STEEL TOE CAP BOOT USAGE AND THE PREVALENCE TO PLANTAR FASCIITIS AMONG INDUSTRIAL WORKERS

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ABSTRACT

Introduction: Steel toe cap boot (STCB) is used as a personal protective equipment in many industries. STCB have an addition of steel plates for the toe and sole resulting it to be heavier shoes, which may leads to pain and discomfort for the users. The aim of this study is to determine the prevalence and associated factors for plantar fasciitis (PF) among STCB users.

Methods: A consent letter were sent to the respective company to gain cooperation before the commencement of this research. This is a cross-sectional study using a self-administered questionnaire to assess symptoms of PF and associate factors among STCB users. Universal sampling were use to choose respondants. The questionnaire comprises of four parts: worker's profile, steel toe cap boot usage, foot pain and symptoms of PF. Hard copies were delivered to four industries. A total of 253 workers from four industries: construction (39.9%), manufacturing (25.3%), oil and gas (14.6%) and shipbuilding (20.2%) participated in the study. Raw data were collected and analyzed using SPSS and Microsoft Excel.

Results: The result revealed 49.8% (n=125) of STCB users reported heel pain with 39.4% (n=100) having symptoms suggestive of plantar fasciitis. Manufacturing workers have the highest prevalence of plantar fasciitis among all four industries (62.5%, n=40). The factors that were associated with plantar fasciitis after taking age, gender and body mass index into consideration were walking (Odds Ratio (OR) 2.833; 95% Confidence Interval (95%CI): 1.637 to 4.905), manufacturing workers (OR=10.579; 95%CI: 4.056 to 27.594), construction workers (OR=4.819; 95%CI: 1.931 to 12.030), change of boots more than once per year (OR=3.462; 95%CI: 1.991 to 6.020) and self-purchased STCB (OR=0.392; 95%CI: 0.200 to 0.770).

Conclusion: The prevalence of plantar fasciitis among STCB is high. It is found to be higher in certain industries and also lower among those who purchased their own STCB.

ABSTRAK

Pengenalan: But keselamatan dengan penutup keluli (BKPK) digunakan sebagai peralatan perlindungan peribadi di kebanyakan industri. BKPK mempunyai tambahan plat keluli untuk kaki sehingga menyebabkan kasut menjadi lebih berat, serta menyebabkan kesakitan dan ketidakselesaan bagi pengguna. Tujuan kajian ini adalah untuk mengenalpasti kelaziman dan faktor yang berkaitan dengan plantar fasciitis (PF) di kalangan pengguna BKPK.

Kaedah: Sebelum kajian dimulakan, surat permohonan kebenaran telah dihantar kepada empat industry di Malaysia. Ini adalah kajian rentas keratan menggunakan soal selidik sendiri untuk menilai gejala PF dan faktor bersekutu di kalangan pengguna BKPK. Soal selidik ini terdiri daripada empat bahagian: profil pekerja, penggunaan BKPK, sakit kaki dan gejala PF, dihantar kepada empat industri. Sejumlah 253 pekerja dari empat industri: pembinaan (39.9%), perkilangan (25.3%), minyak dan gas (14.6%) dan pembinaan kapal (20.2%) mengambil bahagian dalam kajian ini. Data dikumpulkan dan dianalisis menggunakan SPSS dan Microsoft Excel..

Keputusan: Sejumlah 253 pekerja dari empat industri: pembinaan (39.9%), perkilangan (25.3%), minyak dan gas (14.6%) dan pembinaan kapal (20.2%) mengambil bahagian dalam kajian ini. Hasilnya menunjukkan 49.8% (n = 125) pengguna BKPK melaporkan sakit tumit dengan 39.4% (n = 100) yang mempunyai tanda-tanda gejala PF. Industri perkilangan mempunyai prevalensi PF tertinggi di kalangan empat industri (62.5%, n = 40). Faktor-faktor yang dikaitkan dengan PF selepas mengambil indeks jantina, umur dan jisim badan(BMI) telah dipertimbangkan (Odds Ratio (OR) 2.833; Interval Keyakinan 95% (95% CI): 1.637 hingga 4.905),

pekerja pembuatan (OR = 10.579 , 95% CI: 4.056 hingga 27.594), pekerja pembinaan (OR = 4.819; 95% CI: 1.931 hingga 12.030), penukaran but lebih daripada sekali setahun (OR = 3.462; 95% CI: 1.991 hingga 6.020) dan pembelian sendiri BKPK (OR = 0.392; 95% CI: 0.200 hingga 0.770).

Kesimpulan: Prevalensi plantar fasciitis di kalangan BKPK adalah tinggi. Ia didapati lebih tinggi dalam industri tertentu dan juga lebih rendah di kalangan mereka yang membeli BKPK mereka sendiri.

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CHAPTER 1: INTRODUCTION

1.1 Background

Injuries in the workplace can cause disability and functional deficits. As the workers are an asset to the company loss of working days leading to large economic and as well as social costs. Researchers have found injuries of foot and ankle accounted for between 10% and 20% of accidents at the workplace (Conti & Silverman, 2002; Werner et al., 2010). The Italian Institute of Insurance for professional Illness and Injuries reported that among the 60 million insured people, 700,000 work-related injuries are reported each year, out of which 15% of the reports are injuries of the foot and ankle (Chiou et al., 2012). While in the United States, the Bureau of Labour statistics reported, foot and ankle injuries accounted for 10% of the 12 million workplace injuries per year (Caravaggi et al., 2016). These statistics emphasise the importance of foot protection, as the foot is an extremely fragile part of the body region which injury can cause disability and require a long period of recovery.

Safety boots are important in numerous industries to protect workers' foot from physical, chemical and biological hazards at the workplace. The different environmental conditions and multiple tasks performed in different occupations necessitate a variety boots design to match each worker's specific occupational safety requirement. The design of safety boot caters more for occupational safety instead of functionality and comfort. However, until today, there is a paucity of research investigating the effect of safety boots, particularly with steel toe cap features to the development of musculoskeletal disease specifically to plantar fasciitis (PF).

1.2 Scope of study

This is a cross-sectional study conducted among workers wearing steel toe cap boots (STCB) using questionnaire. The questionnaire was distributed to the respective company from four industries in Malaysia: shipbuilding, construction, oil and gas and manufacturing. Three hundred and thirty sets of questionnaires were distributed to the respective companies. The objective is to access the foot pain caused by the usage of steel toe cap boots in these four industries.

1.3 Problem statement

Plantar fasciitis is one of the most common causes of heel pain, which is caused by prolonged standing and continuous walking. As most of the work task in the four industries requires the workers to stand and walk throughout their working hours, they have a higher chance to develop plantar fasciitis. High hazard exposure in this industry, cause the usage of STCB has been made compulsory to minimize accidents and incidents at the workplace. Additional of steel to covers the toe and to protect the sole has added weight to the foot and causing pain to the heel at the end of the working days. Unfortunately till to date there is no research that has been done to assess the STCB as one of the risk factors in developing PF. No data has been published between the influence that STCB and the development of plantar fasciitis. This paucity evidence shows there's a need to investigate STCB as an external risk factor for the development of plantar fasciitis.

1.4 Objective of the investigation

I. To find the prevalence of plantar fasciitis among workers wearing steel toe cap boots.

II. To describe steel toe cap boots problem in four industries.

III. To determine the associated factor for plantar fasciitis among steel toe cap boots users.

1.5 Significant of studies

Losing manpower due to injuries is a loss to an industry. Pain caused the workers not to perform to their very best while foot pain can be crippling. Workers rely on their feet to move around since the main work task in manufacturing, construction, oil and gas and shipbuilding requires the workers to stand and walk most of the time. Having foot pain will reduce their productivity. Identification whether STCB can cause plantar fasciitis can help mitigation step to be taken to prevent further injury to the worker's foot and liability to the company.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Foot pain can be crippling, especially when the main task requires continuous walking and prolonged standing. Plantar fasciitis (PF) is the main diagnose of heel pain. It can be diagnosed with the complaint of pain that occurs upon taking the first step in the morning but relieve after walking (Buchbinder, 2004). The pain can take place at any time of the day and can also be aggravated by walking, weight bearing and prolonged standing. Aetiology of plantar fasciitis can be multifactorial (Buchbinder, 2004); age, increase in body weight, job factor and foot mechanism have widely been discussed. Unfortunately, there are only a few studies about an external factor of plantar fasciitis and no through discussion has been made out on STCB as a factor associated with plantar fasciitis.

2.2 Safety boots and its problem

Safety and health regulation from all over the world require the usage of STCB as a part personal protective equipment (PPE) to protect the foot against common workplace danger, such as crush injury, slip and fall, electric shock, chemical burns and sharp objects penetrating the sole. Safety boots are often heavy, rigid and uncomfortable. Unfortunately, despite this condition workers are required to wear them every day of their life when they are at work and performing their work task. There is no denying in the function of steel toe cap boots as a protector to foot, a study of the impact of a steel toe cap on forefoot injury pattern in a cadaveric model by Kwon et al. (2011) proved the protective function of the steel toe cap to withstand the crush injury. Two cadavers' foot were chosen, one was fitted with non-steel toe cap boots (NSTCB), while another with steel toe cap boots (STCB). A load weight 75kg dropped at three feet in height (Kwon

et al., 2011). X-ray of the foot was done to obtain and assess the severity of the fractures. NSTCB reported significant metatarsal fractures (8.2 fracture/foot) versus STCB (3.6 fracture/foot) bones (Kwon et al., 2011).

The government of Western Australia reported the most common underground mining injuries are to the lower limb. This contributed to approximately 18,900 loss of working days and AUD28 million in compensation claims annually (Armour, 2003; Government of Western Australia, 2011). This was proven by research (Dobson et al., 2018) on Australian coal miner to determine their current satisfaction using STCB. The miners believe their STCB contribute to the high incident of lower limb pain and problems that they experienced. According to Dobson et al. (2018), the underground coal miners were not satisfied with their working boots with 55.3% reported foot problems, 44.5% lower back pain, 42.3% foot pain, 24.9% ankle pain and 21.5% knee pain. However, pain is not the only problem that was given by safety boots, heavy boots and inflexibility by steel toe cap also complained.

2.2.1 Boot mass

Safety boot has various design and weight ranging between one and four kilograms (Chiou et al., 2012; J. A. Dobson et al., 2015; Nunns et al., 2012). Mass depends on the design features such as a material of the boots, steel toe cap, height and wideness of the shaft and type of sole. Changing of this design feature can give an impact to the boot mass. Schulze et al. conduct a study on 37 soldiers (one female and 36 male, mean age: 29 years old, mean BMI 25.9kg/m^2) wearing combat boots, which weight double than the dress shoe and athletic footwear (Schulze et al., 2011). The participants were instructed to walk on a treadmill. An increase in medial tibialis anterior activity was

recorded on elctromyography while wearing combat boots on a treadmill indicates increase strain at this particular muscle (Schulze et al., 2011).

Heavier footwear can alter the way of individual walk, this was observed in a study by analysing kinematic parameters which characterising walking and oxygen consumption. The increase heel contact velocity and oxygen consumption while decreasing trailing limb toe clearance were found in a study of 13 female firefighters and 14 male firefighters in an obstacles training wearing 3.82kg rubber boots, compared to usual 2.93kg firefighting leather boots. Measurements of metabolic and respiratory cost (minute ventilation, absolute and relative oxygen consumption and carbon dioxide production) were found to increase in these studies when participant wore heavier boots (Chiou et al., 2012). According to the Chiou et al.(2012) there was an estimated 5% to 11% increase in metabolic variables per one-kg increase in boot weight. This proved that heavier boot mass causes more strained on muscle which contributes to pain and fatigue.

The heavier boot does not only require more energy on walking, but it appeared to cause loose of control at initial contact at mid-swing. This is important because it has found that slips and fall are more likely to happen at initial contact when foot placement does not control. Heavier boots could possibly be a hazard that can cause a trip and fall in the task that require prolonged working at an uneven surface (Tang et al., 1998).

Increase boot mass is also associated with increased fatigue (Jones et al., 1984). Jones et al. (1984) explained the relationship between energy spent and boot mass. According to him, energy expenditure while walking can increase by 0.7-1.0% for every 100gm increase in footwear mass. This may indicate that an increase in muscle activity, will cause muscular fatigue. However, according to Garner et al. (2013) measurement of

peak torque is more reliable to measure the localised fatigue at an associated joint. This can be observed in a study of 12 professional male firefighters, were examined on stimulated stairs climbing wearing two different boots with different weight and material; rubber boots weight 2.93±0.24kg while leather boot weight 2.44±0.21kg. The significant decrease in peak torque at ankle and knee were observed, as measured by isometric seated strength test. This reduction in peak torque corresponded with significant performance reduction in postural sway, which indicates lighter boots gives more balance compared to heavier boots revealing negative results in muscular fatigue. There is no research that has been done to evaluate the effect of the steel toe cap boot mass to the foot. Even though firefighter boots are different with steel toe cap boots, the point given about the weight are important to validate the weight that is carried by the foot can cause a various problem to the wearer (Garner et al., 2013).

2.2.2 Sole Inflexibility

The ability of sole to flex is called sole flexibility. Amount of sole flexibility does not only determine by its materials used to construct the sole layers but thickness, padding as well as elasticity. In order to withstand sharp object to penetrate foot, safety boots sole are made thick and hard. One of the main complaints of the Australian workers (n=321) from five different industries (publishing, broadcasting, transport, airline and heavy engineering) is inflexibility (Marr & Quine, 1993). Among 321 workers 52% complaints performing the task such ask ladder climbing, fast movement, crouching, bending were difficult wearing safety boots, due to inflexible sole and steel toe cap. Marr & Quine.(1993) also wrote that vehicle driver found that controlling the accelerator and brake pedal are difficult, due to the limited movement that caused by the STCB restriction and inflexible toes (Garner et al., 2013). Australian miners (n=358) having the similar difficulties, which reported in the recent study by Dobson et al.

(2018), the miners complained working roles such as walking, climbing and crouching are very difficult to perform wearing STCB due to inflexibility.

Despite the different boot type and mass from STCB, a study by Chiou et al. (2012) on firefighter boots able demonstrate the relationship on sole flexibility and effort during walking (Chiou et al., 2012). According to the Chiou et al. (2012), there was an estimated 5% to 7% decrease in metabolic variance (VO_2/kg) in more flexible soles. Increase in sole flexibility will reduce walking effort. Flexible sole has a significant reduction in absolute and relative oxygen consumption and carbon dioxide production (Chiou et al., 2012). More flexible sole enhance ankle joint movement subsequently improve power generation which reduces metabolic and respiratory cost. Stiffer boots can increase metatarsal flexion, which can be observed in the biomechanical analysis of the US military boots and commercial footwear. In the military activity such as marching, running on a stiff sole has been found to amplify metatarsal flexion compared to when participants wore other test footwear with more flexible soles (Hamill & Bensel, 1996). Repeated metatarsal flexion is typically happening in continuous walking, which might be a risk factor for plantar fasciitis.

2.3 Overview of Plantar Fasciitis

The plantar fascia is a broad strong fibrous (Singh et al., 1997) band of fibres which took part to maintain the medial longitudinal arch of the foot. The plantar fascia arises from medial and anterior calcaneal tuberosity and it fans out into the plantar plates of the metatarsophalangeal joints (Hossain & Makwana, 2011), the base of the proximal phalanges of the toes and the flexor tendon sheath. During the gait cycle, in the first half of stance phase, the tibia turns inwards and the foot pronates to allow flattening of the foot. In this situation the plantar stretches (Bolgla & Malone, 2004). When the foot arch

is flat, it allows the foot to adapt to irregularities in walking surface and to absorb shock. Plantar fascia acts like a biomechanical shock absorber, supporting the arch in the foot, if the tension on the plantar fascia exceeds the limits of the tissue, the micro tear can develop. Repetitive traction by activities such as extensive running, walking and prolonged standing lead to micro tears of the fascia fibres and this will induce the reparative inflammatory responses, hence causes the plantar fascia to thicken. While sleeping the foot will remain in an equinous position and this will cause the fascia tissue to contract. When making the first step in the morning, putting weight on the foot causing tension plantar fascia and resulting in pain. This is why the main symptom of plantar fasciitis is severe pain in the morning or after a rest period but improves with movement and again can be aggravated by long periods of weight bearing (Buchbinder, 2004; Waclawski et al., 2015).

Heel pain is common and it affects millions of people around the world and can be divided into two broad categories (McNeill & Silvester, 2017) posterior heel pain and inferior (plantar) pain. Posterior heel pain related commonly to the Achilles tendon which causes by the continuation of exercise into older age. Inferior heel pain, which suggests that ‘plantar fasciitis is the most common culprit, accounting for 80% of patients and is predicted to affect one in ten people in their lifetime (Rosenbaum et al., 2014).

The aetiology of plantar fasciitis is commonly multifactorial (Beeson & Rcsp, 2014). It can be divided into four categories (Rajput & Abboud, 2004):

I. Mechanical causes: including a pronated foot, an externally rotated foot, pes cavus and obesity.
II. Degenerative causes: including atrophy of the heel pad and age-related increases in pronation.
III. Systemic causes: including rheumatoid arthritis, systemic lupus erythematosus (SLE), gout, ankylosing spondylitis and Reiter's syndrome.
IV. External Causes: footwear.

Footwear, are recognised as one of the causes of PF, however in a research by Rajput & Abboud, (2004) the footwear that was used by the patient was a standard pair of lace-up men's footwear. Although the type footwear is different, it can prove that PF can be caused external factor that is footwear.

2.4 Risk Factor for Plantar Fasciitis

Risk factors for developing plantar fasciitis include female gender, obesity, older age, exercises such as long distance running, ballet dancing and dances that place high levels of stress on the heel and attached tissue, faulty foot mechanics (flat feet, high arches, or an abnormal pattern of walking), occupations with prolonged standing, and improper shoes (example: shoes that are thin-soled, loose, high heeled, or lacking arch support, heavy) (Paiva de Castro et al., 2010; Werner et al., 2010). For the purpose of this research that aims to focus on STCB problems, risk factor such as obesity and body mass index, age and work task, are chosen to investigate the prevalence of risk factor in the development of plantar fasciitis.

2.4.1 Obesity and Body Mass Index (BMI)

BMI is the ratio of body weight in relation to height (World Health Organization, 2018). Normal BMI range between 18.5-24.9kg/m^2, overweight 25-29.9kg/m^2 and class I obesity is defined BMI more than 30kg/m^2. High body weight (obesity) has implicated as a factor in plantar heel pain (Hill & Cutting, 1989). In 1989, 77 cases of plantar fasciitis are collected and patients weight and height, as well as X-ray of the affected foot, were recorded for investigation. According to Hill & Cutting. (1989), 29 of the patients were detected of having heel spur via X-ray. Out of that 29, 24 patients are recorded to have weight more than 50^{th} percentile.

Increased in BMI correlate with increasing heel fat pad thickness and loss of heel pad elasticity(Beeson & Rcsp, 2014). A study on 50 patients, mean age 49 years old that has been diagnosed with unilateral plantar fasciitis by the physician was done to determine body weight as a risk factor that caused plantar fasciitis. Results of this study by Riddle et al. (2003) concluded, that increased in BMI significantly increase risk of plantar fasciitis, BMI of more than 30kg/m^2 having an odds ratio (OR) of 5.6 (95% confidence interval [95%CI]: 1.9 to 16.6) compared with a BMI of less than 25kg/m^2 with an OR of 2.0 (95%CI: 1.28 to 3.08). In contrary with Riddle et al. (2003), Werner et al. (2010) found no significant association of plantar fasciitis and obesity with employees (n=407) working in automotive engine assembly plant with mean BMI of 29.4kg/m^2 and mean age 48.4 years old. However, there was a selection bias introduced in the study by Riddle et al. (2003). The author study population is mainly patients from the clinic, and there is no information regarding whether the patients diagnosed with plantar fasciitis are work-related or other aetiology.

2.4.2 Age

Common age between 40-60 years old has the highest prevalence in developing plantar fasciitis (Buchbinder, 2004; Riddle et al., 2003). Age-related changes may result in fascia's degeneration, where it can no longer resist normal tensile loads. Degenerative changes are associated with repetitive microtrauma caused by prolonged weight bearing activities. This will lead to a thicker heel pad with decrease shock absorbing capability, which has shown to be associated with pain in an individual with plantar fasciitis. According to Riddle et al. (2003) patients with age group, 41-50 years have the highest percentage of 36% in the prevalence of plantar fasciitis. This result is contrary with Bergenudd et al. (1989) where an evaluation of hand and feet in 574 men and women age 55years old at physical examination did not find and prevalence of foot disorder. Werner et al.(2010) also have negative results proving age as a risk factor for plantar fasciitis when the author found there was no significant association. According to the author, mean age of the research group is 48 years old and have been working in the automotive plant for 20 years, however no complaint or previous history of pain that is related to diagnosing plantar fasciitis. The author called this finding "healthy worker effect" where he assumed the sick worker already left the company.

A study on 17 supermarket workers (n=513) revealed that one-third of the workers having regular musculoskeletal symptoms in some part of their body. The lower back, lower limbs and feet are the body areas with the highest rate. The study of the population revealed one half of the worker age less than 20 years old (Anthony Ryan, 1989) and 44% of the total worker working in the supermarket 12 months or less.

Merlino et al.(2003) examined the prevalence of musculoskeletal symptom in young construction workers (n= 996). Mean age is 27.7(±6.2), year's work at current job 3.2

(±2.5), hours per week 45.1(±8.6). A questionnaire was used to assess musculoskeletal symptoms. Around 9.5% of the workers who reported musculoskeletal symptoms in the feet missed work due to the symptoms. In a 12-month duration, 23.2% of the subjects reported musculoskeletal symptoms in the feet, and 3.0% of the subjects saw a physician for these symptoms. Unfortunately, the author does not specify the exact location of the foot pain. Also, there was no data presented on standing, walking and type of shoes used while working. However, this study is significant in determining that musculoskeletal disease can occur at any age and it can start at relatively a young age.

2.4.3 Work task

Various work task contributed to the development of plantar fasciitis. The task such as continuous walking, prolonged standing, and weight bearing is associated with plantar fasciitis. Observation among Australian miners shows that foot pain is more common in miner performing heavy lifting as the main working role and pain on the heel are associated with prolonged standing. Line workers usually walk continuously throughout the day are associated with foot problems in comparison to desk workers who spend most of the time sitting at the table reported to have less foot problem. Dobson et al.(2018) and Werner et al.(2010) stated that increase 10% time standing and walking would increase the risk of plantar fasciitis by 52%. The author also found out the increased risk of plantar fasciitis in 32 truckers and forklift has corresponded to the number of times the worker exit the vehicle. The authors concluded that with an increase 10 times the worker exited the vehicles will increase the risk of plantar fasciitis by 18%. This finding is consistent with other studies that related higher prevalence with "high impact" activities such as jumping, dancing, running, in which there's present of repetitive loading of the plantar fascia (D'souza et al., 2005).

A study of musculoskeletal symptoms in supermarket workers was conducted by Anthony Ryan.(1989) (n=513). An activity analysis was performed on jobs to characterize job titles. Jobs were observed for 30min at 10second intervals, the subject's posture and activity were recorded. The observations at each of the departments at the store were accumulated to create an "overall activity profile" for each department. The checkout department had the highest prevalence of ankle/foot and lower limb complaints where the workers spend 89.8% of their working hours standing. The analysis, however, did not adjust for BMI, work history, and possibly other important confounders. However, the occupational exposure assessment was a major strength.

CHAPTER 3: METHODOLOGY

This is a cross-sectional study among STCB users in four industries. The research duration was between September 2017 until July 2018. This chapter contains the population size distribution among four industries and questionnaire development. A questionnaire was developed to assess the prevalence of PF among STCB users. Quantitative and qualitative method analysis was used to analyse the data.

3.1 Ethical Consideration

A written permission to conduct the questionnaires was sent to respective company via email (Appendix 1). Verbal and written consent was obtained from the person in-charge in distributing the questionnaire. Participants were informed the purpose of the research and they have the rights to voluntarily consent or to decline participation.

Confidentiality was obtained throughout the research, as no identifying information required to be written on the questionnaire's form by the participant.

3.2 Participants and questionnaire distribution

Method of universal sampling were used to choose STCB users from four industries in Malaysia which came from: shipbuilding, oil and gas, construction and manufacturing. The distribution of the questionnaire took part from January 2018 to March 2018. Table 3.1 shows the quantity of questionnaire that was sent in hard copy to the worker to be answered. A total of 350 questionnaires sent, however only 253 copies delivered back to be analysed. The received copies (253) is sufficient sample size for this research as calculated required sample size is 184 (Survey Monkey).

Table 3.1: Questionnaire distribution among Industrial workers.

Industries	Questionnaire delivered	Questionnaire received	Responds Rate (%)
Shipbuilding	100	51	51
Manufacturing	70	64	91
Construction	140	101	72
Oil and Gas	40	37	93
Total	350	253	72

3.3 Constructing the Questionnaire

A bilingual questionnaire (Appendix 2) was constructed to assess the prevalence of PF. Forward and backward-translations were done to achieve different language version of English and Malay that are conceptually equivalent in the target group. This questionnaire comprised of mix of open and closed questions and was self-administered by the STCB users. It is divided into four categories:

1. Workers profile
2. Steel toe-cap boots usage
3. Foot pain among workers
4. Determining the prevalence of plantar fasciitis

3.3.1 Worker's profile

In the worker's profile, the personal detail such as age, sex and field of work were asked. Height and weight are self-reported which used to calculate their body mass index (BMI).

3.3.2 Steel toe cap boot usage

A confirmation question was asked to ensure that the participant wore STCB. The question such as years of wearing STCB and usage per day were asked to determine the exposure. The main task at the workplace was asked to understand the daily activities that the workers did that can contribute to foot pain and determine the risk factor of PF. Workers were asked about the provider of the STCB to ensure who bought the STCB. All of the questions are close–ended. While complaint of the workers was asked in open-ended questions to take into consideration and to find out what is the main issues that can cause dissatisfaction with the STCB.

3.3.3 Foot pain

Within this section, the STCB users were asked the close-ended questions to find the prevalence of foot pain. Four areas of the foot were labelled (Figure 3.1): toes, the ball of the foot, midsole and heel. Pain numeric scale was used to define the intensity of the pain (Figure 3.2). Users were also asked about the foot where the pain located and to determine whether the pain is unilateral or bilateral. In order to determine the factor that exacerbates the foot pain, users were also asked whether the pain increase by activities such as walking, heavy lifting and at the end of the working day.

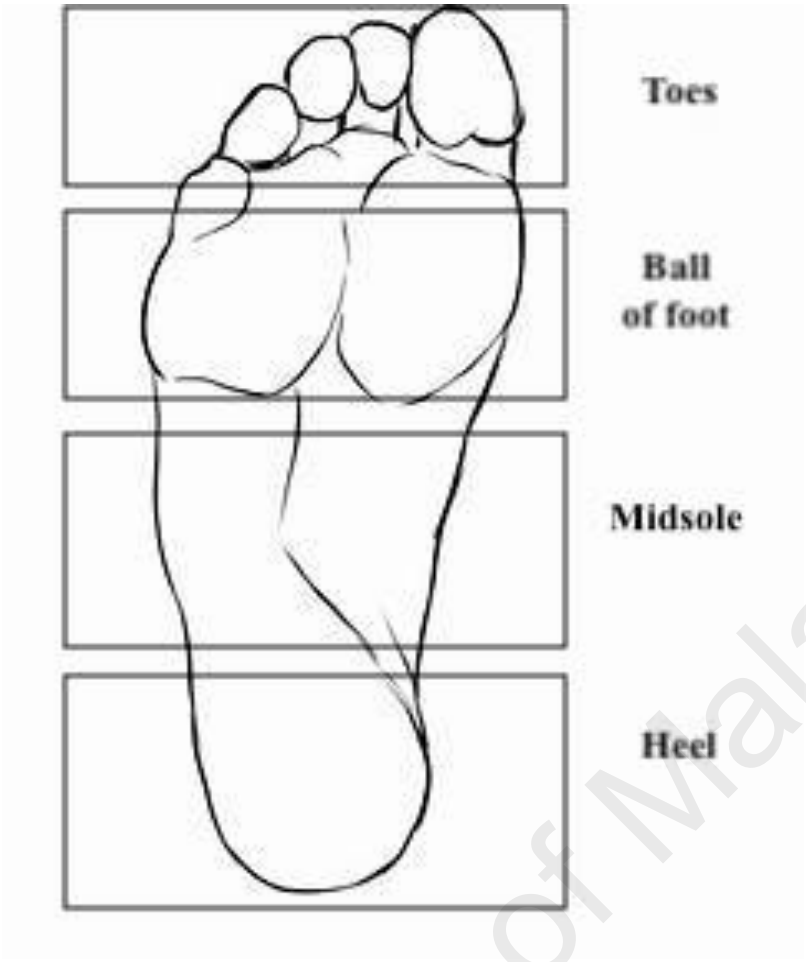

Image adopted from Google

Figure 3.1: Areas of the foot

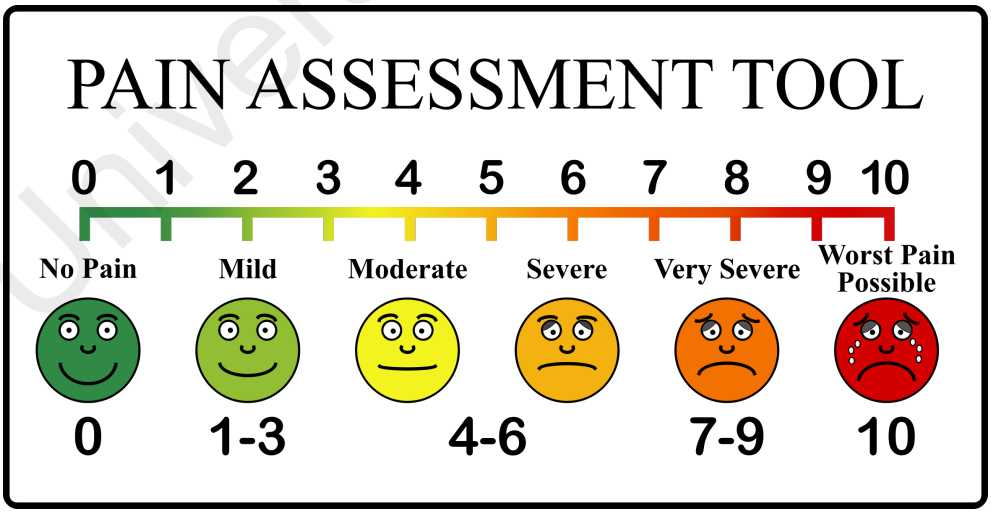

Image adopted from Google

Figure 3.2: Pain numeric scale

3.3.4 Determining the prevalence plantar fasciitis

According to Buchbinder.(2004) and Waclawski et al.(2015), the main symptom of plantar fasciitis is heel pain arising from taking the first step in the morning upon waking up from sleep. In this research, this answer will be chosen as the main symptom in suggestive to PF. Other symptoms of PF such as increased pain upon weight bearing and prolonged sitting were also asked to support the main symptom. All questions in this section is close ended to determine the prevalence of PF among STCB users. A question about whether the users seek doctors attention were asked to see whether this problem is recognize or not by the users and diagnosed by the doctor.

3.4 Inclusion and exclusion criteria

Only workers who wore STCB will be included in this research. Incomplete questionnaire will also be excluded to ease the analysis and to reduce bias in calculating incomplete sample.

3.5 Analysis

3.5.1 Descriptive analysis

All answers to close-ended questions were coded and counted to determine the frequency of the answer from each response, before calculating the descriptive analysis. For the open-ended question, thematic analysis was conducted on the answers to determine the frequencies of the respond. The number of the answers received per questions varied due to multiple answers, no answers or some questions did not require an answer from all participant. Data were analysed only on the workers who provided an answer to that question. Google Form and Microsoft Excel were used to analyse the

research data.

3.3.2 Relationship analysis

Statistical Package for Social Science (SPSS) Version 24, USA was used to analyse the relationship between symptom of heel pain and the risk factor of PF. Univariate and multivariate analysis were performed using the main symptom of PF (heel pain arising from taking the first step in the morning upon waking up from sleep) as a dependent variable and age, BMI, the field of work, provider of the STCB, frequency of STCB changes per year and work task as an independent variable to create a predictive model.

CHAPTER 4: RESULTS AND DISCUSSION

The aim of this chapter is to identify the prevalence of PF among STCB users. Quantitative and qualitative method of research was used to analyse the answer given by the participant. Quantitative approach was used to analysed the user's profile, the STCB usage and foot pain distribution. In order to find the association between risk factor and the development of PF, the qualitative method was used. A total of 350 sets of questionnaire were sent out. However, only 253 were returned back for analysis. The responds rate for this questionnaire is 72% (Table 3.1).

4.1 Steel toe-cap boots user's profile

Workers wearing STCB users (n=253) are predominantly male (85%) and the other 15% are female, mean age 32.37±8.48 years old (Table 4.1). Most participant were from construction industry (39.9%) and the least from oil and gas (14.6%) (Table 4.1).

4.2 Steel toe cap boots usage

Half of the STCB users (50.4%) have been using STCB as a work boot for 1-5 years, mean working hours 8.86±2.67 per day with range of working hours between three and 16 hours per day. Most of the workers work task require prolonged standing (65.4%) and continuous walking (57.5%) while wearing STCB (Table 4.1).

Table 4.1: Demographic of respondents

Questionnaire answers for the STCB			n
Worker's Profile			
Age mean (±SD)		32.37±8.48	
Male		85%	215
Female		15%	38
BMI mean (±SD) kg/m^2		24.65±4.07	
Field of work			
Shipbuilding		20.2%	51
Manufacturing		25.3%	64
Construction		39.9%	101
Oil and Gas		14.6%	37
Steel toe cap boots (STCB) usage			
Years of using STCB	Less than 1 year	11.9%	30
	1- 5 years	50.9%	129
	6 - 10 years	19.5%	49
	11-15 years	10.7%	27
	16 -20 years	3.5%	9
	More than 20 years	3.5%	9
Working hours per day mean (±SD) hours		8.86±2.67	
Prolonged standing		65.5%	165
Heavy lifting		41.3%	104
Sitting		22.2%	55
Driving		11.0%	27
Continuous walking		57.5%	145
Users that satisfied with their STCB.		80%	202
Users that are not satisfied with their STCB.		20%	51
Provider of STCB	Company	77.1%	195
	Self-purchased	22.9%	58
Foot pain distribution			
Toes		39.1%	99
Ball of foot		42.7%	100
Mid sole		19%	48
Heel		49.8%	125

Symptoms of plantar fasciitis		
Pain at the labelled area (heel) while taking the first step in the morning after waking up from bed.	39.4%	100
Pain at heel disappear after walked a lot few steps in the morning.	26.8%	67
Heel pain increase on weight bearing?	24.4%	61
Heel pain appear after period of inactivity	25.2%	63

Worker's in manufacturing industries have the longest working hours (mean±SD: 10.77±2.11hours/day) while shipbuilding has the shortest (mean±SD: 7.96±1.44 hours/per day) . The other two industries worked no more than 8.5 hours per day. Most of the work task in four industries requires prolonged standing (65.4%) and continuous walking (57.5%) while wearing STCB. Table 4.2 below shows, users in manufacturing industries have the highest percentage in all work tasks.

Table 4.2: Comparison of work task, provider, number of complaint and areas of foot pain among workers wearing STCB from different industries.

		Shipbuilding		**Manufacturing**		**Construction**		**Oil and Gas**	
			n		n		n		n
Number of workers		20.2%	51	25.3%	64	39.9%	101	14.6%	37
Worker's Profile									
Age	<40 years old	66.6%	34	81.2%	52	89.1%	90	91.8%	34
	>40 years old	33.4%	17	18.8%	12	10.9%	11	8.2%	3
Male		96.0%	49	79.6%	51	83.1%	84	91.8%	34
Female		4.0%	2	20.4%	13	16.9%	17	8.2%	3
BMI	Normal	56.8%	29	48.4%	31	23.7%	24	62.1%	23
	Pre-obesity	33.3%	17	34.3%	22	32.6%	33	32.4%	12
	Obesity I	9.9%	5	17.3%	10	43.7%	44	5.5%	2
Work task									
Mean working hours per day		7.9 hours/day		10.7 hours/day		8.2 hours/day		8.5 hours/day	

Prolonged Standing	66.7%	34	84.4%	54	52.5%	53	67.7%	25
Heavy lifting	29.4%	15	73.4%	47	22.8%	23	54.1%	20
Sitting	11.8%	6	42.2%	27	11.9%	12	32.4%	11
Driving	5.9%	3	31.3%	20	4.0%	4	2.7%	1
Continuous walking	45.1%	23	62.5%	40	62.4%	63	54.1%	20
Provider of STCB								
Company	33.3%	17	95.3%	61	81.2%	82	95.4%	35
Self-purchased	66.7%	34	4.7%	3	18.8%	19	5.5%	2
Complaint regarding STCB								
Number of complaints	2%	1	27%	17	19%	19	19%	7
Area of foot pain								
Toes	21.6%	11	65.3%	41	38.6%	39	18.9%	7
Ball of foot	19.6%	10	62.5%	40	40.6%	41	45.9%	17
Mid sole	5.9%	3	15.7%	10	30.7%	31	13.5%	5
Heel	17.6%	9	65.6%	41	56.4%	57	48.6%	18

4.3 Steel toe-cap boots and its problems

More than half (80%) of the STCB users are satisfied with their boots, while the other 20% are not (Table 4.1). Among the 20% (n=50) of the dissatisfied worker, only 44 of the users answered the open-ended question stating their reason of dissatisfaction and the main problem they faced with their STCB. Most reported reasons are heavy (34%) and uncomfortable (29.5%). Figure 4.1 shows the list of problems.

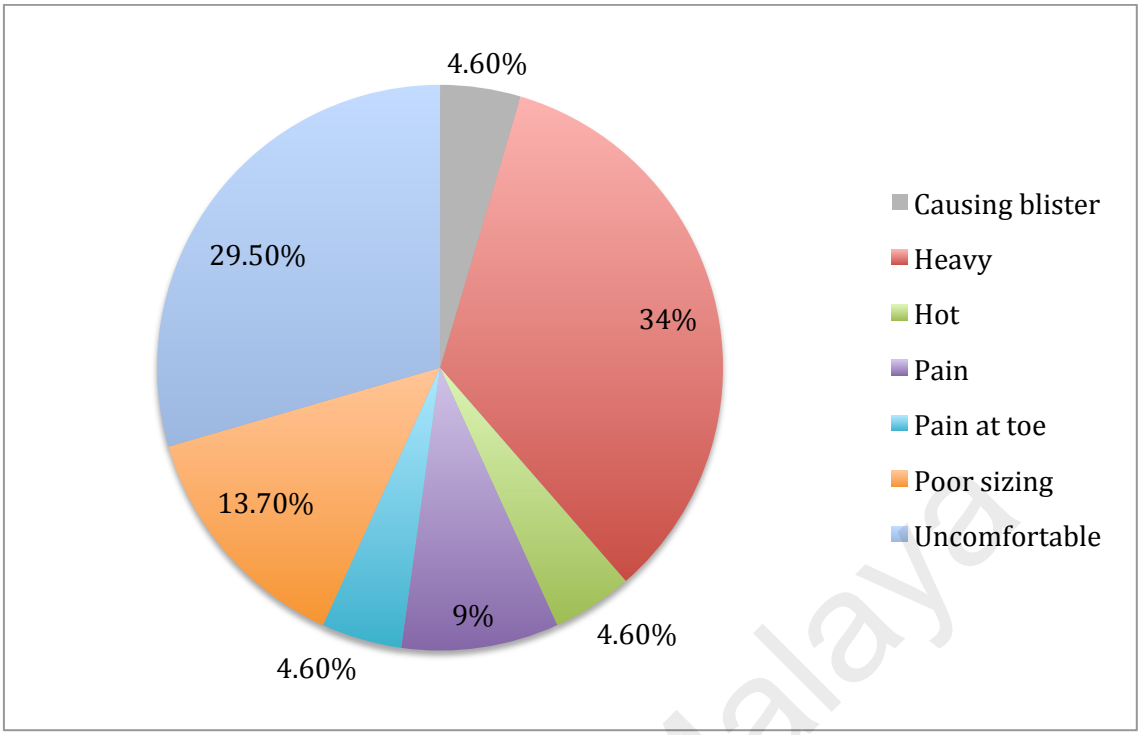

Figure 4.1: The prevalence of problem that caused by the STCB among users from four industries (n=44).

Table 4.3 below shows the list of problems and number of complaint received among four industries. The highest complaint was from the manufacturing industries, whereby 27% of the workers were not satisfied and complained of the STCB were heavy, poor sizing and uncomfortable. They describe that their STCB are too loose and some are too tight. Female workers in manufacturing emphasize currently there are none STCB that can fit the female's foot. Other complaints were pain, but the workers didn't specify the location of the pain, only a few reported pain at toes, which caused by the steel toe-cap. The least complaint came from shipbuilding industries where the only complaint received was the boot being uncomfortable.

Table 4.3: Cross-tabulation between problem and number of complaints caused by the STCB among STCB users from different industries.

Type of Problems	Number of complaints among STCB users				Total
	Construction	Manufacturing	Oil and Gas	Ship-building	
No Complaint	82	47	30	50	209
Causing blister	1	0	1	0	2
Heavy	7	4	4	0	15
Hot	0	1	1	0	2
Pain	1	3	0	0	4
Pain at toe	1	1	0	0	2
Poor sizing	1	4	1	0	6
Uncomfortable	8	4	0	1	13
Total	101	64	37	51	253

4.4 Provider of STCB

A total of 77.1% of the STCB are provided by the company, while 22.9% are self-purchased by the worker (Table 4.1). From Table 4.2, it can be observed that 95.3% STCB users from the manufacturing industries wore boots that provided by the company, while more than half (66.7%) of the workers from shipbuilding industries bought their own STCB. Table 4.4 below shows the frequency of STCB change per year. More than half of the worker (62%) changed their STCB less than once a year or once a year.

Table 4.4: Frequency of STCB change per year among industrial worker

Frequency of STCB change per year	Frequency	Percentage (%)
≤1	157	62
>1	96	38
Total	253	100

4.5 Foot pain

Almost half (49.8%) of the STCB users complained of heel pain, 42.7% complained pain at the ball of foot, 39.1% at toe while only 19% at midsole (Table 4.1). The most pains felt on both feet, which elevated upon prolonged walking and with pain rating between mild and moderate.

Heel pain is prominent in all four industries with highest in manufacturing industries. Table 4.2 shows the pain distribution on foot area among industrial workers. STCB users in manufacturing industries have the highest foot pain. They complained of pain at heel (65.6%), toe (65.3%) and ball of foot (62.5%). The pain located on both feet and increase upon continuous walking. Construction industries have the highest complaints of pain at midsole (30.7%) on both feet. Workers whom complaints of midsole pain rate their pain as moderate to severe.

4.6 Prevalence of plantar fasciitis among industrial workers

Among 253 STCB users, 39.4% (n=100) have the main symptom suggestive of PF with having heel pain while taking the first step in the morning after waking up from the bed (Table 4.1). Table 4.5 shows a univariate analysis of association factors of PF. This analysis revealed the demographic of STCB users with symptoms suggestive of PF (n=100). They are dominated by male (n=85) with age less than 40 years old (n=82) and have normal BMI (18.5-24.9kg/m^2)(n=40). Most of the STCB users wore STCB that

provided by the company (n=86) and change their boots more than once per year n=56). Manufacturing industries have the highest prevalence of worker with symptoms suggestive of PF (62.5%,n=40). Ship building industry has the lowest prevalence of symptoms suggestive of PF with only 15.6%(n=8) from 51 workers having the symptom suggestive of PF.

4.7 Risk factor associated with the development of plantar fasciitis

A multivariate analysis was used to determine the factors associated between PF (Table 4.6). After taking age, gender and BMI into consideration, a strong association found between numbers of STCB change per year (Odds Ratio (OR)=3.462; Confidence Interval (95%CI): 1.991 to 6.020 and the development of PF. Workers who change their boots more than once per year were found to increase the risk of developing PF by threefold. STCB users whom self-purchased their boot, have lower odds in reporting PF (OR=0.392; 95%CI: 0.200 to 0.770). Walking continuously shows a significant association in the prevalence of PF. STCB users that walk continuously was associated with a twofold increase in the prevalence of PF (OR=2.833; 95%CI: 1.637 to 4.905). Manufacturing and construction workers showed a significant association in the development of PF. The analysis shows, workers in manufacturing have 10 times increase of chances of developing PF (OR=10.57; 95%CI: 4.056 to 27.594) while workers in construction industries may increase their odds of developing PF by fourfold (OR=4.81; 95%CI: 1.931 to 12.030).

Table 4.5: Univariate analysis of association between plantar fasciitis (heel pain upon first step in the morning).

Risk Factors	Plantar Fasciitis		Odds Ratio	95%CI		P value
	No; n(%)	Yes; n(%)				
Age						
<40 years old	128(61.0)	82(39.0)	Reference			
≥40 years old	25(58.1)	18(41.9)	1.124	0.577	2.188	0.731
Gender						
Male	132(60.8)	85(39.2)	Reference			
Female	21(58.3)	15(41.7)	1.109	0.541	2.270	0.777
BMI (kg/m^2)						
Normal weight	96(66.7)	48(33.3)	Reference			
Pre-obesity	46(53.5)	40(46.5)	1.73	1.006	3.006	0.048
Obesity	11(47.8)	12(52.2)	2.18	0.897	5.304	0.741
Industry						
Ship Building	43(84.31)	8(15.6)	Reference			
Oil and Gas	27(72.9)	10(27.0)	2.466	0.827	7.354	0.105
Manufacturing	24(37.5)	40(62.5)	10.579	4.056	27.594	<0.001
Construction	59(58.4)	42(41.5)	4.819	1.931	12.030	<0.001
Provider of STCB						
Company provided	109(55.9)	86(44.1)	Reference			
Self-purchased	44(75.8)	14(24.1)	0.392	0.199	0.770	0.007
Boots change per year						
≤1/year	113(71.9)	44(28.0)	Reference			
>1/year	40(41.6)	56(58.3)	3.46	1.991	6.019	<0.001
Work Task						
Standing	104(62.6)	62(37.5)	0.772	0.454	1.314	0.341
Walking all the time	73(50.0)	73(50.0)	2.833	1.637	4.905	<0.001
Heavy lifting	61(58.1)	44(41.9)	1.16	0.691	1.957	0.569
Sitting	30(52.6)	27(47.3)	0.874	0.935	0.405	0.874
Driving	12(42.8)	16(57.1)	2.15	0.963	4.814	0.062

Table 4.6: Multivariate analysis of association between plantar fasciitis (heel pain upon first step in the morning) after controlling for age (continuous), gender and BMI (continuous).

Risk Factors	Odds Ratio	95%CI		P value
Industry				
Ship Building	Reference			
Oil and Gas	2.466	0.827	7.354	0.105
Manufacturing	10.579	4.055	27.594	<0.001
Construction	4.819	1.931	12.030	<0.001
Provider of STCB				
Company provided	Reference			
Self-purchased	0.392	0.199	0.770	0.007
Boots change per year				
≤1/year	Reference			
>1/year	3.462	1.991	6.019	<0.001
Work Task				
Standing	0.772	0.454	1.314	0.341
Walking all the time	2.833	1.637	4.905	<0.001
Heavy lifting	1.163	0.691	1.957	0.569
Sitting	0.874	0.935	0.405	0.874
Driving	2.153	0.963	4.814	0.062

CHAPTER 5: DISCUSSION

The objective of this research project is to find the prevalence of PF among workers wearing STCB and to identify problem caused by STCB. Last but not least is to determine the risk factor associated with PF among STCB users.

5.1 Prevalence of PF among workers wearing STCB

In this research, workers from four industries were chosen to participate. The respond rate was high (72%). Although the workers came from four different industries, but the main tasks performed are the same (walking and standing) and all of them wore STCB. The prevalence of PF can be use to present workers who wore STCB working in this four industries. For workers outside from this industries, the result are still relevant as risk of development PF is not industry-specific but task specific (i.e., walking, standing, heavy lifting). This was proven by Marr & Quine, (1993) where 321 workers from five industries (publishing, broadcasting, air line, transport and heavy engineering) who wore STCB and their main task requires the worker to stand and walk the whole day. The research reported 49% having foot pain. Recent research by J. A. Dobson et al., (2018) to evaluate the underground coal miners satisfaction with their STCB revealed 42.3% of the miner reported foot pain and their main task at work were also walking and standing. Although the workers exposure to work task and location of foot pain were not determine in this two research but it is sufficient to say that there's prevalence of foot pain in workers wearing STCB in various industries.

The results of this cross-sectional studies of industrial workers revealed, 39.4% (n=100) of industrial workers are recorded to have the symptom suggestive of PF (Table 4.1). Among all four industries, manufacturing has the most workers with the symptom of PF (62.5%) followed by construction (41.5%), oil and gas (27%) and shipbuilding (15.6%)

(Table 4.2). Heel is the prominent area of foot pain among STCB users, with almost half (49.8%) of the user's complaint of heel pain. However, this symptom is under-diagnosed as only 5.9%(n=14) of the industrial workers sought doctor's attention.

5.2 Identification of problems caused by STCB

STCB users complaints of their boots were heavy, uncomfortable and causing foot pain. Foot pain is the same complaints reported by J. A. Dobson et al.(2018) among Australian coal miners. Even though the boots and working environment are different but the complaint is the same. Manufacturing industries recorded to have the highest complaint among all four industries with their complaints of poor sizing, uncomfortable and heavy. Poor sizing and ill-fitting shoes can exacerbate PF due to lack of cushioning (Roxas, 2005). This explains why manufacturing industries have the highest prevalence of PF.

5.3 Risk factor associated with PF among STCB users

Heel pain while taking the first step in the morning after waking up from the bed is the main symptom suggestive of PF reported by Buchbinder, (2004) and Waclawski et al., (2015). This symptom was used in comparison to the risk factor of PF. The main risk factor for PF that were analyse in this research are BMI more than 30kg/m^2 (Hill & Cutting, 1989; Riddle et al., 2003), age between 40-50 years old (Buchbinder, 2004; Riddle et al., 2003) and work task that requires prolonged standing and walking the whole day (J. Dobson et al., 2013; Werner et al., 2010).

From the research data, the mean BMI of the industrial workers having symptom suggestive of plantar fasciitis is 25.2±4.50 kgm^2 (Table 4.1). According to World Health Organization, (2018) this BMI classified as Pre-obesity weight. A contrary with

Hill & Cutting, (1989) and Riddle et al., (2003) which stated that the risk factor of PF is having BMI more than 30kg/m^2 (Obesity Class I). From the logistic regression modelling of the prevalence of PF, mean (SD) BMI (25.2±4.5kg/m^2) shows no significant association with PF (Table 4.5). This asserts that BMI is not a risk factor of developing PF among STCB users in this research.

Riddle et al.(2003) suggested that patients with age 41-50 years old have the highest percentage of 36% in the prevalence of PF. More than half of the worker with suggestive symptom of PF age less than 40 years old with the mean age 33.2±8.4 years (Table 4.1). No significant association found between age and the prevalence of PF (Table 4.5). The results from this research supported by Bergenudd et al.,(1989) and Werner et al.,(2010) which stated negative results proving age as a risk factor, as they also found no association between age and PF.

Prolonged standing (65.4%) and continuous walking (57.5%) are the main work task for industrial workers (Table 4.1). Walking continuously show a significant association in the prevalence of PF. STCB users that walk continuously was associated with a twofold increase in the prevalence of PF (Table 4.6).

Workers in manufacturing and construction industries have a significant association with of PF. They work on average 10.7 hours per day (manufacturing) and 8.2 hours per day (construction), which is longer than usual working hours. They also have the highest percentage of standing and walking among four industries during working hours. Dobson et al.(2018) and Werner et al.,(2010) stated that increase 10% of the time standing and walking would increase the risk of PF by 52%. Although the duration working hours and work exposure are different, this can be concluded that increase time standing and walking would increase the risk of PF.

STCB users who purchased their own boots have lower odds in developing PF (Table 4.6). There is a relationship found between shoe provider, users satisfaction and prevalence of PF. Among four industries, almost all (95.3%) workers in manufacturing industries wore boots provided by the company (Table 4.2). They have the highest reported complaints (26.5%) and the highest prevalence of PF (62.5%). In comparison to shipbuilding industries, more than half of the workers (66.7%) bought their own STCB, they have the least complaint (2%) and lowest prevalence of PF (15.6%). It can be observed that workers who bought their own STCB are more satisfied with their boots and having lesser complaint and resulted in lesser prevalence of PF, in comparison to those whom their shoes are provided by the company. This is because the workers who bought their own shoe or boots have the freedom to choose the one that fit and suit their feet best.

It was also revealed workers who change their STCB more than once per year were found to have a significant association with PF. A contrary to Werner et al. (2010), which stated that shoe rotation can reduce the significant of PF by 72% (OR=0.3; 95%CI: 0.1 to 0.7). In this research project, as company is the main provider of the STCB, it is important for the company to not only choose STCB base on just safety and functionality. The company need to take into consideration worker's complaint and satisfaction before purchasing STCB. Replacing the same type of STCB every year won't help in reducing the exposure to PF, but there's a possibility the symptom of foot pain can worsen.

The results highlight there is 39.4% (n=100) prevalence of PF among workers wearing STCB. Manufacturing industries reported having the highest prevalence of PF among all four industry (62.5%, n=40). The problems with STCB are heavy, uncomfortable

and causing pain on foot. The risk factor in developing PF among industrial workers wearing STCB in this research are, work task that requires continuous walking, workers from manufacturing and construction industries, frequency of boot change more than once per year a self-purchased STCB.

5.4 Strength and limitation of research

5.4.1 Strength of research

The strength of this cross-sectional study are:

1. Most of the questions in the questionnaire are close-ended, this made it easier to compare responds by the participants.
2. Bilingual questionnaire: To meet the comprehension of the multilingual population of workers to ensure that no misunderstanding that caused by the language barrier.
3. Designation of foot area to rate the pain (Figure 3.1). This is to ensure that the participants are not confused different area of the foot.
4. Anonymity of the participants were preserved as no identification information required, so the participants can answer their questionnaire without fear of being identified.

5.4.2 Research limitation

The limitations of this cross-sectional study are:

1. One of the weaknesses of using questionnaire as data collection instrument is that the respondent answers might not reflect their true opinion but might answer what they think will satisfy the researcher.
2. Unequal amount respondents from the four industries.

3. It did not standardize the brand and pricing of STCB users among the four industries as different company have different allocated budget on boots.

CHAPTER 6: CONCLUSION AND RECOMMENDATION

6.1 Conclusion

STCB is one of the personal protective equipment that needs to be worn by workers in the various industries in Malaysia. Due to high exposure to various work hazards, most of the industry had made it compulsory for the worker to wear STCB while working. Despite the safety purposes, STCB has caused foot pain among users, particularly on the heel. In this research project, PF has been found to be the caused the heel pain among STCB users from four industries (shipbuilding, manufacturing, construction and oil and Gas). With the result of among 253 workers, 100 STCB users (39.4%) meet the symptoms of PF with heel pain upon first step in the morning after waking up from the bed.

The reported problems with STCB are heavy, uncomfortable, poor sizing and causing pain on foot. Manufacturing industries was reported to have the highest prevalence of PF (62.5%, n=40). In this research, it has been determine that risk factor in developing PF among STCB users are: work task that requires continuous walking, frequency of STCB change more than once per year, manufacturing and construction industries, change of boots more than once per year and self purchased STCB. It has also found that workers that bought their own STCB have less complaint and lesser prevalence of PF compared to the workers whom their STCB provided by the company.

According to research by J. A. Dobson et al., (2018) and Marr & Quine, (1993) there are prevalence of foot pain (42.3% and 49%) among STCB users. Although this research does not specified the specific area of foot pain, but there was an evidence of foot pain occurrence among STCB users. It can be concluded that, the prevalence of

plantar fasciitis among STCB users in this research is high. It is found to be higher in certain industries and also lower among those who purchased their own STCB.

6.2 Recommendation

Injury to foot can cause disability to industrial workers. Since their main work task requires them to walk and stand the whole day, the pain can reduce the worker's productivity and causes liability to the company. As proven earlier, STCB provider does contribute to prevalence of PF among industrial workers, hence this recommendation are specifically made to the company:

1) Sufficient budget should be allocated to buy a STCB that gives comfort and safety to the users.
2) In workers with the symptoms of suggestive PF, shoe orthosis with medial longitudinal arch and metatarsal pad can be use as a treatment strategy for workers (Werner et al., 2010).
3) To consider worker's complaint and problems with their STCB before buying a new one.
4) Reduce percentage of time standing and walking by providing work station by allowing workers to alternate between standing and sitting postures. This may lower the risk of PF (Werner et al., 2010).

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