Biomedical & Pharmacology Journal, June 2022. Vol. **15**(2), p. 1193-1200

Studying Proposes Requirements for Deabetics' Shoes in Viet Nam

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https://dx.doi.org/10.13005/bpj/2455

(Received: 19 January 2022; accepted: 28 March 2022)

Complications of Foot's diabetics such as foot pain, skin changes, callus, foot deformity, foot ulcer, amputation are common. Diabetic shoes play an important role in protecting the feet from injury. The article was based on the opinions of 412 female diabetic patients, 110 male diabetic patients and 20 doctors at medical centers on shoe evaluation criteria such as structural features, materials, and comfort. From that result, the requirements for diabetic shoes were proposed in Vietnam. This requirement is an important basis for the design and selection of suitable materials for diabetics.

Keywords: Deabetics' shoes; Proposing Requirements; Requirrements For Deabetics' Shoes.

Diabetic patients' feet often suffer injuries such as foot pain, skin changes, calluses, foot deformities, foot ulcers, foot amputation. Many studies around the world have demonstrated the effectiveness of using medical shoes in preventing injury and foot ulcers in diabetics[1, 2, 3, 4, 5]. Therefore, in many countries, such as in the United States, diabetics receive specialized shoes, also known as Therapeutic Shoes for Persons with Diabetes, depending on the condition of the foot as prescribed by the doctor and covered by health insurance[6]. Diabetics with mild complications of foot use shoes that are deep and wide, with 3 full degrees to ensure a good fit, choose the right type of insole. Feet with more severe complications use insoles designed and manufactured to the shape and size of the patient's sole. Footwear that is ulcerated, deformed, or severely injured is custom-made, but these shoes are expensive because of the need to design and manufacture individual shoe and shoe forms for each patient's foot[6, 7, 8].

In Vietnam, the number of people with diabetes is increasing rapidly. Diabetic patients not only increased sharply in urban areas but also increased sharply in rural, remote and isolated areas. In addition to using the right materials, to design and manufacture shoes that are suitable for use by diabetics requires a systematic approach from studying the anthropometric characteristics of the patient's foot. individual, setting shoe requirements, establishing a sizing system, designing and manufacturing shoe forms, designing patient shoes. Currently, in the world, new studies have proposed and recommended requirements for the form of shoes and shoes for diabetics, but there are no standards for this type of shoe[7, 9, 10, 11].

However, the use of protective and supportive shoes and sandals for the treatment of foot ulcers is still quite new for both patients and treating doctors. Therefore, researching and proposing requirements for shoes for diabetics in Vietnam is a necessary scientific and practical work, which is the basis for designing shoe shape, designing and manufacturing quality shoes. high for the patient.

Literature review

So far, in the world, there is no standard for diabetic shoes, many research works in the world have proposed for the design of this type of shoe.

In 2013, the group of authors[9] at Queensland University of Technology - Australia developed guidelines and recommendations for the use of footwear for diabetics and requirements for the specific classes of footwear:

• Uppers should be made of leather or some combination of materials (such as those used in sports shoes) with a smooth inner lining and no prominent seams at the toe area.

• Insole: At least 1 cm longer than the foot length when the customer is standing.

• Toe depth: Wide enough to accommodate the toes without putting too much pressure on: The edges of the shoe should not protrude much from the sole when walking (shoe width, use soles with wide edges)

• Heel height: Less than or equal to 2cm

• A shoe fixer on the foot: Use a suitable type such as shoelaces or adhesive sanders to keep the foot in place from sliding forward

• Outsole and inner lining: About 0.5 to 1 cm thick below the forefoot

In 2011, the research team[12] at the Vietnam Leather and Footwear Research Institute made the following requirements for shoes for diabetics:

• Low-cut or low-cut style shoes with laces or use emery tape to easily adjust the shoe to fit the foot.

• Shoes have a low heel of 1.5 - 2.5 cm to ensure normal pressure distribution, so the foot, sole and wide heel create stability for the patient when walking and standing.

• Shoes must fit the foot, have a high and wide toe to avoid local and overall compression of the foot.

In 2008, a study[13] of the authors Nather & Singh recommended that the weight of shoes for diabetics should be light, preferably less than 700g/pair and the sole height should be less than 5 cm.

According to John Giurini - Beth Israel Deaconess Medical Center[14], diabetics should choose and try on shoes as follows: the distance between the longest toe and the toe is ½ of the width of the thumb to allow space for toe movement. Slip-on design, the shoe has a width that fits the patient's foot, adding depth (height). It is recommended to choose soft leather as a material for producing shoes for diabetics, because it can stretch and breathe well. The inner lining should be made of thin leather material, because it has better absorption.

Research by the authors[7, 15] on the design of footwear for patients with foot disease has recommended:

• Shoes should not be too tight, should have adhesive tape or straps to easily adjust to the foot at all times.

• In the evening, shoes should be looser because the feet are swollen.

• The sole of the shoe should be made of rubber to avoid slipping.

• Heel height from 2 to 3 cm, wide sole design ensures stability.

The research group[10, 16] showed that: diabetic feet are suitable for shoes with hard soles and large toe lift. The principle of shoe design for diabetics is that when walking, the joints of the foot are least affected. The author also makes recommendations when designing footwear for diabetics:

• Low heel shoes to reduce pressure on the metatarsal head.

• There are few seams to connect the parts.

• Shoes should be wide and deep to accommodate insoles, and insoles should be changed frequently.

• Design features: beautiful, fashionable shoes to avoid the distinction between shoes for ordinary people and shoes for patients.

• Firm and resilient sole;

• Soft and breathable uppers, leather materials should be chosen;

• The opening of the shoe should use emery tape or lace;

• It is recommended to use environmentally friendly materials.

• Shoes should come in different widths (fillers) to accommodate large feet.

Research by Foto[11] suggests that for shoes

Table 1. Opinions about shoe characteristics

No	Shoes Details	Selection Criterias					
1	Shoe neck	Soft	Elasticity	Normal			
	Survey results (%)	32.1	53.2	14.7			
2	Shoe tongue	Soft	Elasticity	Normal			
	Survey results (%)	28.3	56.3	15.4			
3	Form of shoe cap toe	Wide (Oval)	Wide (Square)	Medium (Oval)	Medium (Square)		
	Survey results (%)	84.2	1.7	14.1	0		
4	Kind of shoes	Derby shoes	Lace-ups with elastic	Lace-ups with velcro	Lace-ups with zipper		
	Survey results (%)	4.3	45.3	38.4	2		
5	Height of rocker sole (cm)	0	0.5	1.0	1.5	2.0	2.5
	Survey results (%)	5	5	44.7	42.3	2	1
6	Hard Toe puff	Hard	Soft (resilience)				
	Survey results (%)	64.2	35.8				
7	Height of shoe heel (cm)	Flat shoes	1,0	1,5	2,0	2,5	3,0
	Survey results (%)	13.2	6.8	2.0	22.6	50.4	5.0
8	Kind of shoes	Sandal	Open-Shoes	Boat Shoes	Low-necked shoes	High-necked shoes	Loafer
	Survey results (%)	12.0	70.1	7.8	11.1	0	0
9	Thickness of shoe heel (cm)	0,5	0,8	1,0	Others		
	Survey results (%)	16.5	18.2	48.1	17.2		
10	The assembling method	Cemented	Sewing	Cemented and Sewing			
	Survey results (%)	33.9	2	64.1			

Table 2. Opinions about shoe materials

No	Shoes Details	Selection Criterias					
1	Upper	Leather	Woven	Knitted	Mix		Others
	Survey results (%)	56.1	0	20.4	23.5	0	
2	Lining upper	Leather	Woven	Knitted (padded foam)	Antibacteria	Antibacteria (padded foam)	Others
	Survey results (%)	4.0	1	1.5	58.3	35.2	0
3	Insole	Leather + Foam	Woven + Foam	Knitted + Foam	Antibacteria + Foam	Others	
	Survey results (%)	7.0	1.1	12.1	79.8	0	
4	Sole	Leather	Foam Rubber	Foam Ethylene Vinyl Acetate (EVA)	Foam Polyurethane (PU)	Others	
	Survey results (%)	2	28.6	19.2	50.2	0	

Table 3. Opinions about shoe comfort

No	Shoes Details	Selection Criterias				
1	Fitness of shoes	Tight	Normal	Litle Large	Others	
	Survey results (%)	0.5	64.3	35.2	0	
2	The softness of upper	Vers soft	Soft	Nomal	Hard	Others
	Survey results (%)	36.3	59.8	3.9	0	0
3	Hardness when being bent of the shoes	Vers soft	Soft	Nomal	Hard	Others
	Survey results (%)	8.1	84.3	7.6	0	0
4	Hardness of the materials to make sole	Very soft, resilience	Soft, resilience	Normal	Hard	Others
	Survey results (%)	43.4	45.2	9.4	2	0
5	Insole's features	Rough	Smooth	Normal	Others	
	Survey results (%)	0	14.4	83.6	2	
6	The place where shoes harm the feet	Heel	Ankle	Metatarsal Joints	Toes	Others
	Survey results (%)	16.3	17.3	53.8	12.3	0.3

for diabetics, attention should be paid to the volume and capacity of the material to withstand pressure and compression.

Materials for manufacturing shoes for diabetics must be well ventilated and ventilated (materials are capable of allowing air, water and steam to pass through); excrete foot sweat to the outside environment to create a dry feeling for the feet[17].

These recommendations are intended to guide the design of shoe form, design and manufacture shoes suitable for the specific characteristics of diabetic feet.

Data collection

Objects

In this study, we focused on surveying the opinions of diabetic patients from 30 to 70 years old about the requirements for shoes for patients.

Research Methods

• Using direct interview method: Respondents listen to questions and interact directly with the interviewer, so the interviewer can use long and complex questions, and can explain the content of the interview. Specific content of each question to avoid the case that the respondents misunderstood the question.

• Synthesize and analyze the results of the survey and document review.

Studying location and number of samples

The number of samples to be surveyed is calculated according to the formula[18]:

$$n = \frac{N}{1 + N(e)^2} \quad (1)$$

where: n – is the number of samples to be surveyed (diabetic patients); N – is total of diabetic patients7;

e - standard error, %; e = ±5%.

Based on the results of the first author's research[19], the article has additionally surveyed 412 female diabetic patients, 110 male diabetic patients and 20 doctors at medical centers of the Hung Yen province.

Survey Sheet

The survey sheet consists of two parts:

Part 1: Includes general information of the patient

Part 2: Record the patient's shoe selection criteria (characteristics of shoes, sandals, materials, comfort of shoes).

The content of the survey is presented in simple and easy to understand words, and there

Table 4. Requirements for diabetic shoes

Shoes Details		Requirements
Shoe characteristics	Toe box	Wide, rounded toe to avoid compression.
	Outsole	Be at least 1 cm longer than your foot length
	Heel heigh	From 2 to 3 cm
	Shoes neck	Convenient to wear shoes, use velcro or elastic to keep the foot in place and not slide forward
	Insole	About 0.5 to 1 cm thick, the design follows the surface of the foot to help distribute pressure evenly.
	Sole	Wide, flat
Materials	Upper	Soft, breathable materials, avoid compression, reduce pressure, it is recommended to use knitted fabrics or a combination of leather and some materials used for sports shoes, the inner lining is smooth, antibacterial and no seams prominent joint at the toe position. Stretchy material ensures a snug fit when swollen and swollen in the afternoon.
	Insole	Soft, elastic, antibacterial.
	Sole	Friction, avoids slipping.
Comfort	Fitness	Shoes should fit the foot to avoid compression causing damage to the skin and blood vessels.
	VÇ sinh	Ensure the criteria of dehumidification, dehumidification, ventilation.
	Weight	Light, under 700 g/pair

are additional pictures of shoe samples attached to explain to the patient before filling in the form.

Study results, summary and contribution

Results of the survey

Summary of results of diabetics and doctors specializing in treating and caring for diabetic feet are summarized in Tables 1, 2 and 3.

• Summary of opinions on shoe characteristics

The combined results in Table 1 show that 70.1% of diabetic patients choose open shoes, especially no patients choose low-cut and high-heeled shoes. Most patients choose elastic loafers and rough loafers. These two types of shoes have the effect of firmly holding the foot, the rough tape allows to put on and take off shoes from the foot very smoothly, suitable for diabetics, especially those with foot diseases. 84.2 % of patients chose wide, rounded nose. The wide toe allows the toes to have good mobility in the shoe, without compression. A wide toe also means that the toe is short, so it is more convenient to walk than shoes with a narrow (long) toe. 50.4 % of patients choose a heel height of 25 mm, 23.6% of patients choose a heel height of 20 mm. Shoes with low heels often have wide, flat soles that ensure a steady gait for the patient. The low heel also facilitates even distribution of pressure on the soles of the feet, avoiding localized pressure concentrations on the soles of the feet that cause foot ulcers.

• Summary of opinions on shoe materials

The results of patients' opinions on materials used to make shoe uppers are summarized in Table 2, showing that: 56.1% of patients choose leather materials, 20.4% are knitted fabrics, 23.5% are a combination of types. materials, no patient choice of woven fabric. Leather material has good comfort properties such as moisture absorption, moisture release, form stability. However, compared to knitted fabrics, leather has lower elasticity, less ventilation and ventilation, and at the same time, the cost is much higher. The results in Table 2 also show that, 58.3% of patients choose antibacterial fabric for shoe uppers lining, 79.8% of patients choose antibacterial fabric + foam for insole. According to research[20], the rate of ulcers in the toes, between the toes (areas not subject to great pressure) in diabetics in our country is quite high, this may be related to the foot hygiene. action of bacteria when the feet are wet from sweat). Therefore, the study of using materials with antibacterial and deodorizing properties to make shoe uppers and insoles should be of interest. The use of soft, resilience insoles helps to reduce shock or increase the softness of the sole. In addition, the insole helps distribute pressure evenly on the soles of the feet, thus helping to avoid localized pressure concentration - the main cause of foot ulcers. Therefore, shoe insoles can combine antibacterial fabric + foam to increase the applicability of shoes for diabetics. In addition, 50.2% of patients chose a Foam Polyurethane sole material system.

• Summary of opinions on shoe comfort

The results in Table 3 show that, 64.3 % of the patients' opinions require the level of fitness is fit nomal the foot; 35.2% of patients' comments asked for shoes that are a bit wide, not tight. This opinion is also consistent with the recommendations[12] on shoes for diabetics: Shoes should fit the foot, have a high and wide toe to avoid local and overall compression of the foot, skin damage, and other injuries. blood vessels, nerves or scratching the skin. Table 3 data has shown that shoes cause damage to patients at the metatarsal joints (53.8%), ankle (17.3%), heel (16.3%), toes (12.3%), others (0.3 %). The toe part of the foot is covered by the shoe and is the most affected position with the shoe (due to bending the foot at the toe joint when walking, changing the size of the foot when bending). The forefoot of the sole has less shock absorption than the heel (due to thinner material), thus increasing the load on the toe of the foot. Therefore, the toe part of the foot injured by wearing shoes accounts for the highest percentage. Up to 83.6% of patients think that the insole surface should be normal, 14.4% of patients choose smooth insoles.

Commentation

The results of the research survey on requirements for shoes for women with diabetes showed that: The largest selection rate was the criteria of soft shoes, high and wide toe, heel up to 2.5 cm, insoles. soft, elastic, with straps and emery tape. The materials selected are mainly leather for the uppers, antibacterial fabric + foam for the uppers and insoles, and the soles of the shoes are elastic foam materials. Most patients choose shoes that ensure a good fit or are slightly wide

to create comfort when exercising. The opinions of the surveyed patients are quite similar to the recommendations and research results around the world on the use of shoes for diabetics. The results obtained from this survey are the basis for building requirements for diabetic shoes, in order to design and manufacture shoe forms, and to design shoe models that meet the requirements of the patient's use. appropriate to the socio-economic conditions of our country. The research results also show that the study using materials from knitted fabrics with good elasticity, softness, lightness, good ventilation and ventilation basically meets the requirements of patients. for shoes.

Proposed requirements for diabetic shoes

Based on the survey results on the requirements of diabetics for shoes for patients and the results of the literature review, the study proposes requirements for diabetic shoes (Table 4).

Thus, the proposed requirements for diabetic shoes are necessary data for the design of shoe form, shoe design as well as the selection of materials for diabetic shoes.

CONCLUSION

Being able to design and manufacture high-quality shoes for diabetics in our country, we need more scientific bases: from foot shape and size to converting them to calculated shoe shape and size. to a combination of factors such as changes in foot shape and size during use, design factors and use of shoes to determining shoe style, material construction, sole assembly method. Materials play an important role in the quality of a patient's shoe. The study has built requirements for shoes for diabetics, from the characteristics, materials, and comfort of shoes. This result is the basis for the production of good quality shoes that help to select the materials (according to the mechanical, physical, chemical and biological criteria) to make shoes for diabetics under atmospheric conditions. hot and humid climate of Vietnam.

ACKNOWLEDGEMENT

Authors of this study would like to thank Medical Centers in Hung Yen has assisted us in the experimental process to complete this study.

Funding source

This research is funded by Hung Yen University of Technical and Education under grant number UTEHY. L.2022.08

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