

Evaluation of Predisposing Factors for Recurrence of Diabetic Foot Ulcer in Patients Admitted to the Hospital

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ABSTRACT

Introduction: Diabetic foot ulcer is one of the complications of diabetes mellitus. Diabetic patients with diabetic foot ulcers may require long-term hospitalization and risk of amputation. Despite these challenges, few studies have been conducted on the risk factors for diabetic foot ulcers. The aim of this study was to investigate the risk factors for recurrence of diabetic foot ulcers.

Materials and Methods: This analytical study was performed on 370 patients who were admitted to the infectious ward of Besat Hospital from September 2020 to September 2021. After reviewing the patients' medical records, clinical examination and filling out the questionnaire, the results were statistically analyzed by LISREL and SPSS software version 16.

Results: In this study, the patients consisted of 67% female and 33% male. The mean age of patients was 50 years. Our findings revealed that the occurrence of diabetes mellitus in diabetic foot ulcers was significantly associated with blood pressure, cardiovascular disease, age and a history of more than 10 years of diabetes.

Conclusion: Based on the results presented in this study, blood pressure control, cardiovascular disease control, weight loss and necessary training can have a significant effect on reducing the recurrence of diabetic foot ulcers in patients.

KEYWORDS

Diabetic Foot Ulcer, Diabetes, Blood Pressure.

Introduction

Diabetes mellitus includes a group of common metabolic disorders that share the hyperglycemic phenotype. More than 140 million people suffer from diabetes in the world and its prevalence is estimated at 5 to 8% in Iran (1). Metabolic disorder caused by diabetes is associated with secondary pathophysiological changes in various organs of the body, which causes many problems for the diabetic patients and the health system. Complications of this disease are of two types, including microvascular and macrovascular (2). Microvascular complications include retinopathy, neuropathy, and macrovascular complications include foot ulcers, peripheral vascular disease, and inadequate foot ulcer healing (3). The number of annual cases of hospitalization due to diabetic foot is increasing due to peripheral vascular diseases in most cases (3, 4). Since the feet are part of the lower limbs, their sores are not easily seen and the patient notices these sores when they have entered the stage of inflammation. The severity of this neuropathy in diabetics is such that sometimes their feet burn due to contact with hot objects without realizing it (4).

Motor and sensory neuropathies of the foot leads to abnormal mechanics of the leg muscles and structural changes in the foot. Autonomic neuropathy leads to anhidrosis and altered superficial blood flow to the foot, accelerating dry skin and fissure formation (5). Peripheral vascular disease and impaired wound healing prevent the removal of small skin cracks, causing these cracks to become large and infectious (6). These classifications, along with vascular evaluation, determine the need for hospitalization, specific imaging, surgery or amputation, and the general outcome of patients. Deeper involvement, such as fasciitis, myositis, and osteomyelitis, increases the likelihood of surgical intervention, leading to increased treatment duration. Vasculopathy is also present in 20 to 30% of diabetic patients and more than 40% of people with vasculopathy have foot ulcers (7).

Diabetic foot ulcers affect the quality of life of these people and impose a huge burden on health care centers (8). Diabetic foot ulcers cause lower limb amputation in 85% of cases (8). Also, the mortality rate in diabetic foot ulcer patients is twice as high as in other diabetic patients. Therefore, it is very important to investigate the risk factors for re-infection of diabetic foot ulcers and its prevention (9). Therefore, the aim of this study was to investigate the predisposing factors for recurrence of diabetic foot ulcer in patients admitted to Besat Hospital in Iran.

Materials and Methods

This randomized clinical trial study was performed on 370 patients consisting 123 men and 247 women who were admitted to the infectious ward of Besat Hospital from September 2020 to September 2021. They were randomly included in the study after explaining the study conditions and obtaining informed consent. Exclusion criteria were no infection in the foot ulcer or mild infections. The study was performed based on face-to-face referral and review of medical records of patients. Various factors such as patients' wounds, severity of infection, depth of involvement, involved tissue, evidence of systemic infection, metabolic disorder, critical ischemia, fever, leukocytosis, progressive deep tissue infection, necrosis, gangrene and ischemia, and urgent need for surgical intervention were examined.

Factors affecting patients' recurrence of foot ulcers were investigated. Then, in order to determine the validity of the factors found and the correlation of these factors with each other, a researcher-made questionnaire was prepared and answered by experts (infectious disease physicians and experts and senior nursing experts). The validity and reliability of the questionnaire were confirmed in various studies (10). Structural equation modeling method has been used to analyze the data for testing the research hypotheses. The basic approach to performing factor analysis was summarized in Figure 1.

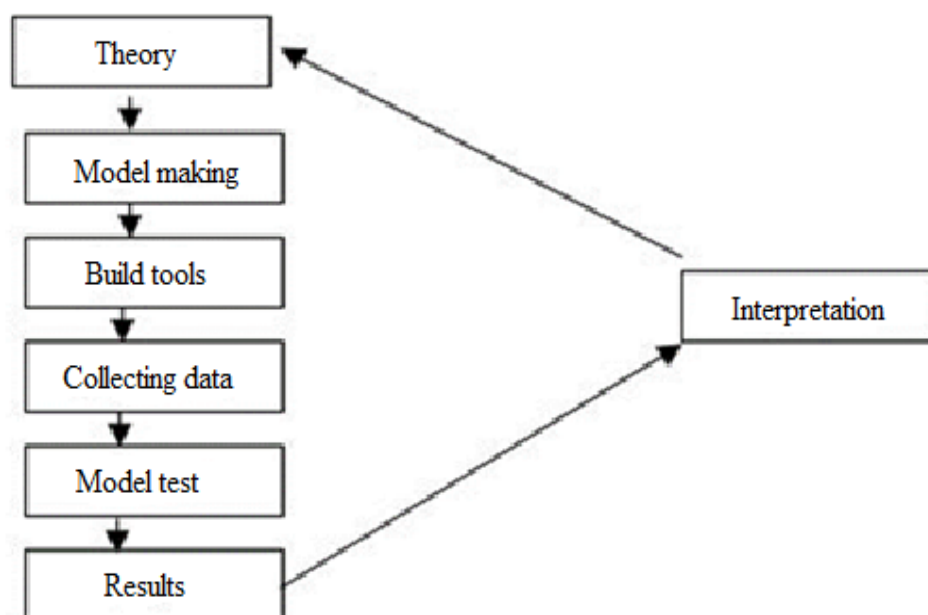


Figure 1. Shows the basic steps of performing factor analysis

Finally, the data obtained from the infectious ward of Besat Hospital were analyzed by SPSS software version 16 and the data obtained from the expert questionnaire were analyzed by LISREL software. Predisposing factors for re-infection of patients with foot ulcers were investigated.

Results

In this study, 67% of the patients were female (Table 1).

Table 1. Frequency distribution of respondents by gender

Line	sex	Frequency	percent
1	Male	123	33
2	Female	247	67
total		370	100%

Table 2. Frequency distribution of respondents by age

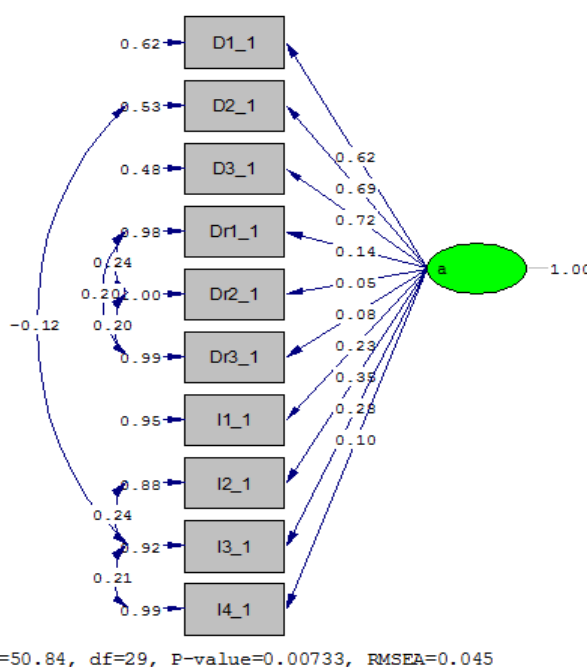
Line	Age range	Frequency	Percent
1	22-30 years	78	21
2	31-38 years	103	27
3	39-46 years	61	16
4	47-54 years	44	11
5	55 years and older	84	25
Total		370	100

In terms of education, most of the subjects (43%, 155 patients) had a master's degree or higher (Table 3).

Table 3. Frequency distribution of respondents by education

Line	Level of Education	Frequency	Percent
1	Diploma and Associate	72	19
2	Masters	143	38
3	Masters and PhD	155	43
Total		370	100

Using lisrel software, standard coefficients for the measurement model (for questions and their related variables) and structural model (path coefficients for the paths proposed in the model among the variables) were plotted (Figure 2).

**Figure 2.** Model of standardized research coefficients using LISREL software

Standardized loads are very important in interpreting the results of factor analysis. These times indicate the correlation between each observer variable (questions) and its related factors. To evaluate the fit of the model of this research, indices such as chi-square on degree of freedom (χ^2/df), root mean square error of approximation (RMSEA), P-Value, CFI index were used. Since in this study we were looking for hypothesis testing at the confidence level of 0.95 or error 0.05, numbers that were greater than -1.96 and +1.96 were considered to be significant for the t-test. This means that if the numerical t-test is between -1.96 and +1.96, it will not be significant. In the following model (Figure 3), the numbers obtained for t-test were significant. Exogenous variables also showed a significant relationship with observer variables (**lambda-matrix Y**).

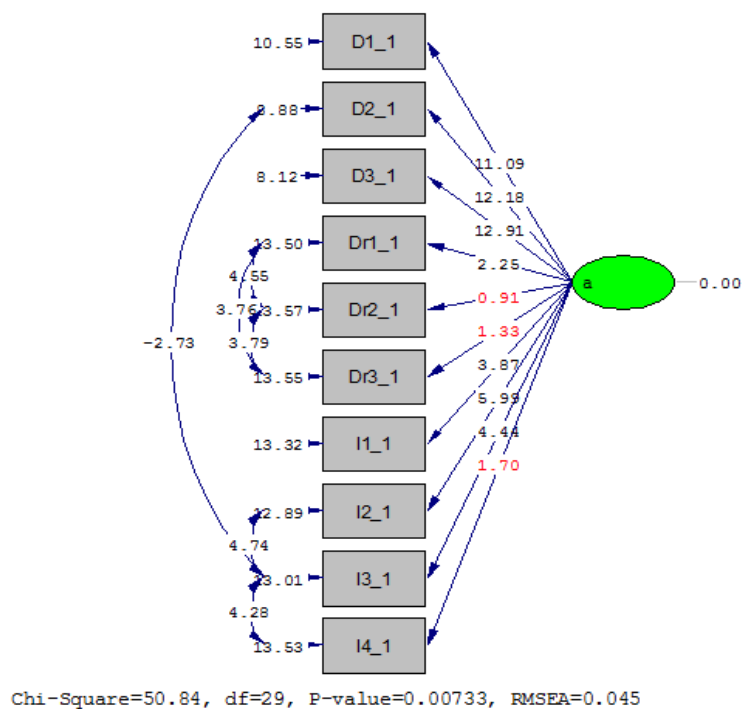


Figure 3. Model of T-coefficients using LISREL software

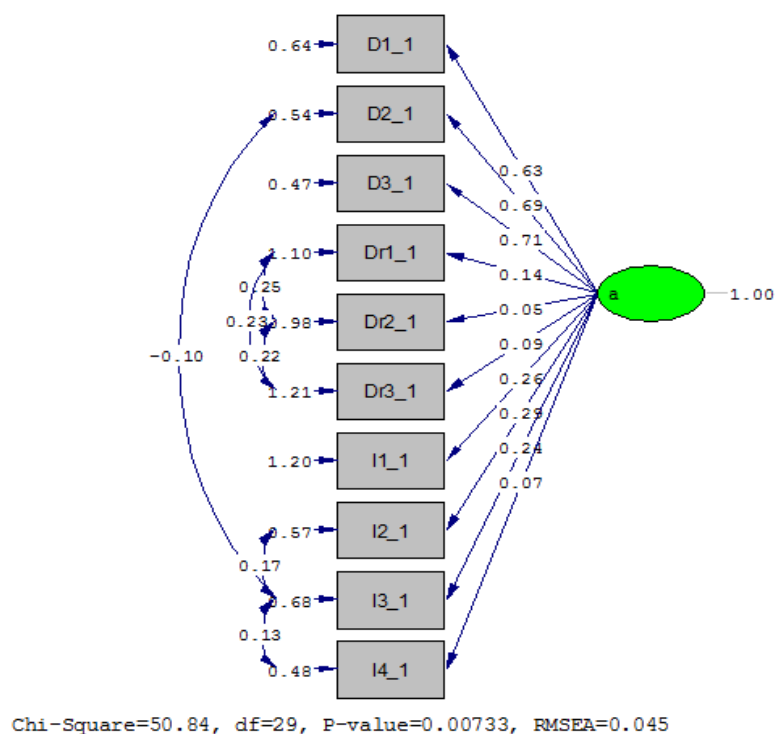


Figure 4. Model of non-standard coefficients using LISREL software

In the non-standard case, the regression coefficients were not homogeneous and there was no possibility to compare

them (Figure 4).

Table 4. Coefficient values (λ) and t-statistic of the model

T	Factor load	Items (observed variables)	Sub-factor
11.09	0.62	Q1	Having a history of high blood pressure
12.18	0.69	Q2	Having a history of high blood fats
12.91	0.72	Q3	Have a history of heart disease
2.25	0.14	Q4	Aspirin use
0.91	0.05	Q5	Consumption of statins
1.33	0.08	Q6	Clindamycin use
3.87	0.23	Q7	Male gender
5.99	0.35	Q8	Age over 65 years
4.44	0.28	Q9	History of more than 10 years of diabetes
1.7	0.1	Q10	Foot care

The value of t for all variables except statins, clindamycin and foot care was less than 1.96 (Table 4). Therefore, the relationship between the confirmed variables and the main factor was found to be significant, and therefore the explanatory factors are suitable for the variable.

Table 5. Ranking of factors based on factor load

T	Factor load	Items (observed variables)	Sub-factor
12.91	0.72	Q3	Have a history of heart disease
12.18	0.69	Q2	Having a history of high blood fats
11.09	0.62	Q1	Having a history of high blood pressure
5.99	0.35	Q8	Age over 65 years
4.44	0.28	Q9	History of more than 10 years of diabetes
3.87	0.23	Q7	Male gender
2.25	0.14	Q4	Aspirin use
1.7	0.1	Q10	Foot care
1.33	0.08	Q6	Clindamycin
0.91	0.05	Q5	Consumption of statins

According to the performed analyzes, factors such as being over 65 years old, history of heart disease, history of hyperlipidemia and high blood pressure were identified as predisposing factors for recurrence of diabetic foot ulcer, which were schematically mentioned in Table 6.

Table 6. Causes of recurrent foot ulcers in patients with diabetes

	Predisposing factors for recurrent diabetic foot ulcers		
Have a history of high blood pressure	Have a history of high blood fats	Have a history of heart disease	Being over 65 years old

Discussion

One of the most debilitating and costly complications of diabetes is diabetic foot ulcer, which has a 15 to 20 percent chance of occurring during a patient's lifetime. Diabetic foot ulcers, in addition to incurring costs, may lead to complications such as limb amputation and subsequent mental health problems as well as impaired mobility and quality of life (11). According to the American Diabetes Association, there are an estimated 324 million people with diabetes by 2025.

The prevalence of diabetes in Iran varies between 3 and 17%, depending on different regions (12). Studies show that 70-60% of patients with diabetes develop peripheral neuropathy and loss of sensation in the foot, up to 25% of whom will experience chronic diabetic foot ulcers (13). More than half of patients with chronic diabetic foot ulcers require hospitalization due to infection, and one in five hospitalized patients needs amputation (13). At present, a diabetic patient is amputated every 30 seconds due to diabetic foot ulcer problems (14). Studies in the country have shown

that the rate of amputation in hospitalized diabetic patients due to foot ulcers is about 30%. Although the exact incidence or prevalence of diabetic foot ulcers is not known, some studies indicated a prevalence of 5.3% and 5.8% in diabetic patients in the British and American communities, respectively, indicating a high prevalence in these communities (15). Also, the prevalence of amputated legs due to ulcers is 14 to 46 times higher than non-diabetic patients, which further highlights the need to pay attention to diabetic foot ulcers (16).

Bentley (2007) found that more than 50% of major amputations in the UK occurred in people with diabetes, half of whom died after three years (17). In 2011, Richard et al. Examined the causative agents of diabetic foot ulcers in a study in which 73% of patients were male and the mean age of the patients was 64.3 years (18). In another study conducted by the Jordanian National Center for Diabetes Endocrinology in 2012, 49% of patients were men and the mean age of patients was determined 52 years (19).

While the highest percentage of the population in our study was women (67%). A study by Bekele et al. on risk factors for foot ulcers in diabetic patients reported that re-infection of foot ulcers in diabetic patients was directly related to hyperlipidemia (20). In our study, it was observed that having a history of hypertension, having high levels of fat in blood, history of heart disease and aspirin use were directly related to re-infection of diabetic patients with foot ulcers. These results are consistent with the results of Bekele et al.

Richard also showed that the presence of peripheral vascular disease along with diabetic foot ulcer was associated with poor prognosis, which is consistent with our results.

In a study by Al Kafrawy et al., the average number of people hospitalized for foot ulcers was over 60 years of age with a history of more than 10 years with diabetes, which confirm our results because most of the subjects had a history of more than 10 years of diabetes in our study, which was directly linked to recurrent foot ulcers in these patients (21). This study was in complete agreement with previous studies on foot ulcers in diabetic patients and was complementary to them. It can also answer the questions and ambiguities of these patients. By observing such things as blood lipids, controlling blood pressure by patients and their families, it is possible to prevent patients from re-infection of foot ulcers to a large extent, resulting in reduction of the costs and economic burden imposed by these patients on hospitals and centers.

Conclusion

Although not all diabetic foot complications can be completely prevented, the incidence and incapacity of them can be greatly reduced by prevention and appropriate and scientific action, as well as reducing the complications and risk factors of diabetic foot ulcers. In other words, it seems that paying attention to strong risk factors in these patients; as well as education and periodic examinations can be a big step towards reducing the incidence of life-threatening complications in diabetic patients.

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