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EFFECT OF FOOTWEAR INSOLE ON FOOT PAIN AND SUBJECTIVE DISCOMFORT ON PROLONGED STANDING AMONG TRAFFIC POLICE IN MALAYSIA

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EFFECT OF FOOTWEAR INSOLE ON FOOT PAIN AND SUBJECTIVE DISCOMFORT ON PROLONGED STANDING AMONG TRAFFIC POLICE IN MALAYSIA

BY,

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ABSTRACT

EFFECT OF FOOTWEAR INSOLE ON FOOT PAIN AND SUBJECTIVE DISCOMFORT ON PROLONGED STANDING AMONG TRAFFIC POLICE IN MALAYSIA

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Prolonged standing is common in the occupational sector especially among traffic police. It can cause pain and discomfort in the foot, legs and lower back.in Malaysia, less studies has been conducted related to traffic police's foot injuries. One of the common interventions for prolonged standing is by using an ideal insole which can help in reduce foot discomfort and are often used in the treatment of musculoskeletal pain as well as problems in the lower limbs. Therefore, this study aims to determine the effect of footwear insole on foot pain and subjective discomfort on prolonged standing among Malaysian traffic police. A simple random sampling of 52 respondents (26 controls, 26 experimental) at the age ranged from 20 to 35 years was selected for this study. This study used two types of questionnaire; Borg's scale discomfort rating, to identify the foot discomfort and; American Academy of Orthopedic Surgeons Lower Limb Outcomes Assessment: Foot and Ankle Module (AAOS-FAM) to assess foot pain. Three types of the insole (memory foam, rubber, and gel) were given to the experimental group whereas, for the control group, they were assessed with an existing insole. During 4 hours period of study, a Borg's scale foot discomfort rating was given to the respondents at every 30 minutes. The results showed that, there was an association between foot-ankle pain and footwear insole, $p=0.022$. Also, when comparing the Borg's scale, control group experience increase in foot discomfort as compared to experimental group that showed constant values or slight increment. After 180^{th} minutes, there were significant difference of foot discomfort between control and experimental group, $p<0.001$ and there were strong correlation between time and foot discomfort among control group at every part of foot areas, $r>0.70$ compared to the experimental groups, $r>0.30$. It also been identified by this study that footwear insoles cause an effect to foot pain and foot discomfort among Malaysian traffic police. In this study, 9 foot areas were categorized into 3 regions; Region I (hallux, lesser toe, MTPJ1, MTPJ23 and MTPJ45), Region II (medial midfoot and lateral midfoot) & Region III (medial rearfoot and lateral rearfoot). Memory foam is the best material to reduce foot discomfort for Region II and III, whereas; gel is best for Region I. This study recommends, new development of insole (combination: Gel + Memory foam) and test among traffic police.

Keywords: Footwear insole, foot discomfort, prolonged standing, traffic police

ABSTRAK

KESAN TAPAK KASUT TERHADAP SAKIT KAKI DAN KETIDAKSELESAAN SUBJEKTIF AKIBAT AKIBAT BERDIRI LAMA DALAM KALANGAN ANGGOTA POLIS TRAFIK DI MALAYSIA

NUR ATIKAH BINTI AHMAD IDRIS

Berdiri lama adalah perkara biasa dalam sektor pekerjaan terutamanya di kalangan polis trafik. Ini boleh menyebabkan kesakitan dan ketidakselesaan di tapak kaki, kaki dan bahagian belakang bawah badan. Di Malaysia, kurang kajian telah dijalankan berkaitan dengan kecederaan kaki polis trafik. Salah satu intervansi yang biasa dilakukan untuk berdiri lama adalah dengan menggunakan tapak kasut yang sesuai. Tapak kasut yang sesuai dapat membantu dalam mengurangkan ketidakselesaan kaki dan sering digunakan dalam merawat kesakitan muskuloskeletal serta masalah pada anggota bawah. Oleh itu, kajian ini bertujuan untuk menentukan kesan tapak kasut pada sakit kaki dan ketidakselesaan subjektif terhadap berdiri lama di kalangan polis trafik Malaysia. Pensampelan secara rawak sebanyak 52 responden (26 kawalan, 26 percubaan) pada usia antara 20 hingga 35 tahun telah dipilih untuk kajian ini. Kajian ini menggunakan dua jenis soal selidik; Borg's scale discomfort rating, untuk mengenal pasti ketidakselesaan kaki dan; *American Academy of Orthopedic Surgeons Lower Limb Outcomes Assessment: Foot and Ankle Module* (AAOS-FAM) untuk menilai kesakitan kaki. Tiga jenis tapak kasut (busa memori, getah, dan gel) diberikan kepada kumpulan percubaan manakala untuk kumpulan kawalan, mereka dinilai dengan tapak kasut yang sedia ada. Sepanjang tempoh 4 jam, Borg's scale discom*fort rating* diberikan kepada responden pada setiap 30 minit. Keputusan menunjukkan bahawa terdapat hubungan antara kesakitan kaki dan tapak kasut, $p = 0.022$. Selain itu, apabila membandingkan, Borg's scale, kumpulan kawalan akan mengalami peningkatan ketidakselesaan kaki berbanding dengan kumpulan eksperimen yang menunjukkan nilai tetap atau kenaikan sedikit. Selepas minit ke-180, terdapat perbezaan ketara ketidakselesaan kaki antara kawalan dan kumpulan eksperimen, $p < 0.001$ dan terdapat hubungan yang kuat antara ketidakselesaan masa dan kaki di antara kumpulan kawalan di setiap bahagian kawasan kaki, $r > 0.70$ berbanding dengan kumpulan eksperimen, $r > 0.30$. Hasil kajian mendapati, bahawa jenis tapak kasut menyebabkan kesan sakit kaki dan ketidakselesaan kaki di kalangan polis trafik Malaysia. Dalam kajian ini, 9 kawasan tapak kaki dikategorikan kepada 3 kawasan; Kawasan I *(hallux, lesser toe, MTPJ1, MTPJ23 dan MTPJ45),* Kawasan II *(medial midfoot dan lateral midfoot)* & Kawasan III *(medial rearfoot dan lateral rearfoot).* Busa memori adalah bahan terbaik untuk mengurangkan ketidakselesaan kaki untuk Kawasan II dan III, manakala; gel adalah yang terbaik untuk Kawasan I. Kajian ini mencadangkan, perkembangan tapak kasut baru (gabungan: Gel + busa memori) seterusnya menjalankan ujian di kalangan polis trafik.

Kata kunci: tapak kasut, ketidakselesaan kaki, berdiri lama, polis trafik

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LIST OF ABBREVIATIONS

DOSH	Department of Occupational Safety and Health
OMSD	Occupational Muscular -Skeletal Disorders
MSD	Muscular -Skeletal Disorders
MTPJ 1	Metatarsophalangeal joints 1
MTPJ 23	Metatarsophalangeal joints 23
MTPJ 45	Metatarsophalangeal joints 45
LBP	Low Back Pain

CHAPTER 1

INTRODUCTION

1.1 Background

According to the Department of Occupational Safety and Health (DOSH), 188 out of 5139 Occupational Musculoskeletal Disorders (OMSD) were reported until September 2018. Based on National Institute of Occupational Safety and Health (NIOSH) chairman Tan Sri Lee Lam Thye said ergonomic problems keep arising among Malaysian workers. Plus, Social Security Organisation's (SOCSO) stated that, 26.4% and 25.3% occupational diseases cases paid by them were for ergonomics-related problems in 2013 and 2014 respectively ("Work related musculoskeletal, ergonomics cases on the rise in Malaysia | Borneo Post Online," 2016).

Meanwhile, DOSH recorded 24 cases for Public Services and Statutory Authorities Occupational Accidents Statistics by Sector until October 2018. Thus, Police Traffic is one of the groups for public service which exposed to the significant hazard which can contribute to increasing occupational accidents cases.

Prolonged standing is one of the common ergonomic problems in the workplace, and is a cause of pain and discomfort in the feet, legs, and lower back. Many previous studies have shown that abundance number of health problems including lower extremity fatigue, foot discomfort, foot swelling and venous blood restriction, lower back pain, and whole body fatigue are the causes of standing for a long time approximately more than 8 hours (Mark, 2000).

There are lots of mitigation actions that being used by industry to ensure foot problems were reduced among workers. A useful anti-fatigue mat is a standard tool used by the employer to minimize foot discomfort among their employees in many industries. Anti-fatigue mats are commonly used in industry to reduce discomfort associated with prolonged standing, and many studies have demonstrated that when compared to hard flooring, mats are capable of reducing discomfort (King, 2002). However, for police traffic, those mitigation actions are not as effective as they need to move from one place to another.

Previous studies have suggested that for reducing foot discomfort, attention should be focused on the design of footwear rather than the design of mats. Footwear insole or footbed is another tool that is used to reduce ergonomic problems related to prolonged standing. Insoles increased the foot comfort and are often used in the treatment of musculoskeletal pain and problems in the lower limbs (Collins, Bisset, McPoil, & Vicenzino, 2007).

1.2 Problem Statement

Traffic police are responsible in making sure that the roads are free from any hazards and directing the traffic. Apart from that, traffic police serves as one of the units under the Royal Malaysian Police who enforce the Road Transport Act 1987(MALAYSIA, 2013; Police Act, 1967). As to ensure there is a standby officer who keeps patrolling 24 hours a day, they were divided into 2 shifts. Each shift will work for every 8 hours in 6 days per week.

Thus, prolonged standing has become a major problem for traffic police. Prolonged standing is one of the ergonomic problems in the workplace, as it cause pain and discomfort in the feet, legs, and lower back (Caravaggi et al., 2016; Cham & Redfern, 2001; Leber & Evanski, 1986). Previous studies have shown that many health problems including lower extremity fatigue, foot discomfort, foot swelling as well as venous blood restriction, whole body fatigue and lower back pain due to standing for a long time approximately more than 8 hours(Chiu & Wang, 2007; Elena, Iglesias, Becerro De Bengoa Vallejo, Palacios, & Na, 2012; Mark, 2000). Workers who spend over 50% of the total working hours during a full work shift are exposed to prolonged standing (Tomei, Baccolo, Tomao, Palmi, & Rosati, 1999).

Traffic police continuously exposed to various types of occupational hazards including ergonomic hazard which can lead them to experience discomfort and accidents(Chen & Jou, 2019; Parsons, 2004). The physical environment exists still play a significant role that contributes to determining the health status of traffic police such as extreme changes of weather, noise level, radiation, air quality and driver road behavior (Satapathy, Behera, & Tripathy, 2009).

Foot discomfort may cause the traffic police to experience foot injury or foot related diseases as they need to stand for a long time using uncomfortable footwear. In industry, many companies have implemented ergonomic interventions which include alterations to the flooring conditions upon which workers stand in an attempt to alleviate these problems. It has suggested that prolonged standing is associated with pain and discomfort experienced by assembly line workers and other occupations (Capodaglio, 2017; Khadijah, Haryati, Rahayu, & Fauzie, 2018; Orlando & King, 2004).

Previous studies have shown a significant effect between types of footwear insole and foot discomfort and negatively impact mainly to workers' health, thus exposing them to any MSD; especially at lower extremities part or foot injury(Pollard et al., 2018; Zein, Halim, Azis, Saptari, & Kamat, 2015). Based on the study by Jefferson, (2013) , has found that the effect of footwear insoles on the subset of 40 workers was to lower low back pain by 38%, foot pain by 37%, and knee pain by 38% ($p < .001$). About 10% and 25% of all accidents occurring in the workplace is related, respectively, to the foot and ankle. According to the Italian Institute of Insurance for Professional Illness and Injuries, 700.000 work-related injuries are reported each year across a population of about 60 million people, and 15% of these affect the foot and ankle(Bracci & Norcia, 2005).

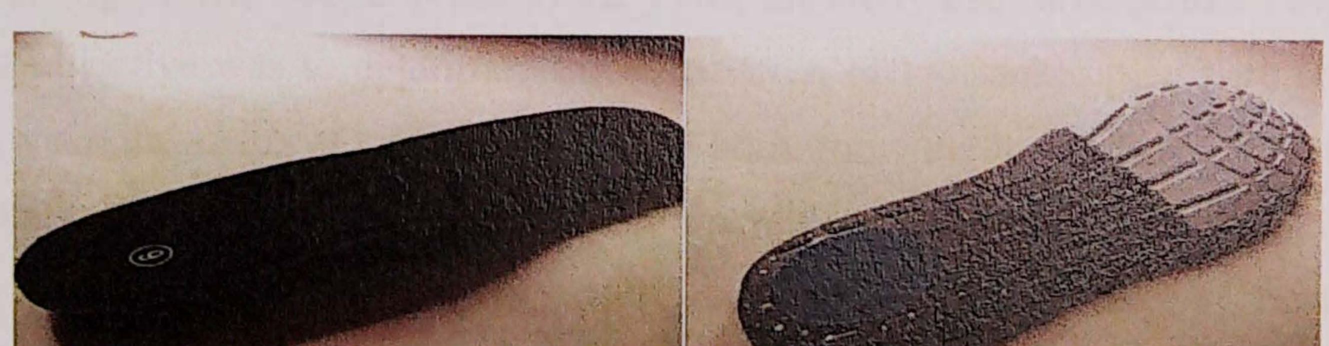
Therefore, it is vital to ensure the traffic police boots is comfortable enough to be used and appropriate to meet their job purpose. However, based on figure 1.1 and 1.2, the current footwear insole of the boots is designed with unsuitable material and majority of the traffic police have experienced stiffness. The current material use for footwear insole is Polyvinyl Chloride (PVC). Hard PVC increases the pressure at the critical point of the foot sole.(Cham & Redfern, 2001; Leber & Evanski, 1986; Y.-H. Lin, Chen, & Cho, 2012; Tong & Ng, 2010).

Redesign of footwear insole will offer a simple, cheap, non-invasive intervention that may help to prevent lower limb overuse injuries alleviate pain and maintain skin integrity at the feet (King, 2002; Shuib, Ahmad, Omar, Borhanuddin, & Hanif, 2018).

The most common method used in the industry involves changing the flooring condition under which workers stand. However, this study focused more on changing better types of footwear insole instead of flooring. Although, limited studies on investigating the effectiveness of footwear insole on foot discomfort have been made, where the studies have attempted to correlate footwear insole with foot discomfort report varied and inconsistent result, however there are still huge prevalence of footwear insole plays a vital role in reducing lower extremity discomfort (Chiu & Wang, 2007).

Figure 1.1: Malaysian traffic police's boot

Figure 1.2: Malaysian traffic police's boot insole



1.3 Study Justification

Traffic Police use boots as one of the accessories that help them to protect their foot from harm. The design of the boot is important in terms of safety and function. In a study by De Souza, (2017) , it stated how important of a shoes that offered protection, improve sportive performance and aesthetic values for society. Although manufacturing of police accessories has advanced greatly in Malaysia but design in boots is still backwards. Malaysian traffic police are supplied with the boots that are designed for normal usage based on the out-sole shape and specifically for the long-lifespan and merely focused in the durability of boot but omitting totally user's comfort and health.

There are limited studies providing quantitative assessment of the functional mechanical properties of insoles especially among traffic police. The impact of insole as a critical influence on musculoskeletal health has been neglected. Shoe insoles considered as best intervention along with floor mats that will reducing discomfort and fatigue after several hours of prolonged standing (Benz, 2017). Studies that investigate the effects of insole on foot biomechanics provide qualitative descriptions of insole properties. This lack of knowledge has made it difficult to determine if a mechanism exists between footwear and the types of insole and foot function.

Fewer studies have been found which investigate the effectiveness or comfort of insoles among Traffic Police in Malaysia. Thus, the study had three primary objectives. The first objective was to determine the association of foot-ankle pain core scale with working year, the status of wearing the issued boot, footwear insole and BMI among the respondents. The second objective was to compare the differences of data distribution of Borgs's scale discomfort level for each areas of the foot between control and experimental groups. Last but not least, this study aim to determine the correlation of time and foot discomfort level among the control and experimental group of insoles over 240 minutes.

1.4 Research Question

1. How many respondents experience ankle and foot pain?
2. Where is the most significant foot area that has high level of foot discomfort while standing?
3. What is the significant difference of foot discomfort level between existing and alternative insole?
4. How many respondents feel discomfort after using alternative materials of footwear insole?

1.5 Objectives

1.5.1 General Objective:

To determine the effect of footwear insole on foot pain and subjective discomfort on prolonged standing among traffic police in Malaysia.

1.5.2 Specific Objective:

1. To determine the prevalence of foot-ankle pain core scale and foot discomfort of the respondents.
2. To determine the association between foot-ankle pain core scale with working year, the status of wearing the issued boot, footwear insole and BMI among the respondents.
3. To determine data distribution of Borg's scale discomfort rating of each foot area between control and experimental groups.
4. To compare the differences of data distribution of Borgs's scale discomfort rating for each areas of the foot between control and experimental groups (Type A, Type B and Type C).
5. To determine correlation between time and foot discomfort rating among the control group and experimental groups (Type A, Type B and Type C) over 240 minutes.

1.6 Hypothesis

1. There is significant association between foot-ankle pain core scale with working year, the status of wearing the issued boot, footwear insole and BMI among the respondents
2. There is a significant difference between data distribution of Borgs's scale discomfort rating for each areas of the foot between control and experimental groups (Type A, Type B and Type C).
3. There is strong correlation between time and foot discomfort rating among the control group and experimental groups (Type A, Type B and Type C) over 240 minutes.

1.7 Conceptual framework

The conceptual framework for this study was visualized as below;

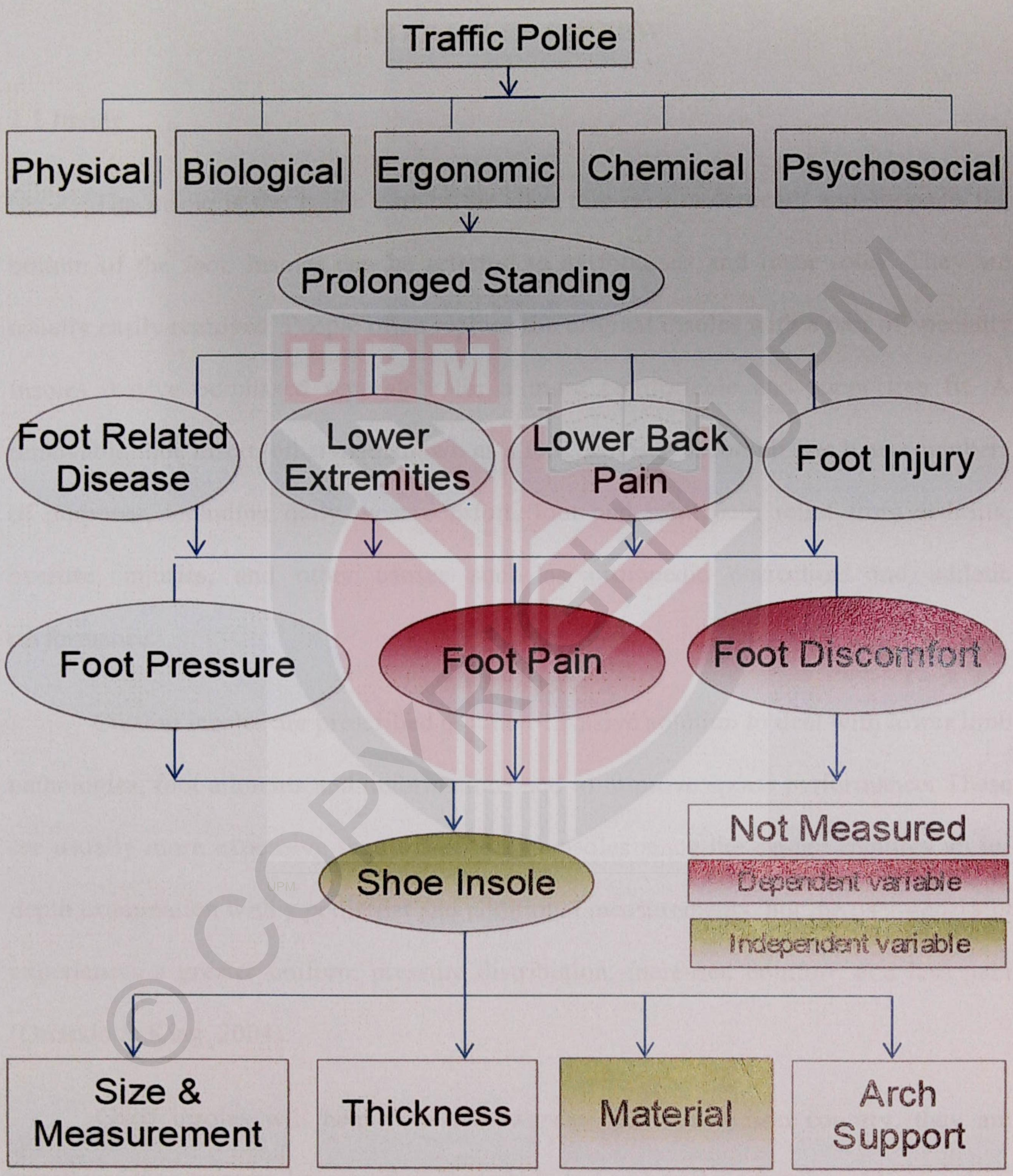


Figure 1.3: Conceptual framework of the study

CHAPTER 2

LITERATURE REVIEW

2.1 Insole

The insole is the inside part of the shoe that runs underneath and supports the bottom of the foot. Insoles can be referred to as footbeds and inner soles. They are usually easily removed. People often replace the original insoles with a pair of specialty insoles they've purchased separately for a more comfortable and supportive fit. A removable shoe insert, otherwise known as a foot orthosis, accomplishes many numbers of purposes, including daily wear comfort, foot and joint pain relief from arthritis, overuse, injuries, and other causes such as orthopedic correction and athletic performance.

Custom insoles are prescribed as a non-invasive solution to deal with lower limb pathologies, foot ailments and deformations and to improve sports performance. These are usually more expensive than off-the-shelf insoles since the design requires an in-depth examination with a podiatrist and additional measurements, but the user generally experiences a greater uniform pressure distribution, increased comfort, and less pain (Orlando & King, 2004).

Good insoles will help your feet warmer. In four season country, they are usually adding an extra layer so that it can help to insulate their feet in colder weather. Insoles can also help to prevent blisters, as they will stop shoes rubbing by creating a tighter fit. The reduction in movement between the shoe and the skin should reduce the chance of blisters.

2.1.1 History of Insoles

Innkeepers made the first insoles from matted animal hair retrieved from the local barn called felt after they recognised that most weary travelers complained of foot pain. Over time, shoemakers, or cobblers, modified the innkeepers' foot pads and began to add leather materials to the insides of shoes to create a better, more comfortable fit--the first arch supports were born. Early arch supports were made by laminating layers of leather strips together, moulding them to shoe lasts, and then shaping the arch support by hand for wearing inside shoes. The early 1900s, people demand more comfortable footwear, lighter and softer materials. They were suggested to combine with leather blanks to create an additional level of comfort (Treado, 1971)

2.1.2 Types of Insoles

In current market, there is lots of type of insoles that being used according to different purposed. Table 2.1 showed the common materials used in footwear insole. Different types of materials used in different types of footwear parts.

Table 2.1: Type of Footwear Insoles' Materials

Bil	Type	Advantage	Disadvantage	Remark
1	Memory Foam	• The potential applications of this material in wide range areas especially in medical and sports • Provide an even distribution of balance, improve the stability of the shoe and ease the pressure(Gnanasundaram, Durairaj, Gopalakrishna, & Das, 2013; Sun et al., 2017). • Able to reduce the foot plantar pressure and give additional cushion support to the foot arches(Gnanasundaram et al., 2013)	• Not water-resistance and hard to maintain. • May cause bad odour on foot.	Refer as "viscoelastic" polyurethane foam, or low-resilience polyurethane foam
2	Gel	• It has high ability to absorb impact shock, decrease foot fatigue, improve postural sway and increase energy return(Christovão et al., 2013; Elena et al., 2012) • Water-resistance and easy to wash	• It has low percentage reduction on mean plantar pressure compared to polyurethane (Shuib et al., 2018) • Production only used as enhancement. Usually comes combination with other materials(Pollard et al., 2018).	A solid jelly-like soft material that can have properties ranging from soft and weak to hard and tough (Demirci & Khademhosseini, 2016)
3	Rubber	• It is washable, odourless and can be cemented to other	• For long term usage that omit comfortable for	It is cellular rubber of open cell

		materials. • High wear-resistant foam rubber soles prove excellent performance and better-cushioning effects, which were lighter and more flexible(H. Lin, Jiang, Lin, & Jiang, 2018)	human foot(Sastri & Sastri, 2014). • May cause foot discomfort and lead to foot problems(Goto & Abe, 2017).	construction (absorbs water)
4	Polyvinyl Chloride (PVC)	• Offer as a cheap material. • Lightweight material (Li & Hashimoto, 2016)	• PVC increases the pressure at the critical point of the foot sole (Tong & Ng, 2010). • For long term usage that omit comfortable for human foot(Viswanath an et al., 2004).	Plastic

2.1.3 The Importance of Insoles

Footwear interventions, such as shoe insoles and foot orthoses, are becoming increasingly popular in clinical and healthy populations. This intervention offers a simple, cheap, non-invasive intervention that may help to prevent lower limb overuse injuries, alleviate pain and maintain skin integrity at the feet (Woodburn, Helliwell, & Barker, 2002).

Mills, Blanch, Chapman, McPoil, & Vicenzino, (2010), said that traditional understanding of the role of foot orthoses focuses on their potential to provide mechanical support and biomechanical realignment, after those alleviating debilitating symptoms such as pain, or enhancing movement. Foot orthoses and insoles may also assist with the prevention of ulceration by reducing shearing forces, dispersing plantar pressures, and providing shock absorption.

Our feet take a lot of stress, and when that stress was not adequately absorbed it can lead to significant pain in ankles, knees and hips that can cause other health issues over time exposure. By wearing comfort insole it can help to absorb shock, evenly distribute weight and provide excellent arch support (Buso & Shitoot, 2019; McRitchie, Branthwaite, & Chockalingam, 2018).

2.2 Traffic Police

The Royal Malaysia Police (RMP) is a uniformed federal police force in Malaysia under the Ministry of Home Affairs. After an agreement was signed on 21 January 1948 between the Malay rulers and Sir Edward Gent, Malaysia or at that time known as the Federation of Malaya has obtain the authority to rule a nation in advised by the British representative (Federation, Annotations, Mar, & Pdf, 2013).

The history of policing in Malaysia started with the adoption of the Charter of Justice in Penang in 1807. However, the role of policing has begun in the early days of the "*Kesultanan Melayu Melaka*" and law enforcement existed. The laws that existed in those days were more towards customary law or sharia law while enforcement was carried out by "Temenggong" ("PDRM," 2016).

RMP is divided into several departments which are; Management Department, Strategic Resources & Technology Department, Criminal Investigation Department, Narcotics Crime Investigation Department, Commercial Crime Investigation

Department, Special Branch, Crime Prevention and Community Safety Department, Internal Security and Public Order Department, Integrity and Standards Compliance Department, and lastly Traffic Enforcement and Investigation Department. Traffic police are mostly under Traffic Enforcement and Investigation Department ("PDRM," 2016).

2.2.1 Duty & Responsibility

According to Police Act 1967, Police under this Act with corresponding ranks and capacities are responsible for the maintenance of law and order, the preservation of the peace and security of Malaysia, the prevention and detection of crime, the apprehension and prosecution of offenders and the collection of security intelligence throughout Malaysia (Police Act, 1967). Apart from that, they also responsible to enforce the Road Transport Act 1987(MALAYSIA, 2013).

2.2.2 Occupational Hazard

Police traffic exposes to various occupational hazard as well as safety issues. The most significant hazard related to police traffic is a chemical hazard. There has been a mass of research completed on air pollution and traffic police. A study on the effects of environmental benzene among traffic police shows that micronucleus frequency was significantly higher among the traffic police than in indoor workers (Maffei et al., 2005).

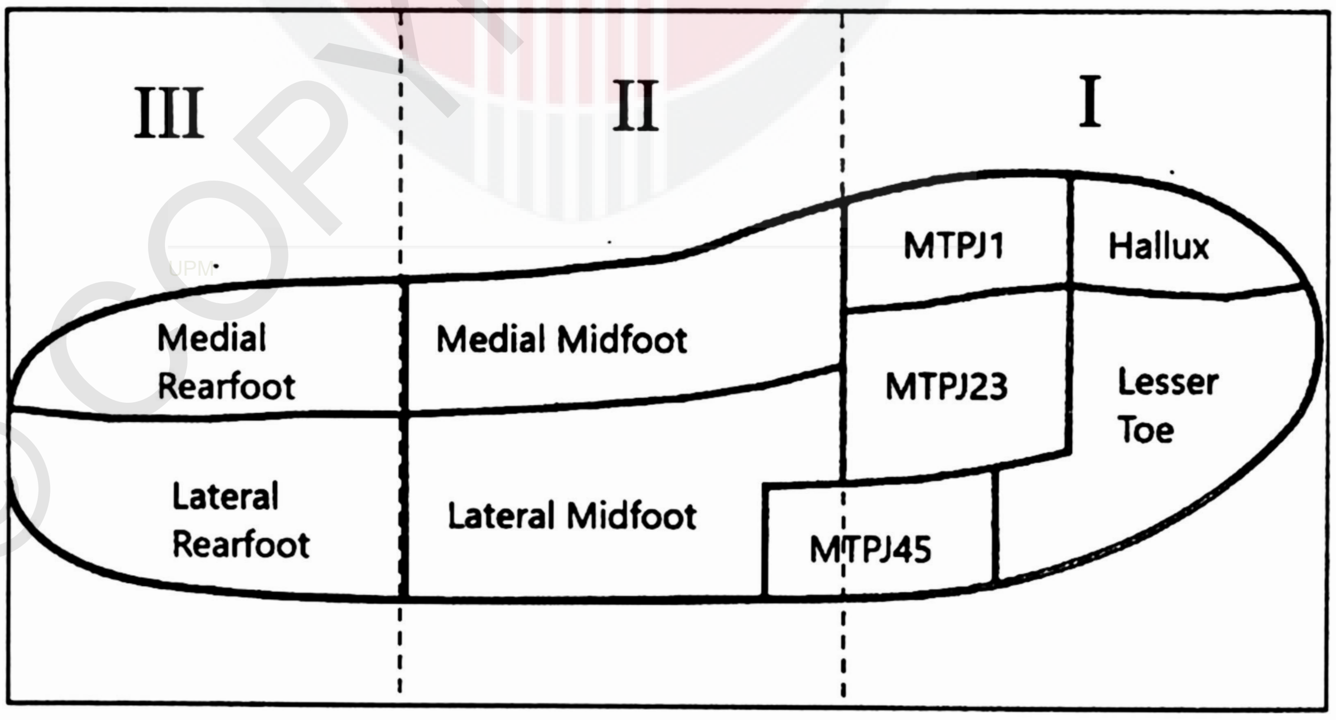
Furthermore, the nature of their work to communicate with other groups of people increased the risk of getting into contact with a communicable disease such as hepatitis (Pretty, Anderson, & Sweet, 1999; Satapathy et al., 2009).

The emergence of ergonomic-related problems among industrialized workers also gives significant result among police. A study in Swedish found that most frequent MSD was lower back pain (43.2%) and followed by multi-site musculoskeletal pain (41.3%) (Larsen, 2018).

2.3 Human Foot

Foot anthropometry plays a vital role in designing proper fitting footwear. Changes in lifestyles, nutrition, and ethnic compositions of the populations have led to the changes in the distribution of foot dimension. Based on Figure 2.3, foot area can be divided into nine areas; hallux, lesser toes, metatarsophalangeal joints 1(MTPJ 1), metatarsophalangeal joints 23(MTPJ 23), metatarsophalangeal joints 45(MTPJ 45) , medial midfoot, lateral midfoot, medial rearfoot and lateral rearfoot (Van der Zwaard et al., 2014).

Figure 2.3: Foot Areas



Development of low back pain (LBP) has also associated in a rigid high arched foot type (Bird & Payne, 1999). This foot type diminishes the capacity for shock absorption by the foot and so pre-disposes to shock-induced pathology in the lower back. In the presence of excessive or prolonged foot pronation, orthoses have traditionally been prescribed to reduce the extent and velocity of foot movement, correcting lower limb function and proximal posture (Landorf & Keenan, 2010). In a rigid high arched foot type, shock-absorbing insoles are proposed to reduce the more proximal propagation of shock, subsequently reducing LBP. Feet morphology, and sometimes deformities, is unique to each person and shoe design can seldom take into account differences between the most typical foot types, such as flat or cavus foot (Buso & Shitoot, 2019; Caravaggi et al., 2016).

There are many shoe designs in the Asian market that do not follow the standard or real foot anthropometric standard. There is no universal footwear size labelling system, but each country prescribes them based on the anthropometric measurements. Measurements are made every 10 to 15 years to improve and promote standardisation (Beazley,1997) . Footwear designers usually use foot length, foot width, foot height, and ankle circumference to design shoes (Waterson & Sell, 2006). These measurements are ergonomic inputs which are necessary to develop footwear products that offer comfort and flexibility to the users when their bodies are in motion (Waterson & Sell, 2006).

2.4 Prolonged Standing

Tomei et al., (1999) , pointed out that worker is exposed to prolonged standing if they spend over 50% of the total working hours during a full work shift in a standing posture. Standing for a prolonged period has been recognised as a vital contributor to a decrease in performance in the industry. It causes occupational injuries, decreased productivity, increased medical costs, and demoralisation of workers (Benz, 2017; Nunfam, Oosthuizen, Adusei-Asante, Van Etten, & Frimpong, 2019; Parsons, 2004).

Prolonged standing at workstations can cause muscle fatigue and mental stress. Furthermore, an insufficient rest period during the standing time coupled with improper footwear can lead to discomfort and fatigue in the lower extremities, causing occupational injuries in the long term(Anderson, Nester, & Williams, 2017; Chen & Jou, 2019; Halim et al., 2014). When workers work in a prolonged standing posture, static contraction occurs particularly in their back and legs, resulting in impaired functioning of calf muscles (Krijnen, Boer, Ader, & Bruynzeel, 1998). Prolonged standing transfers the weight of upper body parts to lower parts and results in lower back pain(Bird & Payne, 1999; Jefferson, 2013).

CHAPTER 3

METHODOLOGY

3.1 Study Design

The study design for this study was an experimental study where to determine the effect of footwear insole on foot pain and subjective discomfort on prolonged standing. In this study, the respondents were divided into two groups:

a) The control group (existing insole)

b) The experimental group (memory foam, gel, and rubber insole)

3.2 Study Location

The study was conducted at Traffic Police Station Jalan Tun H S Lee, City Centre, 50100 Kuala Lumpur, Wilayah Persekutuan Kuala Lumpur.

3.3 Sampling

3.3.1 Study Population

The sampling population was chosen randomly among sentry and point duty workers who work at Traffic Police Station, KL. They were population at risk to suffer from prolonged standing, foot discomfort and foot pain.

3.3.2 Study Sample

The sampling frame was taken from the name list of all respondents working at the Traffic Police Station. The name lists were obtained from the Human Resources Department with:

The inclusive criterial:

a) Male workers

b) 20 to 55 years old of ages.

c) Employment years 1 year above.

The exclusive criterial:

a) Subject with foot abnormalities; high arch foot (Pes Cavus), flat foot (Pes Planus) and foot illness; tinea pedis, hammertoes, corn and calluses.

3.3.3 Sampling Frame

The targeted population for this study includes all the traffic police at Traffic KL.

3.3.4 Sampling Unit

The sampling unit involved traffic police who were identified as prolonged standing, > 50% standing of total working hours. The respondents were among:

1. Point duty
2. Sentry @ Guard house

3.3.5 Sampling method

Firstly, simple purposive sampling method was used in this study. The Royal Malaysian Police Headquarters, Bukit Aman purposely assigned Traffic Police KL to give full cooperation for this study. A total of 52 respondents (26 controls, 26 experimental) of all men were recruited randomly by random sampling from the list name given by the officer in-charge in a traffic police population located at Traffic Police KL, Jalan Tun H S Lee. Informed consent was obtained prior to participation in the study using protocols approved by the Ethics Committee for Research Involving Human Subjects Universiti Putra Malaysia. The mean age of respondents was 26 years and their mean body mass index was 24.61. The working duration as traffic police was 1 year and above and the men's shoe sizes (U.S sizing) ranged from 7 to 10.

The data collection for control group occurred at only one time of the day (Wiggermann & Keyserling, 2013). Each respondent was required to use their existing insole during 4 hours session. Meanwhile, for experimental group, each respondent needs to attend thrice where they get to use memory foam, rubber and gel insoles. The respondent's sessions were scheduled at least 72 hours (2 days) apart to allow ample recovery from fatigue and reduced recall bias from previous sessions. Experimental sessions for all respondents were completed within 4-weeks period. To obtain accurate result, the respondents were not given exercise or dietary restrictions.

3.3.6 Sample size

According to Hatton et al., (2015), the prevalence to compare the immediate effects of wearing different type of insole was 0.23 and 0.3.

Formula:

$$N = \frac{\{Z_{1-\frac{\alpha}{2}}\sqrt{2\bar{P}(1-\bar{P})} + Z_{1-\beta}\sqrt{P_1(1-P_1) + P_2(1-P_2)}\}^2}{(P_1 - P_2)^2}$$

Where,

- $\acute{P} = (P1+P2)/2$
- $P1$ = estimated proportion (larger)
- $P2$ = estimated proportion (smaller)
- $Z1-\alpha/2$=standard errors associated with confidence intervals: 90%, 1.960
- $Z1-\beta$ =standard errors associated with power : 95%, 1.645

Calculation:

$$n = \frac{\{(1.960)\sqrt{2(0.41)(0.59)} + (1.645)\sqrt{(0.62)(0.38) + (0.23)(0.77)}\}^2}{(0.39)^2}$$

N= 28

N= 28+ 20% dropout

N=36

So the samples should be 36 respondents for each group.

3.4 Variables

3.4.1 Dependent Variables

i. The level of foot discomfort

3.4.2 Independent Variables

i. The types of footwear insole

3.5 Data Collection and Study Instrumentation

3.5.1 Questionnaire

i. Pre-survey questionnaire

Each respondents were asked to answer simple survey before participate in this study. The survey consist of personal information and health history and status.

ii. Foot Pain Measure

Foot pain was measured using American Academy of Orthopedic Surgeons Lower Limb Outcomes Assessment: Foot and Ankle Module (AAOS-FAM) (Johanson, Liang, Daltroy, Rudicel, & Richmond, 2004). There were divided into 4 subscales; pain (10 questions), function (5 questions), stiffness and swelling (2 questions) and giving way (3 questions). The participants were asked to answer on scale of 1-5 with 1 being the best outcome and 5 the worst. Scores were standardized to percentage (0-100) score then transformed into normative scale (0-20) pain, (21-59) moderate, (60-79) pain and (80-100) severe.

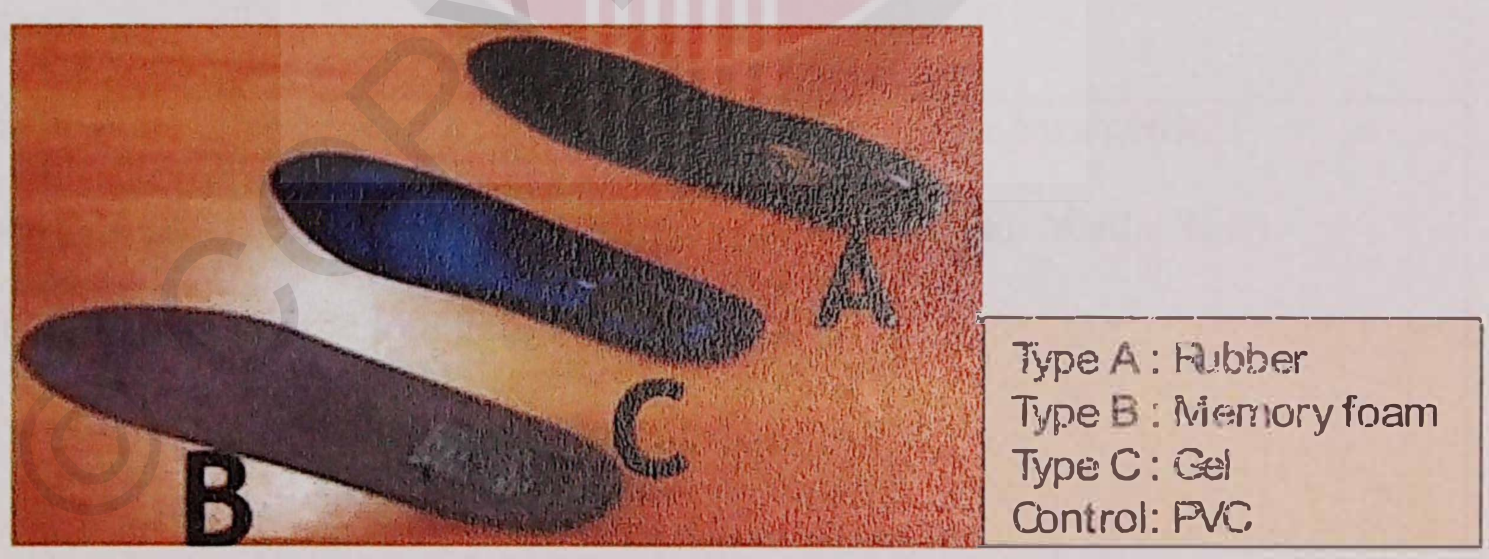
iii. Questionnaire (Borg's Scale Measurement)

The Borg's Scale were used to assess the degree of subjective discomfort on various body parts, which was adapted from the previous research by Karuppiah, Salit, Ismail, Ismail, & Tamrin, 2012 , Koleini Mamaghani, Shimomura, Iwanaga, & Katsuura, 2009 and Borg (1998). A rating were given for a few regions of the body parts including low back, buttocks, thighs, knees, calf and feet. This scale produces rating ranges from 0 (nothing at all) to 10 (extremely discomfort).

3.5.2 Data Collection Techniques

Firstly, the respondents were given a brief about the details and importance of the research by the researcher. After that, the respondents were given a set of questionnaire that needs to be completed and submitted to the researcher. Based on Figure 3.5, the experimental group was given (memory foam, rubber, and gel) insole while the control group was used their existing insole. During 4 hours period, the respondents were allowed to do their daily basis duty. The researcher gave a full foot area of discomfort using the Borg's Scale (CR 10) for every 30 minutes from the beginning until the end of 4 hours. The respondents were not given exercise or dietary restrictions. Also, the respondents were allowed to do their routine normally as traffic police. The results for all questionnaires were analyzed by using Statistical Package for Social Science Software version 25.

Figure 3.5: Types of Insole



3.6 Statistical Analysis

Objectives	Statistical Test
To determine background data of the respondents.	Descriptive statistic (Frequency and Mean)
To determine the prevalence of foot-ankle pain core scale and foot discomfort of the respondents.	Descriptive statistic (Frequency and Percentage)
To determine data distribution of Borg's scale discomfort rating of each foot area between control and experimental groups.	Descriptive statistic (Frequency and Mean)
To determine the association between foot-ankle pain core scale with working year, the status of wearing the issued boot, footwear insole and BMI among the respondents.	Chi-Square Test
To compare the differences of data distribution of Borgs's scale discomfort rating for each areas of the foot between control and experimental groups (Type A, Type B and Type C).	Non parametric (Kruskal- Wallis Test)

To determine the correlation between time and foot discomfort rating among the control group and the experimental groups (Type A, Type B and Type C) over 240 minutes.	Non parametric (Spearman's Rho correlation)

3.7 Ethical Concern

Human subject's approvals obtained from Ethics Committee for Research Involving Human Subjects Universiti Putra Malaysia. All the respondents were given a consent form to read and sign in the beginning of the study. The consent states the study was voluntarily and the respondents can withdraw anytime. It also stated the purpose of the study, the steps they need to follow, the benefits and possible risk. The respondents also allowed asking any question regarding the study and all personal information must be kept privately.

CHAPTER 4

RESULT

4.1 Background of the respondents

A total of 52 respondents have participated in this study. The participation of respondents in this study was voluntary based, and the total of respondents for the control group was 26, and the experimental group was 26. The table 4.1 shows the characteristics of the respondents for the age, body mass index (BMI), working duration as the traffic police, experienced foot discomfort, previous working experience and the status of wearing the issued boot.

The age of the respondents ranged from 20 to 35 with an average of 26.8 ± 3.7. Most of the respondents had normal Body Mass Index (BMI) which average 24.68 ± 3.91. However, only 28.8% and 9.6% of the respondents were overweight and obese respectively. About 51.9% and 48.1% of the respondents were working as the traffic police for less than three years and more than three years respectively.

Almost 76.9% of the respondents had their previous working experience before joining as the traffic police. Among the respondents, only 46.2% were wearing the issued boot and the rest 53.8% did not wear the issued boot.

Table 4.1: The background of the respondents who involved in the study (N=52)

Variables	Frequency (N=52)	%	Mean ± SD
Age			26.79±3.71
20-29	38	73.1	
30-35	14	26.9	
Body Mass Index (BMI)			24.68±3.91
Underweight	2	3.8	
Normal	30	57.7	
Overweight	15	28.8	
Obese	5	9.6	
Working Duration			3.58±3.70
Less than 3 years	27	51.9	
3 years and above	25	48.1	
Experience Foot Discomfort			
Yes	33	63.5	
No	17	32.7	
Uncertain	2	3.8	
Having Working Experience Before Joining Traffic Police			
Yes	40	76.9	
No	12	23.1	
Wear Issued Boot			
Yes	28	46.2	
No	24	53.8	

4.2 Foot-Ankle Pain Core Scale and Footwear Insole

Table 4.2 presents the foot-ankle pain core scale and footwear discomfort of the 52 traffic polices. A total of 21.2% shows no pain, and 69.2% and 9.6% of respondents had moderate and pain core scale respectively. . Only 30.8% of the respondents found their foot was comfortable and the rest 69.2% rated their footwear insole was discomfort.

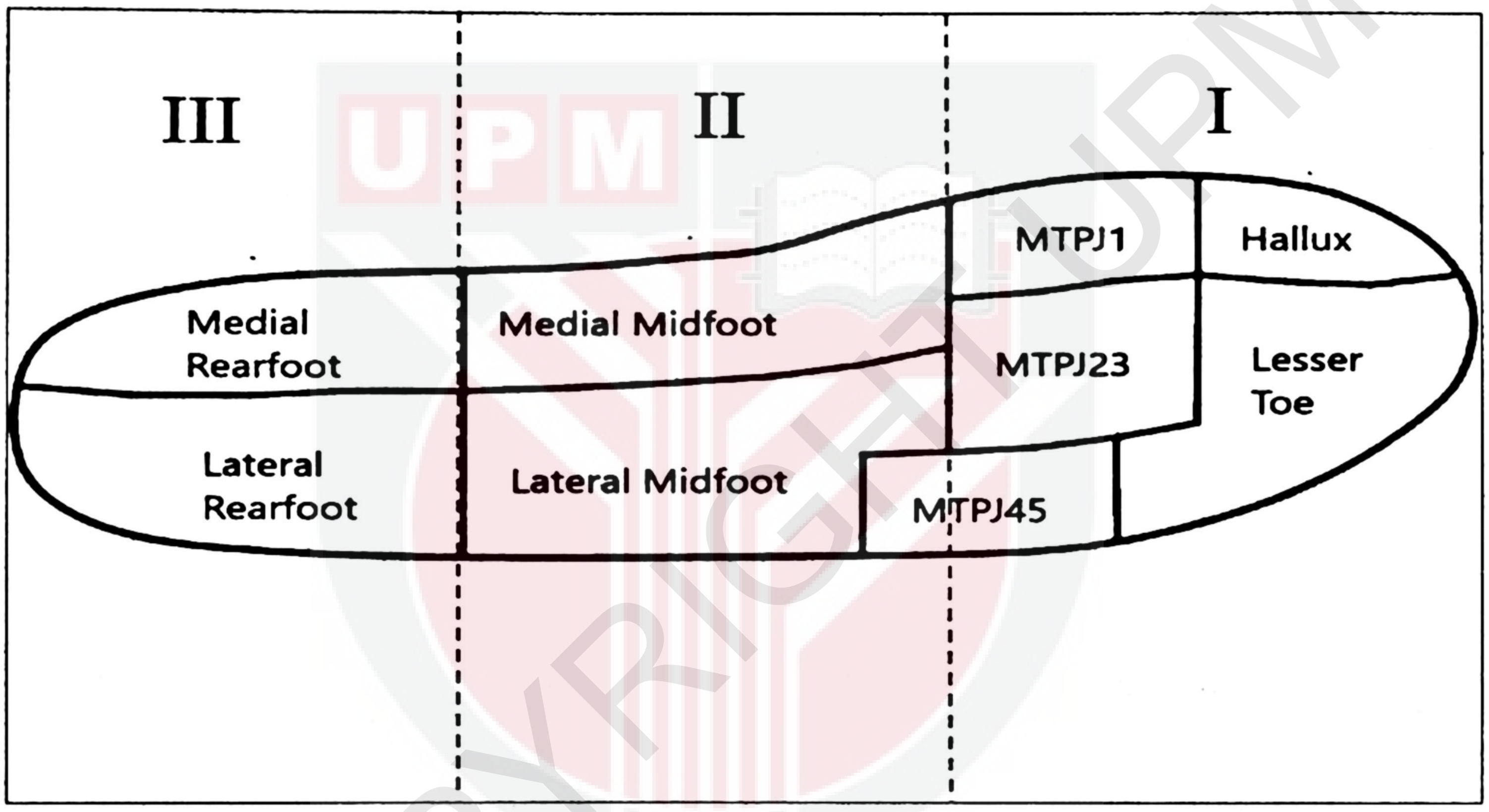
Table 4.2: The prevalence of foot-ankle pain core scale and footwear insole of the respondents (N=52)

Variables	Frequency (N=52)	%
Foot Ankle Pain Core Scale		
No Pain	11	21.2
Moderate	36	69.2
Pain	5	9.6
Severe	0	0
Footwear Insole		
Comfort	16	30.8
Moderate	22	42.3
Discomfort	11	21.2
Severe	3	5.8

4.3 Discomfort rating distribution

Based on the Figure 4.3, the foot area was divided into 3 region which; Region I (hallux, lesser toes, metatarsophalangeal joint 1, metatarsophalangeal joint 23 and metatarsophalangeal joint 45), Region II (medial midfoot and lateral midfoot) and lastly Region III (medial rearfoot and lateral rearfoot).

Figure 4.3: The foot area



The results of Borg's scale foot discomfort rating were presented in Figure 4.3.1, Figure 4.3.2 and Figure 4.3.3. This Borg's scale represented discomfort rating for 240 minutes. Based on Figure 4.3.1, there was continuous increasing for Borg's scale discomfort rating in control group after 150th minutes. However, only two areas (hallux and lesser toes) recorded Borg's scale less than (3.0) whereas another area recorded more than (3.0).

Figure 4.3.1: Borg's scale discomfort rating on Region I

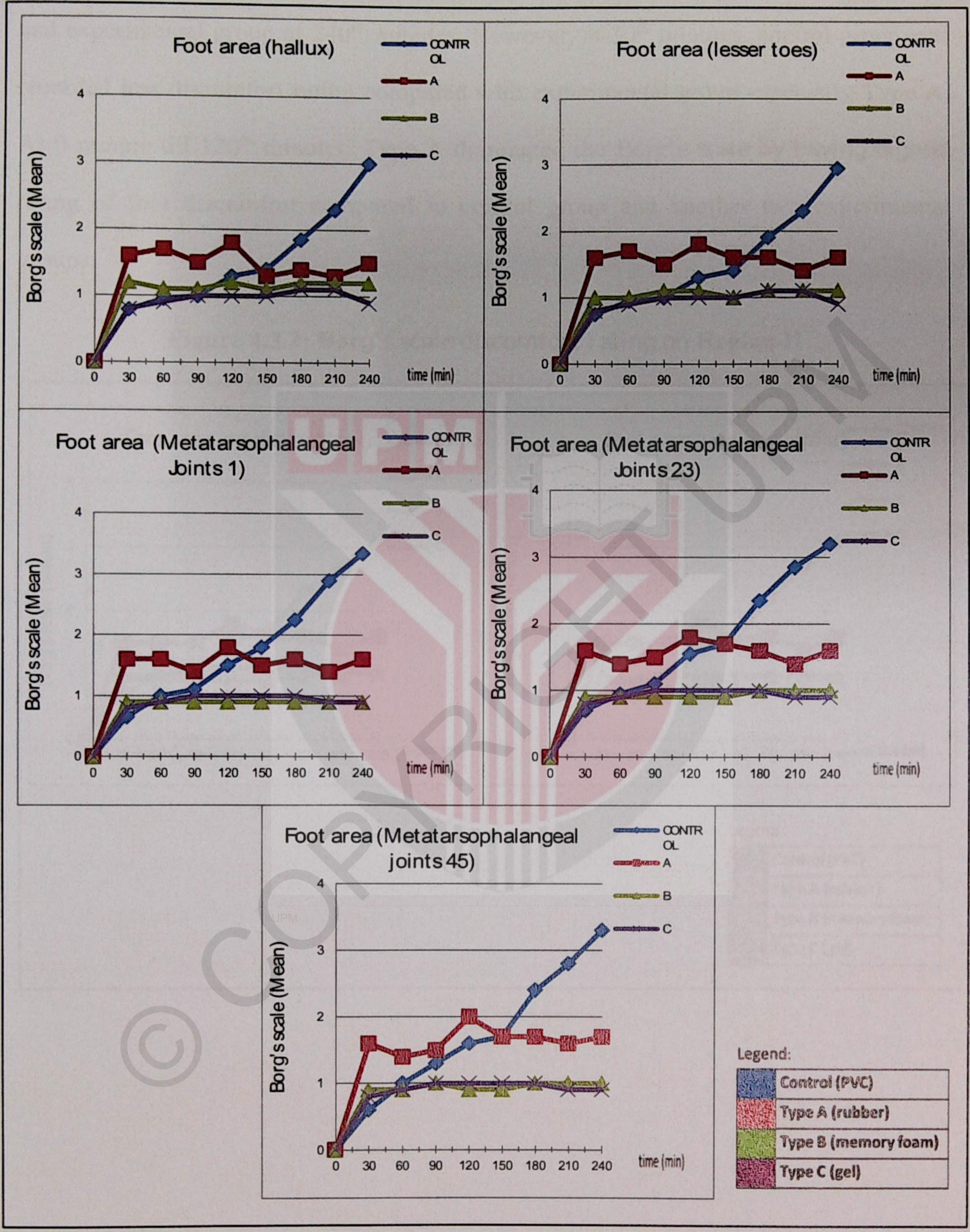


Figure 4.3.2 presented that there was a major difference between control group and experimental group at 240th minutes. However, at 30th minutes, control group was recorded less discomfort rating compared with experimental group especially Type A. At 0 minute till 120th minutes, Type A dominated the Borg's scale by having highest rating of foot discomfort compared to control group and another two experimental groups.

Figure 4.3.2: Borg's scale discomfort rating on Region II

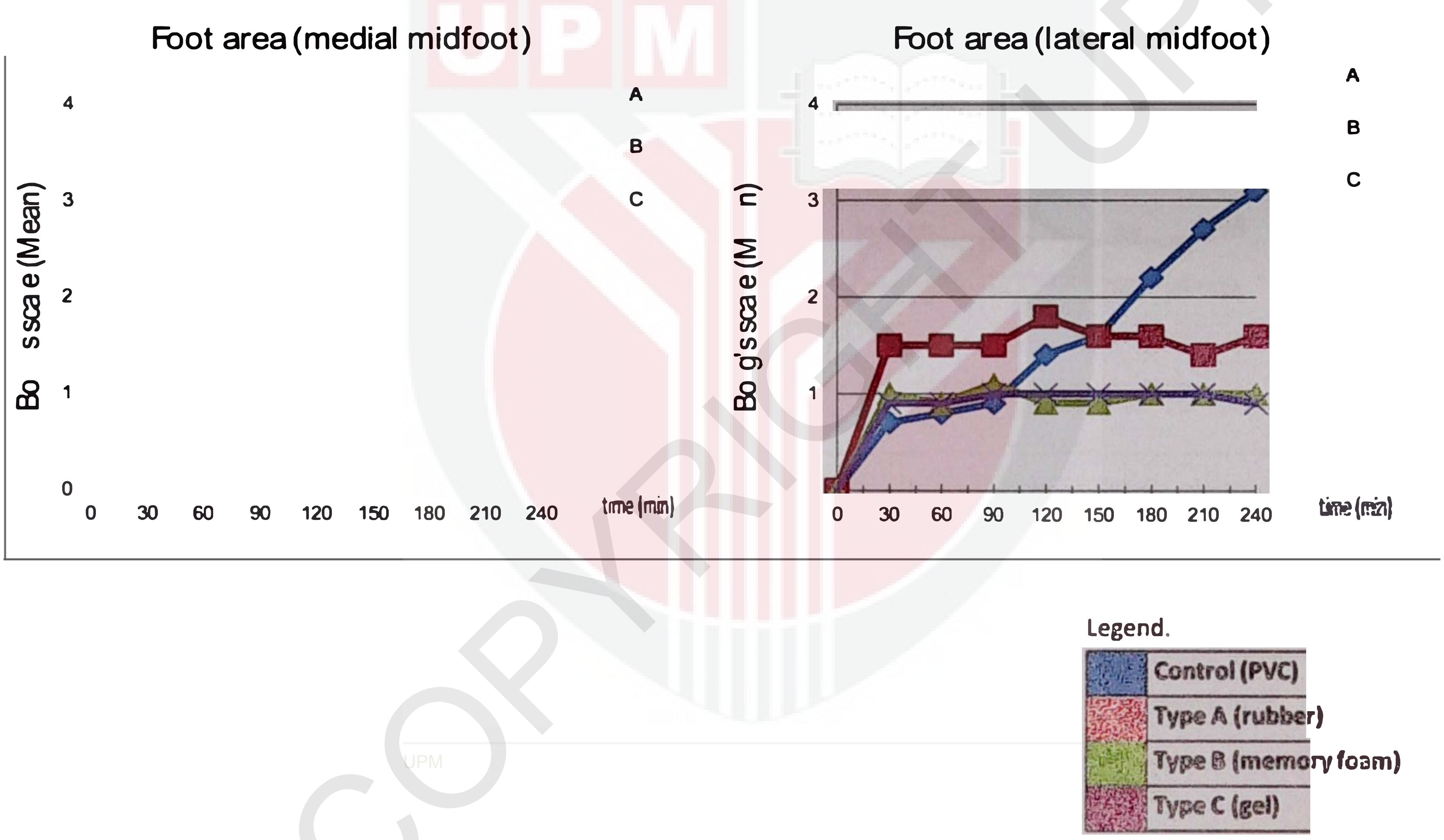
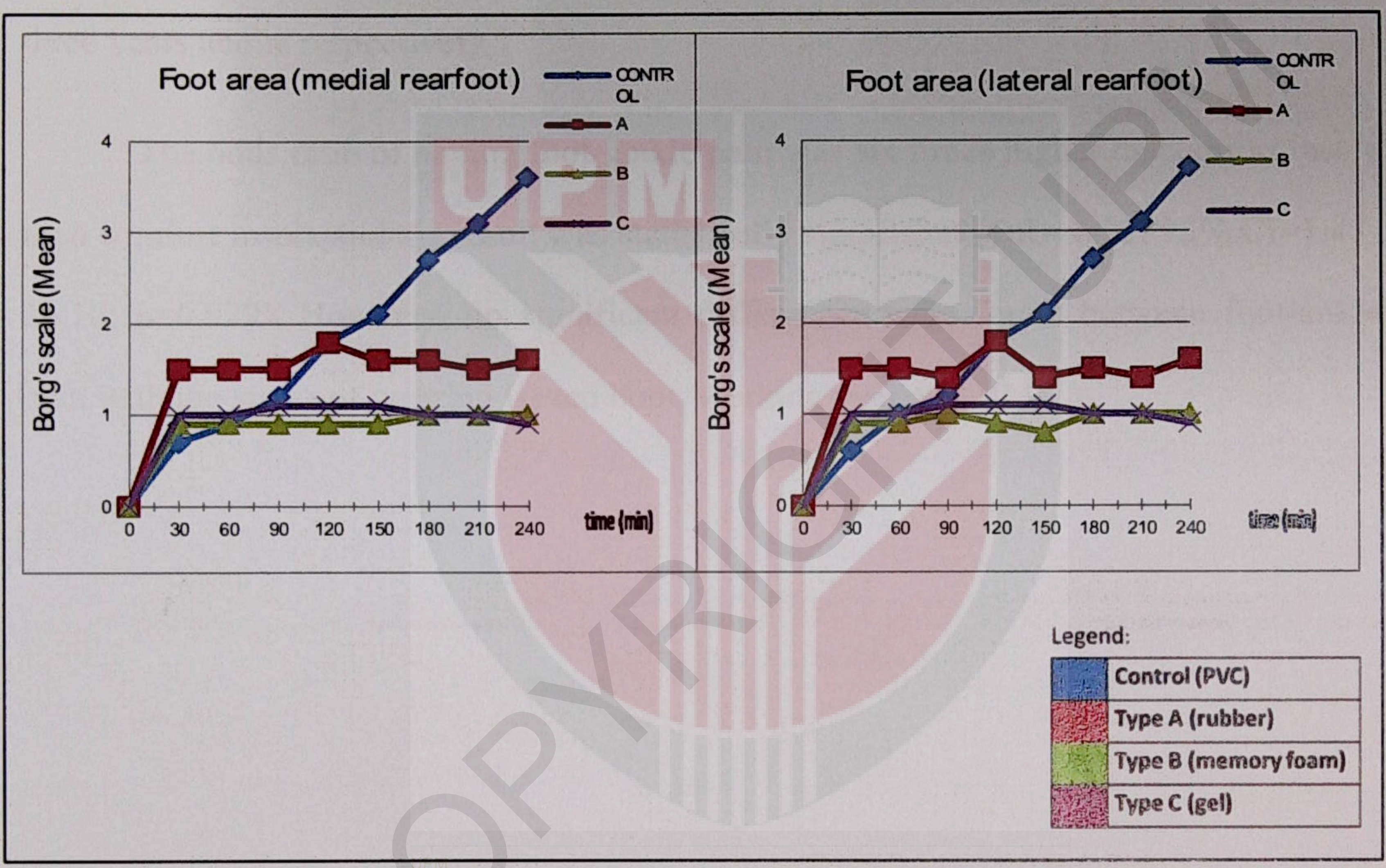


Figure 4.3.3 demonstrated that Region III has highest rating of foot discomfort compared to Region I and Region II. Both medial and lateral rearfoot showed Borg's scale discomfort near to achieve (4.0). Plus, for the control group, it started to increase rapidly after 90th minutes. However, for the type B, it showed a prominent material that can reduce the foot discomfort.

Figure 4.3.3: Borg's scale discomfort rating on Region III



4.4 The association of foot-ankle pain with working year, the status of wearing the issued boot, footwear insole and BMI among the respondents

Table 4.4 shows the association of foot-ankle pain core scale with different variables. The totals of 78.8% of the respondents considered were having pain for foot-ankle pain core scale, and 21.2% did not have any foot-ankle pain core scale. In general, 53.7% and 46.3% were reported having pain after working for less than three years and three years above respectively.

The odds ratio of having foot- ankle pain was six times higher discomfort insole than comfort insole and the result was statistically significant (OR= 6.22; 95% CI=1.48-26.10; p=0.022). However, no significant differences were found between foot-ankle pain with the status of wearing issued boot, working year and BMI.

Table 4.4: The association of foot-ankle pain with working year, status of wearing the issued boot, footwear insole and BMI among the respondents (N=52)

Variables	Foot-Ankle Pain Core Scale		OR[a] (95% CI)	p-value	Respondent (N=52) N (%)
	No Pain (N=11) N (%)	Pain (N=41) N (%)			
Working Year					
Less than 3 year	5 (18.5)	22 (81.5)	0.72	0.63	27(51.9)
3 years and above	6 (24.0)	19 (76.0)	(0.19-2.74)		25(48.1)
Wear Issued Boot					
Yes	7 (25.0)	21 (75.0)	0.600	0.46	28(53.8)
No	4 (16.7)	20(83.3)	(0.15-2.37)		24(46.2)
Footwear Discomfort					
Comfort	7 (43.8)	9 (56.2)	6.22	0.02*	16 (30.8)
Discomfort	4(11.1)	32(88.9)	(1.48-26.10)		36(69.2)
BMI					
Under or Normal	8 (25.0)	24 (75.0)	1.89	0.61	32 (61.5)
Overweight or Obese	3 (15.0)	17 (85.0)	(0.44-8.18)		20 (38.5)

a. Chi-Square Test
**p-value significant at <0.05*

4.5 Comparison of data distribution of Borgs's scale foot discomfort rating between control and experimental groups (Type A, Type B and Type C)

Kruskal Wallis Non-Parametric Test was tested for the comparison of data distribution of Borg's scale discomfort rating between control and experimental groups (Type A, Type B and Type C). Mann Whitney U-test was run to identify the significant differences between two groups after finding out there was a significant difference in Kruskal Wallis Test.

Table 4.5.1 showed there were significant differences between groups at 180^{th} minutes, 210^{th} minutes and 240^{th} minutes for each foot areas at Region I except MTPJ23; significant difference at 30^{th} ,180^{th}, 210^{th} and 240^{th} minutes. For the hallux area, type C appeared the best material as at 180^{th} onward, it showed a significant difference of foot discomfort rating between control and type C; 180^{th} minutes , control (1.85) type C (1.1),$p<0.02$; 210^{th} minutes , control (2.3) type C (1.1),$p<0.01$; 240^{th} minutes, control (3.0) type C (1.1).

For the lesser toes, MTPJ 23 and MTPJ 45, there were significant difference between control and experimental group (type A, type B and type C). However, type C showed the best as it had been recorded less discomfort rating among others throughout 240 minutes. In contrast, MTPJ1 showed, type B was the best material as it was able to maintain the Borg's scale foot discomfort rating at (1.0) and below during 240 minutes.

Table 4.5.1: Comparison of data distribution of Borg's scale discomfort rating between control and experimental groups for Region I

	Time (min)	Con trol	Type A	Type B	Type C	Median (IQR)	$X^{2,a}$	p-value	Mann Whitney U-test
Hallux	0	0.00	0.00	0.00	0.00	0.00 (0.00)	0.00	1.00	-
	30	0.79	1.60	1.20	0.80	1.00 (0.50)	5.54	0.14	-
	60	0.95	1.70	1.10	0.90	1.00 (0.50)	1.64	0.65	-
	90	1.00	1.50	1.10	1.00	1.00 (0.47)	0.31	0.96	-
	120	1.30	1.80	1.20	1.00	1.00 (0.30)	1.24	0.74	-
	150	1.40	1.30	1.10	1.00	1.00 (0.30)	2.74	0.43	-
	180	1.85	1.40	1.20	1.00	1.00 (0.30)	10.36	0.02*	Control vs. Type A, p<0.04; Control vs. Type B, p<0.004; Control vs. Type C, p<0.04
	210	2.30	1.30	1.20	1.10	1.00 (0.20)	21.09	<0.01**	Control vs. Type A, p<0.02; Control vs. Type B, p<0.001; Control vs. Type C, p<0.001.
	240	3.00	1.50	1.20	1.10	1.00 (0.30)	27.37	<0.01**	Control vs. Type A, p<0.01; Control vs. Type B, p<0.001; Control vs. Type C, p<0.001.
Lesser toe	0	0.00	0.00	0.00	0.00	0.00 (0.00)	0.00	1.00	-
	30	0.70	1.50	1.00	0.70	0.00 (0.50)	3.67	0.30	-
	60	1.00	1.70	1.00	0.90	1.00 (0.50)	0.49	0.92	-
	90	1.00	1.40	1.10	1.00	1.00 (0.48)	0.65	0.89	-
	120	1.30	1.70	1.10	1.10	1.00 (0.80)	1.55	0.67	-
	150	1.40	1.50	1.00	1.00	1.00 (0.60)	3.65	0.30	-
	180	1.90	1.50	1.10	1.20	1.00 (1.30)	12.92	0.01**	Control vs. Type A, p<0.033; Control vs. Type B, p<0.001; Control vs. Type C, p<0.004.
	210	2.30	1.30	1.10	1.20	1.00 (1.00)	21.24	<0.01**	Control vs. Type A, p<0.001; Control vs. Type B, p<0.001; Control vs. Type C, p<0.001
	240	2.98	1.50	1.10	0.90	1.00 (1.30)	28.32	<0.01**	Control vs. Type A, p<0.001; Control vs. Type B, p<0.001; Control vs. Type C, p<0.001

MTPJ 1	0	0.00	0.00	0.00	0.00	0.00 (0.00)	0.00	1.00	-
	30	0.60	1.50	0.90	0.70	0.00 (0.50)	6.96	0.73	-
	60	1.00	1.50	0.90	0.90	0.75 (0.50)	0.14	0.99	-
	90	1.10	1.40	0.90	1.00	1.00 (0.50)	0.35	0.95	-
	120	1.50	1.70	0.90	1.10	1.000 (0.88)	0.23	0.52	-
	150	1.80	1.50	0.90	1.00	1.00 (0.70)	6.38	0.10	-
	180	2.30	1.50	0.90	0.90	1.00 (1.18)	22.75	<0.01**	Control vs. Type A, p<0.019; Control vs. Type B, p<0.001; Control vs. Type C, p<0.001
	210	2.90	1.30	1.00	0.90	1.00 (1.23)	40.21	<0.01**	Control vs. Type A, p<0.001; Control vs. Type B, p<0.001; Control vs. Type C, p<0.001
	240	3.40	1.50	0.90	0.90	1.00 (1.30)	39.43	<0.01**	Control vs. Type A, p<0.001; Control vs. Type B, p<0.001; Control vs. Type C, p<0.001
MTPJ 23	0	0.00	0.00	0.00	0.00	0.00 (0.00)	0.00	1.00	-
	30	0.60	1.50	0.90	0.70	0.70 (0.50)	8.43	0.04*	Control vs. Type B, p< 0.003
	60	1.00	1.30	0.90	0.90	1.00 (0.50)	0.21	1.00	-
	90	1.10	1.40	1.00	1.00	1.00 (0.30)	0.12	0.99	-
	120	1.60	1.70	0.90	1.00	1.00 (0.80)	3.97	0.27	-
	150	1.70	1.60	0.90	1.00	1.00 (0.78)	3.42	0.33	-
	180	2.30	1.50	1.00	0.90	1.00 (0.80)	20.87	<0.01**	Control vs. Type A, p<0.017; Control vs. Type B, p<0.001; Control vs. Type C, p<0.001
	210	2.90	1.30	1.00	0.90	1.00 (1.20)	33.68	<0.01**	Control vs. Type A, p<0.001; Control vs. Type B, p<0.001; Control vs. Type C, p<0.001
	240	3.20	1.50	1.00	0.90	1.00 (1.30)	32.09	<0.01**	Control vs. Type A, p<0.001; Control vs. Type B, p<0.001; Control vs. Type C, p<0.001.
MTPJ 45	0	0.00	0.00	0.00	0.00	0.00 (0.00)	0.00	1.00	-
	30	0.60	1.50	0.80	0.70	0.55 (0.50)	9.27	0.26	-
	60	1.00	1.30	0.90	0.90	1.00 (0.50)	1.17	0.76	-
	90	1.30	1.40	1.00	1.00	1.00 (0.40)	0.63	1.00	-
	120	1.60	1.90	0.90	1.10	1.00 (0.30)	4.78	0.19	-
	150	1.70	1.60	0.90	1.00	1.00 (0.80)	0.52	0.18	-
	180	2.40	1.60	1.00	0.90	1.00 (0.80)	22.54	<0.01**	Control vs. Type A, p<0.011; Control vs. Type B, p<0.001; Control vs. Type C, p<0.001
	210	2.80	1.50	1.00	0.90	1.00 (1.20)	34.55	<0.01**	Control vs. Type A, p<0.001; Control vs. Type B, p<0.001; Control vs. Type C, p<0.001
	240	3.30	1.60	1.00	0.90	1.00 (1.68)	33.34	<0.01**	Control vs. Type A, p<0.001; Control vs. Type B, p<0.001; Control vs. Type C, p<0.001.

**p-value significant at <0.01; *p-value significant at <0.05. [a]Krustal Wallis Non-parametric test.

Based on Table 4.5.2, there was a significant difference between groups at 180th minutes, 210th minutes and 240th minutes. Mann Whitney U-test showed significant differences between control and types A, control and type B and control and type C at 180th, 210th and 240th minutes for foot area medial midfoot and lateral midfoot. However, for lateral midfoot, Mann Whitney U-test only shows significant differences between control and type A, control and type B and control and type C at 210th and 240th minutes and no significant difference between control and type A at 180th minutes.

Table 4.5.2: Comparison of data distribution of Borg's scale discomfort rating **between control and experimental groups for Region II**

	Time (min)	Cont rol	Type A	Type B	Type C	Median (IQR)	$X^{2,a}$	p-value	Mann Whitney U-test
Medial Midfoot	0	0.00	0.00	0.00	0.00	0.00 (0.00)	0.00	1.00	-
	30	0.70	1.40	0.90	0.90	0.00 (0.50)	10.51	0.15	-
	60	0.90	1.40	0.90	1.00	0.70 (0.50)	2.22	0.53	-
	90	1.00	1.40	1.00	1.10	1.00 (0.50)	2.63	0.45	-
	120	1.50	1.70	1.00	1.10	1.00 (0.80)	1.59	0.66	-
	150	1.70	1.50	0.90	1.10	1.00 (1.00)	3.80	0.28	-
	180	2.20	1.60	1.00	1.10	1.00 (1.30)	15.47	<0.01**	Control vs. Type A, p<0.04; Control vs. Type B, p<0.01; Control vs. Type C, p<0.01
	210	2.70	1.40	1.00	1.10	1.00 (1.28)	22.02	<0.01**	Control vs. Type A, p<0.02; Control vs. Type B, p<0.01; Control vs. Type C, p<0.01
	240	3.10	1.50	1.00	1.00	1.00 (1.68)	24.84	<0.01**	Control vs. Type A, p<0.02; Control vs. Type B, p<0.01; Control vs. Type C, p<0.01
Lateral Midfoot	0	0.00	0.00	0.00	0.00	0.00 (0.00)	0.00	1.00	-
	30	0.70	1.40	0.90	0.90	0.70 (0.50)	11.33	0.10	-
	60	0.80	1.40	0.90	0.90	1.00 (0.50)	4.27	0.23	-
	90	0.90	1.40	1.10	1.00	1.00 (0.88)	5.36	0.15	-
	120	1.40	1.70	0.90	1.10	1.00 (0.80)	2.06	0.56	-
	150	1.60	1.50	0.90	1.00	1.00 (0.90)	4.84	0.18	-
	180	2.20	1.60	1.00	1.10	1.00 (1.25)	15.33	0.02**	Control vs. Type B, p<0.03; Control vs. Type C, p<0.01
	210	2.60	1.30	1.10	1.00	1.00 (1.30)	23.54	<0.01**	Control vs. Type A, p<0.01; Control vs. Type B, p<0.01; Control vs. Type C, p<0.01
	240	3.10	1.50	1.00	0.90	1.00 (1.30)	26.94	<0.01**	Control vs. Type A, p<0.02; Control vs. Type B, p<0.01; Control vs. Type C, p<0.01.

**p-value significant at <0.01; *p-value significant at <0.05. [a]Krustal Wallis Non-parametric test.

In Region III, in Table 4.5.3, both medial and lateral rearfoot showed significant difference between groups at 180th minutes, 210th minutes and 240th minutes. However, at 150th minutes, Mann Whitney U-test showed, there was a significant difference between control and type B. Thus, it can conclude that type B material is the best for rearfoot area compared to type A and type C.

Table 4.5.3: Comparison of data distribution of Borg's scale discomfort **rating between control and experimental groups for Region III**

	Time (min)	Control	Type A	Type B	Type C	Median (IQR)	$X^{2,a}$	p-value	Mann Whitney U-test
Medial Rearfoot	0	0.00	0.00	0.00	0.00	0.00 (0.00)	0.00	1.00	-
	30	0.60	1.40	0.90	1.10	0.85 (0.50)	10.28	0.16	-
	60	0.90	1.40	0.90	1.00	1.00 (0.50)	3.90	0.27	-
	90	1.10	1.40	0.90	1.2	1.00 (0.98)	1.43	0.700	-
	120	1.70	1.70	0.90	1.20	1.00 (0.80)	4.87	0.18	-
	150	2.10	1.50	0.90	1.10	1.00 (0.80)	8.07	0.05*	Control vs. Type B, p<0.07
	180	2.60	1.50	1.00	1.10	1.00 (1.30)	20.92	<0.01**	Control vs. Type A, p<0.01; Control vs. Type B, p<0.01; Control vs. Type C, p<0.01
	210	3.10	1.30	1.00	1.00	1.00 (1.30)	33.03	<0.01**	Control vs. Type A, p<0.01; Control vs. Type B, p<0.01; Control vs. Type C, p<0.01
	240	3.60	1.50	1.00	0.90	1.00 (1.30)	33.18	<0.01**	Control vs. Type A, p<0.01; Control vs. Type B, p<0.01; Control vs. Type C, p<0.01
Lateral Rearfoot	0	0.00	0.00	0.00	0.00	0.00 (0.00)	0.00	1.00	-
	30	0.60	1.40	0.80	1.10	0.70 (0.50)	10.15	0.17	-
	60	1.00	1.40	0.90	1.00	1.00 (0.50)	3.05	0.38	-
	90	1.20	1.30	1.00	1.20	1.00 (0.88)	1.09	0.78	-
	120	1.80	1.70	0.90	1.20	1.00 (0.80)	4.10	0.25	-
	150	2.10	1.30	0.90	1.10	1.00 (0.80)	9.61	0.02*	Control vs. Type B, p<0.04
	180	2.70	1.40	1.00	1.10	1.00 (1.30)	25.01	<0.01**	Control vs. Type A, p<0.04; Control vs. Type B, p<0.01; Control vs. Type C, p<0.01
	210	3.10	1.30	1.00	1.00	1.00 (1.30)	35.00	<0.01**	Control vs. Type A, p<0.01; Control vs. Type B, p<0.01; Control vs. Type C, p<0.01
	240	3.65	1.40	1.00	0.90	1.00 (1.30)	34.47	<0.01**	Control vs. Type A, p<0.01; Control vs. Type B, p<0.01; Control vs. Type C, p<0.01

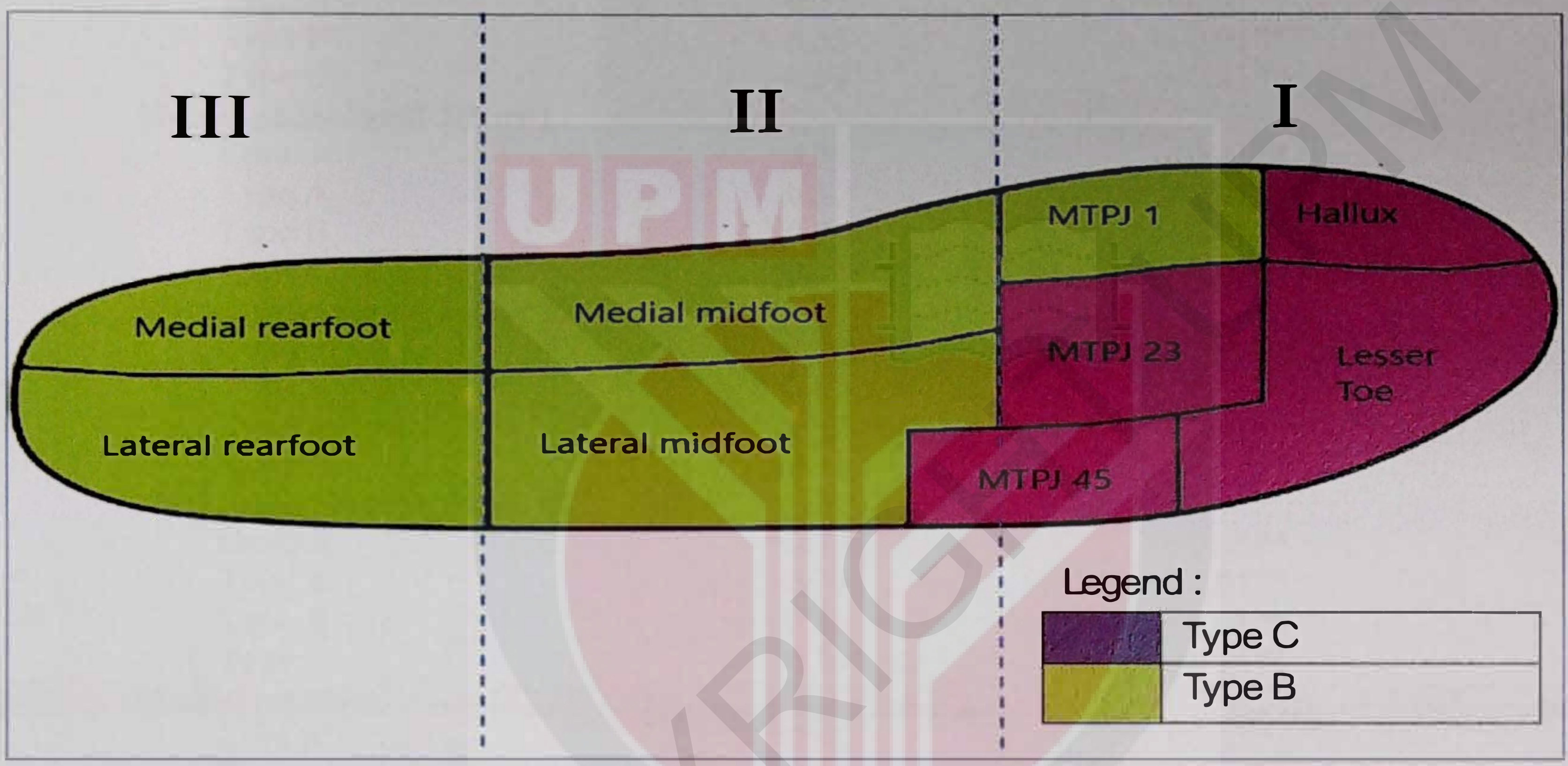
**p-value significant at <0.01; *p-value significant at <0.05

[a]Krustal Wallis Non-parametric test.

4.6 Summary of the best material

Figure 4.6 showed the best material according to Borg's scale discomfort rating and comparison of discomfort level between groups. Most of the Region I concluded that type C was the best material to reduce foot discomfort. Meanwhile for Region II and III, type B was the prominent material that can reduce foot discomfort.

Figure 4.6: Type of materials that can reduce foot discomfort



4.7 Correlation between time and foot discomfort

Spearman's Rho correlation coefficients were calculated between time and foot discomfort rating in control and three different types of insoles to determine the strength of the relationship. Table 4.7 shows that there were strong positive correlation between time and foot discomfort rating for each area in control group (r= 0.72, r=0.73, r=0.76, r= 0.73, r=0.74, r=0.66, r=0.71, r=0.74, r=0.73) and p-value <0.01. For experimental groups, there was a moderate positive correlation between time and foot discomfort rating for each area, p-value <0.0.01.

Table 4.7: Correlation of time and foot discomfort rating among the control and experimental groups (Type A, Type B and Type C) over 240 minutes.

Foot Area	Time	
	Coefficient,(r^2)[a]	p-value
Hallux		
Control	0.72	<0.01**
Type A	0.38	<0.01**
Type B	0.30	<0.01**
Type C	0.37	<0.01**
Lesser Toe		
Control	0.73	<0.01**
Type A	0.37	<0.01**
Type B	0.33	<0.01**
Type C	0.38	<0.01**
Metasophalangeal Joints 1		
Control	0.76	<0.01**
Type A	0.37	<0.01**
Type B	0.34	<0.01**
Type C	0.31	<0.01**
Metasophalangeal Joints 23		
Control	0.73	<0.01**
Type A	0.40	<0.01**
Type B	0.36	<0.01**
Type C	0.31	<0.01**
Metasophalangeal Joints 45		
Control	0.74	<0.01**
Type A	0.39	<0.01**
Type B	0.39	<0.01**
Type C	0.31	<0.01**
Medial midfoot		
Control	0.66	<0.01**
Type A	0.38	<0.01**
Type B	0.36	<0.01**
Type C	0.33	<0.01**
Lateral midfoot		
Control	0.71	<0.01**
Type A	0.39	<0.01**
Type B	0.34	<0.01**
Type C	0.33	<0.01**
Medial Rearfoot		
Control	0.74	<0.01**
Type A	0.38	<0.01**
Type B	0.32	<0.01**
Type C	0.29	<0.01**
Lateral Rearfoot		
Control	0.73	<0.01**
Type A	0.37	<0.01**
Type B	0.30	<0.01**
Type C	0.29	<0.01**

***Correlation is significant at the 0.01 level (2-tailded)*

a. Spearman Rho Correlation Test

CHAPTER 5

DISCUSSION

This study aimed to determine the effect of footwear insole on foot pain and subjective discomfort on prolonged standing among traffic police in Malaysia. All objectives of this study were obtained by determining the respondent's background, measuring foot-ankle pain and foot discomfort rating.

5.1 Respondents' Background

All of the respondents were male, and the age ranged between 20-35 years old. Most of the respondents were from a young age as 73.1% of the respondents were between 20-29 years old and another 26.9% were between 30-35 years old. The current study revealed that older participants performed significantly worse than the younger participants in all the functional mobility tests ($p<0.001$) (Butler, Menant, Tiedemann, & Lord, 2009) .For this reason, most of the respondents were among younger ages as to reduce the factor that might contribute to the foot discomfort rating. Besides, majority of the respondents reported normal BMI. However, there were no significant differences between foot peak in static condition and BMI (Yoon, Park, & Lee, 2016).

5.2 Footwear Insole and Foot Pain

The existing insole is made from polyvinyl chloride (PVC). This is hard material and found out to be less effective in relieving high plantar pressure (Leber & Evanski, 1986; Tong & Ng, 2010). There are lots of factors that contributed to discomfort when wearing footwear and among the elements are hard texture. Several studies had been conducted related to flooring and foot discomfort (Cham & Redfern, 2001; King, 2002; Y.-H. Lin et al., 2012; Mark, 2000; Orlando & King, 2004). The majority of this studies stated that, mats is associated with lower ratings of discomfort when compared to hard flooring (Cham & Redfern, 2001; King, 2002; Y.-H. Lin et al., 2012).

Moreover, it found out that the issued boot is uncomfortable due to the design which is a high cut boot that provided poor airway and causes the respondents to feel hot. The physiological responses to the hot environment reflected an adaption of the human body in the form of heat stress (Al-Ashaik, Ramadan, Al-Saleh, & Khalaf, 2015). Inadequate prevention and control policies on heat stress, adversely affect worker's health and safety, productivity and social well-being(Nunfam et al., 2019).

The study also showed there was an association between foot-ankle pain and foot discomfort. Based on the observation, this might due to the respondent's experience and feeling towards the boot. Several of the previous studies stated, there was a high percentage of the population report footwear related to foot pain. A prior study by McRitchie, Branthwaite, & Chockalingam, (2018), the purchasing factors of the patients were a high level of comfort (p=0.031) and the footwear's value (p=0.009). The feeling of foot pain is complex and difficult to define accurately by diagnosing the source of pain. However, foot pain can be defined as an unpleasant sensory and emotional experience following perceived damage to any tissue (Hawke & Burns, 2009; Laslett et al., 2018).

The result indicated that there is no association found between foot-ankle pains and working year. Theoretically, by identifying the target at-risk group such as working year and advanced age will be associated with the foot pain (Garrow, Silman, & Macfarlane, 2004).

5.3 Discomfort Rating Distribution and Correlation between Time and Foot Discomfort Rating

During 240 minutes, the study found that an increase of foot discomfort rating after 150th minutes for both the control and experimental group. Also, based on Table 4.7, there was a strong correlation between time and control group at every foot area compared to the experimental group. It was similar to the previous study which stated there is an increase in foot discomfort level as the duration of time (Anderson et al., 2017; Bagherzadeh Cham, Mohseni-Bandpei, Bahramizadeh, Kalbasi, & Biglarian, 2018; Orlando & King, 2004).

In comparison between foot areas, hallux and lesser toes had less discomfort compared to metatarsophalangeal joint areas. Previous studies reported various finding about this two areas. Data was absence in homoscedasticity for the hallux and lesser toe areas (Lee, Kong, & Pua, 2019). However, during standing, hallux and lesser toe showed more sensitive foot point, tolerating less amount of pressure compared to medial and heel areas (Buso & Shitoot, 2019; Van der Zwaard et al., 2014).

Also, at lateral and rearfoot recorded the highest foot discomfort rating; nearly (4.0). These findings may be because rearfoot or heel area had normalised maximum and mean pressure ($p<0.0001$) compared to another foot area (Hessert et al., 2005).

However, there were significant difference between control and the experimental groups on foot discomfort rating for every foot areas especially Type C (gel) and Type B (memory foam). Table 4.5.1, Table 4.5.2 and Table 4.5.3 showed both types had the lowest level of foot discomfort compared to Type A (rubber). When comparing the Borg's scale between control and experimental group, there was evidence for the control group will keep increasing compared with experimental which was showing constant values.

5.4 Best Material Based on Foot Mapping

Based on Figure 4.6, region I showed that type C was the best material to reduce foot discomfort. Gel type is well-known as has high ability to absorb impact shock, decrease foot fatigue, improve postural sway and increase energy return (Christovão et al., 2013; Elena et al., 2012). Moreover, the gel type was easy to maintain as it is water-resistance and easy to wash. Most of the athletic shoes or sportswear made from gel type. However, in industry, gel type was mainly used as enhancements for the athletic insole (Pollard et al., 2018).

In region II and region III, material type B (memory foam) was performed better compared with type A (rubber) and type C (gel). When the right stimulus is applied, shape memory will turn into the desired shape (Bothe, Emmerling, & Pretsch, 2013; Huang et al., 2010). Best memory foam is when it provided slow recovery feature that will provide good fitting experience, support and protection (Sun et al., 2017). Plus, increased cushioning of the insole will provide better shock absorption, reduce peak pressure, reduce the risk of injury and increase marketing demand (Pollard et al., 2018.; Socaciu, Simon, Pop, & Freitas, 2010).

Type A (rubber) is generally polyether based product that provide durable, hydrolysis resistant which stimulus long-term usage (Sastri & Sastri, 2014; Viswanathan et al., 2004). This type of material usually used by industrial sectors especially for safety shoe and in order to maximize the life span, it is important to make sure that this insole is appropriate to the working condition (Partner, 2014). Previous studies stated, wearing safety shoes daily leads to foot problems, discomfort and fatigue and reported as one cause of industrial falls (Caravaggi et al., 2016; Goto & Abe, 2017). This might be the cause why insole type A was not the best material in this study to reduce foot discomfort.

CHAPTER 6

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

In conclusion, an experimental research was conducted at Traffic Police Station, Kuala Lumpur which involved 52 respondents (26 controls, 26 experimental). It is aimed to determine the effect of footwear insole on foot pain and subjective discomfort on prolonged standing among the respondents. These are among few findings in this research:-

- The respondents were all men age ranged (20 to 35 years). Most of them had normal BMI and working experienced more than a year.
- The prevalence of the respondents experienced foot discomfort was 63.5%, having foot pain was 78.8% and rated footwear insole discomfort was 69.2%.
- During 240 minutes of study, the result showed that when comparing the Borg's scale, control group will experience increase in foot discomfort compared to experimental groups that showed constant values or slightly increase.
- This study showed that there was an association between foot-ankle pain and footwear insole.
- Kruskal wallis (non-parametric test) showed there were significant differences between groups after 180th minutes for each foot areas.

- Moreover, there was strong positive correlation between time and foot discomfort level for each area for control group and moderate positive correlation for experimental groups
- Type C (gel) was the best material to reduce foot discomfort at Region I. Meanwhile, Type B (memory foam) was the best material to reduce foot discomfort at Region II and III.

5.2 STUDY LIMITATION

There were some limitations that can improvise from this study. First, since the study used questionnaire based tools, the validity of the outcome cannot be proved clinically and precise. There are lots of factors that may influence the respondents to rate the questionnaires. While the standardized footwear insole used in this experiment helped to reduce unwanted variability, it is possible that different boots or socks may yield different results. There are several possibilities for why the result showed inconsistency. Since the study was not laboratory work, the researcher cannot control and observe each respondent every time. Each respondent may do different task from each other's that might contribute to muscle fatigue.

5.3 RECOMMENDATION

This study recommended that the outcome should serve as the fundamental or guidelines for reducing and tackling issues on foot discomfort and foot pain among the Malaysian traffic police. Other than that, since this experiment was conducted by using the questionnaires, it is highly recommended to use some instrument for example, foot plantar pressure to obtain precise foot pressure distribution of the respondents.

Since the study is aimed to reduce foot discomfort among Malaysian traffic police by changing the material, it can improve by trying to measure different prospective such as the density, thickness, flexibility and more of the footwear insole. Plus, during the study, it found that most of the respondents cannot distinguish the range of Borg's scale correctly. The scales should be clearly explained to the respondents prior to the experimental session. Clear example and assistance may help the respondents to rate it correctly.

It recommend that new development of insole (combination: Gel + memory foam) is being develop and test among the Malaysian Traffic Police.

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APPENDICES

- ETHICAL APPROVAL
- QUESTIONNAIRE
- BORG'S SCALE
- DATA (PREVALENCE OF FOOT-ANKLE PAIN CORE SCALE)
- DATA (SIMPLE LINEAR REGRESSION BETWEEN TIME AND FOOT DISCOMFORT RATING)

UNIVERSITI PUTRA MALAYSIA
BERILMU BERBAKTI

QUESTIONNAIRE FORM

BORANG KAJI SELIDIK

EFFECT OF FOOTWEAR INSOLE ON FOOT PAIN AND SUBJECTIVE DISCOMFORT ON PROLONGED STANDING AMONG TRAFFIC POLICE IN MALAYSIA.

Kesan Tapak Kasut Terhadap Sakit Kaki Dan Ketidakselesaan Subjektif Akibat Berdiri Lama Dalam Kalangan Anggota Polis Trafik Di Malaysia.

NO. ID :...

DATE/*Tarikh* :...

QUESTIONS INSTRUCTIONS:
Arahan soalan:

1. THIS QUESTIONNAIRE FORM CONSISTS OF SEVERAL SECTIONS:-
Borang soal selidik ini terdiri daripada beberapa bahagian:-

PART A **: BACKGROUND INFORMATION**
Bahagian A *: Maklumat latar belakang*
PART B **: JOB DESCRIPTION**
Bahagian B *: Maklumat pekerjaan*
PART C **: THE FOOT AND ANKLE CORE SCALE**
Bahagian C *: Skala teras kaki dan buku lali*
PART D **: THE EXISTING INSOLE DISCOMFORT SCALE**
Bahagian D *: Skala ketidakselesaan tapak kasut sedia ada*

2. YOU REQUIRED TO ANSWER ALL QUESTIONS IN THIS QUESTIONNAIRE.
Anda dikehendaki menjawab semua soalan dalam soal selidik ini.
3. PLEASE MARK THE ANSWER IN THE PROVIDED ANSWER SECTION.
Sila tandakan jawapan di bahagian yang telah disediakan.
4. THE QUESTIONNAIRE SHOULD BE RETURNED TO THE RESEARCHER AFTER COMPLETING ALL THE QUESTIONS.
Borang soal selidik hendaklah dikembalikan kepada penyelidik selepas menjawab semua soalan.

Sila baca maklumat berikut dengan teliti. Sekiranya anda mempunyai sebarang pertanyaan, sila kemukakan kepada penyelidik.

1.TAJUK KAJIAN

Kesan tapak kasut terhadap tahap ketidakselesaan akibat berdiri lama di kalangan anggota polis di malaysia.

2. PENGENALAN

Kerja yang melibatkan berdiri lama adalah perkara biasa dalam industri pekerjaan termasuk angkatan tentera, anggota polis dan ianya boleh mengakibatkan rasa sakit di tempat kerja dan ketidakselesaan di tapak kaki, kaki, dan bahagian bawah badan. Berdiri selama lebih dari 8 jam akan mengakibatkan masalah kesihatan termasuk keletihan bahagian bawah kaki, ketidakselesaan kaki, pembengkakan kaki, sakit belakang dan keletihan tubuh badan. Kajian ini bertujuan untuk membuktikan terdapat kesan memakai tapak kasut yang tidak sesuai dengan tahap ketidakselesaan semasa berdiri lama. Hasil dapatan kajian, penyelidik akan mengenal pasti jenis bahan kasut yang sesuai untuk kasut polis.

3. APAKAH YANG PERLU ANDA LAKUKAN?

Berikut adalah langkah-langkah yang perlu anda lakukan dalam kajian ini. Penyertaan anda dalam kajian ini adalah secara sukarela dan anda dibenarkan enggan terlibat tanpa memberikan apa-apa sebab.

Langkah 1: Anda perlu mengisi borang soal selidik yang disediakan oleh penyelidik.
Langkah 2: Selepas mengisi borang soal selidik, anda perlu berdiri selama 4 jam menggunakan but polis anda.
Langkah 3: Untuk setiap 30 minit, penyelidik akan bertanya mengenai tahap ketidakselesaan anda.
* Anda perlu menjawab berdasarkan pengalaman subjektif anda.

Penyelidikan ini mungkin memerlukan kerjasama anda selama 2-3 hari.

4. SIAPA YANG TIDAK BOLEH MENYERTAI KAJIAN INI?

Polis yang mempunyai kaki yang tidak normal dan menghidap penyakit berkaitan dengan kaki, yang berkhidmat kurang satu tahun dan yang berusia di bawah 20 tahun atau lebih 55 tahun akan dikecualikan daripada kajian ini. Polis wanita juga dikecualikan.

5. APAKAH FAEDAH MENYERTAI KAJIAN INI?

a) KEPADA ANDA SEBAGAI PESERTA?

Kajian ini bertujuan untuk membuktikan kaitan antara kesan tapak kasut yang tidak sesuai dengan tahap ketidakselesaan semasa berdiri lama di kalangan anggota polis. Semua maklumat sama ada secara langsung atau tidak langsung, akan berguna dalam kajian ini. Kajian ini akan menyediakan asas bagi kajian lanjut dalam menghasilkan prototaip baru dan reka bentuk terkini untuk kasut polis yang boleh membantu mengurangkan ketidakselesaan kaki, sakit belakang, keletihan otot dan meningkatkan keselesaan otot kepada anggota polis di Malaysia.

b) KEPADA PENYELIDIK?

Melalui kajian ini, penyidik akan mempunyai pengetahuan yang lebih baik mengenai kesan tapak kasut yang tidak sesuai dengan tahap ketidakselesaan semasa berdiri lama di kalangan anggota polis yang boleh menjejaskan produktiviti dan pelaksanaan tugas harian mereka. Penyelidikan ini akan mencadangkan beberapa tapak kasut yang intervensional yang dapat meningkatkan keselesaan kaki dan mengurangkan masalah kaki yang disebabkan oleh berdiri lama.

6. ADAKAH IA BERISIKO?

Para peserta mungkin merasa tidak selesa atau sakit kerana berdiri selama 2 jam. Peserta boleh menarik diri dari kajian pada bila-bila masa tanpa sebarang penalti atau kehilangan faedah.

7. ADAKAH MAKLUMAT DAN IDENTITI SAYA KEKAL RAHSIA?

Semua maklumat yang disediakan akan diadakan sulit oleh penyelidik dan semua keputusan ujian yang diperolehi daripada kajian ini juga tidak akan didedahkan kepada mana-mana pihak ketiga yang tidak berkaitan.

8. SIAPA YANG SAYA PERLU HUBUNGI SEKIRANYA SAYA MEMPUNYAI SOALAN TAMBAHAN SEMASA MENGIKUTI PENYELIDIKAN INI?

Jika responden mempunyai sebarang soalan yang berkaitan dengan kajian ini, mereka boleh menghubungi penyelidik dan orang yang berkaitan dengan kajian ini dengan maklumat yang tertera :

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Sila tandatangan di sini sekiranya anda telah membaca dan memahami kandungan halaman ini

____________________.

9. PERSETUJUAN

Saya.. No Kad Pengenalan. .... beralamat.. ....dengan ini bersetuju untuk mengambil bahagian secara sukarela dalam penyelidikan yang tersebut di atas *(kajian klinikal/percubaan ubat-ubatan/rakaman video/kumpulan sasaran/temuduga/ soal selidik).

Saya telah diberi penjelasan secara menyeluruh mengenai penyelidikan ini dari segi metodologi, risiko dan komplikasi (seperti tertulis pada Helaian Penerangan Responden). Saya memahami bahawa saya berhak menarik diri dari penyelidikan ini pada bila-bila masa tanpa memberi sebarang alasan.Saya juga memahami bahawa sebarang maklumat yang berkaitan identiti saya akan dirahsiakan.

Saya* berminat / tidak berminat untuk mengetahui keputusan kajian yang melibatkan saya.

I setuju/tidak bersetuju untuk imei/gambar/rakaman video/ rakaman suara digunakan dalam apa jua bentuk penerbitan atau pembentangan. (sekiranya berkaitan).

*potong yang tidak berkenaan

Tandatangan .... Tandatangan ....

(*Responden*) (*Saksi*)

Tarikh :... Nama :...

No. K/P: ....

Saya mengesahkan bahawa saya telah menerangkan kepada responden ini sifat dan tujuan penyelidikan yang tersebut di atas.

Tarikh .... Tandatangan ....

(*Penyelidik*)

PART A : BACKGROUND INFORMATION
Bahagian A : Maklumat latar belakang

1.1 AGE/*umur* : ☐☐ **YEAR OLD**

1.2 RACE/bangsa :
1. ☐ **MALAY**/*melayu*
2. ☐ **CHINESE** /*cina*
3. ☐ **INDIA**/*India*
4. ☐ **OTHERS**/*lain-lain*

1.3 STATUS/*status* :
1. ☐ **SINGLE**/*bujang*
2. ☐ **MARRIED**/*berkahwin*
3. ☐ **DIVORCED**/*bercerai*

1.4 EDUCATION :
1. ☐ **ILLITERATE**/*tidak bersekolah*
2. ☐ **PRIMARY SCHOOL**/*sekolah rendah*
3. ☐ **SECONDARY SCHOOL** /*sekolah menengah*
4. ☐ **UNIVERSITY**/*universiti*

1.5 HEIGHT/*tinggi* : ______**CM**

1.6 WEIGHT /*berat* : ______**KG**

***BMI** :______

1.7 ARE YOU WEARING AN ISSUE POLICEMEN BOOTS?
Adakah anda memakai but yang diperuntukkan ?
1. ☐ **YES**/*ya*
0. ☐ **NO**/*tidak*

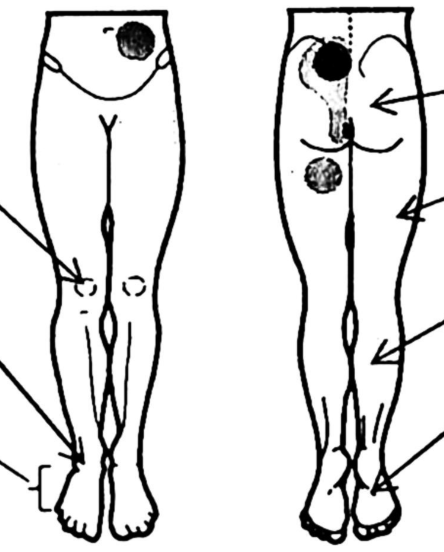
IF NO, STATE THE BRAND/ *Jika tidak, nyatakan jenama* : ______________________________

1.8 HOW MANY TIMES YOU WERE GIVEN AN ISSUE POLICEMEN BOOTS IN A YEAR?
Dalam setahun, berapa kali anda diperuntukkan but polis?
_______**TIMES/YEAR** *kali/tahun*

1.9 BOOT SIZE/*saiz but* : ____________

1.10 DO YOU HAVE ANY INJURIES OR ILLNESSES OF THE FOLLOWING PARTS OF THE BODY?

1. ☐ **KNEE**/*lutut*
2. ☐ **ANKLE**/*buku lali*
3. ☐ **FOOT**/*kaki*



4. ☐ **HIP**/*pinggul*
5. ☐ **THIGHS** /*peha*
6. ☐ **CALF**/*betis*
7. ☐ **ARCH** /*lengkungan tapak kaki*

2.8 DO YOU WORK NORMAL OR SHIFT HOUR?
Adakah anda bekerja secara normal atau shift?

1. ☐ **NORMAL (8.00am-5.00pm)**
2. ☐ **SHIFT (Morning/*pagi*) (7.00am-7.00pm) / SHIFT (Night/*malam*) (7.00pm-7.00am)**
3. ☐ **BOTH/*kedua-duanya***

2.9 DO YOUR POLICE BOOTS COMFORTABLE?
Adakahah but polis anda selesa?

1. ☐ **YES/*ya*** 2. ☐ **NO/*tidak*** 3. ☐ **UNCERTAIN/*tidak pasti***

2.10 DO YOU EXPERIENCE FOOT DISCOMFORT DURING WORKING?
Adakah anda pernah mengalami ketidakselesaan pada kaki semasa bekerja?

1. ☐ **YES/*ya*** 2. ☐ **NO/*tidak*** 3. ☐ **UNCERTAIN/*tidak pasti***

2.11 ARE YOU PRONE TO SIT OR STAND DURING WORKING?
Adakah anda cenderung untuk berdiri atau duduk semasa bekerja?

2.11.1 1. ☐ **SITTING/*duduk*** 2. ☐ **STANDING/*berdiri*** 3. ☐ **BOTH/kedua-duanya**

2.11.2 PERCENTAGE/*peratus*(%): ___________SITTING/*duduk* ______STANDING/*berdiri*

PART C : **THE FOOT AND ANKLE CORE SCALE**
Bahagian C : *Skala teras kaki dan buku lali*

PLEASE RATE BASED ON THE SCALE GIVEN .
Sila tanda berdasarkan skala yang diberikan.

1=NEVER */tidak pernah*, **2=RARELY/** *jarang*, **3=SOMETIMES /** *kadang-kadang* ,

4=FREQUENTLY/ *kerap* , **5=ALWAYS/** *selalu6*

NO.	DESCRIPTION	1	2	3	4	5
3.1	**DURING THE PAST WEEK, HAVE YOU EVER EXPERIENCED STIFFNESS IN YOUR FOOT/ANKLE?** *Sepanjang minggu yang lalu, pernahkah anda mengalami kekakuan pada kaki/buku lali?*					
3.2	**DURING THE PAST WEEK, HAVE YOUR FOOT/ANKLE SWOLLEN?** *Sepanjang minggu yang lalu, pernahkan kaki/buku lali anda bengkak?*					

1=NOT PAINFUL/tidak sakit , **2=MILDLY PAINFUL**/sedikit sakit , **3=MODERATELY PAINFUL**/sederhana sakit,

4=VERY PAINFUL/sangat sakit , **5=EXTREMELY PAINFUL**/sakit melampau

NO.	DESCRIPTION	1	2	3	4	5
3.3	**DURING THE PAST WEEK, DID YOUR FOOT/ANKLE FELT PAIN WHEN WALKING ON UNEVEN SURFACES?** *Sepanjang minggu yang lalu, adakah kaki/buku lali anda rasa sakit semasa berjalan diatas permukaan yang tidak rata?*					
3.4	**DURING THE PAST WEEK, DID YOUR FOOT/ANKLE FELT PAIN WHEN WALKING ON FLAT SURFACES?** *Sepanjang minggu yang lalu, adakah kaki/buku lali anda rasa sakit semasa berjalan diatas permukaan yang rata?*					
3.5	**DURING THE PAST WEEK, DID YOUR FOOT/ANKLE FELT PAIN WHEN GOING UP OR DOWN STAIRS?** *Sepanjang minggu yang lalu, adakah kaki/buku lali anda rasa sakit semasa turun naik tangga?*					
3.6	**DURING THE PAST WEEK, DID YOUR FOOT/ANKLE FELT PAIN WHEN LYING IN BED AT NIGHT?** *Sepanjang minggu yang lalu, adakah kaki/buku lali anda rasa sakit semasa baring diatas katil di waktu malam?*					

1 = DID NOT GIVE WAY AT ALL/tidak rasa lemah langsung **,**
2 = PARTIALLY GAVE WAY, BUT DID NOT FALL/*rasa lemah tetapi tidak tumbang,*
3 = COMPLETELY GAVE WAY, SO THAT FELL/*rasa lemah sehingga tumbang,*
4 = COULD NOT DO BECAUSE OF FOOT/ANKLE GIVING WAY/*Tidak boleh lakukan kerana kaki/buku lali lemah*
5 = COULD NOT DO FOR OTHER REASONS/*Tidak boleh lakukan kerana disebabkan lain.*

NO.	DESCRIPTION	1	2	3	4	5
3.7	**DURING THE PAST WEEK, DID YOUR FOOT/ANKLE GIVE WAY DURING STRENUOUS ACTIVITY?** *Sepanjang minggu yang lalu, adakah kaki/buku lali anda rasa lemah semasa melakukan aktiviti berat?*					
3.8	**DURING THE PAST WEEK, DID YOUR FOOT/ANKLE GIVE WAY DURING MODERATE ACTIVITY?** *Sepanjang minggu yang lalu, adakah kaki/buku lali anda rasa lemah semasa melakukan aktiviti sederhana berat?*					
3.9	**DURING THE PAST WEEK, DID YOUR FOOT/ANKLE GIVE WAY DURING LIGHT ACTIVITY?** *Sepanjang minggu yang lalu, adakah kaki/buku lali anda rasa lemah semasa melakukan aktiviti ringan?*					

1=DID NOT NEED SUPPORT/*tidak memerlukan bantuan*
2=MOSTLY WALKED WITHOUT SUPPORT/*kebanyakkan berjalan tanpa bantuan*
3=MOSTLY USED 1CANE/CRUTCH/*kebanyakkan berjalan menggunakan sebelah tongkat*
4=MOSTLY USED 2 CANES/CRUTCHES /*kebanyakkan berjalan menggunakan dua tongkat*
5=USED A WHEELCHAIR/*menggunakan kerusi roda*
6=MOSTLY USED OTHER SUPPORTS/SOMEONE/*kebanyakkan berjalan dengan bantuan orang*
7=UNABLE TO GET AROUND AT ALL/*tidak boleh berjalan/bersiar-siar langsung*

NO.	DESCRIPTION	1	2	3	4	5	6	7
3.10	**DID YOU ABLE TO GET AROUND MOST OF THE TIME DURING PAST WEEK?** *Adakah anda boleh berjalan /bersiar-siar seperti biasa sepanjang miggu yang lalu?*							

1=NEVER /*tidak pernah*, **2=RARELY**/ *jarang*, **3=SOMETIMES** / *kadang-kadang* **,**

4=FREQUENTLY/ *kerap* **, 5=ALWAYS**/ *selalu*

NO.	DESCRIPTION	1	2	3	4	5
3.11	**DURING THE PAST WEEK, HAVE YOU TROUBLE WITH BALANCE?** *Sepanjang minggu yang lalu, adakah anda mengalami masalah keseimbangan?*					
3.12	**DURING THE PAST WEEK, HAVE YOU FELT DIFFICULT TO PUT OR TAKE OFF SOCKS?** *Sepanjang minggu yang lalu, adakah anda rasa susah untuk memakai atau membuka sarung kaki?*					

1=NO AT ALL/ *tidak sama-sekali* **, 2=MILD/***sedikit* **, 3=MODERATE/***sederhana* **,**

4=SEVERE/*teruk,* **5=EXTREME/***melampau,*

NO.	DESCRIPTION	1	2	3	4	5
3.13	**DURING THE PAST WEEK, HOW PAINFUL WAS YOUR FOOT/ANKLE WHEN DOING STRENUOUS ACTIVITY?** *Sepanjang minggu yang lalu, berapa sakit kaki/buku lali anda ketika melakukan aktiviti berat?*					
3.14	**DURING THE PAST WEEK, HOW PAINFUL WAS YOUR FOOT/ANKLE WHEN DOING MODERATE ACTIVITY?** *Sepanjang minggu yang lalu, berapa sakit kaki/buku lali anda ketika melakukan aktiviti sederhana berat?*					
3.15	**DURING THE PAST WEEK, HOW PAINFUL WAS YOUR FOOT/ANKLE WHEN DOING LIGHT ACTIVITY?** *Sepanjang minggu yang lalu, berapa sakit kaki/buku lali anda ketika melakukan aktiviti ringan?*					
3.16	**DURING THE PAST WEEK, HOW PAINFUL WAS YOUR FOOT/ANKLE WHEN STANDING FOR AN HOUR?** *Sepanjang minggu yang lalu, berapa sakit kaki/buku lali anda ketika berdiri selama sejam?*					
3.17	**DURING THE PAST WEEK, HOW PAINFUL WAS YOUR FOOT/ANKLE WHEN STANDING A FEW MINUTES?** *Sepanjang minggu yang lalu, berapa sakit kaki/buku lali anda ketika berdiri beberapa minit?*					
3.18	**HOW MUCH DIFFICULTIES HAVE YOU WALKING ON UNEVEN SURFACES?** *Berapa susah anda untuk berjalan diatas permukaan tidak rata?*					

1=NOT AT ALL/*tidak,* **2=A LITTLE BIT/***sedikit* **, 3=MODERATELY/***sederhana*

4=VERY/*sangat,* **5=EXTREMELY/***melampau*

NO.	DESCRIPTION	1	2	3	4	5
3.19	**HOW MUCH DID YOUR FOOT/ANKLE PROBLEM INTERFERE WITH NORMAL WORK?** *Berapa banyak masalah kaki/buku lali menganggu kehidupan normal anda?*					
3.20	**HOW MUCH DID YOUR FOOT/ANKLE PROBLEM INTERFERE WITH LIFE/ABILITY TO DO WHAT YOU WANT?** *Berapa banyak masalah kaki/buku lali menganggu hidup/kebolehan yang ingin anda lakukan?*					

PART D : **THE EXISTING INSOLE DISCOMFORT SCALE**

Bahagian D : *Skala ketidakselesaan tapak kasut sedia ada*

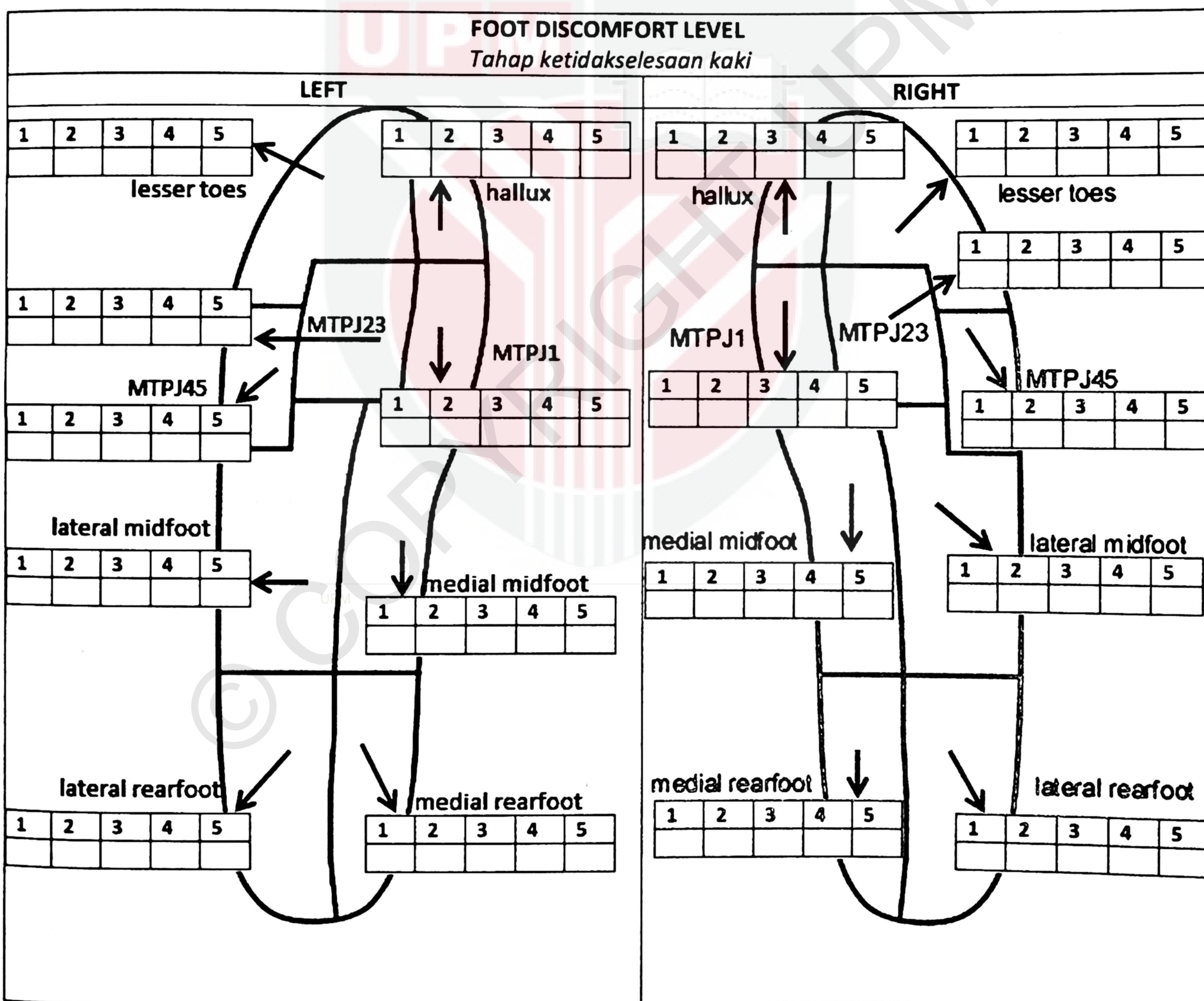
PLEASE RATE BASED ON THE SCALE GIVEN .

Sila tanda berdasarkan skala yang diberikan.

1=COMFORT/*selesa*, **2=MILDLY DISCOMFORT/**sedikit tidakselesa,

3=MODERATELY DISCOMFORT/*sederhana tidakselesa*, **4=VERY DISCOMFORT/***sanaat tidakselesa*,

5=EXTREMELY DISCOMFORT/*tidakselesa melampau*



- End of Questionnaire -

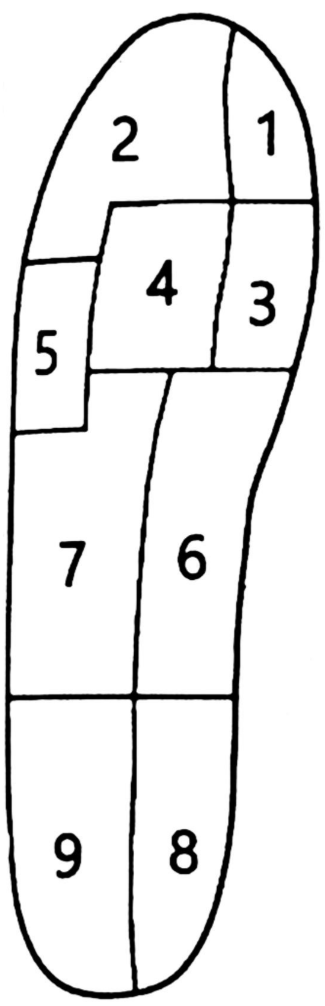
RESPONDENT NO:_______ DATE:______

Insole material:
Bare Foot; Existing; Type A; Type B; Type C

Time: 0 min; 30 min; 60 min; 90 min; 120 min; 150 min; 180 min; 210 min, 240 min

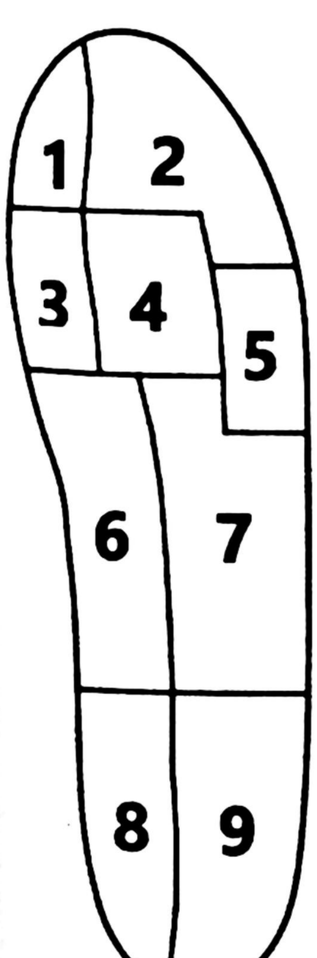
Please rate based on the scale given.

Nothing at all (*tiada rasa apa-apa*) — Very Comfort (*sangat selesa*) — Comfort (*selesa*) — Mildly Discomfort (*sedikit tidakselesa*) — Moderate Discomfort (*(sederhana tidakselesa*) — Discomfort (*tidakselesa*) — Very Discomfort (*sangat tidakselesa*) — Extremely Discomfort (tidakselesa melampau)



	Foot Area	0	0.3	0.5	0.7	1	1.5	2	2.5	3	4	5	6	7	8	9	10
1	Hallux																
2	Lesser toes																
3	Metar sophalangeal joints 1 (MTJ1)																
4	Metar sophalangeal joints 1 (MTJ23)																
5	Metar sophalangeal joints 1 (MTJ45)																
6	Medial midfoot																
7	Lateral midfoot																
8	Medial rearfoot																
9	Lateral midfoot																

LEFT FOOT



	Foot Area	0	0.3	0.5	0.7	1	1.5	2	2.5	3	4	5	6	7	8	9	10
1	Hallux																
2	Lesser toes																
3	Metar sophalangeal joints 1 (MTJ1)																
4	Metar sophalangeal joints 1 (MTJ23)																
5	Metar sophalangeal joints 1 (MTJ45)																
6	Medial midfoot																
7	Lateral midfoot																
8	Medial rearfoot																
9	Lateral midfoot																

RIGHT FOOT

The prevalence of foot-ankle pain core scale of the respondents.

Variables	Frequency (N=52)	%
Experienced Stiffness		
Never	26	50
Rarely	9	17.3
Sometimes	14	26.9
Frequently	3	5.8
Always	0	0
Foot Ankle Swollen		
Never	39	75
Rarely	6	11.5
Sometimes	6	11.5
Frequently	1	1.9
Always	0	0
Felt Pain Walking On Uneven Surfaces		
No	28	53.8
Mild	7	13.5
Moderate	14	26.9
Very Painful	1	1.9
Extreme	2	3.8
Felt Pain Walking On Flat Surfaces		
No	30	57.7
Mild	7	13.5
Moderate	12	23.1
Very Painful	3	5.8
Extreme	0	0
Felt Pain When Going Up/Down Stairs		
No	29	55.8
Mild	10	19.2
Moderate	8	15.4
Very Painful	5	9.6
Extreme	0	0

Felt Pain When Lying In the Bed		
No	35	67.3
Mild	6	11.5
Moderate	6	11.5
Very Painful	5	9.6
Extreme	0	0
Foot/Ankle Give Away During Strenuous Activity		
No	24	46.2
Partially	20	38.5
Completely	5	9.6
No, because give away	3	5.8
No, because other reasons	0	0
Foot/Ankle Give Away During Moderate Activity		
No	32	61.5
Partially	12	23.1
Completely	6	11.5
No, because give away	2	3.8
No, because other reasons	0	0
Foot/Ankle Give Away During Light Activity		
No	40	76.9
Partially	4	7.7
Completely	4	7.7
No, because give away	3	5.8
No, because other reasons	1	1.9

Able To Get Around		
Yes	36	69.2
Mostly, without support	7	13.5
Mostly, with 1cane	6	11.5
Mostly, with 2 canes	1	1.9
Wheelchair	1	1.9
Mostly, with someone support	0	0
Not at all	1	1.9
Having Trouble With Balance		
Never	38	73.1
Rarely	7	13.5
Sometimes	5	9.6
Frequently	1	1.9
Always	1	1.9
Having Difficulty to Put /Take Off Socks		
Never	41	78.8
Rarely	4	7.7
Sometimes	4	7.7
Frequently	2	3.8
Always	1	1.9
Felt Foot Pain When Doing Strenuous Activity		
No	32	61.5
Mild	12	23.1
Moderate	6	11.5
Very Painful	1	1.9
Extreme	1	1.9
Felt Foot Pain When Doing Moderate Activity		
No	33	63.5
Mild	11	21.2
Moderate	6	11.5
Very Painful	1	1.9
Extreme	1	1.9

Felt Foot Pain When Doing Light Activity		
No	33	63.5
Mild	11	21.2
Moderate	6	11.5
Very Painful	1	1.9
Extreme	1	1.9
Felt Foot Pain When Standing for 1 Hour		
No	31	59.6
Mild	10	19.2
Moderate	8	15.4
Very Painful	2	3.8
Extreme	1	1.9
Felt Foot Pain When Standing for Few Minutes		
No	30	57.7
Mild	13	25
Moderate	5	9.6
Very Painful	3	5.8
Extreme	1	1.9
Having Difficulty Walk on Uneven Surface		
No	31	59.6
Mild	9	17.3
Moderate	9	17.3
Very Painful	1	1.9
Extreme	2	3.8

Foot/Ankle Problem Interfere With Normal Work		
No	26	50
A little bit	15	28.8
Moderate	8	15.4
Very	3	5.8
Extreme	0	0
Foot/Ankle Problem Interfere With Quality of Life		
No	30	57.7
A little bit	11	21.2
Moderate	8	15.4
Very	2	3.8
Extreme	1	1.9

Simple linear regression between time and foot discomfort rating among the control and experimental groups (Type A, Type B and Type C)

Variable	Time			
	b (95% CI)	*t-value*	$r^{2,a}$	p-value
Foot area				
Hallux				
Control	1.174 (0.964,1.383)	11.039	0.344	<0.001**
Type A	0.372 (0.121, 0.623)	2.923	0.036	0.004**
Type B	1.278 (0.808, 1.747)	5.365	0.110	<0.001**
Type C	1.687 (1.177, 2.198)	6.511	0.154	<0.001**
Lesser toe				
Control	1.184 (0.974, 1.394)	11.120	0.348	<0.001**
Type A	0.261 (0.052, 0.471)	2.460	0.025	0.015*
Type B	1.534 (1.024, 2.043)	5.932	0.132	<0.001**
Type C	1.697 (1.188, 2.206)	6.569	0.157	<0.001**
MetasophalangealJoints1				
Control	0.963 (0.793, 1.134)	11.146	0.349	<0.001**
Type A	0.296 (0.079, 0.514)	2.682	0.03	0.008**
Type B	2.775 (2.026, 3.542)	7.299	0.187	<0.001**
Type C	1.426(0.892, 1.959)	5.268	0.103	<0.001**
Metasophalangeal Joints 23				
Control	0.927 (0.755, 1.099)	10.642	0.328	<0.001**
Type A	0.337 (0.114, 0.561)	2.971	0.037	0.003**
Type B	3.148 (2.411, 3.886)	8.406	0.233	<0.001**
Type C	1.426 (0.892, 1.959)	5.268	0.107	<0.001**
Metasophalangeal Joints 45				
Control	1.035 (0.862, 1.208)	11.774	0.374	<0.001**
Type A	0.352 (0.140, 0.564)	3.266	0.044	0.001**
Type B	3.095 (2.387, 3.082)	8.609	0.242	<0.001**
Type C	1.426 (0.892, 1.929)	5.268	0.107	<0.001**
Medial midfoot				
Control	0.980 (0.800, 1.161)	10.696	0.330	<0.001**
Type A	0.334 (0.113, 0.555)	2.981	0.037	0.003**
Type B	2.331 (1.703, 2.959)	7.308	0.187	<0.001**
Type C	1.290 (0.820, 1.759)	5.411	0.112	<0.001**
Lateral midfoot				
Control	1.101(0.915, 1.287)	11.661	0.370	<0.001**
Type A	0.334 (0.113, 0.555)	2.978	0.037	0.003**
Type B	2.253 (1.167, 2.888)	6.986	0.174	<0.001**
Type C	1.608 (1.062, 2.154)	5.804	0.127	<0.001**
Medial rearfoot				
Control	0.897 (0.744, 1.051)	11.506	0.363	<0.001**
Type A	0.344(0.120, 0.569)	3.026	0.038	0.003**
Type B	1.909 (1.327, 2.491)	6.462	0.153	<0.001**
Type C	1.308 (0.760, 1.856)	4.704	0.087	<0.001**
Lateral rearfoot				
Control	0.890 (0.737, 1.043)	11.469	0.362	<0.001**
Type A	0.368 (0.117, 0.618)	2.893	0.035	0.004**
Type B	1.801 (1.216, 2.386)	6.067	0.137	<0.001**
Type C	1.308 (0.760, 1.56)	4.704	0.087	<0.001**

a. Simple linear regression

***p-value significant at <0.01; *p-value significant at <0.05*