TYPES AND GRADES OF FOOTWEAR AND FACTORS ASSOCIATED WITH POOR FOOTWEAR CHOICE AMONG DIABETIC PATIENTS IN USM HOSPITAL

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ABSTRACT

Background: Diabetic foot ulcer (DFU) is a preventable yet debilitating complication that is frequently seen in diabetic patients. Footwear has been implicated as contributing towards the development of foot ulcers and is the initial step leading towards lower limb amputations.

Materials and Methods: The objective of this study was to determine the types and grades of footwear worn by diabetics and factors associated with poor footwear choice. This cross-sectional study was conducted using an interviewer-administered questionnaire that included the Footwear Suitability Scale for Diabetics. 174 diabetics were recruited via systematic random sampling from three outpatient clinics in University Sains Malaysia (USM) Hospital, Kelantan, Malaysia.

Results: It was seen that 71.3% of diabetics wore poor grade footwear. The most preferred type of footwear was open sandals without back support [66 (37.9%)], followed by open sandals with forking, closed shoes with laces or adjustable straps and closed shoes without laces or adjustable straps which was 23 (13.2%), 15 (8.6%) diabetics wore open sandals with back support and high heels respectively. The significant associated factors influencing poor footwear choice were sex and the presence of active DFU with OR: 6.85 (95% CI 2.95, 15.89), 0.99 (95% CI 0.98, 1.00) and 5.51 (95%CI 1.69, 17.95) respectively.

Conclusion: This study was able to capture the prevalence of poor footwear choice among diabetics and understand the associated factors. It reinforces the need of effective intervention programs pertaining the importance of footwear as primary prevention of DFU's.

Keywords: Footwear, types, grades, associated factors, diabetics

1.0 Introduction

Diabetic foot ulcer (DFU) is a full thickness wound below the ankle in a diabetic patient, irrespective of duration (Apelqvist et al., 2000). It is believed that every 30 seconds a lower limb is lost somewhere in the world as a consequence of diabetes (Bharara et al., 2009). Footwear plays an essential role in the maintenance of foot health (Williams, 2007) and has been implicated as contributing between 21% and 89% of foot ulcers (Cavanagh & Ulbrecht, 2006). 54% of ulcers were due to trauma from the footwear itself (McGill et al., 2005). Suitable footwear not only reduces the incidence of DFU's, but diminishes the risk of falls, foot deformities, improves mobility and decreases overall morbidity and mortality among diabetics (Williams, 2007).

The National Health Morbidity Survey revealed that the prevalence of diabetes mellitus (DM) among Malaysian adults was 17.5% (Ministry of Health Malaysia, 2015). The prevalence of DFU in Malaysia was 9.5% (Rabia & Khoo, 2007) and Letchuman et al., discovered 4.3% of Malaysian diabetics had undergone lower limb amputations (Letchuman et al., 2010). DFU is a major concern in Malaysia resulting in infection, morbidity, engendering financial costs and is usually the initial step leading to lower limb amputations (Singh et al., 2005). Footwear plays an imperative role in the overall wellbeing of diabetics, however, there was scarce information on suitability of footwear worn by diabetics and their awareness in Malaysia.

Our study was aimed to determine the types and grades of footwear as well as to determine factors associated with poor grade footwear choice among diabetic patients in USM Hospital.

2.0 Materials and Methods

This cross-sectional study involved 174 diabetic patients that were recruited via systematic random sampling from three outpatient clinics in University Sains Malaysia (USM) Hospital, Kelantan. The inclusion criteria were patients aged 18 years and above and diagnosed with diabetes mellitus type 1 or 2. We excluded patients with gestational diabetes mellitus, individuals with bilateral lower limb amputation and those who were activities of daily living (ADL) dependent.

This research was conducted using an interviewer-administered questionnaire which enquired details regarding sociodemographic factors such as age, sex, ethnicity, level of education, household income as well as duration of diabetes. Physical examination of bilateral feet was also performed to determine the presence of DFU.

An objective footwear assessment was carried out by the examiner to ascertain the type (style) of footwear and the grade of footwear worn by the patient. Footwear assessed in this study refers to the footwear worn at the time of the interview. The type of footwear was categorized based on style which were open sandals with forking, open sandals with back support, open sandals without back support, closed shoes with laces or adjustable straps, closed shoes without laces or adjustable straps, high heel, orthotic or custom made shoes and others.

The grade of footwear was determined based on the criteria given by the Footwear Suitability Scale for Diabetics (Nancarrow, 1999). Grading was performed based on 10 footwear

characteristics namely length, depth, heel support, cushioning material, sole, restraining mechanism, heel height, style, materials and potential for injury. A measuring tape was used to measure the parts of the footwear. Grade 3 footwear was classified as poor grade and grade 0 (optimal), 1 (good), 2 (fair) was classified as non-poor grade. The prevalence of diabetic patients with poor grade footwear was calculated by the proportion of respondents that were wearing grade 3 footwear.

Multiple logistic regression was performed to identify associations between poor grade footwear and sociodemographic factors as well as duration of diabetes and presence of DFU. Factors with p-value of less than 0.25 were included for variable selection. The level of significance for the final model for associated factors for poor grade footwear choice was set at $p<0.05$. Adjusted odds ratio, 95% confidence interval and p-values were presented to establish the association. Data analyses was computed using SPSS Statistics Version 22.

3.0 Results

3.1 Grades of Footwear Worn by Diabetic Patients in USM Hospital

Table 1 shows the various grades of footwear worn by diabetic patients in this study. The prevalence of diabetic patients wearing poor grade footwear was 71.3%. Optimal footwear were worn by 4.0% of the study respondents, good was 12.1% of them and fair was12.6%

Table 1: Grades of Footwear Worn by Diabetic Patients

Grade of footwear (n=174)	n	%
Non-poor:	50	28.7
Grade 0 (Optimal)	7	4.0
Grade 1 (Good)	21	12.1
Grade 2 (Fair)	22	12.6
Poor:		
Grade 3 (Poor)	124	71.3

3.2 Types of Footwear Worn by Diabetic Patients in USM Hospital.

We assessed 174 diabetic patients in this study. Table 2 exhibits the different types of footwear worn by diabetics based on style. The most preferred type of footwear was slippers (open sandals with forking, open sandals without back support) which were worn by more than half of the study population (51.1%). Individuals who wore closed shoes with adjustable laces or straps were only 13.2% and orthotic or custom-made shoes (3.4%).

Table 2: Types of Footwear Worn by Diabetic Patients

Types of Footwear (n=174)	n	%
Open sandals with forking	23	13.2
Open sandals with back support	15	8.6
Open sandals without back support	66	37.9
Closed shoes with laces or adjustable straps	23	13.2
Closed shoes without laces or adjustable straps	23	13.2
High heels	15	8.6
Orthotic or custom made shoes	3	1.7
Others	6	3.4

3.3 Baseline Characteristics of the Study Population by Footwear Choice.

Table 3 demonstrates the baseline characteristics of the study population by footwear choice. The mean (SD) age of those with non-poor and poor footwear was 60.5 (9.71) and 58.63 (11.97) respectively. It was seen that 80 (64.52%) women had poor footwear choice compared to 44 (35.48%) men. More men wore non-poor footwear, which were 38 (76.00%) compared to diabetic women 12(24.00%).

In this study, 111(89.52%) of the Malays and 13 (10.48) non-Malays wore poor footwear. Those who had not received tertiary education had a higher prevalence of poor footwear choice [97 (77.41%)] versus those who secured tertiary education [28(22.59%)]. The mean household income of RM 2468.95 (2521.81) in the poor footwear group was relatively lower than the non-poor footwear group that was RM 4167.00 (2827.12). In the poor grade footwear category, 17 (13.71%) never had a DFU, 63 (50.81) had a previous history of DFU and 44 (35.48%) of them had an active DFU at the time of assessment.

Table 3: Baseline Characteristics of the Study Population By Footwear Choice

Variables	Footwear (n=174) Non-poor footwear (n=50)		Poor footwear (n=124)	
	Mean (SD)	Frequency (%)	Mean (SD)	Frequency (%)
Age	60.56 (9.71)		58.63 (11.97)	
Sex:				
Male		38 (76.00)		44(35.48)
Female		12 (24.00)		80(64.52)
Ethnicity:				
Malay		43 (86.00)		111(89.52)
Non-Malay		5 (14.00)		13(10.48)
Education Level:				
Below tertiary		30 (60.00)		96 (77.41)
Tertiary & above		20 (40.00)		28 (22.59)
Household income per month (RM)	4167.00(2827.12)		2468.95(2521.81)	
Duration of diabetes (years)	10.80 (6.78)		11.17 (8.07)	
DFU status:				
Never		41(82.00)		17 (13.71)
Previous		5 (10.00)		63 (50.81)
Active		4 (8.00)		44 (35.48)

Simple logistic regression was performed to determine the factors associated with footwear choice among diabetics. At the level of univariable analysis, sex, education, household income and DFU status were significantly associated with the choice of grade of footwear as displayed in Table 4. The other variables such as age, ethnicity, and duration of diabetes were not significant.

Multiple logistic regression analysis was performed to identify associated factors influencing poor grade footwear choice. The statistically significant factors were sex and the presence of DFU. The Hosmer-Lemeshow goodness of fit test suggested that the model was fit [Chi square: 6.10 (p=0.64)]. The overall percentage of the classification table was 82.8%. The area

under the Receiver Operating Characteristics (ROC) curve was 0.852 (95% CI 0.79, 0.92). There was no multicollinearity and interaction found.

Female diabetics have 6.84 higher odds of poor grade of footwear choice as compared to males (95% CI 2.95, 15.89, $p=<0.001$). Diabetics with active DFU's had 5.51 higher odds of poor footwear choice as compared to those with no active DFU (95% CI 1.69,17.95, $p=0.005$).

Table 4: Factors Associated with Poor Grade Footwear Choice among Diabetic Patients in USM Hospital.

Variables	Crude OR (95% CI)	*p*-value[a]	Adjusted OR (95% CI)	*p*-value[b]
Age	0.98 (0.95, 1.02)	0.3111		
Sex:				
Male	1.00		1.00	
Female	5.76 (2.73, 12.514)	<0.001	6.84 (2.95,15.89)	<0.001
Ethnicity:				
Malay	1.00			
Non-Malay	0.72 (0.27,1.93)	0.512		
Education Level:	1.00			
Below tertiary	0.44 (0.22, 0.87)	0.022		
Tertiary & above				
Household income	1.00 (1.00, 1.00)	0.001		
Duration of diabetes	1.01 (0.96, 1.05)	0.774		
Presence of active DFU:				
No	1.00		1.00	
Yes	6.33 (2.13,18.74)	0.001	5.51 (1.69,17.95)	0.005

[a]Simple Logistic Regression
[b]Multiple Logistic Regression.

4.0 Discussion

Our study discovered that more than 71.3% of diabetics wore poor grade footwear. In the United Kingdom it was observed that 72% (Burns et al., 2002) wore incorrect footwear size and 74% in the United States (Nixon et al., 2006) among the elderly group. In Thailand, 50% of women and 34% of women wore shoes that were too narrow (Chaiwanichsiri et al., 2008). In Malaysia, the probable cause of the high number of diabetics wearing poor grade footwear may be due to the hot climate. People here tend to wear more open footwear.

Open footwear was automatically classified as poor grade and injurious for diabetics based on the footwear assessment. Classification based on Tovey's criteria also classifies open footwear as dangerous. Open backed footwear (such as open sandals with forking and without back support) can result in injury to the skin around the heel and usually require the individual to claw their toes in order to keep them on, increasing risk of ulceration and is not recommended (Bergin et al., 2013).

The different types of footwear based on categories (open sandals with forking, straps with and without back support, closed shoes with and without laces and orthotic or custom-made shoes) among the respondents in this study revealed an almost similar preference as compared to a study in India (Chandalia et al., 2008). This may be attributed to the similar climate in both regions. There is also resemblance in culture. In both studies, respondents preferred open footwear. Customarily, people in India and Malaysia generally remove their footwear before entering houses. Some shops and offices also require you to remove footwear as well.

Majority of diabetics (71.4%) in this study were Malay Muslims who performed prayers five times a day to fulfill their religious obligation. Places of worship such as mosques and temples (Hindu and Buddhist) in Malaysia and India require individuals to be barefoot. Therefore it is easier to slip in and out of open sandals as compared to closed shoes; as removing and putting on footwear is required throughout the day.

Only 1.7% of the patients were wearing orthotic or custom made shoes. Diabetics who required medical grade footwear may have found the cost prohibitive. Some countries, assist those who cannot afford to be eligible for government funding, aiding them to acquire medical grade footwear for themselves (Bergin et al., 2013).

There were seven associated factors assessed in this study. Sex was found to be significantly associated with poor footwear choice. It was seen that from all diabetics with poor footwear, 64.5% were females. The study in Australia observed the similar trend that more women chose to wear poorer quality shoes, however the factor was not statistically significant factor (p=0.06) (Nancarrow, 1999). 92 (almost 70%) women recruited in this research were unemployed. This reduced their ability and liberty in choosing and purchasing suitable footwear for themselves. Another reason for this scenario in women, may be due to the perception that high heels and open sandals are more fashionable as compared to closed flat shoes with laces or straps. In most workplaces, men are compelled to wear closed shoes as a work regulation; this rule does not necessarily apply to women. Therefore, men were found to be wearing better grade footwear as compared to women.

It was also seen that those with active DFU's were at greater risk of wearing poor footwear. For optimal healing of foot ulcers, diabetics are advised not to weight bear, as constant

pressure on the ulcer makes healing difficult. Patients should be prescribed special footgear, brace and casts or opt to use a wheelchair or crutches. These devices reduce pressure and irritation to the ulcer and speed up the healing process. In the study centre, services provided were aimed and specialized more towards limb orthoses post amputation.

In this study, 91.7% of diabetics with foot ulcers were still found walking in poor grade and open footwear. It is challenging to fit their affected foot into an off the shelf shoe. After dressing and bandaging the ulcer, the only footwear option that they were left with was open or poor footwear. From another perspective, many of those who wore poor footwear eventually developed of DFU's. Therefore, the poor footwear choice persisted even after experiencing the ulcer formation.

Age, ethnicity, level of education, occupation categories, household income, duration of diabetes and history of footwear education were not associated with poor footwear choice. The mean income for those who were in optimal, good and fair footwear was higher (RM4167.00) compared to those with poor footwear (RM 2468.95). However, it was not statistically significant. Orthotic and custom-made shoes, good materials such as leather, good cushioning and architecture plus fulfilling all requirements for optimal footwear come with a price and may not be affordable for many.

Age was not a significant factor in this study. These findings coincide with the study by Desalu et al., 2011 in Nigeria. The mean age of those with poor and non-poor footwear was 58.6 and 60.6 years respectively. Level of education was not a significant factor and this was in line with Nancarrow, 1999. Ethnicity and occupation categories showed no relationship with footwear suitability.

This study was able to capture the magnitude of poor footwear choice among diabetics and understand the associated factors as well as reinforces the need for effective intervention programs highlighting the importance of footwear as a part of primary prevention of DFU's.

There were a few limitations in this research as it was a cross-sectional in nature, therefore determination of whether the poor footwear was the antecedent, or was consequent to the DFU remains a challenge. A prospective study design would have been able to rectify this drawback. There was a limitation in literature review as there was scarce information and published journals on predictors associated with footwear choice among diabetics. This research could not include various footwears worn by the individuals as the Footwear Suitability Scale was designed to evaluate particularly footwear worn at the time of assessment.

5.0 Conclusion and Recommendations

In conclusion, footwear although not a panacea for the development of DFU's, requires consistent education and efforts from healthcare providers in reinforcing the significance of the role of footwear suitability. Various prophylactic strategies via a multidisciplinary approach is obligatory as an impetus in diminishing the incidence of foot ulceration and resolving this debilitating complication. DFU's steals not just limbs, quality of life but potentially life itself.

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Declaration

All authors declare no conflict of interest in this study.

Authors Contribution

Author 1: Study concept, data collection, data analyses, writing
Author 2: Supervision, study concept
Author 3: Study concept, data collection
All authors read and approved the manuscript prior to submission.

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