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Prevalence of Risk Factors for Egyptian Diabetic Foot Ulceration.

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Abstract
Background: *Diabetic foot ulcers (DFUs) contribute significantly to the morbidity and mortality of patients with diabetes mellitus. Foot ulceration is an important health issue with significant levels of disability, pain, and financial expense for those affected and the community as a whole. The diabetic patients with foot ulcers require long hospitalization and carry risk of limb amputation. The risk of ulcers is increased in people who have had diabetes ≥10 years, are male, have poor glucose control, or have cardiovascular, retinal, or renal complications. Fortunately, the modifiable risk factors for developing diabetic foot ulcers are preventable and manageable.* ***Aim:*** *The purpose of this study was to determine the prevalence of risk factors for foot ulceration in Egyptian diabetic patients.*
Settings*: this study was conducted at different areas comprising upper and Lower Egypt as well as delta region (Assiut, Elmina, Kena, Aswan, Alexandria, and Mansura)****.***
Subjects*: the study comprised a total of randomly selected one thousand adult diabetic patients with any type of diabetes, not taking any medications that might adversely influences their peripheral nerve function as chemotherapy and free from complications other than diabetes origin such as Parkinson's disease or Multiple Sclerosis.*
Tool*: One tool was used for data collection of this study: Modified Inlow's 60-second Diabetic Foot Screen. Two parts were attached to the study tool:*
Part I: *Patients Socio-demographic data (age, gender, marital status, education level, occupation, and area of residence) and Patient's related medical data.*
Part II*: Assessment of diabetic patient foot care related knowledge and Practices.*
Methods: *Descriptive correlational research design was used in this study.*
Results: *diabetic patients ages ranges from 18-65 years. The largest percentage (45.4) of patients was in age group of 50 years to less than 65. More than half (56.9 %) of the subjects had type 2 diabetes. More than one-third of the studied subjects (39.6 %) were smokers. Blood glucose levels of the diabetic subjects were elevated among two-thirds (64.4 %) of them. The findings of this study show that 38.9 % didn't understand the effect of diabetes on their foot health. More than half (58.2 %) of them couldn't identify appropriate foot care-related practices and already about (57.8) of the studied patients were not adequately cared for their feet. There are statistical significant differences between socio-demographic characteristics, medical data, assessment of patient foot care knowledge and practice and risk factors for studied subjects.*
Conclusion: *the current study shows that 47.9 % have potential risk for diabetic foot ulcer. It moreover, reveals that patients with elevated blood glucose levels were 2.9 more likely to have foot ulcer, patients with inappropriate foot care practices were 2.1 more likely to have foot ulcer, and patients from Elmenia (one of Egyptian governorates) were 41.9 more likely to have foot ulcer compared with patients with maintained blood glucose levels, patients with appropriate foot care practices, and patients from other studied settings. The lack of knowledge regarding diabetic foot problems, inappropriate footwear and the high prevalence of skin and nail pathology in the study population could explain these findings.*
Recommendations: *From the results of the present study it can be recommended that; nurses should instruct and emphasize the diabetic patients about the importance of knowledge and practices of foot care, appropriate footwear, podiatric care and regular follow up. Moreover, Nurses should adopt one of the low-cost effective and available strategies to identify the persons at risk for diabetic foot ulcers and the timely referral of those at high risk. Furthermore, formal and informal Organization of the Diabetes and foot-care service in Egypt should establish a global education programs that tailored to the patient's understanding and social background to manage an epidemic of foot abnormalities expected to be seen in the near future.*
Key words: *Prevalence - Risk factors - Foot ulceration*

I. Introduction

The number of people with diabetes is increasing due to population growth, aging, urbanization, and increasing prevalence of obesity and physical inactivity [(1)]. The International Diabetes Federation estimated that in 2013, 381 million people had diabetes mellitus [(2)]. This number is estimated to be almost doubled by 2030[(3)]. Egypt was ranked ninth in the world, where there are 7 million and a half million Egyptians are living with diabetes [(4)]. A systematic literature review of papers published on diabetes prevalence and complications in North Africa from January 1990 to July 2012 reveals that diabetes prevalence ranged from 2.6% in rural Sudan to 20.0% in urban Egypt [(5)]. Up to 15% of those with diabetes will develop a foot ulcer during their lifetime [(6)]. Diabetic foot ulcers contribute significantly to the morbidity and mortality of patients with diabetes mellitus. The diabetic patients with foot ulcers require long hospitalization and carry risk of limb amputation [(7)]. The risk of foot ulcers is increased in people who have had diabetes ≥10 years, are male, have poor glucose control, or have cardiovascular, retinal, or renal complications. In Egypt, there is scarcity of data on prevalence of such risk factors [(8)]. A number of low-cost effective strategies are available to identify the persons at risk for diabetic foot ulcers. These strategies must be more widely adopted by all diabetic care providers to maintain the integrity and function of the lower limb, and thus improve the health related outcomes for people with diabetes. A number of studies [(9-11)]and pre-post-design as well as the Center for Disease Control and Prevention (CDC) estimates that comprehensive foot-care programs that include risk assessment, foot-care education and preventive therapy, treatment of foot problems, and referral to specialists can reduce amputation rates by 45%-85% [(12,13)]. These programs have usually included a thorough foot risk assessment, special callus and nail care, customized footwear, wound care, and patient education provided by a multidisciplinary team with a special interest and expertise in the foot [(14, 15)]. A comprehensive examination of the foot, including an assessment of the neurological, vascular and biomechanical status is fundamental to identifying patients with risk factors and to implementing appropriate and timely interventions. One-year interval is the optimum interval for screening asymptomatic diabetic people has been suggested by experts, based on the natural history of neuropathy and peripheral vascular disease. However, routine foot examination and rapid risk stratification is often difficult to incorporate into eventful primary care settings [(16)]. Data suggest that the diabetic foot is adequately evaluated only for 12% to 20% of the time. It has now been 10 years since the position statement by the American Diabetes Association on preventive foot care in diabetes. Yet the data supporting the optimal application of such preventive care in Egypt remains unclear. All health care providers of people with diabetes including nurses should be able to conduct a simple foot screening exam of the neurological, vascular, dermatological, and musculoskeletal systems. Nurses, in particular, have significant opportunities to promote maintenance of healthy feet, identify emerging problems, inform patients of their risk status, and positively influence and support appropriate self-care practices [(17)]. Health care providers with interest in the diabetic foot may choose to obtain additional training and provide focused management of high-risk foot conditions [(18, 19)].

II. Significant Of The Study

Over 246 million people live with diabetes across the world. Previous amputation, past foot ulcer history, peripheral neuropathy, foot deformity, peripheral vascular disease, visual impairment, and poor glycemic control, in addition to cigarettes smoking as well as low self-care practices, neglected or inadequately routine foot examination and risk stratification at eventful primary care settings can lead to amplified risk for foot ulcers, which might result in 85% of all amputation. Egypt is currently in the top 10 countries with the highest number of people with diabetes. This research paper was done primarily at different Egyptian regions to shed the light on the high unnecessarily prevalence of risk factors for diabetic foot ulcer in our population which can be easily prevented, or even early identified by adopting effective, low-cost preventive strategies.

III. Materials And Method

Aim of the study: This study aimed to determine the prevalence of risk factors for diabetic foot ulcer at Egypt

Research Question:

Which risk factors have higher association with the development of foot ulceration among diabetic patients at different Egyptian region?

Research design: A descriptive correlational design was utilized to fulfill the aim of this study.

Setting: The study was conducted in diabetes out-patient clinics at a group of Governmental University Hospitals (Elmina, Assiut, Kena, Aswan, Alexandria and Mansoura). These hospitals serve both urban and their surrounding rural areas covering upper, lower Egypt and middle delta.

Subjects: A total of one thousand adult patients (both males and females) with any type of diabetes, not taking any medications that might adversely influences their peripheral nerve function as chemotherapy and free from complications other than diabetes origin such as Parkinson's disease or Multiple Sclerosis. They were randomly selected from aforementioned different Egyptian University Hospitals through one year (2014).Their ages

ranges between 18 – 65 years. The sample size was determined based on epi info program using 10 % acceptable error, 95 % confidence coefficient.

Tools: One tool was used for data collection of this study including: Modified Inlow's 60-second Diabetic Foot Screen checklist [20, 21]. This risk assessment screen was adopted from Inlow' s 60- second foot exam for people with diabetes [21]. It contains 12 parameters of foot assessment as the following**:**

The first – 20 seconds; look for skin, nails, deformity, and footwear

1. **Skin:** to assess the skin on the foot: top, bottom and sides including between the toes. Scores were given as the following: Zero denotes skin is intact and healthy. One denotes skin is dry with fungus or light callus. Two denotes heavy callus build-up and three denotes open ulceration or history of previous ulcer.
2. **Nails:** to assess toenails and to determine how well they are being managed either by the patient or professionally. Zero denotes nails well-kept, one denotes unkempt and ragged nails, and two denotes nails are thick, damaged or infected.
3. **Deformity:** Look for any bony changes that can put the patient at significant risk and prevent the wearing of off-the-shelf footwear. Zero denotes no deformity detected, 2 denotes that patient may have some mild deformities such as dropped metatarsal heads, and 4 denotes major deformities as amputation.
4. **Footwear:** Look at the shoes that the patient is wearing and discuss what he or she normally wears. Zero denotes shoes provide protection, support and fit the foot and on its removal there are no reddened areas on the foot, one denotes shoes are inappropriate, do not provide protection or support for the foot and two denotes shoes are causing trauma (redness or ulceration) to the foot either through a poor fit or a poor style

The second – 10 seconds touch for temperature and range of motion.

5. **Temperature – cold:** Does the foot feel colder than the other foot or is it colder than it should be considering the environment. Zero denotes foot is of "normal" temperature for environment, 1 denotes foot is cold compared to other foot or compared to the environment.
6. **Temperature – hot:** Does the foot feel hotter than the other foot or is it hotter than it should be considering the environment. Zero denotes foot is of "normal" temperature for environment, 1 denotes foot is hot – compared to other foot or compared to the environment.
7. **Range of Motion:** Ask patient to move the first toe back and forth – plantar flex and dorsal flex. Zero denotes first toe (hallux) is easily moved, 1 denotes hallux has some restricted movement, 2 denotes hallux is rigid and cannot be moved and 3 denotes hallux is amputated.

The last– 30 seconds assesses for sensation – monofilament testing, sensation – questions, pedal pulses, dependent rubor, and erythema.

8. **Sensation – Monofilament testing:** Using the 5.07 monofilament, the following ten sites (1st, 3rd, and 5th digits, 1st, 3rd, 5th metatarsal heads, medial and lateral midfoot, heel, and top (dorsum) of foot) were tested. Score out of 10 is assessed as the following: Zero denotes 10 out of 10 sites detected, 2 denotes 7 to 9 out of 10 sites detected, and 4 denotes 0 to 6 out of 10 sites detected
9. **Sensation – Questions:** the following four questions, are your feet ever numb, do they ever tingle, do they ever burn, and do they ever feel like insects are crawling on them, were asked to our subjects. Zero denotes answered No to all four questions, 2 denotes answered yes to one or more of the four questions.
10. **Pedal pulses:** the dorsalis pedis pulse or the posterior tibia pulse was palpated. Zero denotes pulse is present, 1 denotes pulse is absent.
11. **Dependent rubor:** Pronounced redness of the feet when the feet are down and pallor when the feet are elevated was assessed. Zero denotes no dependent rubor, 1 denotes dependent rubor is present.
12. **Erythema:** Look for redness of the skin that does not change when the foot is elevated. Zero denotes no redness of the skin and 1 denotes redness.

Interpreting Results of Modified Inlow's 60-second Diabetic Foot Screen: the highest score from left or right foot was used as follows: Score 0 to 6 = no problem, Score 7 to 12 = mild risk, Score13 to 19 = moderate risk and Score 20 to 25 = Severe risk.

All specific instructions for use of Modified Inlow's 60-second Diabetic Foot Screen were considered during data collection.

The following are two attached two parts to the study tool:

Part I: Diabetic Patients Socio-demographic and Medical related Data. A structured interview data sheet was developed by the researchers. It involved data related to socio-demographic characteristics of the selected subjects such as age, gender, marital status, education level, occupation, and area of residence. It also comprised structured items to identify patient's related medical data including: type of diabetes (Type 1or Type 2), duration of diabetes (years), weight (kg), height (cm), and body mass index, smoking (smokers or non-smokers), and treatment (oral hypoglycemic agent (OHA), Insulin, or combined, and glucose level (maintained or elevated which identified by more than 200 mg/dl).

Part II: Assessment of knowledge and Practices of Foot Care among Diabetic Patients:

This part was intended to assess patients' ability to identify the effects of diabetes on their foot health, appropriate foot care practices, patient's feet care, and patient vision acuity (scored by yes or no)

IV. Method

1. Permissions for data collection were obtained from the responsible authorities after explanation of the aim of the study.
2. Validation of tool was assessed before starting data collection, jury composed of 7 experts in medicine, research, and nursing fields revised the content validity to ascertain the appropriateness of items for measuring what they are supposed to measure.
3. Tool reliability was calculated using Cronbach's Alpha test which equal 0.96 (0.93-0.98) right foot, 0.97 (0.95-0.98) left foot.
4. A pilot study was carried out on 10 % (100 diabetic males and females patients) of estimated sample size to ascertain the relevance, clarity, and applicability of the research tool. No modifications were needed.
5. Data were collected through an individual interview from chosen settings according to inclusive criteria. Agreement was obtained from patients after explanation of the purpose, nature of the study to gain their cooperation.
6. The researchers prescheduled three patients to be undergo foot examination every 45 minutes, give appointment to other three patients same day or next visit according to both patients and researchers accepted time.
7. In a private examination area, patients were asked to respond to questions not found in patient record (tool part I and II), height and weight were measured to obtain patients body mass index according to Carven [(22)]. Random blood sugar was tested, it was abnormal if it equal or exceed 200 mg/dl based on literature review [(23)].
8. Afterwards, diabetic patients were asked to remove shoes and socket of feet, any dressings or devices that impair the screening was removed in order to complete their feet examination using the Modified Inlow's 60-second Diabetic Foot Screen checklist (part III of the study tool).
9. Review each of the parameters for each foot and select the appropriate score based on patient's status and use the highest score from either the left or right foot.
10. By combining the results from different 12 parameters identified with Inlow's 60-second Diabetic Foot Screen, diabetic foot interpreted indicators of pathological changes and self-care deficits were identified as follows:

Self-Care Parameters:

High scores in parameters 1, 2 and 4 were indicative of self-care deficit.

Integument Parameters:

High scores in parameters 1, 6 and 12 were indicative of infected ulcer.

Arterial Flow Parameters:

High scores in parameters 5, 10 and 11 were indicative of peripheral arterial disease.

Sensation Parameters:

High scores in parameters 8 and 9 were indicative of neuropathy.

Boney Changes Parameters:

High scores in parameters 3, 8 and 9 were indicative of Charcot changes

Ethical Considerations:

The purpose of the study was explained to each diabetic patient and an informed written consent to participate in the study was obtained. Confidentiality of the collected data and the right to withdrew at any time were ensured.

V. Statistical Analysis of The Data

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0[(25)]. Qualitative data were described using number and percent. Quantitative data were described using minimum and maximum, mean and standard deviation. Relation between levels of risk regarding categorical variables was tested using Chi-square test. For normally distributed data, Relation between level of risk and quantitative parameters were analyzed using independent t-test and F-test (ANOVA). Univariate and Multivariate logistic regression was assessed. Significance of the obtained results was judged at the 5% level.

Table (1): Distribution of the studied patients according to their socio-demographic characteristics (n = 1000):

Patient characteristics	No.	%
Sex:		
– Male	491	49.1
– Female	509	50.9
Marital status:		
– Single	112	11.2
– Married	686	68.6
– Divorced	89	8.9
– Widowed	113	11.3
Age:		
– 18 > 30	126	12.6
– 30 > 40	187	18.7
– 40 > 49	233	23.3
– 50 > 65	454	45.4
Education level:		
– Illiterate	448	44.8
– Reading and writing	152	15.2
– Preparatory school	215	21.5
– Secondary school	102	10.2
– University	83	8.3
Occupation:		
– Non-working	668	66.8
– Farmer	190	19.0
– Professional	142	14.2
Area of residence:		
– Rural	515	51.5
– Urban	485	48.5
Government:		
– Alex	201	20.1
– Assuit	250	25.0
– Aswan	99	9.9
– Elmenia	100	10.0
– Kena	100	10.0
– Mansura	250	25.0

Table (1): represents number and percent distribution of the studied patients according to their socio-demographics data. The current study comprised almost equal percent of males and females (49.1% and 50.9 % respectively), their ages ranges from 18-65 years. The majority (45.4) of patients were in age group of 50 years to less than 65.

Regarding patients educational level, the largest percent (44.8 %) were illiterate, while only 8.3 % were university graduates. As regards occupation, 66.8 % were not working**,** 19% were farmers and about 22 % were non-professional workers. Patients from Upper Egypt (Aswan, Assuit, Kena, and El-menia) represents more than half (54.9 %) of the studied subjects. Lower Egypt (Alexandria) comprised around 20 % of the selected subjects and Delta (Mansoura) subjects were about 25 %.

Table (2): Distribution of the studied patients according to their related medical data (n = 1000).

Patient's related Medical Data	No.	%
Type of diabetes:		
– Type 1	431	43.1
– Type 2	569	56.9
Duration of diabetes (yrs):		
– Min. – Max.	1.0 – 38.0	
– Mean ± SD.	11.14 ± 6.36	
Body mass index (BMI):		
– Min. – Max.	17.77 – 59.02	
– Mean ± SD.	28.95 ± 5.75	
Smoking:		
– Smokers	396	39.6
– Non-smokers	604	60.4
Treatment:		
– Oral hypoglycemic agent (OHA)	268	26.8
– Insulin	643	64.3
– Combined	89	8.9
Blood Glucose Level:		

– Usually maintained	356	35.6
– Usually elevated ≥ 200 mg/dl	644	64.4

Table (2): shows the number and percent distribution of the studied patients according to their medical data. More than half (56.9 %) of the subjects had type 2 diabetes. The mean and standard deviation of duration of diabetes were 11.14 ± 6.36**.** The subjects BMI ranges between 17.8-59.02 and its mean and standard deviation were 28.95 ± 5.75. Regarding smoking habits, more than one-third of the studied subjects (39.6 %) were smokers. Blood glucose levels of the diabetic subjects were elevated among two-thirds (64.4 %) of them.

Table (3): Distribution of the studied patients according to their foot care-related knowledge and Practices (n = 1000)

Assessment of Patient foot care knowledge and Practices	**No.**	**%**
Does the patient understand the effects of diabetes on foot health?		
– Yes	611	61.1
– No	389	38.9
Can the patient identify appropriate foot care practices?		
– Yes	418	41.8
– No	582	58.2
Are the patient's feet adequately cared for?		
– Yes	422	42.2
– No	578	57.8
Does the patient have impaired vision?		
– Yes	430	43.0
– No	570	57.0

Table (3) illustrates distribution of the studied patients according to their knowledge and practices of their feet care. It shows that 38.9 % didn't understand the effect of diabetes on their feet health. More than half (58.2 %) of them couldn't identify appropriate foot care-related practices and already about (57.8) of the studied patients were not adequately cared for their feet. This table also clarifies that 43.0% of the studied subjects have impaired vision**.**

Table (4): Distribution of the studied patients according to Parameters of Diabetic Foot Screen (n = 1000)

Parameters of Diabetic Foot Screen				
Look – 20 seconds	**Left Foot**		**Right Foot**	
	No.	**%**	**No.**	**%**
1. Skin:				
– Intact and healthy	565	56.5	592	59.2
– Dry with fungus or light callus	210	21.0	226	22.6
– Heavy callus build up	108	10.8	98	9.8
– Open ulceration or history of previous ulcer	117	11.7	84	8.4
2. Nails:				
– Well-kept	490	49.0	458	45.8
– Unkempt and ragged	340	34.0	405	40.5
– Thick, Damaged, or Infected	170	17.0	137	13.7
3. Deformity:				
– No deformity	825	82.5	867	86.7
– Deformity	98	9.8	75	7.5
– Amputation	77	7.7	58	5.8
4. Footwear:				
– Appropriate	498	49.8	484	48.4
– Inappropriate	325	32.5	347	34.7
– Causing trauma	177	17.7	169	16.9
Touch – 10 seconds				
5. Temperature – Cold:				
– Foot warm (normal)	649	64.9	635	63.5
– Foot is cold	351	35.1	365	36.5
6. Temperature – Hot:				
– Foot is warm (normal)	847	84.7	818	81.8
– Foot is hot	153	15.3	182	18.2
7. Range of Motion:				
– Full range to hallux	524	52.4	590	59.0
– Hallux limitus	232	23.2	192	19.2
– Hallux rigidus	172	17.2	163	16.3
– Hallux amputation	72	7.2	55	5.5
Assess – 30 seconds				
8. Sensation – Monofilament Testing:				

– 10 sites detected	535	53.5	541	54.1
– 7 to 9 sites detected	315	31.5	322	32.2
– 0 to 6 sites detected	150	15.0	137	13.7
9. Sensation – Ask Four Questions:				
– No to all questions	571	57.1	548	54.8
– Yes to any of the questions	429	42.9	452	45.2
10. Pedal Pulses:				
– Present	806	80.6	819	81.9
– Absent	194	19.4	181	18.1
11. Dependent Rubor:				
– No	876	87.6	873	87.3
– Yes	124	12.4	127	12.7
12. Erythema:				
– No	841	84.1	843	84.3
– Yes	159	15.9	157	15.7

Table (4) shows distribution of the studied subjects according to their diabetic feet screen- related data. Actually open foot ulceration or history of previous foot ulcer was found among 11.7 % of the studied subjects at their left foot. Feet deformity was noticed in 9.8 % and 7.5 % of diabetic left and right foot respectively. Footwear was inappropriate among one-third of the studied diabetics at their both feet and causing trauma in around 17 % of them.

Regarding palpation findings, this table reveals that patient's feet temperature was abnormally cold in 36.5 % and was abnormally hot in 18.2% of diabetic right foot. Hallux (great toe) amputation was found among 7.2 % of them at their left foot.

As regards sensation related assessment, impaired sensation was found among 15 %, 13.7 % of diabetic left and right foot respectively. Subjective sensation related-questions show that abnormal sensations were felt by 42.9 % and 45.2% of diabetic left and right foot respectively.

Concerning assessment of pedal pulses, dependent rubor, and erythema, this table clarifies that they were normal in more than 80 % of the study subjects.

Table (5): Distribution of the studied patients according to the total score of foot diabetic screen (n = 1000)

Diabetic Foot Screen score	No.	%
– No problem (0 - 6)	521	52.1
– Mild risk (7 - 12)	287	28.7
– Moderate risk (13 - 19)	145	14.5
– Severe risk (20 - 25)	47	4.7

Table (5): Shows distribution of the subjects according to their diabetic foot screen scores, it shows that 47.9 % have potential risk for diabetic foot ulcer (28.7% mild risk, 14.5 moderate risks and 4.7 experience severe risks.

Table (6): Distribution of the studied patients foot pathologies/ Self-care deficit and their high score of different parameters of diabetic foot screen (n = 1000)

Parameters of Diabetic Foot Screen	Foot pathologies/ Self-care deficit (n=198)	No.	%
Self-Care Parameters 1. Skin	**Self-care deficit**	21	2.1
2. Nails			
4. Footwear			
Integument Parameters 1. Skin	**Infected ulcer**	13	1.3
6.Temperature – Hot			
12. Erythema			
Arterial Flow Parameters 5. Temperature – Cold	**Peripheral arterial diseases**	30	3.0
10. Pedal Pulses			
11. Dependent Rubor			
Sensation Parameters 8. Sensation – Monofilament Testing	**Neuropathy**	112	11.2
9. Sensation – Ask Four Questions			
Boney Changes Parameters 3. Foot deformity	**Charcot changes**	22	2.2
8. Sensation – Monofilament Testing			
9. Sensation –Questions			

Table (6) illustrated that 198 subjects out of one thousand (19.8 %) had already experience either foot pathologies or self-care deficit. High scores in **self-care parameters** 1, 2 and 4 as indicators of self-care deficit were identified among 2.1% of the studied diabetic subjects. High scores in **integument parameters** 1, 6 and 12 as indicators of infected ulcer were identified among 1.3 % of the studied diabetic subjects. **Peripheral arterial disease** was identified among 3 % of the studied diabetic subjects as a result of high scores in **arterial flow parameters** 5, 10 and 11. High scores in **sensation parameters** 8 and 9 as indicators of neuropathy were identified among 11.2% of the studied diabetic subjects. High scores in **boney changes parameters** 3, 8 and 9 as indicators of Charcot changes were found among 2.2 of the studied subjects.

Table (7): Relation between risk factors for DFU and Patients Socio-demographic characteristics:

	Level of Risk								**χ^2**	**p**
Variables	**No problem (n = 521)**		**Mild risk (n = 287)**		**Moderate risk (n = 145)**		**Sever risk (n = 47)**			
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**		
Sex:										
– Male	228	43.8	166	57.8	63	43.4	34	72.3	26.722*	<0.001*
– Female	293	56.2	121	42.2	82	56.6	13	27.7		
Marital status:										
– Single	66	12.7	37	12.9	5	3.4	4	8.5	43.217*	<0.001*
– Married	377	42.4	187	65.2	87	60.0	35	74.5		
– Divorced	40	7.7	26	9.1	20	13.8	3	6.4		
– Windowed	38	7.3	37	12.9	33	22.8	5	10.6		
Age (years)										
– 18 > 30	91	17.5	18	6.3	12	8.3	5	10.6	67.308*	<0.001*
– 30 > 40	111	21.3	39	13.6	16	11.0	21	44.7		
– 40 > 49	114	21.9	77	26.8	34	23.4	8	17.0		
– 50 > 65	205	39.3	153	53.3	83	57.2	13	27.7		
Education:										
– Illiterate	211	40.5	147	51.2	77	53.1	13	27.7	100.924*	<0.001*
– Reading and writing	47	9.0	66	23.0	27	18.6	12	25.5		
– Preparatory school	145	27.8	32	11.1	29	20.0	9	19.1		
– Secondary school	58	11.1	27	9.4	4	2.8	13	27.7		
– University	60	11.5	15	5.2	8	5.5	0	0.0		
Occupation:										
– Non-working	244	46.8	125	43.6	72	49.7	8	17.0	110.947*	<0.001*
– Farmer	57	10.9	72	25.1	40	27.6	21	44.7		
– Professional	116	22.3	20	7.0	4	2.8	2	4.3		
– Others	104	20.0	70	24.4	29	20.0	16	34.0		
Area of residence:										
– Rural	235	45.1	154	53.7	102	70.3	24	51.1	29.684*	<0.001*
– Urban	286	54.9	133	46.3	43	29.7	23	48.9		
Government:										
– Alex	111	21.3	54	18.8	26	17.9	10	21.3	182.220*	<0.001*
– Assuit	187	35.9	55	19.2	8	5.5	0	0.0		
– Aswan	55	10.6	24	8.4	14	9.7	6	12.8		
– Elmenia	7	1.3	39	13.6	39	26.9	15	31.9		
– Kena	51	9.8	35	12.2	10	6.9	4	8.5		
– Mansura	110	21.1	80	27.9	48	33.1	12	25.5		

χ^2: Chi square test *: Statistically significant at $p \leq 0.05$ Diabetic foot ulcer: DFU

Table (7): illustrated that there are highly statistically significant relationships between all socio-demographic characteristics and risk factors for DFU for studied subjects. This table also shows that diabetic patients who were males, married, in age group between 30-< 40, illiterate/secondary school graduate, work as farmer, from rural areas have severe potential risk for DFU**.**

Table (8): Relation between risk factor for DFU and Patient's related Medical Data

Variables	Level of Risk								Test of sig.	p
	No problem (n = 521)		Mild risk (n = 287)		Moderate risk (n = 145)		Sever risk (n = 47)			
	No.	%	No.	%	No.	%	No.	%		
Type of diabetes:										
– Type 1	195	37.4	142	49.5	78	53.8	16	34.0	χ^2= 19.927*	<0.001*
– Type 2	326	62.6	145	50.5	67	46.2	31	66.0		
Duration of diabetes:										
– Min. – Max.	1.0 – 31.0		1.0 – 35.0		2.0 – 38.0		3.0 – 25.0		F= 16.573*	0.081
– Mean ± SD.	9.85 ± 5.87		12.80 ± 6.93		12.48 ± 6.27		11.15 ± 4.87			
Body mass index:										
– Min. – Max.	17.77 – 59.02		23.14 – 39.36		22.86 – 34.60		21.60 – 38.95		F= 16.573*	<0.001*
– Mean ± SD.	29.39 ± 7.06		28.57 ± 3.93		28.44 ± 3.32		28.02 ± 4.39			
Smoking:										
– Smokers	194	37.2	114	39.7	55	37.9	33	70.2	χ^2= 19.803*	<0.001*
– Non-smokers	327	62.8	173	60.3	90	62.1	14	29.8		
Treatment:										
– Oral hypoglycemic agent	165	31.7	77	26.8	21	14.5	5	10.6	χ^2= 52.396*	<0.001*
– Insulin	322	61.8	192	66.9	100	69.0	29	61.7		
– Combined	34	6.5	18	6.3	24	16.6	13	27.7		
Blood Glucose Level:										
– Usually maintained	232	44.5	97	33.8	21	14.5	6	12.8	χ^2= 57.420*	<0.001*
– Usually elevated	289	55.5	190	66.2	124	85.5	41	87.2		

χ^2: Chi square test F: F test (ANOVA) *: Statistically significant at $p \leq 0.05$
Diabetic foot ulcer: DFU

Table (8): Mentioned that there are statistically significant relationship between all medical data and risk factors for studied subjects except for duration of diabetes. It also reveals those diabetic patients who have type II diabetes, with mean BMI of 28.02 ± 4.39, smokers, undergoing insulin therapy, and have elevated blood glucose levels have severe potential risk for DFU**.**

Table (9):Relation between risk factor for DFU and Patient-related foot care knowledge and Practices

Variables	Level of Risk								χ^2	p
	No problem (n = 521)		Mild risk (n = 287)		Moderate risk (n = 145)		Sever risk (n = 47)			
	No.	%	No.	%	No.	%	No.	%		
Does the patient understand the effects of diabetes on foot health?										
– Yes	371	71.2	145	50.5	83	57.2	12	25.5	61.836*	<0.001*
– No	150	28.8	142	49.5	62	42.8	35	74.5		
Can the patient identify appropriate foot care practices?										
– Yes	278	53.4	97	33.8	38	26.2	5	10.6	69.420*	<0.001*
– No	243	46.6	190	66.2	107	73.8	42	84.4		
Are the patient's feet adequately cared for?										
– Yes	293	56.2	84	29.3	36	24.8	9	19.1	89.949*	<0.001*
– No	228	43.8	203	70.7	109	75.2	38	80.9		
Does the patient have impaired vision?										
– Yes	172	33.0	157	54.7	75	51.7	26	55.3	44.652*	<0.001*
– No	349	67.0	130	45.3	70	48.3	21	44.7		

χ^2: Chi square test *: Statistically significant at $p \leq 0.05$ Diabetic foot ulcer: DFU

Table (9): Shows that there are statistically significant relationship between all items of patient foot care knowledge and practice and risk factors DFU for studied subjects. It also clarifies that those diabetic patients who don't understand the effects of diabetes on their foot health, Can't identify the appropriate foot care practices, aren't adequately cared for their feet and have impaired vision have severe potential risk for DFU**.**

Table (10):Univariate analysis for risk factor for DFU and socio-demographic characteristics data

	Risk				χ^2	**p**
	No + Mild risk (n = 808)		**Moderate+ Sever risk (n = 192)**			
	No.	**%**	**No.**	**%**		
Government						
Assuit ®	242	30.0	8	4.2	125.053*	<0.001*
Kena1	86	10.6	14	7.3		
Aswan2	79	9.8	20	10.4		
Alex3	165	20.4	36	18.8		
Elmenia4	46	5.7	54	28.1		
Mansura5	190	23.5	60	31.3		

χ^2: Chi square test *: Statistically significant at $p \leq 0.05$ Diabetic foot ulcer: DFU

Table (10): This table reveals the predicted rank of Governorates at where study performed and potential severity of risk factors for DFU, using Univariate analysis. It highlights rank of Governorates as follows: Mansura (31.3 % moderate/severe risk), Elmenia (28.1 % moderate/severe risk), Alexandria (18.8 % moderate/severe risk), Aswan (10.4 % moderate/severe risk), Kena (7.3 % moderate/severe risk), and Assuit (4.2 % moderate/severe risk).

Table (11): Multivariate analysis logistic regression and potential risk factors of DFU

	B	**Sig.**	**OR**	**95% CI**	
				LL	**UL**
Marital status					
Single	-1.527	0.002*	0.217*	0.083	0.566
Married	-0.749	0.006*	0.473*	0.277	0.806
Divorced	-0.477	0.214	0.621	0.293	1.318
Occupation					
Non-working	0.181	0.490	1.198	0.717	2.003
Farmer	0.372	0.188	1.451	0.834	2.526
Professional	-0.865	0.089	0.421	0.155	1.143
Duration of diabetes (yrs)	0.000	0.981	1.000	0.970	1.032
Body mass index	-0.063	0.002*	0.939*	0.902	0.978
Smoking	0.252	0.244	1.287	0.842	1.968
Treatment					
Oral hypoglycemic agent (OHA)	-1.273	<0.001*	0.280*	0.137	0.571
Insulin	-0.716	0.014*	0.488*	0.276	0.864
Blood Glucose Level	1.091	<0.001*	2.978*	1.749	5.069
Does the patient understand the effects of diabetes on foot health?	-0.869	<0.001*	0.419*	0.263	0.669
Can the patient identify appropriate foot care practices?	0.748	0.011*	2.112*	1.186	3.759
Are the patient's feet adequately cared for?	0.500	0.087	1.648	0.931	2.920
Does the patient have impaired vision?	-0.254	0.206	0.775	0.523	1.150
Government					
Assuit ®					
Kena1	1.085	0.034*	2.959*	1.084	8.077
Aswan2	2.295	<0.001*	9.920*	3.746	26.267
Alex3	1.740	<0.001*	5.700*	2.339	13.886
Elmenia4	3.736	<0.001*	41.924*	16.802	104.611
Mansura5	2.217	<0.001*	9.184*	3.880	21.737

Diabetic foot ulcer: DFU

Table (11): Using multivariate logistic regression analysis, interactions of Univariate associations were analyzed and reveals that patients with elevated blood glucose levels were 2.9 more likely to have foot ulcer, patients with inappropriate foot care practices were 2.1 more likely to have foot ulcer, and patients from

Elmenia were 41.9 more likely to have foot ulcer compared with patients with maintained blood glucose levels, patients with appropriate foot care practices, and patients from other studied settings.

VI. Discussion

Diabetic foot ulceration is a common, preventable, complication that affects patients with diabetes. Risk factors for ulceration include insensitivity (secondary to somatic neuropathy), vascular impairment and structural foot deformity and most importantly a history of ulceration [(26, 27)]. Poor glycemic controls has also been proposed as a risk factor [(28, 29)].

As proved elsewhere, the current study results clearly demonstrate that diabetes mellitus (DM) is associated with many risk factors for foot ulceration. Among these risk factors, Peripheral neuropathy (11.2%), peripheral vascular disease (3%), and Charcot changes (2.2 %) were lower than the equivalent rates reported in other Arab populations [(30)]. However, 47.9 % of the current study subjects have potential risk for diabetic foot ulcer and 4.7 % of them experience severe risks. This finding was in same line with Jbour et al [(31)].

The present study clarified that the majority (45.4%) of patients were in age group of 50 years to less than 65. This finding was in the same line with the results of El-Nahas et al [(32)], Faris et al [(33)] and Hurley, et al [(34)] who reported that, the peak incidence of foot ulcer in their subjects was in age ranged from 50 ≥ 65 years and the mean age of their study subjects was 50.5 ± 10.9 years. The current study comprised almost equal percent of males and females. However males were highly correlated with severe risk factors of foot ulceration. In this regards, El-Nahas et al [(32)] mentioned that, 36.8% of their study subjects were male. However, Bagdady[(35)] added that two thirds of her studied sample were females. Regarding patients educational level, the largest percent (44.8 %) were illiterate, while only 8.3 % were university graduates. In the same line, Hurley, et al [(34)] illustrated that the majority (48%) of their sample have primary education and the university graduates comprised 6% of their subjects. As regards occupation, more than two thirds of the subjects were not working**;** this result was in agreement with Hurley, et al [(34)].

More than half of the current study subjects had type II diabetes. The mean and standard deviation of duration of diabetes were 11.14 + 6.36. This result was supported by other findings [(33)]. The mean and standard deviation of the current study subject's body mass index (BMI) were 28.95 ± 5.75. This alarmingly high figure is comparable with the figure (34.5 ± 6.7) in other study [(32).] Regarding smoking habits, more than one-third of the studied subjects were smokers. This result is in line with Khalil [(36)] and Al Kafrawy [(37)] findings. The present study found that more than half of subjects were on insulin treatments. These high percentages were in line with those of Nyamu et al [(38)] who reported that, there are an observed high proportion of patients on insulin.

As regard knowledge and practices of diabetic patients, the current finding shows that more than one third of the subjects didn't understand the effect of diabetes on their feet health. More than half of them couldn't identify appropriate foot care-related practices and already about more than half of the studied patients were not adequately cared for their feet. Skin abnormalities are commonly detected in diabetic patients. In current study, dry skin with fungus and light calluses were recorded in about one third in left and right foot. This finding was in the same finding of Helfand et al [(39)], who mentioned that more than one third of the patients have dry skin and callus. It is possible that dry thick skin could reduce the sensitivity to monofilament testing leading to inappropriate estimation of the prevalence of neuropathy.

As regard open ulceration or history of previous ulcer, less than one third in left and right foot was observed in this study subjects. This result was in the same line with other findings [(32, 40)]. The present study findings have shown that; less than one third of the study subjects had had feet deformity and amputation in the left and right foot. This result came in close with the findings of Pavicic et al [(41)] and Pataky et al [(42)] who added that diabetic foot deformities could play a role in the high prevalence of diabetic foot ulcers. In this regards, American Diabetic Association (ADA) consensus group found that among persons with diabetes, the risk of foot ulceration was increased among men, patients who had had diabetes for more than 10 years, and patients with poor glucose control or with cardiovascular, retinal, or renal complications[(8)].

According to many studies, Pataky et al [(42)] and Boyko et al [(43)], mentioned that monofilament has been suggested to be effective for the detection of the loss of protective sensations in diabetic foot. Monofilament insensitivity has substantial predictive power for the development of diabetic foot ulcer and lower extremity amputation. The present study revealed that, more than half of the study subjects were have 10 sites detected when perform Sensation – Monofilament Testing. As regard pedal pulses, less than one third in left and right foot in the study subjects were have absent pedal pulses.

In this study, it was found that one third of the subjects used inappropriate footwear which might results in trauma and complicated by foot ulcer. To complicate the picture of diabetic foot care in our study settings, we have no podiatry services available and since amputations are almost preceded by foot ulcers in 75-85% of diabetic patients, these figures seem important for the upcoming future of diabetic foot ulcer and subsequent amputation in our diabetics. Going with this, diabetic foot problems in Egypt might be exacerbated by many biosocial-cultural factors such as increased level of illiteracy, lack of knowledge regarding diabetic

foot complications, inappropriate footwear, dry hot climate especially in Upper Egypt, and the high indices of BMI.

VII. Conclusion

The current study shows that 47.9 % have potential risk for diabetic foot ulcer. It moreover, reveals that patients with elevated blood glucose levels were 2.9 more likely to have foot ulcer, patients with inappropriate foot care practices were 2.1 more likely to have foot ulcer, and patients from Elmenia (one of Egyptian governorates) were 41.9 more likely to have foot ulcer compared with patients with maintained blood glucose levels, patients with appropriate foot care practices, and patients from other studied settings. Furthermore, the lack of knowledge regarding diabetic foot problems, inappropriate footwear and the high prevalence of skin and nail pathology in the study population could explain these findings. It is suggested that regional differences in the risk factors for diabetic foot ulcer should be considered when preventative strategies for diabetic foot ulcer are planned. Education of patients and health care providers, together with establishment of podiatric care, may produce better outcomes.

VIII. Recommendations

From the results of the present study it can be recommended that; nurses should instruct and emphasize the diabetic patients about the importance of knowledge and practices of foot care, appropriate footwear, podiatric care and regular follow up. Moreover, Nurses should adopt one of the low-cost effective and available strategies to identify the persons at risk for diabetic foot ulcers and the timely referral of those at high risk. Pamphlets and simple illustration booklet should be available for illiterate diabetics are also a necessity. Furthermore, formal and informal Organization of the Diabetes and foot-care service in Egypt should establish a global education programs that tailored to the patient's understanding and social background to manage an epidemic of foot abnormalities expected to be seen in the near future.

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