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Prevalence of musculoskeletal discomfort (msd) among heeled shoe user: the correlation between the foot regions and discomfort

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ABSTRACT

The purpose of this study is to analysis the correlation between the foot regions and discomfort among heeled shoes user. This study used the quantitave correlation method with 250 sample. The questionnaire was adapted from the standardized Nordic questionnaire and Cornell Musculoskeletal Discomfort questionnaire. Result shows that there is relationship between heel height and the discomfort at foot palm. The cumulative percentage of discomfort at forefoot area 2 (F2) have the highest percentage (20.4 %) followed by hindfoot (19.58 %), forefoot area 5 (F5) and midfoot (18.06 %), Forefoot area 1 (F1) (14.3 %) and Forefoot area 4 (9.5 %). Based of the result it is recommended to have more education exposure related to MSD prevalence as most of the wear do not aware the risk of foot discomfort may lead to low back pain if ignoring the foot discomfort. Further research is needed in order to find the most suitable height of the heel shoes in minimizing the risk of having foot MSD.

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Introduction

Career women have a very high risk in having occupational disease (OD). An OD is a disease caused by the working condition or environment. The increasing number of OD have been proved to be a major problem among Malaysian workers and drastic increment from 204 cases in 2001 to 1,670 cases in 2018 (SOCCSO,2010;2018). Musculoskeletal Discomfort is a collective and descriptive term for symptoms caused by work which reveal the symptom through pain, aches, discomfort, and strain in join, muscles and other soft tissues at certain area. High incidence rates for MSDs have been reported for workers in a wide range of industries including office work, manufacturing, agriculture and numerous manual materials handling occupations. MSD have become a major concern because of the negative impact on the health and productivity of employees. Without our concern, MSD problem is crucial and the development of the symptoms needed to be control and prevented. This prevention will reduce the cost related to medical or any other muscle treatments, emotional distress and demoralization of workers. In occupational settings, significant disability, long period of sick leave and demotivate have been implicated with the occurrence of MSDs (Shiri et al., 2011). Personal factor such as female gender, low social class, older age, all these will increase the risk of being disabled due to disease. The prevalence of MSD among heeled user may feel the

discomfort and pain at foot palm due to repetitive movement, postural strain, shoe mismatch, vibration and also the unbalance of the body mass centre. (Strazdins & Bammer, 2004; Domínguez et al., 2006, p. 132; Gong et al., 2011, p. 38)

Foot is the platform for human when standing. Human barely can stand with hands but the nature of the body is standing, walking, running and crawling using the feet. The other function of the foot is supporting the weight of the entire body and in locomotion. Human body can have the good benefit of the foot if it was being used properly. Some of the benefits of strong feet are increased tolerance of impacts and work loads, increase threshold of standing and working fatigue, built in immunity to foot disorder, foundation of good body posture and become a loader of the body. Figure 1 shows that the foot prevalence of pain in Framingham Foot Study from journal of Arthritis & Rheumatism. However, the pain is not always restricted to the feet but indirectly, these misalignments will affect our feet, hips, neck, knees and back. It is because all of our body parts is connected to the feet through the skeleton (Dairman, 2016). When wearing different heel height, it is known that the effect is different. The higher the heel height, the higher the risk of falling, bones fracture, sprain ankle and etc. When the hind-foot is being elevated, the center of body gravity will be shifted forward. In order to balance the changes, our body automatically will tend to move the pelvis forwards, which is closer to the center of body gravity. At the same time, the movement also makes the neck, shoulders and chest backwards as all the element is connected together as shown in Figure 2 (Nelson-Wong & Callaghan, 2010, p. 788)

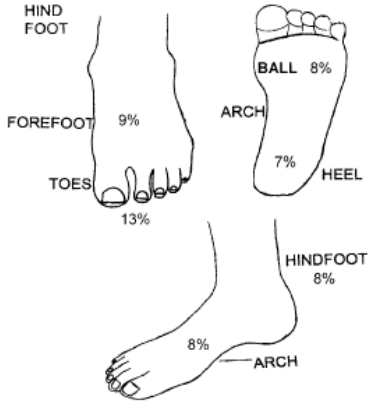

Figure 1 <Foot prevalence of pain from Framingham Foot Study Source: (Menz et al., 2013b, p. 2281)>

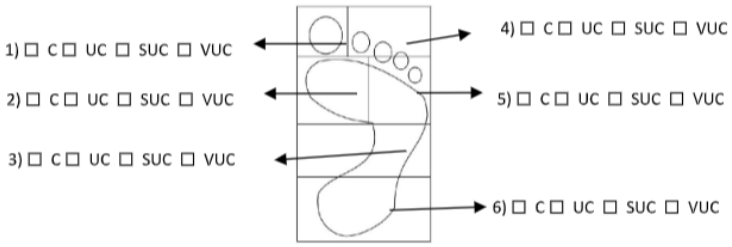

Figure 2 <Body Map of Foot Palm>

Preventing MSD is vital in Malaysia as most of Malaysian do not aware the effect of exposing their self to the risk. Although the research status of MSDs in Malaysia is still at the early stage, at least we know the early symptom of this occupational disease. The topic has been studied in other countries including the USA, the UK, France, Sweden, Japan, etc. Therefore, the purpose of this study aims to to find the correlation between the foot regions and discomfort among heeled shoes user.

Method

A cross-sectional survey was done with a total of 250 office workers were being selected from several departments in Dungun and the surrounding area. The working environment must be related to sitting, walking and climbing stairs during the working hours. The working hours must be between 6 to 8 hours. A self-administered questionnaire together with the information about the study was distributed to an individual by hand. The author made an appointment in order to come back to collect the questionnaire.

The research material was divided into three, the first phase is by distributing the questionnaire. The questionnaire was adapted from the standardized Nordic questionnaire and Cornell Musculoskeletal Discomfort questionnaire. The Cornell Musculoskeletal Discomfort questionnaire is a screening tool which assesses the risk that a worker will develop a symptom of failing to return to work following a musculoskeletal injury. In the questionnaire, the individual factors included are age, height, body weight, marital status, average monthly income, shoe size and types of preference shoes in daily usage. Other information that were gathered regarding to health issues and sleeping hours. Work related physical

factor is included the average working hour per day, weeks and overtime working hours. Factor that may contribute to their fatigue and the responsibility required at workplace had also been asked. Within the questionnaire, body chart discomfort was also used for the respondent to choose which part of their feet that always have a pain problem, inflammation and else.

Research Material

Using Rapid Entire Body Assessment (REBA) (Hignett & McAtamney, 2000, p. 203), Modified Nordic and Cornell Musculoskeletal Discomfort questionnaire and Body discomfort chart – specifically at foot palm and lower part of body in the questionnaire. The relationship between the heel height and the discomfort at the foot palm was obtained by using statistical methods (Spearman rho correlation test) where the strength of the correlation is based on the correlation coefficient size (r). Spearman correlation was chosen because both of the items are ordinal data. The relationship of the correlation was determined based on "Guildford's Rule of Thumb'.

The foot region was analyzed into three group, forefoot (item number 1, 2, 4, and 5), mid-foot (item number 2) and hind-foot (item number 6). The foot region is divided based on its category and function. The question is attempts to obtain feedback from the respondents regarding to the pain sensation that they have been experiencing at the foot palm. The picture was labeled in order to help the respondent in identifying which area in their foot palm experience discomfort and pain as in Figure 1.1. In evaluating the reliability of the questionnaire, a pilot test was done at Mechanical Engineering Department, Politeknik Sultan Mizan Zainal Abidin Dungun where 10 participants were randomly choose in June 2013 (α = 0.91). In order to do the pre-test, the participant evaluated the questionnaire by answering the entire question given and gave some comments on what they do not understand in the questionnaire given. Their comment were considered as added value to the questionnaire

Results and Discussion

In this study,53.6 % of the respondents are lecturers, nurse (14.4 %), office woman (9.1%), and 17.7 % are others. Most of the respondent level of education is from bachelor degree. Majority of the respondent physical movement while doing their work are standing, sit and climb stairs (56.1 %). Most of them are Malay (91.9 %) and the body mass index range for the respondent are normal (54.5%) followed by obese (35.4%) and underweight range (3.8%). The percentage for obese is quite high, so it probably giving an effect for the discomfort and instability while wearing heel shoe. Present research shows that the body mass index (BMI) correlates with a balance instability (Hue et al., 2007, p. 36), an statistically correlation between BMI and heel height will be done to ensure that wearing heel height may worsen the instability and thus lead to muscle fatigue so far.

The shoe size will indicate the length of the feet of each of the respondent. From previous study, there are no specific anthropometry dimensions for women in Malaysia, except for elderly in Asian Social Science Journal (M.Y. et al., 2009, p. 139). However, anthropometry data from rural Asian country can be taken as a reference which are from Thailand, anthropometry dimension for foot length median is 25.16 cm, India 22.67 cm, Singapore 22.00 cm, Indonesia 21.0 cm and China 25.3 cm (Klamklay et al., 2008, p. 116; Chuan et al., 2010, p. 761), so the foot length can be estimated in between 21.00 to 25.3 cm. Forty one percent (41%) of the respondent standing for more than an hour while working by wearing heel shoes and only four percent (4%) of the respondent are never stand for that long. From Figure 1.3, in total 63% of the respondents used to have foot massage at reflexology and 94% have self-feet massage at home. Both of this percentage shows that, most of the respondent have feet discomfort and feet massaging is one of the way in relieving the pain. Meanwhile, referring to Figure 1.4, most of the respondent use to have foot discomfort and 14.8% of the them tend to have foot palm regularly which is very serious.

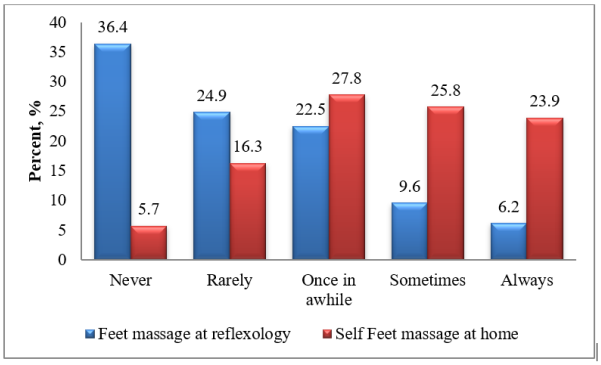

Figure 3 <Percentage of Having Foot Massaging for Foot Comforting>

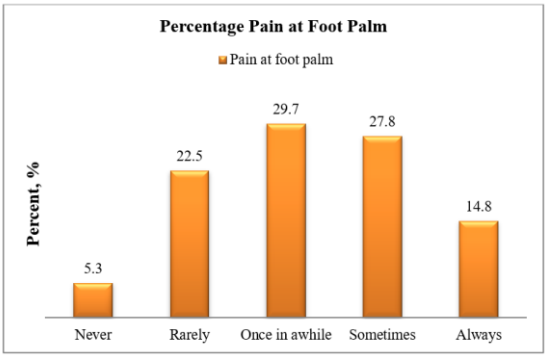

Figure 4 <Percentage of Pain at Foot Palm>

In order to determine the relationship between heel height and discomfort level at foot palm, Spearman Rho statistic has been used. Table 1 shows, there is weak relationship in between heel high and discomfort level at most of the foot region. There is no statistically correlation between heel height and foot palm discomfort at Forefoot 1, Forefoot 2, mid foot, Forefoot 5 and hind foot and the strength for the relation is very weak. However, statistically, there is relationship in between heel height and the discomfort at foot palm, Forefoot 4. Pain at the foot palm is known as metatarsalgia. Wearing high heel is the main factor which will be able to cause extreme pressure in ball of foot in metatarsalgia that the heel is too high and walking with a high impact activity. Although majority of the respondent wear low to medium height of heel, the discomfort can be also be felt may be because it has been worn for a long period.

Majority of the women that working prolongs standing (cashier, operator, lecturers and nurse) choose to use flat heel shoe because they feel comfortable and easy to move while working. However, if the flat shoes do not have arch support, it can also hurt our feet. One can get inflamed tissues along the bottom of the foot. Flats without arch support may also lead to lower back pain and ankle pain. Although there as metatarsal pad sold separately, a researcher Yung-Hui and Wei-Hsien (2005, p. 361) do not agree with the usage of the pad because the pad is not reliable in making the heel wearer feel more comfortable. The reason is because the pad is not designed to be customized. Lack of information regarding to advantages and disadvantages usage of suitable heel shoe make most of career women suffer and need to sustain the discomfort feeling while doing their work although they wear flat heel shoe. These misunderstandings of the knowledge about heel shoe make them to confuse. Career women should know the best level of heel shoe usage and how long they will wear the shoe.

Referring to Table 1, the relationship between heel height and most of the foot region, forefoot 1 (r = 0.031), forefoot 2 (r = -0.034), forefoot 4 (r = -0.156), forefoot 5 (r = -0.003), mid foot (0.048) and hind foot (0.091) are very weak. However, the correlation is significant at the level 0.05 level (2 tailed) at forefoot 4 region which when squared, becomes $R^2 = 0.025$ or 2.5 %. So, the heel height can only explain 2.5% of the variance of the forefoot 4 region. This result is in agreement from the research done by Speksnijder et al. (2005, p. 18) which is found by clinical research that, most of the heel height shoe wearer among working women will suffer foot pain at the forefoot, at the metatarsal region and this may lead to bursitis of the intermetatarsal bursae under the metatarsal heads. The correlation is also significant at the level 0.01 level (2 tailed) in between most of the foot region. From Table 2, the relationship between forefoot 1 and 4 (r = 0.655) have a medium strength of correlation compared to other foot region as the $r^2 = 0.429025$. This means that forefoot 1 shares 42.9% of the variance with forefoot 4. The strength of the relationship in between the foot region was summarize in Table 2

Table 1 <Correlation between Heel Height and Foot Region in Determining Foot Palm Discomfort>

Correlations

			Heel height	Forefoot 1	Forefoot 2	Midfoot	Forefoot 4	Forefoot 5	Hindfoot
Spearman's rho	Heel height	Correlation Coefficient	1.000	.031	-.034	.048	-.156*	.003	.091
		Sig. (2-tailed)	.	.653	.620	.490	.025	.961	.190
		N	209	209	209	209	209	209	209
	Forefoot 1	Correlation Coefficient	.031	1.000	.462**	.357**	.655**	.406**	.319**
		Sig. (2-tailed)	.653	.	.000	.000	.000	.000	.000
		N	209	209	209	209	209	209	209
	Forefoot 2	Correlation Coefficient	-.034	.462**	1.000	.405**	.440**	.641**	.397**
		Sig. (2-tailed)	.620	.000	.	.000	.000	.000	.000
		N	209	209	209	209	209	209	209
	Midfoot	Correlation Coefficient	.048	.357**	.405**	1.000	.335**	.495**	.392**
		Sig. (2-tailed)	.490	.000	.000	.	.000	.000	.000
		N	209	209	209	209	209	209	209
	Forefoot 4	Correlation Coefficient	-.156*	.655**	.440**	.335**	1.000	.479**	.287**
		Sig. (2-tailed)	.025	.000	.000	.000	.	.000	.000
		N	209	209	209	209	209	209	209
	Forefoot 5	Correlation Coefficient	.003	.406**	.641**	.495**	.479**	1.000	.433**
		Sig. (2-tailed)	.961	.000	.000	.000	.000	.	.000
		N	209	209	209	209	209	209	209
	Hindfoot	Correlation Coefficient	.091	.319**	.397**	.392**	.287**	.433**	1.000
		Sig. (2-tailed)	.190	.000	.000	.000	.000	.000	.
		N	209	209	209	209	209	209	209

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Table 2 <Strength of the Correlation between the Foot Regions and Discomfort Feeling>

Foot region	Spearman Rho coefficient size (r)	R^2	Percentage of the shared variance.	Strength to correlation
Forefoot 1 and 2	0.462**	0.21344	21.3 %	Medium
Forefoot 1 and 4	0.655**	0.42902	42.9 %	Strong
Forefoot 1 and 5	0.406**	0.16483	16.5 %	Medium
Forefoot 1 and hind foot	0.319**	0.10176	10.1 %	Medium
Forefoot 1 and mid foot	0.357**	0.12744	12.7 %	Medium
Forefoot 2 and mid foot	0.405**	0.16402	16.4 %	Medium
Forefoot 2 and 4	0.440**	0.11222	11.2 %	Medium
Forefoot 2 and 5	0.641**	0.1936	19.36 %	Medium
Forefoot 2 and Hind foot	0.397**	0.15760	15.8 %	Medium
Mid foot and forefoot 4	0.355**	0.12602	12.6 %	Medium
Mid foot and forefoot 5	0.495**	0.24502	24.5 %	Medium
Mid foot and Hind foot	0.392**	0.15366	15.3 %	Medium
Fore foot 4 and 5	0.479**	0.22944	22.9 %	Medium
Fore foot 4 and hind foot	0.287**	0.08236	8.2 %	Weak
Forefoot 5 and hind foot	0.433**	0.18748	18.7 %	Medium

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

Conclusions

It can be concluded that majority of the respondent do not realize that they are having a prevalence of musculoskeletal disorder. 12% of the respondent have a frequent back pain and they do not know that wearing high heel for a long period may contribute for what they have experience. 70.3 % of the respondent agreed that they know the reason they have a back pain. However, they still wear high heel shoe which means they really do not know that high heel is one of the contributors of MSD. The statistical findings found that the percentage of the discomfort zone of the forefoot is increasing when the heel height was increased. The author research result suggested that the pain at foot palm is depends on the angle of the heel. If it is more slanting, so the muscle will be stress and this will extending the ankle joint just to adapt with the heel height. The finding of this study is also accordance to several studies which found out that an increase in heel height increase the pressure of the foot palm (Speksnijder et al., 2005, p. 18; Barkema et al., 2012, p. 487). However, there are poor relationship between heel height and perceive discomfort. Most probably it is because of 45.5 % of the respondent use to change their heel shoe to sandals when break time. It is recommended to have more education exposure related to MSD prevalence as most of the wearer do not aware the risk of foot discomfort may lead to low back pain if ignoring the foot discomfort. Further research is needed in order to find the most suitable height of the heel shoes in minimizing the risk of having foot MSD.

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