ISSN 214-453-2

A STUDY ON PREFERRED FOOTWEAR FASTENING MECHANISM FOR THE PREVENTION OF DIABETIC FOOT COMPLICATIONS

J. I. TAGANG[1] AND R. C. CHEN[2]

[1] Footwear Technology Department, Nigerian Institute of Leather and Science Technology, Zaria, Nigeria

[2] School of Design, Faculty of Art, Design and Humanities, De Montfort University, Leicester, UK.

[jerrytagang@yahoo.com]

ABSTRACT

Use of appropriate footwear among people suffering with diabetic foot complications has been well documented to play a vital role in the prevention and treatment of established foot diseases. The incidence and prevalence rates of diabetes in Africa are increasing and foot complications are rising parallel. However, there is a paucity of literature on the role of people suffering with diabetics in ensuring the use of appropriate footwear in the management of diabetic foot complications. This paper explores current practice in the use of appropriate footwear among patients with diabetes mellitus in Kaduna State, Nigeria. The study was carried out at different hospitals in Kaduna State. A self-administered structured questionnaire was developed. The questionnaire was divided into two sections: Demographic and footwear questionnaire. The footwear questionnaire focused on three themes: Diabetic foot problems, type of footwear worn by diabetic patients frequently and the role of proper footwear fastening mechanism in the prevention of diabetic foot complications. The findings indicate that up to 77% females and 62% males' respondents used footwear that do not have any form of fastening or are slip-on footwear. Lace-up shoes were used by 28% of the male participants and only 12% of female patients used a similar type of footwear. Footwear with fastening mechanism were the least popular type of footwear used by the research subjects. This study shows that the use of appropriate footwear in the management of diabetic foot complications in this part of the World is suboptimal.

Key Words: *Diabetics, Foot complications, Footwear, Footwear fastening mechanism.*

1.0 Introduction

This study investigated the most preferred footwear fastening mechanism for diabetic foot. The incidence and prevalence rates of diabetes in Africa are increasing and foot complications are rising parallel. Nigeria is Africa's most populous nation which also has the highest number of people (up to 3 million) suffering with diabetes in the continent (IDF 2013). This is related to the lifestyle of the people which is changing including diet. Many urbanites are embracing Western way of living. There is however lack of adequate knowledge about the role of footwear in the management of foot related problems among diabetic patients in the country.

Wright (2010), Levin and O'neals (2008) revealed that diabetic foot syndrome is one of the most devastating complication affecting both the quality of life and health care utilization. It is the leading cause of lower limb amputation, generally preceded by foot ulcers and gangrene (Bergin, et al 2013). In addition, it has been revealed that a significant number of diabetic patients are reported to have foot problems and these are related to the wearing of ill-fitting footwear (Torreguitart, 2009).

Furthermore, foot problems are seen as the major complication of diabetes (National Diabetes Fact Sheets 2011; Vernon 2007). Some Krentz and Bailey (2001); World Footwear (2008); Johnson and Rogers, (2011) pointed out that people suffering with diabetes could easily develop foot problems because of how easily nerve damage can occur there without immediate detection. This usually leads to loss of blood flow, and subsequently numbness to the extremities. Consequently, infections may go entirely unnoticed until it spreads beyond repair. This condition can also have a significant effect on wound healing and management (White 2010). Therefore, it is advisable that people with diabetes should be more vigilant to prevent injuries that are more likely to damage their feet (Kennedy 2010; World Footwear 2006).

However, Nather and Signh (2008) have pointed out that diabetic foot complications may be prevented and minimized with early diagnosis, good patient education, effective treatment and the use of quality footwear. The literature has shown that prescription of diabetic footwear leads to a reduction in new foot ulceration and as a result, a reduction in lower extremity amputation rates.

An important consideration in the choice of footwear is in the area of how to manage shoe fastenings. Some people find it difficult or impossible to fasten their shoes for a variety of reasons. They may be physically incapable of reaching their feet because of obesity, paralysis, arthritis, may be unable to see sufficiently well; they may have lost one or more fingers, or they may have lost a hand or an arm; or lack of co-ordination, and many other reasons too many to mention here. The development of appropriate footwear for people suffering with diabetes requires so many considerations including footwear style or design, fitting/ fastening mechanism, comfort factors, cultural and environmental issues. Some of the common

footwear fasteners used are; laces, a transverse strap and buckle, Velcro (figure 1). Therefore, this work was aimed at understanding the role of proper footwear fastening mechanism in protecting the diabetic foot from complications.

(a) Lace up shoe

(b) A shoe with velcro fastening mechanism

(c) A Half-shoe

(d) Slippers

Fig.1. Different footwear with (a and b) or without (c and d) footwear mechanism.

2.0 Materials and Methods

A cross-sectional descriptive study was conducted at different hospitals in Kaduna, Nigeria. People suffering with diabetes mellitus were invited to participate in the study. The study was approved by the research ethics committee at the Ministry of Health, Kaduna State and at Ahmadu Bello University Teaching Hospital, Zaria Nigeria. Participants at the beginning of the study were given information on the nature of the survey, the participants' right to withdraw from the study at any time, and the confidentiality of the personal data provided. In order to maintain confidentiality, questionnaires were made anonymous.

A self-administered structured questionnaire was developed. The questionnaire was divided into two sections: Demographic and footwear questionnaire. The footwear questionnaire focused on three themes: Diabetic foot problems, type of footwear worn by diabetic patients frequently and the role of proper footwear fastening mechanism in the prevention of diabetic foot complications. The questionnaire included a range of open-ended questions as well as closed questions with the answer options. Data were processed and analyzed using Microsoft Excel 2007. Simple descriptive statistics were used (frequency with percentage distribution for categorized variables).

In addition, a Standard Operating Procedure (SOP) was designed and used for the study. It consisted of structured questions that helped the researchers to identify the locations of the research participants. In addition, it was also used to guide the researchers in step by step conducting of the survey.

3.0 Results

Overall, 180 questionnaires were given out to people living with diabetes and 164 were collected back, giving a response rate of 91.1%. However, 8 were rejected or excluded from the analysis because they were not properly completed. Therefore, 156 (75 male and 81 female) filled questionnaires were analyzed and the results presented below.

The demographic profile of the participants is shown in table 1. The findings are shown as percentages with n=156 for both males (48%) and females (52%) participants. The findings indicate a wide spectrum of different age groups who are suffering with the disease. Half of the participants are 51-65 years and those that are between 36 years and 50 years accounts for 31% of the respondents. Therefore, eighty one percent of the participants are less than 65 years of age.

Table 1 has also shown that up to 31% of the respondents were employed and 27% are engaged in their own businesses. Eighteen percent of those that participated in the study were housewives. The majority (81%) of the patients involved in the survey live in towns, whereas only 19% live in rural areas. This is because most of the survey was carried out in urban hospitals.

When patients were questioned about type of diabetes they were suffering with, up to 67% reported that they did not know, while 28% state that they were suffering with type 2 diabetics and only 5% reported that they have type 1 diabetes.

It has been discovered (see table 2) from this study that up 60% of the respondents were suffering with one form of foot complication or the other. It was also found out that 71% of the patients find it difficult to put on shoes or to take off shoes. In addition, 75% of the respondents do not receive information about the type of footwear they should wear most often while up to 75% do not receive information on the issue.

The results presented in figure 2 has shown the top two footwear type worn by the female respondents are slippers (53%) and sandals (19%). For the male participants, up to 37% wear slippers most often and 29% use sandals most times. None of the patients used custom-moulded footwear. Only 17% male and 13% female respondents wear shoes. This is seen as a very poor result because diabetic patients are expected to use footwear that gives good instep support.

With regards to shoe fastening, figure 3 provides information on the preference for the different types of shoe fastenings or otherwise. The findings indicate that up to 77% females and 62% respondents used footwear that do not have any form of fastening or are slip-on footwear. Lace-up shoes were used by 28% of the male participants and only 12% of female patients used a similar type of footwear. Footwear with buckle and Velcro fastening were the least popular type of footwear used by the research subjects. The selected comments made by the research participants give an insight into

the importance of footwear fastening mechanism for the diabetic foot.

Table 1. Demographic profile of participants (Diabetic patients).

Enquiry		Males % (n=75)	Females % (n=81)	Overall % (n=156)
1. Sex		48	52	100
2. Age (years)	≤ 20	0	0	0
	21-35	08	05	06
	36-50	24	42	33
	51-65	49	38	44
	≥ 66	19	15	17
	Mean	55.3	52.9	54.1
3. Occupation	Employed	34	28	31
	0wn business	23	31	27
	Unemployed	03	03	03
	Retired	23	05	14
	Student	0	0	0
	Farmer	15	0	07
	housewife	NA*	33	18
4. Residency	Rural	16	22	19
	Urban	84	78	81
5. Type of diabetes	type 1	07	04	05
	type 2	36	20	28
	Do not know	57	76	67

Table 2. Diabetic foot problems/ footwear features.

	Males (n=75)		Females (n=81)		Overall (N=156)	
Enquiry	**Yes** (%)	**No (%)**	**Yes (%)**	**No** (%)	**Yes (%)**	**No (%)**
1. Patient suffering with foot problems like ulcer, blisters, wound, etc.	44	66	35	65	40	60
2. Regular shoes not able to accommodate patients' feet due to foot problems.	38	62	30	70	34	66
3. Find it difficult to put on shoes or to take off shoes.	31	69	28	72	29	71
4. Receive information about type of footwear to wear most often.	25	75	34	66	25	75

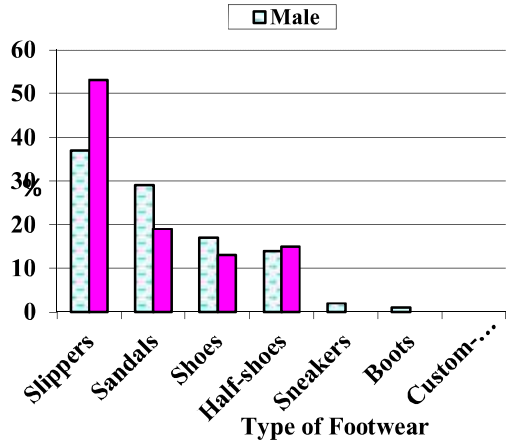

Fig. 2. Type of footwear most often used by participants.

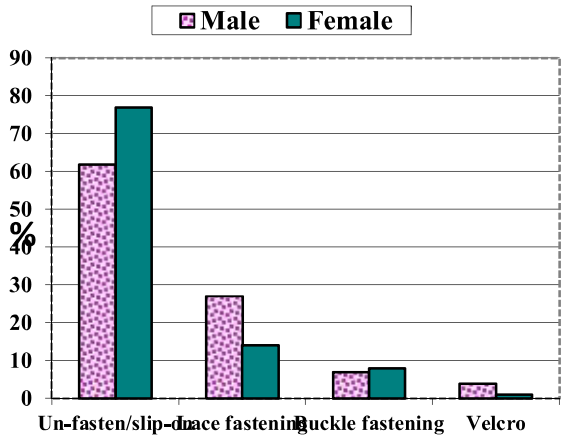

Fig.3. Footwear used most often with regards to footwear fastening mechanism.

Table 3: Shoe features that diabetic patients should be aware of when purchasing footwear.

Shoe feature	Criteria for choosing appropriate footwear feature
Upper part of shoe	These should be made from leather or a combination of materials (such as those used in sports shoes) with smooth inner lining and without bulky seams at the toe area.
Correct length	1 cm from end of the longest toe when the patient is standing.
Correct depth	Should accommodate all the toes without causing pressure.
Correct width	The side of the shoe should not bulge over the sole when worn.
Low heels	Should be less or equal to 2 cm.
Fastening	Adequate fastening such as laces or straps to keep the foot from sliding forward.
Cushioned outer and inner soles	Approximately 0.5- 1 cm thick under the forefoot.
Enclosed	Shoes with an open back 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, also increasing risk of ulceration.
Soles	Should not be slippery.

Adapted from Bergin, SM et al (2013).

Selected comments made by the participants.
Selected comments made by the research participants during the questionnaire survey are given below.

The simple comment I have is that, at times one foot may be bigger than the other due to swollen, so something like elastic grip can be considered on slip on shoes.

Sometimes I walk barefooted without knowing because my shoes can go off my feet and I will not know.
I use slippers and even the slippers go off my feet without knowing that they have gone off my feet
My ulcered foot caused by diabetes has deprived me from wearing any type of shoes I like.
Diabetes have spoiled my legs (more to the left) and now I can't wear shoes
My condition has made me scared of wearing shoes, less my feet get blistered and wounds.
I was using a half shoe with socks, which latter resulted to the injury on my left toe.
The gangrene on my right big toe and the swollen condition of my right foot as a result of diabetes has prevented me from using shoes as I would.
Because of the wound on my left foot, I find it difficult to put on shoes.

4.0 Discussion
The findings presented in this paper points out the need for appropriate footwear and footwear fastening mechanism to prevent foot complications in this part of the world. Research (Tagang, 2014) has shown that majority of diabetic patients are reported to have foot problems and these are related to wearing of inappropriate footwear. This contributes significantly to the susceptibility of the diabetic foot to injury and ulceration. Diabetics and diabetic foot disease with its related morbidity and mortality have become a serious global burden. The prevalence rates of the disease in Africa are increasing and foot complications are rising parallel (Abbas & Archibald 2007). Therefore, Jannink and his colleagues (2004) advocate for regular use of proven therapeutic interventions (footwear) in the prevention of diabetic foot complications. They pointed out that it is possible to reduce amputation rates by between 49 to 85% through a foot care strategy that combines the following: prevention, a multidisciplinary approach in the use of appropriate footwear, close monitoring, and the education of people with diabetes and healthcare professionals.

According to Boulton and Jude (2004), footwear is probably one of the major reasons for the lack of progress in reducing foot ulceration and amputation rates. In agreement with their assumption, up to 75% of the diabetic subjects that participated in this study reported that they have not received information about the type of footwear they should wear most often. Comments made by the research participants have further proven that footwear cause and/ or complicate their foot problems.

An important finding of this study is the nature or type of footwear worn by diabetic patients in this part of the world. Our data give a very poor choice of footwear by people suffering with diabetes (fig. 2). Poor knowledge of the diabetic foot complications and lack of knowledge of the management of the disease are seen as the major reasons for the high percentage of diabetic patients experiencing foot complications in the region. Therefore it has been advocated that patients' education on avoidable complications of diabetes and awareness of appropriate footwear for maintenance of good foot health should be emphasized by health care providers (Chandalia et al. 2008).

In this study, patterns of footwear were generally similar for both men and women except for more frequent use of open toe footwear (slippers) by women. In addition, up to 66% of people suffering with diabetes may be wearing footwear that does not have any form of fastening. It was also observed that the type of footwear considered most appropriate for diabetic patients to use (For example custom molded, sneakers, shoes etc) were the least frequently worn. This finding is similar to an earlier study which revealed that provision of professional diabetic foot care services and the use of protective diabetic footwear were sub-optimal in both

developing and developed countries. Rubbing from footwear was identified as the definite cause of 35.0% of foot ulcers (Bergin 2013; Ferguson 2012; Abbas & Archibald 2007).

The consistent use of appropriate footwear is important in all diabetic patients, especially those who demonstrate loss of protective sensation from peripheral neuropathy. These patient groups, who are unable to feel pressure and/or pain caused by inappropriate or ill-fitting shoes are more likely to develop blisters, callus and corns. These early complications require prompt intervention if ulceration and potential amputation are to be avoided. The simple measure of wearing appropriately fitted or prescribed footwear has been shown to significantly reduce plantar foot pressures, therefore decreasing the likelihood of developing callus and ultimately ulceration (Bergin 2013). Custom-made footwear (e.g orthopaedic shoes) is seen as appropriate footwear that could be prescribed to a wide variety of patients to diminish or prevent foot problems (Sharma and Kerri 2000).

These findings brought out a very poor choice of footwear made by both male and female diabetic patients in Nigeria. The frequent use of slippers and inappropriate footwear has serious consequences like susceptibility of the patients' feet to injury and infection. This situation requires a joint effort on the part of the health care providers and the footwear industry. However, to reduce foot problems, patients should be given education by clinicians about foot care in order to improve their choice and selection of footwear.

It was discovered that majority (66%) of the patients may be wearing footwear that do not have any form of fastening. That is, most of them are using slip-on or slippers with no fasting mechanism most often. It is really regrettable to observe that footwear with important fastening features like lace, buckle or velcro are the least likely type of footwear to be used by diabetic patients in Nigeria (see fig. 4.10). A respondent comment that, "too loose footwear sometimes get off my feet unaware". This comment demonstrates the importance of wearing footwear with a fastening. In addition, Chandalia et al. (2008) and Shiu & Wong (2011) argue that use of inappropriate footwear like slippers without back strap predisposes patients to foot injury.

To change the dreadful situation of diabetic foot complications, identification of a foot problem by clinicians must be followed by appropriate treatments including prescription of appropriate footwear. Also, to help patients make informed choices of self-care, particularly in relation to footwear, health care providers should always give diabetic patients relevant information and assistance on how to recognize (Table 3) footwear broadly suitable to the maintenance or improvement of foot health and the type of footwear that should be avoided as being potentially detrimental (Stimpert, 2014) . It is also very important that healthcare professionals support and stimulate research in establishing diabetic footwear programmes in the country.

Velcro, which looks like two opposing strips of coarse velvet and adheres on impact, may be used by people living with diabetes. One of the great advantages of using Velcro is that it can be made to work without any precision of touch, even by means of the pressure of one foot upon the other.

Even though it could be argued that this research was carried out at different hospitals in Kaduna State, Northern Nigeria that admit patients from different regions of the country, still, generalizations of the findings of this study should be made with caution. For a complete view of the subject matter in Nigeria, a similar study should be carried out in different regions of the country. In addition, there is a lack of perspective of health professionals. Therefore, to further obtain valid data on the role of appropriate footwear and footwear fastening mechanism in the prevention of diabetic foot complications, their views should be included. However, we believe that publication of these findings will serve as a catalyst for further studies in the subject area, where health professionals and researchers can evaluate the extent to which appropriate footwear can prevent foot complication among diabetic patients.

5.0 Conclusion

In summary, this study demonstrates that the use of appropriate footwear in the prevention of diabetic foot complications is suboptimal. Generally, the patients' knowledge about diabetes and its complications, foot care, the use of appropriate footwear, etc was found to be very poor. The findings indicate that majority of those that participated in the research worn improper footwear (i.e wrong styles of footwear and without shoe fasteners). The authors conclude that healthcare professionals and researchers support and stimulate research in establishing a diabetic footwear programme in this part of the World. It is believed that this will lead to improved outcomes for patients at risk of diabetic foot challenges.

References

Achigbu, E. O; Oputa, R N; Achigbu, K. I and Ahuche, I. U (2015) Knowledge and impact of diabetes in patients in a tertiary clinic in Southeast Nigeria. Africa Journal of Diabetes Medicine, Vol. 23, No. 1. PP. 1-3. Available at: http://www.africanjournalofdiabetesmedicine.com/articles/may_2015 (Accessed on 15/03/16).

Abbas, Z. G. and Archibald, L. K. (2007) Challenges for management of the diabetic foot in Africa: doing more with less. International Wound Journal, 4. (4), pp. 305-313.

Bergin, S. M, Nube, V. L, Alford, J. B, Allard, B. P, Gurr, J. M, Holland, E. L, et al. (2013) Australian Diabetes Foot Network: Practical guideline on the provision of footwear for people with diabetes. Journal of foot and ankle research, 6 (6).

Boulton, A. J. M. and Jude, B. E. (2004*) Therapeutic Footwear in Diabetes.The good, the bad, and*

the ugly? Journal of American Diabetes Association, 27 (7), pp.1832-1833.

Chandalia, H. B, Singh, D, Kapoor, V, Chandalia, S. H, Lamba, P.S. (2008) Footwear and Foot Care Knowledge as Risk Factors for Foot problems in Indian Diabetics. International Journal of Diabetes of Developing Countries. 28 (4) pp. 109-113.

Ferguson, T. S. (2012) Foot Care and Footwear Practices in Patikents with Diabetes: Simple interventions and adherence to guidelines may be limb saving. West Indian Medical Journal, Vol. 61, pp. 657-658.

Jannink, M. J, Van Dijk, De Vries J, Grootholf J. W, Lankhorst G. J. (2004) A systematic review of the methodological quality and extent to which evaluation studies measure the usability of orthopaedic shoes. Clin Rehabil. Issue 18, PP. 15-26.

Johnson, A. R. and Rogers, L. C. (2011) The venous leg ulcer complicated by diabetes: These lesions present a unique treatment challenge. Podiatry Management, August 2011. Available from: www.podiatrym.com. (Accessed 15/01/2012).

International Diabetes Federation (2013) Diabetes Atlas. [WWW] Available from: www.idf.org/diabetsatlas/5e/africa. (Accessed on 11/11/2013).

Kennedy, S. (2010) Choosing the right shoe. In motion Journal, 20 (2).

Levin, M. E. and O'neal L. W. (2008) Foreward. In: Bowker, J. H. & Pfeifer, M. A. (2008) Levin and O'Neal's, The diabetic foot. 7th Ed. China. Mosby Elsevier.

National Diabetes Fact Sheet (2011) Fast facts on diabetes. Centers for Disease Control and Prevention. National estimates and general information on diabetes and prediabetes in the United States, 2011. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2011. [WWW] Available from: http://www.cdc.gov/diabetes/pubs/pdf/ndfs-2011. (Accessed on 14/04/2012).

Sharma, D. L. and Kerri D. (2000) Practical management of neuropathic diabetic foot ulcers. The Diabetic Foot. 3 (2): pp. 49-54

Shiu, A. T-Y and Wong, R. Y-M (2011) Diabetes Foot Care Knowledge: A Survey of Registered Nurses. Journal of Clinical Nursing. Vol. 20. pp. 2367-2370.

Stimpert, D. (2014) About Shoes: Custom shoes and where to find trendy styles. E-mail. 14/2/2014.

Tagang, J. I, Pei, E, Chen C. R, Higgett, N, Dahiru, L. I, Ibrahim, A. (2014) The role of appropriate footwear in the management of diabetic foot: Perspective of clinicians in a low resource setting. Archieves of International Surgery. Vol. 4, Issue 1. PP.15-19.

Torreguitart, M. V. (2009) Education in the Care of Diabetic Foot (II). In: Viade, J. (2009) Digital Diabetic Foot. The Journal for the Diabetic Foot Care Taker. N0. 5, February 2009. pp. 27-32.

Vernon, W, Borthwick, A. M, Walker, J, Hardy, B, Dunning, D, Denton, C, Drew, C, Nunn, M. (2007) Expert Group Criteria for the recognition of healthy footwear. British Journal of Podiatry, 10 (4), pp. 127-133.

White, J. (2010) The Medicare Therapeutic Shoe Programme: New Challenges, New Opportunities. Podiatry Management. Available at: www.podiatrym.com . (Accessed on 5/3/2012)

World Footwear (2008) Diabetics demand footwear that fits. pp. 16-19.

World Footwear (2006) Aiding Diabetics. May/ June, pp. 26-27.

Wright, K. and Ojo, O. (2010) Foot care for residents with type 2 diabetes. Nursing and Residential Care, 12 (12), pp. 585-589.