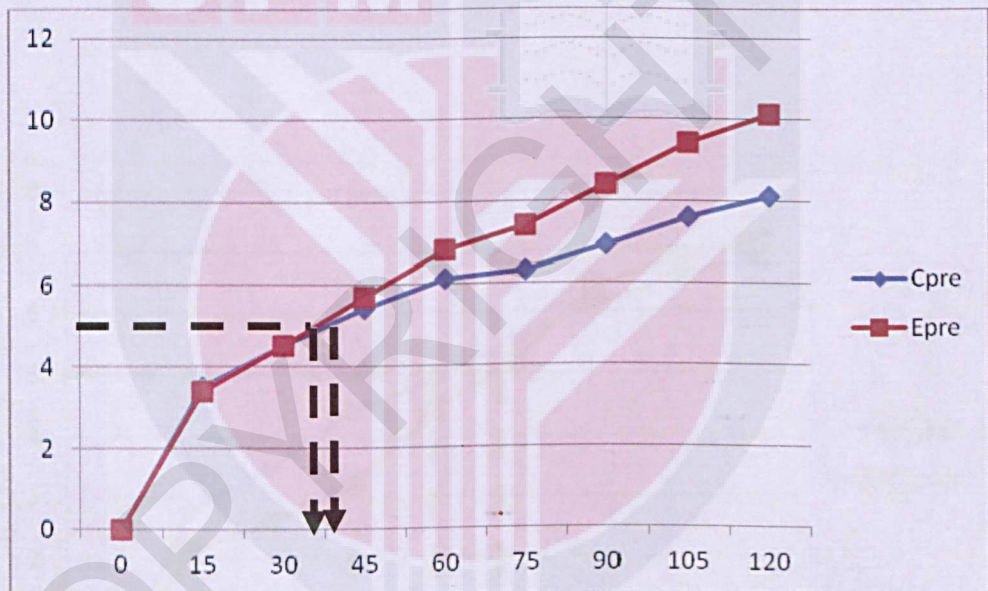


Figure 4.5: Graph of Borg Scale of Discomfort Rating between Pre Control and Pre Experimental group

4.3.4 Comparison of Borg Scale of Discomfort Rating between Post Control and Post Experimental group

From the graph of Borg Scale of Discomfort Rating between Pre Control and Pre Experimental group in this study show that most of respondent in discomfort condition in minutes 60 for post test control group. While for post experimental group is between 65 and 75. The 'break point' of discomfort is ≥ 5 for both group of test.

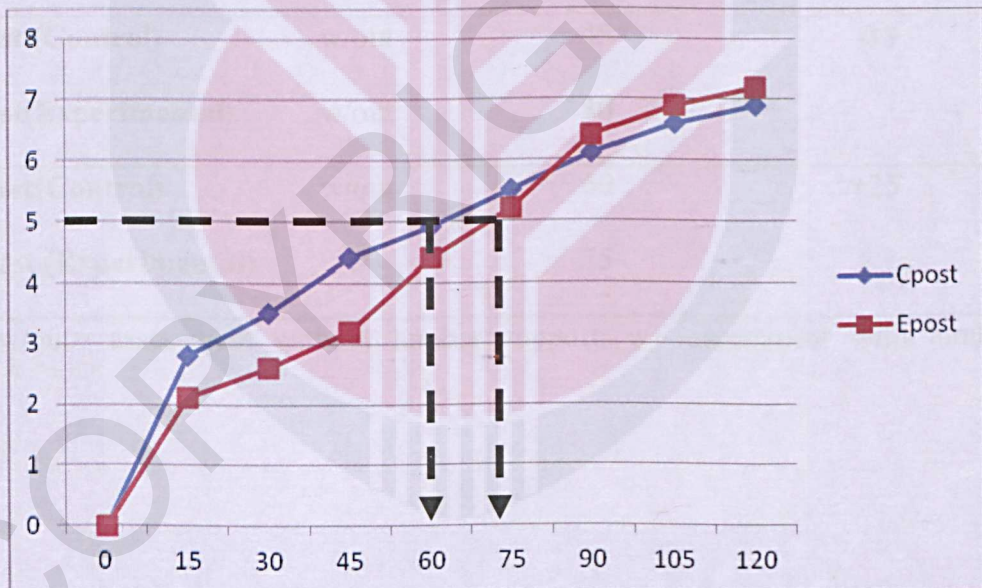


Figure 4.6: Graph of Borg Scale of Discomfort Rating between Post Control and Post Experimental group

Table 4.2: Discomfort ‘Break Point’ data distribution at lower back (Borg Scale rating ≥ 5).

Borg Scale Rating (≥ 5) at end time period			
Group test	Condition	Time Period (minutes)	% of comfort changes (\pm)
Pre-Test (Control)	w/out	45	+33
Post-Test(Control)	w/out	60	
Pre-Test(Experimental)	w/out	30	+150
Post-Test (Experimental)	w	75	
Pre-Test (Control)	w/out	45	-33
Pre-Test(Experimental)	w/out	30	
Post-Test(Control)	w/out	60	+25
Post-Test (Experimental)	w	75	

Note: w/out= assessment without lumbar support, w= assessment with lumbar support

From the table 4.3, the data was show that the comfortability have been changes when the test with the prototype which is lumbar support. By using paired t-test, this study showed there is a statistically significant ($p < 0.05$) difference between pre and post for control and experimental group.

Test	Mean± SD	t	p
Pre-Test (Control)- Post-Test(Control)	0.9±0.4	7.04	<0.001
Pre-Test(Experimental)- Post-Test (Experimental)	2.0±0.9	6.81	<0.001

Table 4.3: Paired Sample t-test for both group

While, comparison between pre for control and experiment groups and between post for control and experiment group is using Man Whitney U-test because both study have show the data is not statistically significant.

Test	Median(IQR)	Z	p
Pre-Test (Control)-	6.1(3.25)	-0.663	0.507
Pre-Test(Experimental)	6.8(4.95)		
Post-Test(Control)-	4.9(3.20)	-0.265	0.791
Post-Test(Experimental)	4.4(4.30)		

Table 4.4: Mann- Whitney U test for both groups

4.4 Comparison of Electromyography with Muscle Activity

4.4.1 Comparison of Electromyography with Muscle Activity between Pre and Post Control group

From the electromyography with muscle activity graph for control group shows that the reading of muscle activity during pre session is lower compare to the post session in every 15 minutes. For the pre session, the muscle activity show increasing for every minute while for post session show decreasing.

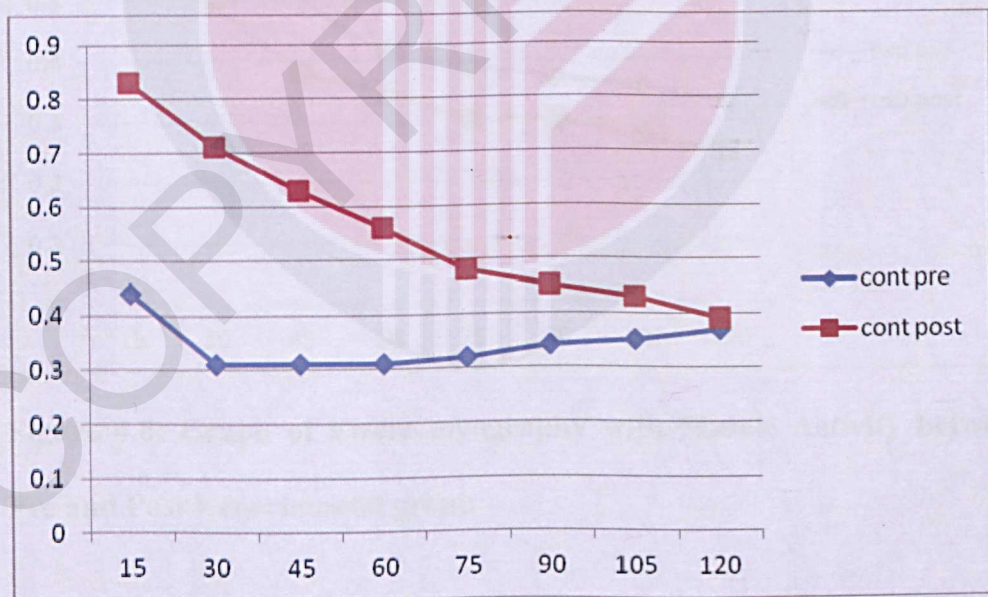


Figure 4.7: Graph of Electromyography with Muscle Activity between Pre and Post Control group

4.4.2 Comparison of Electromyography with Muscle Activity between Pre and Post Experimental group

From the electromyography with muscle activity graph for experimental group shows that the reading of muscle activity during post session is lower compare to the pre session in every 15 minutes. For both graphs also shows the decreasing value in every minutes.

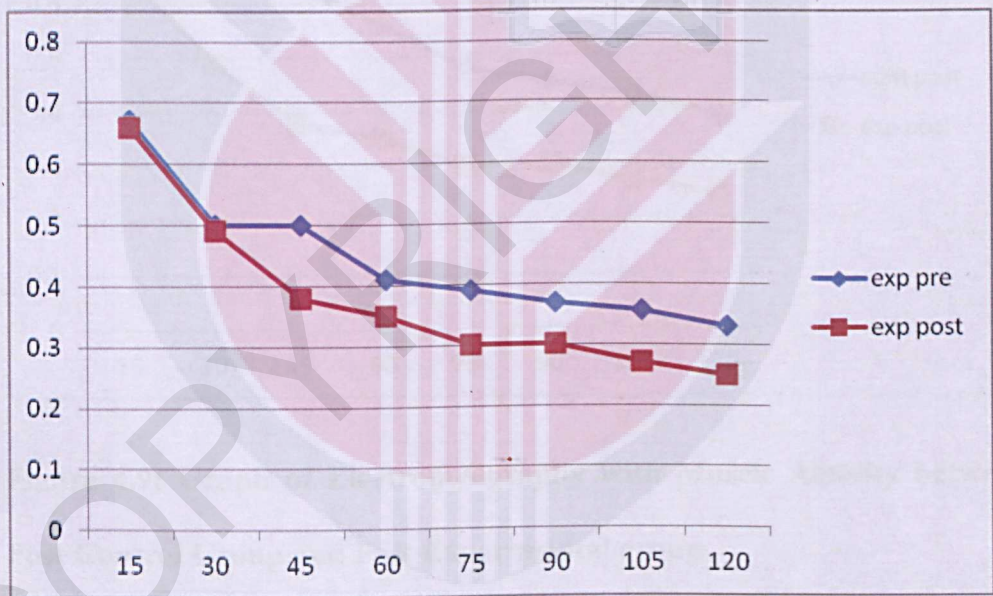


Figure 4.8: Graph of Electromyography with Muscle Activity between Pre and Post Experimental group

4.4.3 Comparison of Electromyography with Muscle Activity between Post Control group and Post Experimental group

From the electromyography with muscle activity graph for both post evaluation group have shown the reading of muscle activity is reducing in every minutes.

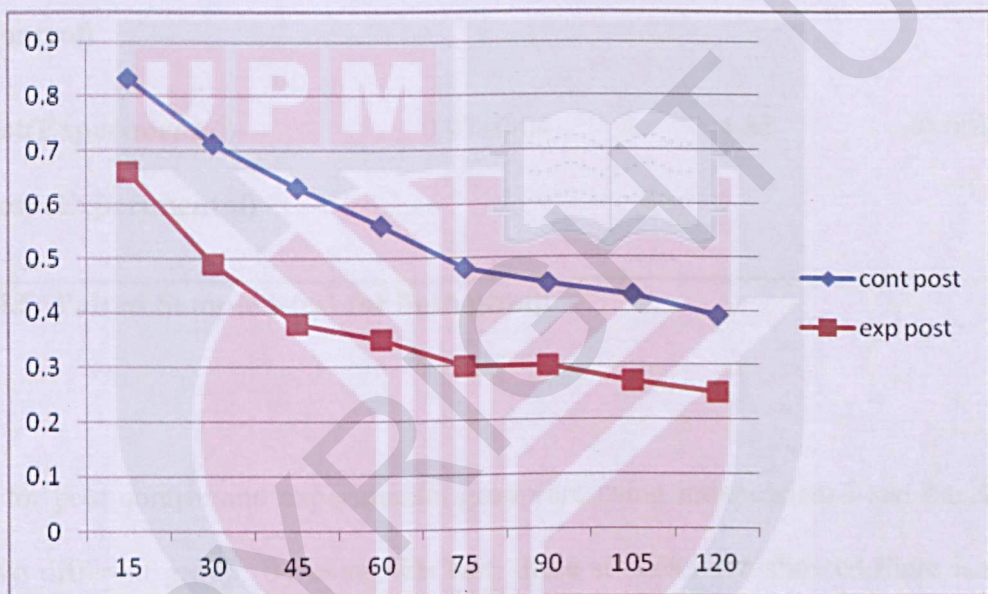


Figure 4.9: Graph of Electromyography with Muscle Activity between Post Control Group and Post Experimental group

From the table below, the data was show that the comfortability have been changes when the test with the prototype which is lumbar support. By using paired t-test, this study showed there is a statistically significant ($p < 0.05$) difference between pre and post for experimental group while there is no significant for control group.

Test	Mean± SD	t	p
Pre-Test (Control)- Post-Test(Control)	-0.22±0.15	-4.22	0.43
Pre-Test(Experimental)- Post-Test (Experimental)	0.07±0.04	4.82	<0.001

Table 4.5: Paired Sample t-test for both group

While, for post control and experimental group are using independent t-test because have two different group. By using this test, these studies have showed there is not statistically significant for both post evaluation group.

Test	Mean±SD	t	p
Post-Test (Control)- Post Test (Experimental)	0.56±0.15	2.53	0.62
	0.38±0.14		

Table 4.6: Independent t-test for Post Control and Experimental Group

CHAPTER 5

DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1 DISCUSSION

5.1.1 Subject and Methods

In this study, there were 120 male university students (60 control group, 60 experimental group) that recruited in this experiment which include 32 of them are postgraduate student and staff and the rest were undergraduate students. Subject's age was 18-23 (73.3%), 24-29 (23.3%) and 30-35(3.3%) with the normal BMI with the average 18.5-24.9. This study population must considered because 20.7% of total accidental deaths were riding motorcycle, 19.8% were occupant of lorry/truck, 10.1% by busses and 9.2% were travelling by car (Balasubramanian & Jagannath, 2014). One of the risk factor of accidental issue is ergonomic factor that cause fatigue when

riding the motorcycle other than environment factor (Onawumi& Lucas, 2012). Therefore, the ergonomic improvement was important to give comfortability to the rider when riding. This is because, when the rider had comfortable during riding, the number of accident was decreasing because rider will be more focus during riding.

Survey from the questionnaire reported the average sleep amount, doing heavy work and playing sport. For the average sleep amount, majority of student had sleep 6.59 ± 1.70 hours daily, do not doing heavy work (75%) and playing sport (80%), which shows that all respondent are physically active and have enough sleep. From the previous study by Jacobson, Wallace & Gemmell, 2006 was stated that the quality of sleep were contribute to low back pain disorder. This is because, the amount of sleep effected the muscle used. If the amount of sleep is less than 6 hours, there is a lot of muscle used and the muscle had become fatigue. Therefore, it will give effect the result because of muscle fatigue cause of less amount of sleep.

Other than that, physically active were important as criteria of the subject because it shown the muscle strength of the subject which were strengthen the result for this study. This is because, when the muscle was not used like playing any sport or doing any heavy work, muscle cell structure were changes and functioning had increased the fat and fibrous material among the muscle cell (Josephson, 2009). Therefore, person not physically active effected the result of this study because their muscle were easily fatigue cause of energy used or muscle used not adaptable with daily used (Bogdanis, 2012).

5.1.2 Discomfort information

From the discomfort information, it was proved that lower back is the parts of the body that feel more pain, aches, burning or discomfort on the part of the body (N= 48) compared to other parts of the body especially when riding the motorcycle (N=48). The discomfort caused from low back pain during riding, it will contributed to the accident especially to prolonged riding. (Donnelly, Callaghan, & Durkin, 2009). The low back pain had cause from an expected force that contract the muscle with a long time that facing to the rider especially in prolonged riding with an unsupported posture (Asa et. al, 1999). When discomfort from prolonged sitting increase, it cause muscle fatigue, it will decrease intervertebral disc nutrition, reduced blood flow in muscles and increased risk of disc herniation (Durkin, Harvey, Hughon & Callaghan, 2006 ; Donna.A, 2007).

5.1.3 Comparison of electromyography with muscle activity between pre evaluation and post evaluation of experimental group.

The result shows that there is statistically significant when compare the muscle activation between pre and post from experimental group ($t = 4.82, p < 0.001$). In this study, the subjects have been in riding position for 2 hours and the wavelength that

appear in the screen of the computer that came from the electromyography is taken. From the wavelength produce, the mean frequency of the wavelength will be taking to show the reading of muscle activity of the rider within 2 hours (Bilodeau, Schindler-Ivens, Williams, Chandran, & Sharma, 2003). From the graph in figure 4.8 show that the reading of muscle activation is decreasing when the intervention is provided during post evaluation compare to the pre evaluation in every minute. In this situation, there is support at the lower back when post evaluation.

Based on the result, the subjects have show that they have felt comfortable and relaxing when the intervention been providing in the post session. This is because, backrest or lumbar support contributed the stress on the lower body can be reduced and ideal sitting posture can be obtained because the backrest will supported seated person to transfer part of their upper body load to the lower part of the body, which decreases the intradiscal pressure and enhance the relaxation of the supporting back muscles. There was a higher comfort change in the upper back, low back and buttock (karmegam et. al 2012).

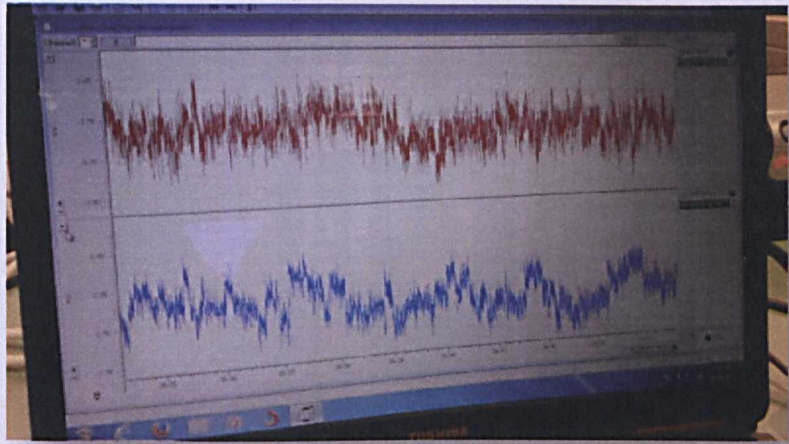


Figure 5.1: Wavelength recorded from the electromyography

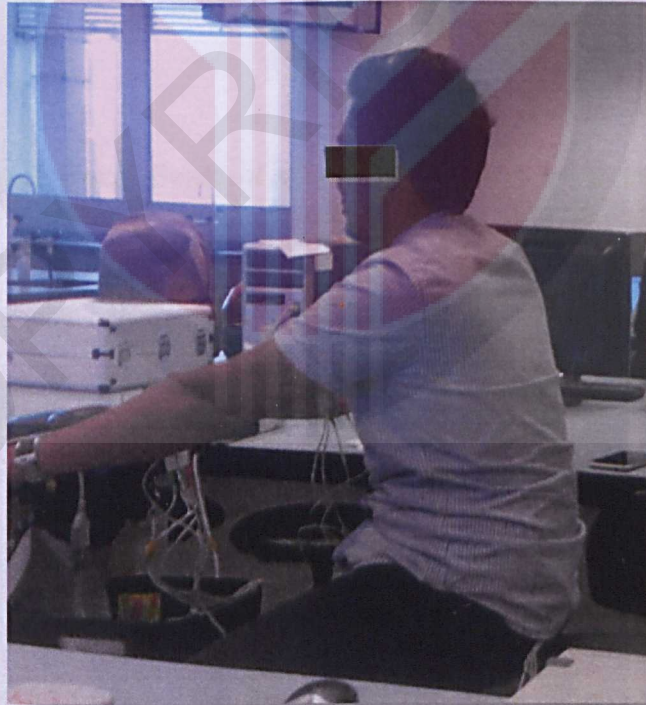


Figure 5.2: The control group subject without intervention

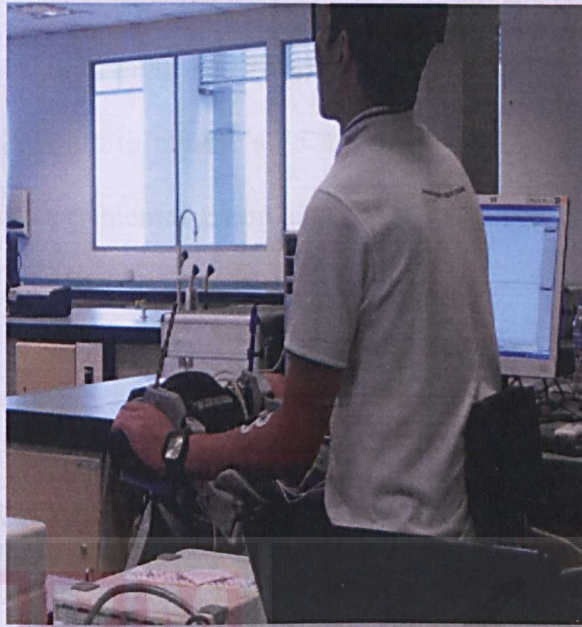


Figure 5.3: The experimental subject with an intervention

5.1.4 Comparison of Borg' Scale of discomfort rating between pre evaluation and post evaluation of experimental group

The result revealed that there is a statistically significant comparison between the ratings in Borg' Scale of discomfort in pre and post evaluation of experimental group. In this study, the subjects have also been in riding position for 2 hours. There have to tick the level of discomfort for every 15 minutes. The environment for the subject influence the rating have been control and the rating is based on the

psychological scale of the subjects (Spielholz, 2006). From the result, the percentage of comfort changes is increasing (+150%) from the time period discomfort at minute's 30 in pre evaluation to minute's 75 in post evaluation. The graph of Borg' scales for pre and post experimental group also show the rating is increasing the time to feel discomfort.

When the result showing the time for subject feel discomfort is increasing, there is comfortable when an intervention that supports the lower back during riding and reduce psychological stress among motorcyclist. This is because, the intervention had reduce the muscle tightness, mechanical strain on spinal structures and fatigue that cause traumatic injury among motorcyclist (Alperovitch-Najenson et al., 2010).



Figure 5.4: Seat without intervention during pre evaluation



Figure 5.5: Seat with intervention during post evaluation

5.1.5 Comparison of electromyography with muscle activity in post evaluation between control and experimental group.

The result have show there is no statistically significant the comparison of muscle activation in post evaluation between control and experimental group ($t = 2.53, p = 0.62$). This is because, there is different reading of muscle activity between control and experimental group with different type of muscle strength for every person (Saeterbakken, van der Tillar, & Fimland, 2011). While, from the graph have show there is decreasing of the amount of muscle activity between control group without any intervention and experimental group with an intervention.

Therefore, it is proved that the intervention or having support at the lower back will reduce the muscle activity which causes comfortable to the rider because the subject can lean their back at the support. This is because, the muscle contraction cause of expected force can be maintained with normal posture of part of the body. With proper posture, circulation is improved because blood vessels are open rather to pinched shut (Josephson, 2009)

5.1.6 Comparison of Borg' Scale of discomfort rating between pre and post evaluation for control and experimental group

The result for pre and post evaluation for control and experimental group show, there is no statistically significant (pre: $Z = -0.663$, $p = 0.507$, post: $Z = -0.265$, $p = 0.791$). This is because, the comparison between two different groups whether pre or post evaluation have cause the difference psychological scale (Spielholz, 2006). From the percentage of discomfort changes data in table 4.2 have shows that there is of reading of Borg' scale for pre evaluation between control and experimental group. The time for control group feel discomfort at minute 45 while experimental group feel discomfort at minute 30. Therefore, the percentage of comfort changes between two groups is -33 which is not comfortable.

While, for the post evaluation between two groups have show there is differences the time for feel discomfort which control group without any intervention at minute 60 and experimental group with an intervention or support at the lower back of the subject at minute 75. Therefore, the smaller percentage of comfort changes between both groups which is +25 because the perception of discomfort for every person were different for both group due to the physical condition for every person. As conclude, when there are support or any intervention will increase the comfortability (Norman & Wells, 1998). This is because, lower back support had relax and comfortable caused by reducing the pressure that pointed at the lower back during sitting (Giuseppe et.al, 2002).

5.2 CONCLUSION

- I. There are significant different ($p < 0.05$) the comparison of muscle activity between pre and post evaluation for experimental group.
- II. There are significant different ($p < 0.05$) the comparison of rating in Borg' Scale between pre and post for experimental group.
- III. There are not significant different ($p > 0.05$) the comparison of muscle activity of post evaluation between control and experimental group

- IV. There are not significant different ($p>0.05$) the comparison of rating in Borg' Scale of discomfort in pre and post evaluation between control and experimental group.
- V. As a conclusion, the intervention (lumbar support) is engineering improvement that gives the effectiveness and relaxation riding for motorcyclist.

5.3 RECOMMENDATION

- I. The readjusted the distance of lower back support from the handle which can move forward and backward. This is because, the distance of lower back is too forward to the handle and make the subject uncomfortable to get a sit, when sitting and to move out from the motorcycle.

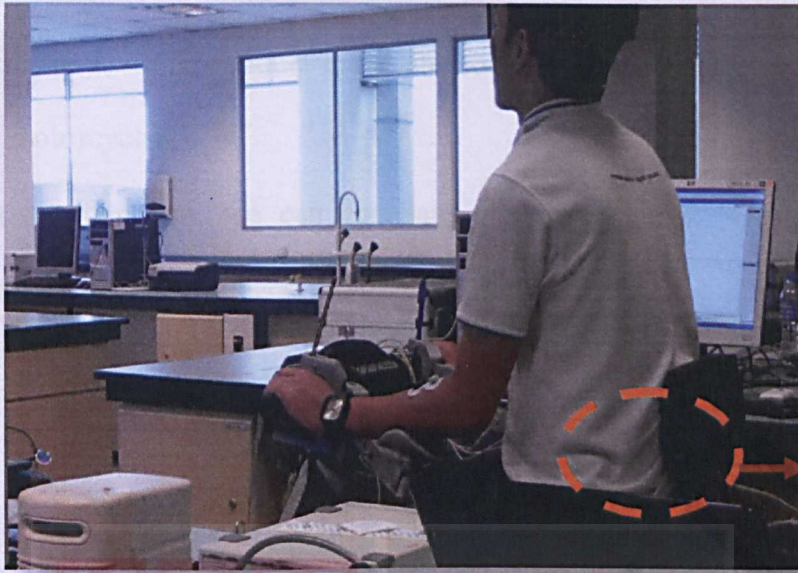


Figure 5.6: Recommendation on lower back support sitting posture

- II. Seating material should be soft and suitable to make the subject comfortable. This is because, the material of seating is hard and makes the subject uncomfortable especially at the buttock part.

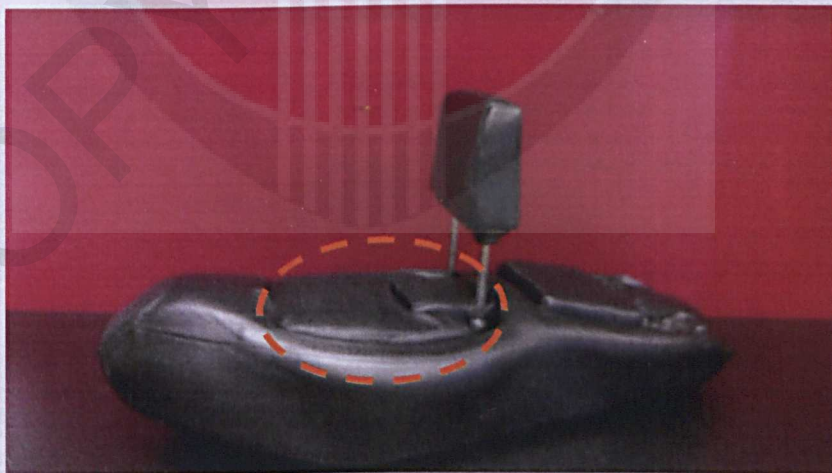


Figure 5.7: Recommendation on seating material

REFERENCES

- III. The study will be conduct in the environment condition that always use by motorcyclist.
- IV. As improvement, we can correlate other body parts when there is support at the lower back.



REFERENCES

- Asa Dederling, Gunnar Nemeth & Karin Harms-Ringdahl, (1999). Correlation between electromyographic spectral changes and subjective assessment of lumbar muscle fatigue in subjects without pain from lower back. *Clinical Biomechanic vol.14, 103-111.*
- Alperovitch-Najenson, D., Santo, Y., Masharawi, Y., Katz-Leurer, M., Ushvaev, D., & Kalichman, L. (2010). Low back pain among professional bus drivers: ergonomic and occupational-psychosocial risk factors. *Israel Medical Association Journal, 12*(January), 26–31.
- Balasubramaniam, V & Jagannath, M (2014). Detecting motorcycle rider local physical fatigue and discomfort using surface electromyography and seat interface pressure. *Transportation Research Part F: Traffic Psychology and Behaviour vol.22, 150-158*
- Bilodeau, M, Schindler-Ivens, S, Williams et.al (2003). EMG frequency content changes with increasing force and during fatigue in the quadriceps femoris muscle of men and women. *Journal of Electromyography and Kinesiology vol.13, 83-92*

Borg, G.A.V. (1982). Physical bases of perceived exertion, *Medicine and Science in Sport and Exercise*, vol.14(5), 337-381.

Bogdanis, G. C. (2012). Effects of physical activity and inactivity on muscle fatigue. *Frontiers in Physiology*, 3 MAY(May), 1–15. doi:10.3389/fphys.2012.00142

Cheng,D.& Lee,E. (2013,Sept 3). Mixed reaction to sudden fuel price increase. *The Sun Daily*. Retrieved from <http://www.thesundaily.my/news/820816>.

Cifrek,M, Medved, V, Tonković, S et.al (2009), Surface EMG based muscle fatigue evaluation in biomechanics, *Clinin Biomechanic* vol. 24, 327-340

Dina, M (2014, 5 March), Miros: Road safety in Malaysia matter of concern. *The Star Online*. Retrieved from <http://m.thestar.com.my/story.aspx?hl=Miros+Road+safety+in+Malaysia+matter+of+concern&sec=news&id=%7B0E6C87A7-86A9-4A29-AA3C-962C95848E10%7D>

Donnelly, C, Callaghan, J, & Durkin, J (2009), The effect of an active lumbar system on the seating comfort of officers in police fleet vehicles. *International Journal of Occupational Safety and Ergonomics* vol. 15, 295-307.

Donna Alderman (2007), Prolotherapy For Low Back Pain. *Practical Pain Management*.58-63.

Durkin,JL, Harvey,A, Hughson, RL, & Callaghan, Jack,P (2006), The effects of lumbar massage on muscle fatigue, muscle oxygenation, low back discomfort, and driver performance during prolonged driving. *Ergonomics*, vol.49(1), 28-44.

Faulkner, J (2003), Terminology for contractions o muscles during shortening, while isometric, and during lengthening. *Journal of applied physiology (Bethesda, Md:1985)* 95, 455-495.

González-Izal,M, Malanda,A, Gorostiaga,E, et.al (2012), Electromyographic models to assess muscle fatigue, *Journal of Electromyography and Kinesiology* vol.22, 501-512.

Giuseppe.A, Giorgio.CS, Marco.Rabuffeti, Antonio Pedotti (2002), Method for analysis of posture and interface pressure of car drivers. *Applied Ergonomics*, 511-522.

Hsu, Tien-Pen, Sadullah, Eng Ahmad Farhan Mohd, & Dao, Ing Nguyen Xuan. (2003). A comparison study on motorcycle traffic development in some Asian countries—case of Taiwan, Malaysia and Vietnam.

Jacobson, B, Wallace, T, Gemmell, H (2006), Subjective rating of perceived back pain, stiffness and sleep quality following introduction of medium-firm bedding system, *Journal of Chiropractic Medicine* vol. 5, 128-134.

Jacobson, B. H., Wallace, T., & Gemmell, H. (2006). Subjective rating of perceived back pain, stiffness and sleep quality following introduction of medium-firm bedding systems. *Journal of Chiropractic Medicine*, 5(4), 128–134. doi:10.1016/S0899-3467(07)60145-1

Karmegam, K, Ismail, M, Sapuan, S, Ismail, N, (2008), Conceptual design and prototype of an ergonomic back-leaning posture support for motorbike riders, *Journal of Scientific and Industrial Research* vol.67, 599-604.

Karmegam, K, Ismail, M.Y, Sapuan, S.M, Ismail, N et.al, (2009), A study on motorcyclist's riding discomfort in Malaysia, *Engineering e-Transaction* vol.4, 39-46.

Karmegam,K, Sapuan,S.M, Ismail, et.al (2011). Conceptual design of motorcycle's lumbar support using motorcyclists' anthropometric characteristics. *Maejo International Journal of Science and Technology*, vol. 5(1), 69-82.

Karmegam,K, Sapuan,S.M, Ismail, et.al. (2012). Evaluation of motorcyclist's discomfort during prolonged riding process with and without lumbar support. *Anais da Academia Brasileira de Ciências*, vol. 84(4), 1169-1188.

Keyserling,W, Brouwer,M, Silver, B, (1992), A checklist for evaluating ergonomic risk factors resulting from awkward postures of the legs, trunk and neck, *International Journal of Industrial Ergonomics* vol. 9, 283-301

Laughton, C. a., Slavin, M., Katdare, K., Nolan, L., Bean, J. F., Kerrigan, D. C., ... Collins, J. J. (2003). Aging, muscle activity, and balance control: Physiologic changes associated with balance impairment. *Gait and Posture*, 18, 101–108.
doi:10.1016/S0966-6362(02)00200-X

Ma'arof,M.I.N, Ahmad,I.N, Abdullah,N, Karim,S, (2012), Motorcycling Riding Issues: Understanding the Phenomenon and Development of Ergonomics Intervention in Improving Perceived Comfort for Prolonged Riding, 15-16

Marco Gazzoni (2010), Multichannel Surface Electromyography in Ergonomic Potentialities and Limits. *Human Factor and Ergonomic in Manufacturing & Service Industries*, 255-271.

Mario Cifrek, Vladimir Medved, Stanko Tonkovic, Sasa Ostojic (2009). Surface EMG based muscle fatigue evaluation in biomechanics. *Clinical Biomechanics* 24, 327-340.

Micheal, E.G (2007), Surface Electromyography. *Biofeedback, Springer*, 13-16.

Mike Kolich (2003), Automobile seat comfort: occupant preferences vs. Anthropometric accommodation. *Applied Ergonomic* 34, 177-184.

Norman, R, Wells, R (1998), Ergonomic interventions for reducing musculoskeletal disorders: An overview, related issues and future direction, 1-34

Onawumi, A, Lucas, E, (2012), Ergonomic investigation of occupational drivers and seat design of taxicabs in Nigeria, *ARPN Journal of Science and Technology* vol 2, 214-220.

Piia, H, et.al (2013), Muscle Activity and Inactivity Periods during Normal Daily Life, *PLoS ONE* vol 8, issue 1.

Phinyomark, A, Limsakul, C, Phukpattaranont, P, (2011), Application of wavelength Analysis in EMG Feature Extraction for Pattern Classification, 45-52.

Saeterbakken, A, Van den Tillaar, R, Fimland, M, A comparison of muscle activity and 1-RM strength of three chest-press exercises with different stability requirements, *Journal of Sports Sciences vol 29, 533-538.*

Serge, HR, Carlo, JDL, Mark Emley, Rudi, JCB, (1995), Spectral Electromyographic Assessment of Back Muscles in Patients with Low Back Pain Undergoing Rehabilitation. *SPINE, 38-48.*

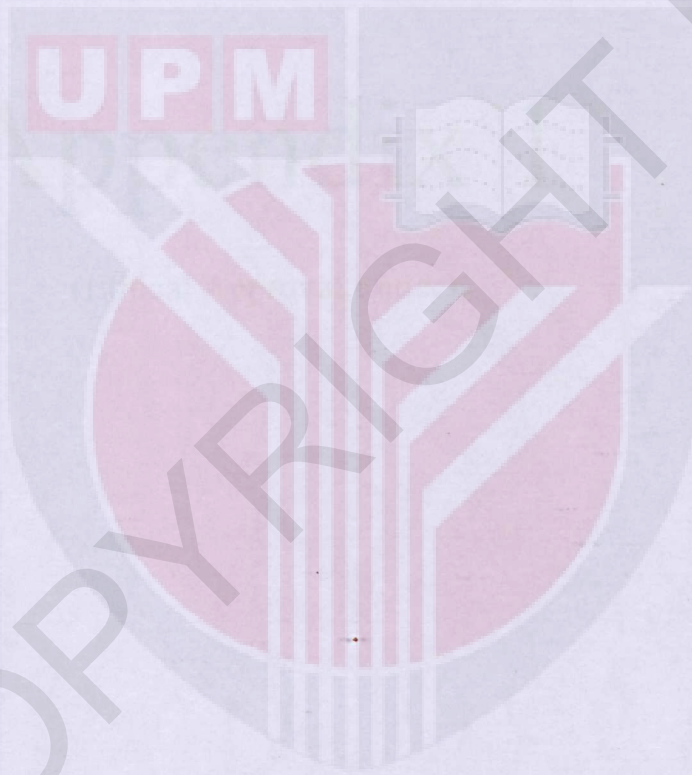
Shivakumara BS, Sridhar V (2010), Study of vibration and its effect on health of motorcycle rider. *Online Journal of Health and Allied Sciences.*

Spielholz, P. (2006), Calibrating Borg Scale ratings of hand force exertion, *Applied Ergonomics vol 37, 615-618.*

Soraria Pereira, Claudia C.S, Silvia Ferreira, Claudia Silva et.al (2014), Anticipatory postural adjustments during sitting reach movement in post-stroke subjects. *Journal of Electromyography and Kinesiology 24, 165-171.*

World Health Organization (2013), Malaysia. Retrieved from

http://who.int/violence_injury_prevention/road_safety_status/2013/country_profiles/malaysia.pdf



PEJABAT TIMBALAN NAIB CANSelor (PENYELIDIKAN DAN INOVASI)

Ref. : UPM/TNCP/IRMC/14.18.1 (KEUPM)F2
Date : 5th December 2014

Dr. Karmegam Karupiah
Department of Environmental &
Occupational Health,
Faculty of Medicine and Health Sciences,
Universiti Putra Malaysia,
Serdang, Selangor

Dear Sir,

Appendix 1

(Ethical Approval Letter)

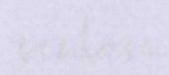
The Ethics Committee for Research Involving Human Subjects, Universiti Putra Malaysia (KEUPM) has studied the proposal and approved it on the condition that there were no objectionable ethical issues involved in the research.

Please find the list of documents received and returned with reference to the study and committee members who reviewed the documents (attached).

Notwithstanding above, we will not be responsible for any incidents on the part of researcher in the course of carrying out the research.

Thank you

"WITH KNOWLEDGE WE SERVE"

Sincerely,

PROFESSOR DR. NORLIDA YUSMAN
Chairperson
Ethics Committee for Research Involving Human Subjects (KEUPM)
Universiti Putra Malaysia



JKEUPM Ref No. : FPSK(EXP14-OSH)U048

a) Members of the JKEUPM who reviewed the documents:

- Prof. Dr. Zamberi Sekawi

b) Date of approval: 21/11/2014

Endorsed at JKEUPM Meeting on 5/12/2014, attended by:

NAME	DESIGNATION	GENDER	TICK IF PRESENT
Prof. Dr. Norlijah Othman	Paediatrics & Dean, Faculty of Medicine and Health Sciences	Female	
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. Samsinar Md. Sidin	Professor, Dept of Management and Marketing & Head of Accreditation Section, Faculty of Economics and Management	Female	
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	√
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	



UPM
UNIVERSITI PUTRA MALAYSIA

JAWATANKUASA ETIKA UNIVERSITI UNTUK
PENYELIDIKAN MELAKUKAN MANUSIA (JKEUPM)
UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG,
SELANGOR, MALAYSIA

FORM B1: RESPONDENT'S INFORMATION SHEET AND CONSENT

TITLE: Surface EMG Based Muscle Activity Analysis for Prolonged Motorcyclist Riding

We would like to invite you to participate in a research project on effect of lumbar support to reduce discomfort during prolonged riding among motorcyclists. Before you decide to take part, it is very important for you to understand why the research is being done and what it will involve. Participation is voluntary and you can withdraw from the study at any time. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything you do not understand or need more information. Thank you for reading this information.

Appendix 2

(Ethical Consent Form)

What is the purpose of the study?
This study aims to look at the effect of lumbar support on motorcyclists. The study involves the assessment of lumbar discomfort and muscle activity during riding.

What will you have to do?

If you agree to take part in this study, you will need to complete the questionnaire enclosed with this sheet. This is a questionnaire that asks questions about your background information. Then, you need to complete a physical examination (measure height and weight) to ensure that you are suitable for the study. After that, we will explain to you about the procedure and what you will be doing. For the experimental session, you need to attend the laboratory for a maximum three-days interval between them. During the session, you need to ride on the state motorcycle for two hours in a controlled room environment. Each respondent in intervention groups will receive pre and post interventions (with and without lumbar support) while respondents in control groups will receive pre and post intervention without lumbar support. At 15 minutes intervals, you are required to evaluate your discomfort level on the Borg's CR-10 questionnaire. At the same time, surface electromyography electrodes will be attached on your lumbar region to measure and analyze your muscle activity.

Who should not participate in the study?

You should not participate in this study if:

- Inadequate sleep prior to experiment.
- Taking medication prior to experiment.



UPM
UNIVERSITI PUTRA MALAYSIA

**JAWATANKUASA ETIKA UNIVERSITI UNTUK
PENYELIDIKAN MELIBATKAN MANUSIA (JKEUPM)
UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG,
SELANGOR, MALAYSIA**

FORM B1: RESPONDENT'S INFORMATION SHEET AND CONSENT

TITLE: Surface EMG Based Muscle Activity Analysis for Prolonged Motorcycle Riding

We would like to invite you to participate in a research project on effect of lumbar support to reduce discomfort during prolonged riding among motorcyclists. Before you decide to take part, it is very important for you to understand why the research is being done and what it will involve. Participation is voluntary and you can withdraw from the study at any time. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Thank you for reading this.

What is the purpose of the study?

This study aims to look at the effect of lumbar support towards motorcyclist. It involves the assessment of lumbar discomfort of the participants before and after the intervention.

What will you have to do?

If you agree to take part in this study, we will ask you to complete the questionnaire enclosed with this sheet. This is a questionnaire that asks some questions about your background information. Then, you need to undergo a physical examination (to measure height and weight) to ensure that you are meet the required criteria of the study. After that, we will explain to you about the procedure and informed consent letter will be distributed. For experimental session, you need to attend on two different days (with a minimum three days interval between them). During the session, you need to sit on the static motorcycle for two hours in a controlled room environment. Each respondent in intervention groups will receive pre and post interventions (with and without lumbar support) while respondents in control groups will receive pre and post intervention without lumbar support. At 15 minutes intervals, you are required to evaluate your discomfort level on the Borg's CR-10 questionnaire. At the same time, surface electromyography electrode will be attached on your lumbar region to measure and analyze your muscle activity.

Who should not participate in the study?

You should not participate in this study if:

- Inadequate sleep prior to experiment.
- Taking medication prior to experiment.

What will be the benefits of the study:

a) To you as the subject?

There are no individual benefits in taking part in this research study. However, to acknowledge your help with our research all participants will be given a token of appreciation from us.

b) To the investigator?

By volunteering you will help us to reveal effects of lumbar support during prolonged riding towards motorcyclists. The research will contribute greatly to the advancement of the science and ergonomic intervention.

What are the possible risks?

If you decide to take part in this study, you may experience some discomfort due to prolonged sitting on motorcycle for 2 hours. Besides that, you also might feel slightly discomfort when we attach the electromyography electrodes on your lumbar region during the experimental session.

Will the information that you provide and your identity remain confidential?

Yes, all information collected will be kept strictly confidential. Any information relating to you, your workplace and results of the data obtained will not be identifiable in published material, your data not disclosed to any regulatory body and is for research purposes only.

Who should you contact if you have additional questions during the course of the research?

Dr. Karmegam Karuppiah (Supervisor)
Department of Environmental and Occupational Health,
Faculty of Medicine and Health Science,
Universiti Putra Malaysia.
Tel: +603 8947 2643
Email: karmegam@upm.edu.my

CONSENT FORM

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 Signature
(Respondent) (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)



UPM
UNIVERSITI PUTRA MALAYSIA
KAMPUS SEREMBAN, NEGERI SEMBILAN

QUESTIONNAIRE FOR PRE-SURVEY

TITLE OF PROPOSAL

SURFACE EMG BASED MUSCLE ACTIVITY ANALYSIS FOR PROLONGED

Appendix 3

(Questionnaire for Pre-Survey)



COPYRIGHT UPM

DEPARTMENT OF ENVIRONMENTAL AND OCCUPATIONAL HEALTH

FACULTY OF MEDICINE AND HEALTH SCIENCE

UNIVERSITI PUTRA MALAYSIA

2014



ID:163934

QUESTIONNAIRE FOR PRE- SURVEY

TITLE OF PROPORSAL

SURFACE EMG BASED MUSCLE ACTIVITY ANALYSIS FOR PROLONGED
MOTORCYCLE RIDING

SUPERVISOR NAME:

DR KARMEGAM KARUPPIAH

(Department of Environmental and Occupational Health)

PREPARED BY:

NUR FARHANA BT ABD JAIZ

163934

DEPARTMENT OF ENVIRONMENTAL AND OCCUPATIONAL HEALTH

FAÇULTY OF MEDICINE AND HEALTH SCIENCE

UNIVERSITI PUTRA MALAYSIA

2014

PRE-SURVEY QUESTIONNAIRE

This page contains questions that will provide your personal information. Please answer each question completely.

SECTION A: BACKGROUND INFORMATION

1. Age: _____ year

2. Weight: _____ kg

3. Height: _____ cm

4. Dominant hand:

Right Left

4. Race:

Malay Chinese
 Indian Other: _____

5. Education level:

UPSR PMR
 SPM STPM/MATRIKULASI
 DIPLOMA Degree
 Master PhD

SECTION B: DAILY ACTIVITIES

6. On average, how many hours per day do you sleep?

Less than 4 hours
 4 until 8 hours
 More than 8 hours

7. On average, how many hours per day do you ride a motorcycle?

Less than 4 hours

4 until 8 hours

More than 8 hours

8. Are you doing heavy work activities?

Yes

No

If yes, how often do you do heavy work activities in a week? _____

Please mention heavy work activities. _____

9. Do you play sports?

Yes

No

If yes, how often do you play sports of the week? _____

SECTION C: HEALTH INFORMATION

10. Have you ever experienced the problems that have been diagnosed by a doctor?

Yes

No

If yes, please answer question 10 (i), if not, please proceed to question 11.

10 (i). Illness is, as stated below:

(Can choose more than one illness)

High blood pressure

Heart disease

Diabetes

Mental problems

Others. Please state _____

11. At present, do you take any medical treatment from doctors?

Yes

No

If not, please proceed to question 12; if yes, please specify the type of medicine below:

12. Would you describe yourself as?

A current smoker

An ex smoker

Never smoke

13. How many per day do you smoke?

1-5

5-10

10-15

>15

14. How many days ago did you have your last cigarette?

Today

Yesterday

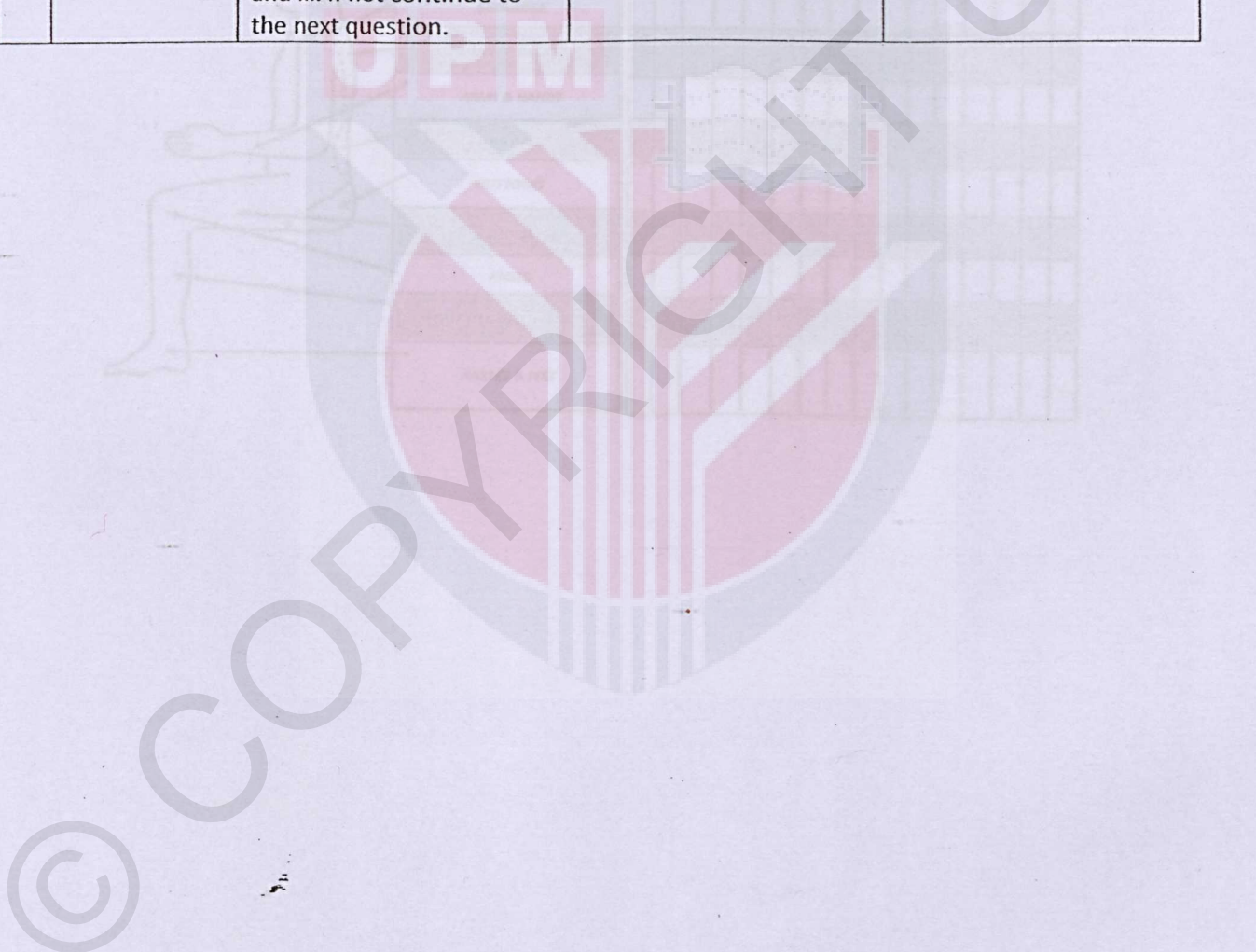
Day before yesterday

More than 2 days ago

SECTION D: MUSCULOSKELETAL DISORDERS INFORMATION

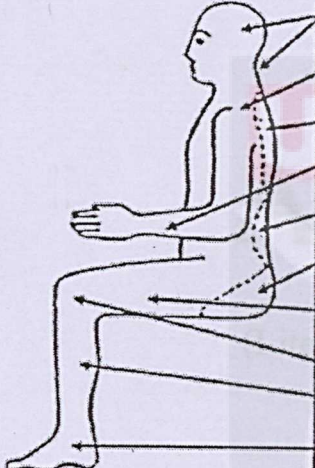
	Parts of body	i) Do you ever feel pain, aches, burning or discomfort on the part of the body below?	ii) Do you ever feel pain, aches, burning or discomfort on the part of the body below within 7 days lately?	iii) Do you feel pain when riding a motorcycle on the part of the body below?
1	Neck	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes, answer questions ii and iii. If not continue to the next question.	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
2	Shoulder	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes, answer questions ii and iii. If not continue to the next question.	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
3	Upper back	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes, answer questions ii and iii. If not continue to the next question.	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
4	Lower back	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes, answer questions ii and iii. If not continue to the next question.	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
5	Elbow	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes, answer questions ii and iii. If not continue to the next question.	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
6	Wrist	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes, answer questions ii and iii. If not continue to the next question.	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
7	Arm	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No

		If yes, answer questions ii and iii. If not continue to the next question.		ID:
9	Knees	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes, answer questions ii and iii. If not continue to the next question.	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
10	Feet	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes, answer questions ii and iii. If not continue to the next question.	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No



ID:.....

BORG'S SCALE (DISCOMFORT RATING)



	Nothing at all	Extremely weak	Very weak	Weak	Moderate	Strong	Very strong	Extremely strong								
	0	0.3	0.5	0.7	1	1.5	2	2.5	3	4	5	6	7	8	9	10
NECK OR HEAD																
SHOULDER																
UPPER BACK																
ARMS & HANDS																
LOW BACK																
BUTTOCKS																
THINGS																
KNEES																
CALF (LEG BELOW KNEE)																
ANKLES & FEET																

© COPY

Appendix 4

(Literature Review for Data Analysis)

Journal	Shoulder	Upper Back	Arms & Hands	Low Back	Buttocks	Thighs	Knees	Calf	Ankles & Feet
Analysis of the supraspinatus and rhythm and electromyography of the trapezius muscle during elevation and lowering	EMG								
Comparison of dominant and non-dominant forelimb muscle activity	EMG								
Yoshida et al. (2005)									
Assessment of early onset of driver fatigue using multimodal fatigue markers in a real situation, CN-Japan/China	RMS	RMS							
Yoshida Hideo, et al. (2005)									
Comparison of an individual and environmental factors associated with fatigue-related motoric injury in a labor group	RMS	RMS							
Al-Tajer, et al. (2012)									
Examining motorcycle injury risk potential	RMS	RMS							

RESULTS

Journal	Neck & Head	Shoulder	Upper Back	Arms & Hands	Low Back	Buttocks	Thighs	Knees	Calf	Ankles & Feet
Analysis of the scapulothoracic rhythm and electromyography of the shoulder muscle during elevation and lowering: Comparison of dominant and non dominant shoulder. (Kunio Yoshizaki, et.al, 2009)	-	• IEMG	-	-	-	-	-	-	-	-
Assessment of early onset of driver fatigue using multimodal fatigue measures in a static stimulator. (M.Jagannath & Venkatesh Balasubramanian, 2013)	• RMS	• RMS	-	• RMS	• RMS	-	-	-	-	-
Comparison of an intermittent and continuous forearm muscles fatigue protocol with motorcycle riders and control group. (M.Marina, et.al, 2012)	-	-	-	• RMS	-	-	-	-	-	-
Detecting motorcycle rider local physical fatigue and	• RMS	• RMS	• RMS	• RMS	• RMS	-	-	-	-	-

No	Year	Location	Objective	Method	Sample Size	Study Duration	Variable	Finding	Conclusion	Recommendation	Study Type
1.	1999	Karolinska Institute, Stockholm, Sweden.	<p>General: To correlate objective measurements of muscle fatigue in the lower back to the subject's own assessment of fatigue.</p> <p>Specific: -to distinguish between patient with and without pain in the lower back. -to discriminate between patient with pain in the lower back and healthy control subject. - to assess muscle fatigue in back extensor muscle of healthy subjects from three angles using EMG, endurance time and Borg' scale. -to assess how healthy subjects scored their physical activity and correlate it to measurements of fatigue.</p>	<p>✓ Modified Sorensen's test will tolerate small involuntary movement by sensor. ✓ Borg' scale- subject will assess fatigue every 15 minutes during modified Sorensen test and the test of recovery. ✓ Surface EMG were attached in a bipolar configuration and parallel to the muscle fibres. ✓ Physical activity was assessed by using six-grade scale for classification of physical activity.</p>	Fifty (25 men and 25 women) healthy, medical student and no history of pain in the lower back or experienced in previous year at the Karolinska Institute.			<p>✓ For the endurance time, the relative means at a Borg rating of 3 was 30% of the total time, 5 was 48% and 7 was 62% of the total times. ✓ For Borg' scale, the highest correlation was at 3 min. Borg ratings at 2 and 3 min correlated significantly with the MF and MPF slopes for total time at all electrode sites. ✓ For EMG, the mean reduction of the four electrode sites at Borg rating of 3 was 29% in MF and 35% in MPF, at Borg rating 5, there was a reduction of 53% in MF and 55% in MPF and Borg rating of 7, the reduction of 67% in MF and 69% in MPF compared to the total reduction. ✓ For physical activity, there is no correlation between physical activity and EMG measurement of fatigue or endurance was found.</p>	The modified Sorensen test in combination with assessment of lumbar muscle fatigue on the Borg CR-10 scale can be used in sub-maximal assessment for prediction of endurance time and EMG MF and MPF shifts.	<p>✓ The subject must experience duration of exhaustion before because if the subject do not have an experienced, it was hard to rate properly the first time and it will be rate too high. ✓ Considering for one gender only because study men and women have differ significantly in the end of MF and MPF at all electrode sites.</p>	Intervention
2	2007	Kuopio University Hospital	<p>General: To compared the dynamic surface electromyography (EMG) activities of back muscle before and after traditional bone</p>	<p>✓ Questionnaires about their perception of their functional disability (Oswestry Disability Questionnaire),</p>	150 patients, 70 were found to be eligible for study inclusion and were randomized	2 month	Independent: Age between 20-60 years, weight, height and Body Mass Index.	<p>✓ Visual analog scale (F=15.7; P<.001; Oswestry index), and depression (F=8.1; P<.01) ✓ For electromyography, the FFR decreased significantly at the L4-5 level on the right side (F=6.56; P=.013) after treatment. The FFR at the L1-2 level showed a Right-Left x Group interaction before (F=8.39; P=.005)</p>	TBS and PT reduce the subjective feeling of pain as indicated by the VAS and alleviate functional disability as	<p>✓ The patient with low back problems were a heterogeneous group and an assessment of the impact of the treatments</p>	Intervention

<p>setting and physical therapy. Specific: -To examine EMG activities during trunk flexion and extension among patients with LBP before and after TBS and PT. - To estimate the results of dynamic sEMG activity in relation to pain level</p>	<p>depression (Rimon's Brief Depression Scale Questionnaire) and pain intensity during the study period (100mm visual analog scale (VAS)). ✓ sEMG activity of muscles was recorded (ME3000P) from right and left paraspinal muscles. ✓ Statistical analysis was conducted with the use of SPSS version 11.5.</p>	<p>into two subgroups by treatment. One group received TBS (n=35), whereas the other group received PT (n=35).</p>	<p>Independent Age, Height, Weight, Riding experienced, Riding in a week, BMI</p>	<p>and after (F=14.86;P=0.001)</p>	<p>shown by the Oswestry Disability Questionnaire. However, no and statistically significant association between back pain and EMG parameter was found in the study.</p>	<p>used because of the lack of plausible pathophysiological or pathoanatomical explanation to account for nonspecific symptom found in CLBP.</p>
<p>General To examine the effects of backrest (a prototype of the lumbar support by the author's earlier study; Karmegam et.al. 2008) Specific -to determine and to verify the data distribution (mean discomfort rating) over time periods (every 15 minutes for a total of 120 minutes). -to determine and to verify the discomfort 'break point' (Borg Scale Rating ≥ 5)</p>	<p>✓ Questionnaire collect data within the scope of this study which adapt from the previous research by Lusted et.al (1994), Koleini et.al (2008), Falou et.al. (2003) and Borg (1998). ✓ Data analysed by using the statistical computer software (Statistical Package Service and Solution-SPSS).</p>	<p>100 motorcyclists from the Polytechnic Sultan Azlan Shah (50 male and 50 female)</p>	<p>2 hours testing</p>	<p>✓The result indicates that male and female motorcyclists do experience discomfort symptoms on their body parts during testing process and reduced when tested with lumbar support prototype. ✓The highest comfort changes in male participants were seen in the low and upper back, both recorded +100% changes with the usage of the lumbar support prototype. Similarly the female participant also recorded the highest comfort changes in low back and upper back with +60.0% changes.</p>	<p>The rate of discomfort level decreases over time during the testing period with the prototype. Both male and female participants recorded low back and upper back as the body part that had the highest comfort changes during testing with the prototype.</p>	<p>Cross-Sectional Study</p>

4	2008	<p>and comparison between testing with and without prototype.</p> <ul style="list-style-type: none"> -to compare the discomfort T-test output for the paired samples (with and without prototype) -to compare the classification of effect size of sweat the end session. <p>Objective To study muscle activity and fatigue during real task.</p> <p>Specific</p> <ul style="list-style-type: none"> -to analysis the muscle activation. -to analysis of exerted forces and torques. -to analysis of muscle fatigue. 	<p>✓ sEMG and joint angle signals were synchronously acquired.</p>	<p>Ten male subjects participated in this study (age:26.7±4.7 years, height: 179.8± 2.7 cm, weight: 77.4 ± 8.6kg).</p>	<p>✓ In case 1, for amplitude variable, Initial value increases increasing load (ARV;p<0.01,F=12.9,RMS;p<0.01,F=12.95) the increase is higher in concentric than in eccentric phase and slope increases with increasing load.</p> <p>✓ In the case 2, the CV decreases because the MUs with higher CV, recruited in the previous cycle.</p> <p>✓ In case 3, a high variability among subject was observed in the muscle activation intervals and sEMG signal develop.</p>	<p>Many factors play important roles in the correct interpretation of information provided by sEMG. Among these factor are the signal nonstationarity, the shift of the electrodes with respect to muscle fibres and the changes in the volume conductor. Further improvements are necessary to develop multichannel sEMG into an effective tool supporting other methodologies for evaluation of work related risk.</p>	<p>Intervention</p>
---	------	---	--	--	---	--	---------------------

5	1995	<p>General To determine the electromyography procedure.</p> <p>Specific -to distinguish muscle impairment between patient with low back pain and normal subject. -to monitor changes in muscle function after low back rehabilitation</p>	<p>✓ Back Analysis System used to acquire the process EMG and force data.</p>	<p>Patient with chronic low back pain (n=85). A subset (n=28) of these patient was re-test after low back pain rehabilitation and normative sample (n=42).</p>	<p>✓ A significant lumbar level by lumbar side interaction present (P=0.001). History of back surgery did not significant influence the change in MF recovery with rehabilitation.</p> <p>✓ However, the normative data the regression was significant (P=0.001) and the factor age, body mass index and height account for 36% of the variance of baseline MVC.</p>	<p>Low back pain and normal classification based on MF parameter were independent of the subject maximal trunk extension force. This finding implies that the abnormal muscle functioning measured by the MF parameters in this population was not influenced significantly by differing abilities of subjects to exert a maximal contraction.</p>	<p>Fundamental</p>
6	2011	<p>Polytechnic of Sultan Azlan Shah, Malaysia</p> <p>General To provide for the safety and comfort of the motorcyclist by reducing fatigue during the riding process.</p> <p>Specific -to devise a system or product with added human value -to design a product or system that can accomplish criteria is demanding as the advancement in technology.</p>	<p>✓ Product design specification (PDS) are used for design, manufacturing and construction of a structure or a component in order to achieve a specified degree of safety, efficiency, performance or quality as well as a common standard of good design practice.</p>	<p>1032 student (595 male, 437 femalrs)</p>	<p>✓ The lumbar support should be 16.0cm in height and 38.5 cm in width. It should also be adjustable between 14.2-30.2 cm from the motorcycle seating surface. In addition, 5.0 cm is recommended as the minimum thickness for the lumbar support.</p>	<p>Motorecyclists were satisfied with the prototype as it provides comfort to their lumbar region during riding and reduced the frequency of their posture changes.</p> <p>- Lumbar Support could be adjust to suit their height dimensions. - Evaluation on the prototype needs to be conduct to determine their stability, solidity, durability, and safety over prolonged use.</p>	<p>Fundamental</p>

7	1997	Nordic countries, Scandinavea	<p>General To identify effective ergonomic interventions for improved musculoskeletal health in the workplace.</p> <p>Specific -to make recommendations for quality criteria in ergonomic intervention research. -to avoid ambiguity in terminology a list of definition of the ergonomic term used.</p>	<p>✓ Literature retrieval. Literature search was a selection of about 30 papers considered relevant for this review.</p>				<p>✓ A total of 92 studies reported were classified as mechanical exposure intervention, 32 as production system intervention and 39 as modifier intervention.</p> <p>✓ Most single factor mechanical exposure intervention target exposure level through work place redesign.</p>	<p>Modifier intervention that actively involve the worker (medical management of workers at risk, physical training or active training in work technique or combination of these approach).</p>	<p>✓ The efficacy of investigated intervention in relation to the ergonomic preventable fraction. ✓ Organizational prerequisites for successful implementation of ergonomic intervention. ✓ Means to obtain adequate contrast in intervention targeting mechanical exposure. ✓ Evaluation of intervention sustainability.</p>	Case-control study
8	2007	Washington State Department of Labor and Industries	<p>General To justify an investment in ergonomics intervention.</p>	<p>✓ Literature search focusing on report and publication evaluating the effectiveness of ergonomic interventions at the workplace.</p>				<p>✓ 87 of the case study described interventions in manufacturing industries, 40 were in an office environment, and 36 were in healthcare setting. ✓ Over 150 of the case studies reported the result of ergonomic program. ✓ The effectiveness estimates are based on range of reduction in WMSD numbers and incidence rate as well as lost workdays and worker compensation cost are indicator of injury severity.</p>	<p>The fact that most intervention have payback period of less than one year would allow for simpler models that do not have account for depreciation or discounted cash flow. While, some organization may have reduce WMSD costs by 80% over a one-year period.</p>		Fundamental
9	2003		<p>General To challenge ergonomics criteria related to anthropometry in the same way.</p>	<p>Seat design position. ✓ The seatback angle was set to 25° from vertical.</p>				<p>✓ Most seat comfort surveys used ordinal scale. The survey used in the present contribution.</p>	<p>Based on this finding, it was concluded that, while it is important for designer to</p>	<p>✓ There is a discrepancy between the ergonomic criteria related to anthropometry</p>	Fundamental

10	2005	Healthy college student	<p>General To propose a method for using body pressure distribution data in order to measure driver's postural change during driving.</p> <p>Specific</p>	<p>✓ The track position was set to full rear.</p> <p>✓ The H-point manikin was placed in the seat.</p> <p>✓ The seat was adjusted until the H-Point manikin was adequately positioned in front of pedals and steering wheel.</p> <p>✓ The H-point manikin was loaded according to the standard develop by the Society of Automotive Engineers</p> <p>✓ In this position, the H-point to heel point relationship and the H-Point manikin's critical angle (torso, hip, knee and foot) were determined for each seat.</p>	16 male healthy college students.	-	<p>Independent Driving period, stature group, and lumbar support prominence.</p> <p>Dependent Subjective discomfort</p>	<p>✓ Subjective discomfort rating increased as the driving period increased.</p> <p>✓ Driving posture</p> <p>The interaction effect of stature group and lumbar support prominence showed that knee angle of the shorter subjects increased as lumbar support prominence increase and knee angle of the taller subjects decreased.</p> <p>✓ Body pressure distribution</p>	<p>understand the related ergonomic especially physiology and anthropometry, seat automobile comfort is a unique science.</p>	<p>and subjective perception of comfort.</p>	<p>Intensive and manifold analyses of dynamic body pressure distribution are needed in real driving situation</p>
----	------	-------------------------	---	---	-----------------------------------	---	---	--	---	--	---

11	2000	<p>-to investigate the relationship between dynamic body pressure data with driver's posture.</p>	<p>(AHP) ✓ Body pressure distribution The differences between the total pressure of the seat back or the seat pan. Body pressure change variable is the count of pressure changes that exceed 15% of the average total pressure of the seat back and 5% of the seat pan.</p>	<p>rating, driving posture and body pressure distribution.</p>	<p>The interaction effect showed that the body pressure change variable increased as lumbar support prominence increased for the taller subjects.</p>		Fundamental
		<p>General To detect typical induced changes such as an increase in EMG amplitude. Specific -to establish the occurrence of fatigue -to compare EMG for situation in which muscle force is identical.</p>	<p>✓ Preliminary remarks For this purpose characteristic representing the average amplitude like Root Mean Square(RMS) and Electrical Activity. ✓ Test contraction Possible EMG changes over time observed under such condition are attributed to the occurrence of muscle fatigue. The use of this method needs an exact</p>		<p>✓ EMG recording and evaluation Parallel to the EMG the action code describing the occupational activity of the person was recorded on the same tape and used in data evaluation for the selection of reference activities representing EMG sections which are associated similar muscle force production. ✓ Fatigue indication using reference activities During the study the following activities were encoded among other: lifting a bobbin. For the purpose of fatigue analysis the lifting activity was chosen as a reference activity and the temporal behaviour of the EMG amplitude for such activity section was follow up. ✓ Fatigue indication using JASA method More general approach the newly developed JASA method for the joint analysis of EMG spectrum and amplitude is used in which, in addition to the change in the EMG amplitude, the change in the spectral distribution is considered. Before redesign about 80% of the EMGs are characterized by an increase in EA over time and a decrease in MF.</p>	<p>From a practical point of view, indication of muscular fatigue is needed in occupational studies in order to quantify the time for performing a certain activity without reaching the state of immoderate fatigue and disabling the person to continue the activity with necessary precision.</p>	

12	2009	<p>General To evaluate local muscle fatigue by means of surface electromyography (sEMG) signal processing.</p> <p>Specific -to determine differences before and during fatigue.</p>	<p>control of the body posture during performance of the test contraction.</p> <ul style="list-style-type: none"> ✓ Joint analysis EMG spectrum and amplitude (JASA) ✓ Methodology for fatigue indication was enhanced and both, the change in the amplitude and the spectrum were considered simultaneously <p>The spectrum also depends on fatigue a left shift in the spectral distribution was consistency found.</p>			<p>After redesign this amount was lowered to about 45%. It is concluded that for the muscle affected most, the right trapezius muscle, fatigue is reduced by the ergonomic intervention but not completely avoided.</p>		Fundamental
		<p>General To evaluate local muscle fatigue by means of surface electromyography (sEMG) signal processing.</p> <p>Specific -to determine differences before and during fatigue.</p>	<p>control of the body posture during performance of the test contraction.</p> <ul style="list-style-type: none"> ✓ Joint analysis EMG spectrum and amplitude (JASA) ✓ Methodology for fatigue indication was enhanced and both, the change in the amplitude and the spectrum were considered simultaneously <p>The spectrum also depends on fatigue a left shift in the spectral distribution was consistency found.</p>			<p>After redesign this amount was lowered to about 45%. It is concluded that for the muscle affected most, the right trapezius muscle, fatigue is reduced by the ergonomic intervention but not completely avoided.</p>		Fundamental
		<p>General To evaluate local muscle fatigue by means of surface electromyography (sEMG) signal processing.</p> <p>Specific -to determine differences before and during fatigue.</p>	<p>control of the body posture during performance of the test contraction.</p> <ul style="list-style-type: none"> ✓ Joint analysis EMG spectrum and amplitude (JASA) ✓ Methodology for fatigue indication was enhanced and both, the change in the amplitude and the spectrum were considered simultaneously <p>The spectrum also depends on fatigue a left shift in the spectral distribution was consistency found.</p>			<p>After redesign this amount was lowered to about 45%. It is concluded that for the muscle affected most, the right trapezius muscle, fatigue is reduced by the ergonomic intervention but not completely avoided.</p>	<p>In clinical diagnostic applications- both in sport and in medical rehabilitation contexts- standardization of modern methods embodied in a novel type of a muscle fatigue monitor device is yet to be realized.</p>	Fundamental
		<p>General To evaluate local muscle fatigue by means of surface electromyography (sEMG) signal processing.</p> <p>Specific -to determine differences before and during fatigue.</p>	<p>control of the body posture during performance of the test contraction.</p> <ul style="list-style-type: none"> ✓ Joint analysis EMG spectrum and amplitude (JASA) ✓ Methodology for fatigue indication was enhanced and both, the change in the amplitude and the spectrum were considered simultaneously <p>The spectrum also depends on fatigue a left shift in the spectral distribution was consistency found.</p>			<p>After redesign this amount was lowered to about 45%. It is concluded that for the muscle affected most, the right trapezius muscle, fatigue is reduced by the ergonomic intervention but not completely avoided.</p>	<p>Insight into physiological phenomena underlying changes in sEMG signal with fatigue. Beside the type and size of the dominant muscle fibres, the net lactate concentrations depend also on the force level. Increased concentration of the lactate is responsible for fatigue by changes in intracellular pH. As a result, muscle fibre conduction velocity (CV) decrease, directly changing the shape of the motor unit action potential (MUAP) waveform and finally the properties of the surface EMG as interference signal of all generated MUAPs.</p>	Fundamental

13	2002	<p>General To present a multi-factor method for the analysis of sitting posture</p> <p>Specific -to establish quantitative or qualitative models for comfort measurement or prediction -to measure the pressure in the intervertebral discs that represent an indirect assessment of the load acting over the vertebral column.</p>	<p>✓ ELITE system Optoelectronic system able to reconstruct, at a sampling rate of 100Hz and with accuracy of about 0.8mm, the three dimensional trajectories of passive markers placed on the subject skin.</p> <p>✓ TEKSCAN system. Recording of the load exerted on a suitable thin flexible matrix of piezoresistive sensors.</p> <p>✓ Biomechanical model Adopted biomechanical model.</p> <p>✓ Standing posture acquisition To allow the visibility of all the markers applied in agreement with the previously defined biomechanical model.</p>	<p>Young and healthy subjects (7 males and 1 females) All university student.</p>		<p>✓ From the analysis of pressure distribution on the backrest, identification of the adopted sitting strategies was pointed out by mean pressure value along the sagital interfacing line which provide a synthetic indicator of the behaviour of the trunk on the seat.</p> <p>✓ The lateral support function of the seat was also evaluated as the fraction of the load exerted on the lateral regions of the seat with respect to the total pressure and total contact data.</p>	<p>Outcome is the possibility to consider lumbar flexion angle as an indicator of the postural comfort, the method also proposed the qualitative classification of the sitting modalities through the observed pressure maps.</p>	<p>✓ A larger number of analysed seat with different shapes and foam stiffness, in performed correlation with the shape of the human body at the interface.</p>	<p>Intervention</p>
----	------	---	--	---	--	---	---	---	---------------------

14	2014	<p>General To assess the effect of velocity of arm movement on antipacipitatory postural adjustment (APAs) generation in the contralateral and ipsilateral muscles of individual with stroke in seating.</p>	<p>✓ Surface electromyography</p> <p>✓ Skin impedance was measured using the Noraxon Impedance Checker system.</p> <p>✓ Kinematic was recorded using 4 camera Qualisys Motion Capture System and analyse using Qualisys Track Manager Software.</p> <p>✓ SPSS 18 version.</p>	<p>2 groups: 1 include healthy control (n=10) and group 2 (n=8). Group 1 include 3 males and 7 females, group 2 include 2 female and 6 males.</p>	<p>✓ Post stroke subject used a greater trunk displacement of 1.98±1mm when reaching the bottle with the affected limb, and a displacement of 0.68±0.235mm while the movement was performed by the non-affected limb.</p>	<p>Post stroke subject may be less capable of adapting their disturbance of the center of pressure inherent of daily life activities and ambient changes.</p>	<p>To evaluate the influence of damaged hemisphere on timing and amplitude of APAs.</p>	<p>Cross sectional observational study</p>
----	------	---	---	---	---	---	---	--