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Feet Plantar Pressure Distribution Among Female School Teachers

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ABSTRACT– Plantar pressure measurements have been recognized as a significant information to clinicians and researchers to identify and manage impairments associated with various feet disorders. Objective: To determine the feet plantar pressure distribution among female school teachers. Methods: This research consisted of 124 female school teachers. A self-administered questionnaire and feet plantar pressure measurement have taken place in the data collection. Respondents have been asked to walk at a regular pace for 10 seconds from a fixed starting point while using footwear pressure insole device and pressure measurement was recorded. Results and discussion: The findings show that lateral heel exerted the most pressure in the right and left foot (94 kPa vs 85 kPa) and there were significant differences as the right foot often exerted greater pressure on any part of the foot than the left foot. Conclusion: The significant findings on pressure plantar distribution of foot provides important information about the conditions of teachers who faces with various posture and movement. By revealing this findings, plantar pressure distribution data among school teachers aided the researcher in understanding how distinct pressure values are generated and may be used as baseline data to develop footwear intervention for teachers in future.

Keywords: Feet, plantar pressure distribution, femaleschool teachers, posture

1.0 INTRODUCTION

The roles of teachers had changed due to advanced technology, globalization and change of education exposure. In the stage of rapid technology development, well-evolved and sophisticated, the roles and duties of teachers are quite challenging and demanding. Skilled teachers should creatively blend the knowledge with learning and teaching methodologies so that the concepts of contents are well understood by the students during learning process (Taharim et al., 2017). Teacher spends most of the school hours standing in the classroom, working between desks in small spaces,

educating students, writing on the chalkboard, planning lessons, assessing assignments and performing extra school administrative work, that can develop mental and physical health problems (Chong and Chan, 2010).

Eventually, when teachers have spent a long time of energy in a standing posture throughout their school hours, at the end of the working day they may experience discomfort and muscle fatigue. For a long period of time, they may have suffered musculoskeletal injuries. Slow posture degradation can be caused by long standing or standing for long periods of time. Teachers usually slowly move their weight from one foot to the next when standing in the classroom in order to ease the strain. Slouching facilitates a standing posture that makes it possible for teachers to be less alert and passive. When this uncomfortable pose is maintained for long-standing teachers, it may lead to problems of circulation such as swollen legs and feet. Long standing also renders the joints in the back, knee and feet partially immobilized or stiff (Vaghela and Parekh, 2017).

Postural pain in the classroom, uncomfortable sitting and standing, because of long teaching hours, repetitive and uncomfortable bend, MSDs on the lower extremities may suffer from impairments among school teachers (Yue, Liu and Li, 2012). Even so, school teachers are faced with social and psychological difficulties both within and after school hours every day and have reported less time to relax after teaching, due to extra work that could lead to chronic musculoskeletal problems (Shimizu et al., 2011; Vignoli et al., 2015). Basically, a teacher is expected to uphold a standing position when he or she gives lesson in a classroom by putting one foot up, often trying to adjust the position and keeping the posture at pleasant height even from wearing shoe with heel. A teacher is considered to be subject to prolonged standing if he or she spends more than half of the school hours every day in a standing position (Darwish and Al-Zuhair, 2013).

Plantar pressure distribution is often used in foot clinical assessment and offers a view of plantar load characteristics during practical tasks such as running and walking. The assessment, evaluation and enhancement of the function of the foot and lower limb can be combined with these data. In order to identify and treat individuals with a diverse range of lower limbs disorders linked with musculoskeletal and neurological conditions that can affect both adult and young patients, data collected from a plantar pressure assessment may be used. If plantar pressure levels are found to be anomalous, the insight can be used footwear adjustments, foot custom insoles, fitness routine and weight bearing restrictions to modify the patient's treatment regimen. Information derived from pressure processes is often valuable from a theoretical viewpoint to address a range of aspects related to the relationship between plantar and lower limb posture (Orlin and McPoil, 2000). In

addition to relevant literature on plantar pressure distribution, none of these studies was performed among school teachers.

2.0 METHODOLOGY

2.1 Participants Selection

The aim of this cross-sectional study was to determine the feet plantar pressure distribution among female teachers in primary school. The subjects of study included 124 female school teachers in 6 different primary schools in Terengganu, Malaysia. In 6 different schools, questionnaires were administered to all school teachers and agreed to participate in this study.

2.2 Plantar Pressure Measurement

In order to identify the location of high point pressure, foot was divided into 9 areas to allow an experimental recording of pressure which were Hallux (HA), Lesser Toes (LT), Medial Forefoot (MF), Central Forefoot (CF), Lateral Forefoot (LF), Medial Midfoot (MF), Lateral Midfoot (LM), Medial Heel (MH) and Lateral Heel (LH) (Wafai et al., 2015; Chun et al., 2018; Gurney, Kersting and Rosenbaum, 2008) (Figure 1). In accordance with the protocol for documenting the distribution of plantar foot pressure, respondents were asked to walk at a regular pace for 10 seconds from a set starting point. They were advised to look straight ahead while walking a shoe pressure insole system. Until the final set of readings was taken, it was assured that respondents walked comfortably (Chun et al., 2018).

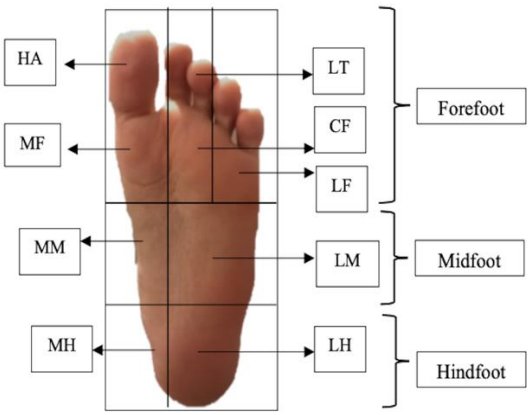

Figure 1: Regions of foot

3.0 RESULTS

The study involved 124 female school teachers teaching in different of 6 primary schools in Terengganu, Malaysia with 100% of response score. The average teachers' age was 31 years, according to Table 1**.** Teachers who were included in this study, from age 20 to 35 years old and

classified as young adult. Additionally, average of BMI data reported was 22.8kg/m^2. Most of them had adequate sleep, with range of 7 to 9 hours a day (54.8%). In spite of shoe preference, heel-selecting teachers (57.3%) is marginally higher than those who prefer to wear flat shoes (42.7%).

Table 1: Background Characteristics of the Female School Teachers

Variables	Total (%) (n=124)	Mean	SD
Age (years)	-	31	3.62
BMI (kg/m^2)	-	22.8	2.19
Sleeping hours		-	-
< 7 hours	10 (8.1)		
7 – 9 hours	68 (54.8)		
>9 hours	46 (37.1)		
Shoes		-	-
Flat	57 (42.7)		
With heel	67 (57.3)		

There were 5 significant areas chosen based on high pressure distribution of feet (the plantar side of Medial Forefoot (MF), Lateral Forefoot (LF), Central Forefoot (CF), Lateral Midfoot (LM), and Lateral Heel (LH). According to the figure below, lateral heel exerted the most pressure in the right and left foot (94 kPa vs 85 kPa). The second highest average of plantar pressure distribution for right foot among female school teachers was medial forefoot (67 kPa), followed by central forefoot (55 kPa) and lateral forefoot (52 kPa). The least pressure exerted on right foot among teachers was lateral midfoot with 49 kPa. For the left foot, the second highest for average of plantar pressure distribution was medial forefoot (58 kPa), followed by lateral forefoot (48 kPa), and central forefoot (47 kPa). Lastly, compare to the right foot, lateral midfoot had the least pressure left foot pressure of 33 kPa. The outcome showed significant differences as the right foot applied more strain on each section of the foot than the left foot, as seen in Figure 2.

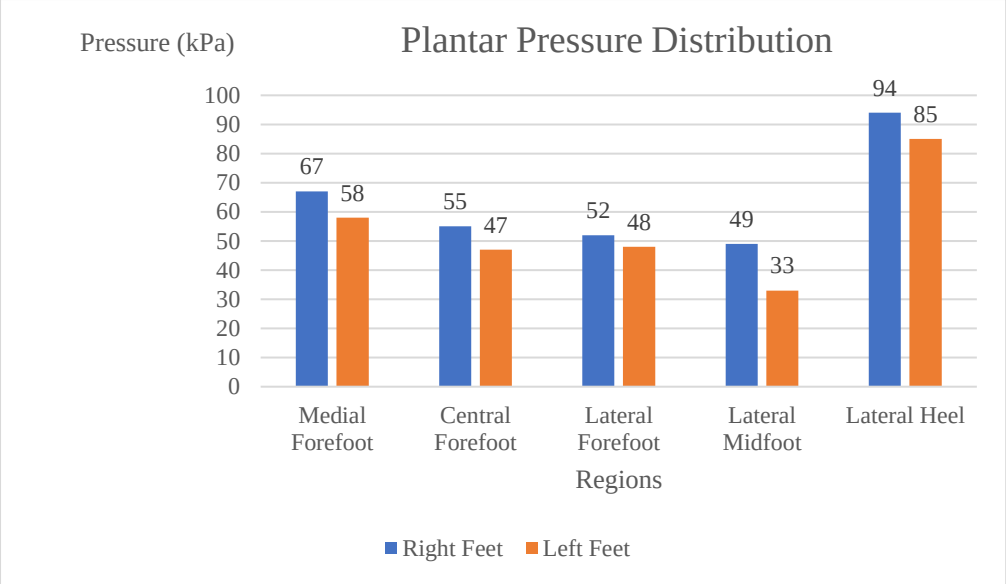

Figure 2: Mean Pressure Distribution of Feet

4.0 DISCUSSION

The foot is the lowest region of the body that carries weight. The structure of bones, muscles and joints facilitates stability by sustaining and supporting vigorous strain or pressure during standing and walking. The physiological pattern of distribution of pressure on the sole is almost symmetrical and gives the foot, and hence our body, an optimum flexibility (Sutkowska et al., 2019). The ground surface and feet made contact with each other while we were standing. Upon landing on the ground, the sole of our foot had force. The force impact on foot sole or on the distribution of plantar pressure may be erratic and imbalanced, such impacts may exploit changes of stress, as results of severe applied to the foot, may trigger transient or long-lasting discomfort or foot pain and thus induce foot pressure. In the meantime, this can exacerbate foot disorders or negatively affect an individual's overall health (Chun et al., 2018).

Furthermore, feet have been detected as the highest MSD among all parts of the body, concerning 32.5% of female school teachers (Alias et al., 2020) as shown by latest observations in Terengganu, Malaysia. The distribution of plantar pressure in various studies has generally been recognised as a critical evaluation for postures and movements of human. The variations and severity of plantar pressure would provide valuable analysis on musculoskeletal disorders especially on ankle and feet parts (Hessert et al., 2005). Several studies (Cavanagh and Ulbrecht, 1994; Grieve and Rashdi, 1984,Hessert et al., 2005) on foot anatomy and physiology have stated that differences in plantar pressure are useful in assessing irregular posture. The pathological gait can be classified into either neuromuscular or musculoskeletal on the basis of basic etiology (Lehmann, Lateur and Price, 1992). Evidence gained from pressure systems is also beneficial from a scientific point of view to discuss a

number of issues related to the relationship between plantar pressure production and lower limb's posture (Orlin and McPoil, 2000).

Important distinctions were shown in the outcome as the right foot usually imposed more pressure in each area of the foot compared with the left foot among female school teachers in the classroom. In regular walking, the heel was the first part of the foot to bear body weight followed by midfoot and forefoot, eventually the load moved to the toe for the raise. Heel hit the ground on the posterolateral part of the heel, and the highest peak pressure occurred at roughly 18 to 36% of the standing period where heel, midfoot and forefoot were in touch with the ground (Rai and Aggarwal, 2006). According to many reports, natural forefoot pressure patterns are strongest under the 2nd and 3rd metatarsal regions and offer useful information when determining abnormal forefoot conditions. Studies have indicated that toes do not play a major role in the movement of load and produce lower pressure patterns relative to other foot areas (Bryan, Tinley and Cole, 2005; Hessert et al., 2005; Rai and Aggarwal, 2006;).

The primary goal of researchers for plantar pressure measurements for discomfort of lower limb was to explore the effects of foot pain and footwear adjustment, shoe insoles and various products used to cushion the foot. Various types of insole materials and internal and external footwear modifications have been assessed by researchers using pressure measurement platforms. The results collected from these studies can be used to help clinicians assess the acceptable form and volume of posting needed for foot pain or discomfort, as well as the amount of pressure relief that can be anticipated by using different types of insole interventions (Childs et al., 1996; Cornwall and McPoil, 1996; Orlin and McPoil, 2000).

CONCLUSION

There were 5 significant areas were detectedwith significantlyhigh pressure distribution of feet. Indeed, lateral heel exerted the most pressure in the right and left foot (94 kPa vs 85 kPa). As overall, findingshoweda significant difference as the right foot exerted more pressure in every part of the foot than the left foot. By revealing this findings, plantar pressure distribution data among school teachers aided the researcher in understanding how the various plantar regions of the foot produced different pressure value and might be utilized for the development of footwear intervention, especially insole to promote posture dynamics that did not place excessive stress on the foot and lower limbs muscles.

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