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ORIGINAL ARTICLE

A cost-based comparative analysis of diabetic hand ulcers and diabetic foot ulcers

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Abstract

Background: In 2021, the Social Insurance Institution (SII) of Turkey reported that there were approximately 12 million patients with diabetes under universal health insurance and the expenditure was incurred for the treatment of complications was 2.6 billion Turkish Liras (₺). Although several previous studies have analyzed the cost of diabetic foot ulcers, no study from Turkey has compared the costs of diabetic hand ulcers and foot ulcers together and analyzed the relationship between the cost and demographic characteristics of patients, yet.

Methods: In this study, the data of 49 patients with diabetic hand ulcers and 44 patients with diabetic foot ulcers, from January to June, in 2022, have been analyzed retrospectively based upon the demographic datas and costs. In order to analyze the correlations, cross tables, chi-square statistics, and partial correlation analysis have been used. The groups in the study have been compared by using t-test for independent groups and covariance analysis.

Results: The calculated average cost of the patients who were followed up and treated for diabetic hand and foot ulcers between January and June, in 2022 was 257.01 US dollars ($) and 462.54 $, respectively. There has been no statistically significant difference between the patients with diabetic hand and diabetic foot ulcers in terms of mean age, the length of hospital stay, or hemoglobin A1c and C-reactive protein levels at admission. It is seen that the mean cost of the patients with diabetic hand ulcer has been lower than that of the patients with diabetic foot ulcer, and this difference is statistically significant.

Conclusions: Although diabetic hand infections are less costly and cause fewer major amputations, it is a clinical condition that should be given at least as much attention as diabetic foot ulcer due to its atypical localized onset and the reproductive potential of different microorganisms.

Keywords: Cost Analyze, Diabetic Foot Ulcer, Diabetic Hand Ulcer, Tropical Hand Infection.

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INTRODUCTION

According to the data taken from the Turkish Statistical Institute, private sector and general government health expenditure in Turkey increased by 41.6% in 2021 when it is compared to the previous year, reaching 353.941 billion (1)". An analysis of the distribution of total health expenditure by health service providers has showed that the top three health service providers are hospitals (49.5%), retailers and other medical equipment providers (22.8%), and ambulatory care providers (9.4%) (1). By the year 2025, the number of people with diabetes is expected to increase in developed countries by 41%, from 51 million to 72, and by 170% in developing countries, from 84 million to 228 (2). Increases in diabetes-related complications have resulted in a situation where most related health expenditures are incurred for the treatment of complications rather than for the treatment of diabetes itself (3). While carrying out an analysis, not only the direct costs arising from the follow-up and the treatment of diabetes and related diseases, but also the indirect costs arising from reduced productivity at work, shorter life expectancy, and the loss of productivity of caretakers should also be taken into account. A study conducted in 2016 reported that the annual direct cost of diabetes worldwide was 825 billion $. The same study reported that China, the United States of America (USA), India, and Japan were some of the countries with the highest diabetes-related direct costs and that approximately 60% of the global cost of diabetes originated from low and middle-income countries (4). In 2021, the Social Insurance Institution (SII) of Turkey reported that there were approximately 12 million patients with diabetes under universal health insurance whose diabetes care was covered by the SII. The expenditure incurred by the SII for the treatment of these patients in 2021 was 8.6 billion ₺, and 2.6 billion ₺ of it was for the treatment and the complications (5). Although several previous studies have analyzed the cost of diabetic foot ulcers, no study from Turkey has compared the costs of diabetic hand ulcers and foot ulcers together and analyzed the relationship between the cost and demographic characteristics of the patients, yet. Therefore, our study is the first cost-based comparative analysis on the subject.

MATERIALS AND METHODS

In this study, the data of 49 patients with diabetic hand ulcers and 44 patients with diabetic foot ulcers, all of whom were treated as inpatients in the wound care clinic from January to June, in 2022, have been analyzed retrospectively based upon the demographic datas and costs. The data that belongs to the patients have been retrieved from the online hospital records. This study was approved by the clinical research Ethics Committee of the Kartal Dr. Lütfi Kırdar Training and Research Hospital (Date: 29.05.2023, Number: 2023/514/250/23). Recorded data includes demographic characteristics of the patients (age, gender, education status, income percentile, and the distance between their residence and the health care facility), as well as ulcer site, hemoglobin A1c (HbA1c) levels at time of admission, presence or absence of chronic renal failure (CRF), microbial wound culture result (if positive, the isolated agent), levels of C-reactive protein (CRP) at time of diagnosis, antibiotherapies used, treatment administered, and the length of hospital stay. For diabetic hand, the upper limb has been divided into anatomical subregions consisting of the phalanx, thenar, and hypothenar region, palmar region, dorsum of the hand, and forearm, and the foot has been divided into anatomical subregions consisting of the phalanx, dorsum of the foot, plantar region, heel, ankle, and cruris. Phalanx amputations for the extremity are considered as minor, and amputations proximal to the phalanx are considered as major. Besides, in this study, a household has been defined as a group of one or more peeople, relatives or non-relatives, who reside in the same domicile and who provide financial support to each other. Also, per capita income has been calculated as the annual disposable income of the household and divided equally between the household. The distribution of annual equivalized household disposable income has been divided into quintiles. Thus, percentile 1 represents the lowest income group, and 5 represents the highest. The distance between the residence of the patient and the nearest healthcare facility has been divided into three subgroups as <1 km, between 1 and 3 km, and >3 km. The report of costs for each patient covered by the SII has been taken from the income accrual unit of our hospital. Total costs include preoperative diagnostic tests, emergency room costs, operating room charges, hospital accommodation, medication, surgical instruments, anesthesia, and facility care charges. While analysing the cost, the patients who received conventional wound dressing as part of the follow-up and treatment are included and the patients who received specialized wound care products (topical/injectable growth factor,

stem cell, PRP (platelet rich plasma) and SVF (stromal vascular fraction), etc.) are excluded because the cost of patients without conventional wound dressing is thought to cause confusion for basic patient cost. The study has also excluded the patients with ulcers in both limbs (hand and foot) to avoid confusion during the analysis. The costs are calculated in Turkish Liras (₺) and converted into USD ($) using the currency exchange rate applicable at the time of discharge between January and June, in 2022 (1$ = 18.75₺/January, 1$ = 16.63₺/June). In this study, the data have been analyzed by using SPSS 22.0. Descriptive statistics and quantitative variables are provided as mean ± standard deviation. After the data have been checked for the normality of distribution, the correlations are analyzed by using cross tables, chi-square statistics, and partial correlation analysis, and groups are compared by using t-test for independent groups and covariance analysis. Statistical significance is set at $p < 0.05$ for all tests.

RESULTS

In this study, the mean age is 60.8 years old (21-84) for patients with diabetic foot ulcers and 60.5 years old (28-82) for patients with diabetic hand ulcers. When the data is analysed, it is observed that men are affected in 74% and 72% of diabetic foot ulcers and hand ulcers, respectively. The mean HbA1c level measured at the time of admission was 9.3 (7.1-12.8) for the patients with diabetic foot ulcers and 9.8 (5.5-14.8) for the patients with diabetic hand ulcers. CRF was present in 31% of the patients with diabetic hand ulcers and in 16% of the patients with diabetic foot ulcers. The site of onset of symptoms was the phalanx in 73% of the patients with diabetic hand ulcers, and the dorsum of the foot and heel in 54% of the patients with diabetic foot ulcers (Figure 1 and 2). Mean CRP levels recorded at the admission were 110 and 111 mg/L for the patients with diabetic hand and foot ulcers, respectively. The patients with diabetic hand ulcers stayed at the hospital for an average of 18.3 days and those with diabetic foot ulcers stayed for an average of 20.5 days. Major amputation was performed in 0.04% of the patients with diabetic hand ulcers, while 34% of the patients with diabetic foot ulcers underwent major amputation. When the demographic data have been analysed, it can be seen that 52% of the patients with diabetic hand ulcers had only a primary school education and 36% were in a low income group (first or second quintile). In addition, 78% of them had their residence at a distance of less than 3 km from the nearest healthcare facility. 45% of the patients with diabetic foot ulcers had only a primary school education and 29% were in a low income group (first or second quintile). Besides, 66% of them had their residence at less than 3 km from the nearest healthcare facility. While no growth has been detected in 47% of the patients with diabetic hand ulcers, the most common microorganisms that grew in the isolated agents are staph. aureus, strep agalactia, and candida. Enterococcus Faecalis and Pseudomonas Aureginosa are the agents most frequently isolated from tissue cultures at hospitalizations of the patients with diabetic foot ulcers. The demographic data of the patients is summarized in Table 1. The calculated average cost of the patients who have been followed up and treated for diabetic hand and foot ulcers is 257.01 $ and 462.54 $, respectively. It is determined that, there is no statistically significant difference between the patients with diabetic hand and diabetic foot ulcers in terms of mean age, the length of hospital stay, or HBA1C and CRP levels at the admission ($p > 0.05$). The mean cost for the patients with diabetic hand is lower than the mean cost for the patients with diabetic foot, and it can be concluded that this difference is statistically significant ($t = -2.11$, $p < 0.05$). The analysis using diabetic hand or foot status as a covariate has demonstrated that variables such as the presence or absence of CRF, the presence or absence of microbial growth in wound culture, the distance between the residence and the hospital, the previous use of antibiotherapy, the history of surgery, the educational status, and income quintile ($p > 0.05$) do not have a significant effect on the cost of the ulcers. The analysis of the relationship between variables and ulcer development has also indicated that there is no statistically significant difference between the diabetic hand and diabetic foot groups in terms of mean age, the length of hospital stay, or HBA1C and CRP levels at the admission ($p > 0.05$). Moreover, CRF is not statistically related with ulcers in the patients with diabetic hand or foot ulcers ($p > 0.05$). Furthermore, it is also seen that the education level, income status and the distance between the residence and the nearest healthcare facility have no statistically significant relation with the development of hand or foot ulcers ($p > 0.05$). (Table 2 and 9)

Figure 1: The presentation of diabetic hand infection - volar aspect

Figure 2: The presentation of diabetic hand infection - dorsal aspect

Table 1. The demographic data of the patients

		Diabetic Hand Ulcer %(n)		Diabetic Foot Ulcer %(n)	
Education Status	None	4 (2)		2 (1)	
	Primary School	52 (25)		45 (20)	
	Secondary School	33 (16)		27 (12)	
	High School	10 (5)		16 (6)	
	University and Postgraduate	5 (3)		12 (5)	
Income Status	Percentile 1	8 (4)		7 (3)	
	Percentile 2	28 (14)		22 (10)	
	Percentile 3	34 (17)		37 (16)	
	Percentile 4	19 (9)		21 (9)	
	Percentile 5	11 (5)		13 (6)	
The Distance Between the Residence and the Nearest Healthcare Facility	<1 km	26 (13)		30 (13)	
	1-3 km	52 (25)		36 (16)	
	>3 km	22 (11)		34 (15)	
Ulcer Site		Phalanx	73 (36)	Phalanx	21 (9)
		Hypothenar region	4 (2)	Dorsum of the foot	27 (12)
		Thenar region	4 (2)	Plantar of foot	12 (5)
		Palmar region	6 (3)	Heel	27 (12)
		Dorsum of the hand	10 (5)	Ankle	9 (4)
		Forearm	2 (1)	Cruris	4 (2)
CRF*	Absent	69 (34)		84 (37)	
	Present	31 (15)		16 (7)	
Treatment	None	36 (18)		36 (16)	
	Minor Amputation	60 (29)		30 (13)	
	Major Amputation	4 (2)		34 (15)	

** CRF: Chronic Renal Failure*

Table 2. The difference between the costs of diabetic hand ulcer and diabetic foot ulcer

	Diabetic Ulcer	N	Mean	Std. Deviation	t	p
Cost	Diabetic Hand Ulcer	49	4950.67	2736.19	-2.11	0.04
	Diabetic Foot Ulcer	44	8909.57	8634.76		

Std. Deviation: Standart Deviation

Table 3. The relation between Diabetic hand/foot ulcer and the Length of Hospitalization, Age, Hemoglobin A1c and C-Reactive Protein Levels

	Diabetic Ulcer	N	Mean	Std. Deviation	t	p
The Length of Hospitalization	Diabetic Hand Ulcer	49	18.3158	10.36046	-0.59	0.55
	Diabetic Foot Ulcer	44	20.5833	13.81215		
Age	Diabetic Hand Ulcer	49	60.5263	13.18403	-,0.06	0.94
	Diabetic Foot Ulcer	44	60.7917	13.38389		
HBA1c*	Diabetic Hand Ulcer	49	9.8000	2.52477	0.72	0.47
	Diabetic Foot Ulcer	44	9.3333	1.69158		
CRP**	Diabetic Hand Ulcer	49	110.0000	96.33160	-0.03	0.97
	Diabetic Foot Ulcer	44	111.0417	100.24166		

Std. Deviation: Standart Deviation

t: t-value

**HBA1c: Hemoglobin A1c*

***CRP: C-Reactive Protein*

Table 4. The Relation Between the Costs of Chronic Renal Failure and Diabetic Ulcer

Dependent Variable: Cost					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	188574551.798[a]	2	94287275.899	2.064	0.140
Intercept	3434132.908	1	3434132.908	0.075	0.785
Diabetic Ulcer	140739333.499	1	140739333.499	3.081	0.087
CRF*	22369312.580	1	22369312.580	0.490	0.488
Error	1827252696.330	90	45681317.408		
Total	4220427194.967	93			
Corrected Total	2015827248.128	92			

R Squared = 0.094 (Adjusted R Squared = 0.048)

Sig.: Significance

df: Difference of Freedom

f: f-value

**CRF: Chronic Renal Failure*

Table 5. The Relation Between the Tissue Culture and Diabetic Ulcer Cost

Dependent Variable: Cost					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	179161850.973[a]	2	89580925.486	1.951	0.155
Intercept	7565719.610	1	7565719.610	0.165	0.687
Diabetic Ulcer	110313957.769	1	110313957.769	2.402	0.129
Tissue Culture	12956611.755	1	12956611.755	0.282	*0.598*
Error	1836665397.155	90	45916634.929		
Total	4220427194.967	93			
Corrected Total	2015827248.128	92			

R Squared = 0.089 (Adjusted R Squared = 0.043)

Sig.: Significance

df: Difference of Freedom

f: f-value

Table 6. The Relation Between the Distance to the Nearest Health Center and the Cost of Diabetic Ulcer

Dependent Variable: Cost					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	228666341.764[a]	3	76222113.921	1.663	0.191
Intercept	6730997.057	1	6730997.057	0.147	0.704
Diabetic Ulcer	164972727.989	1	164972727.989	3.600	0.065
The distance between the residence of the patient and the nearest healthcare facility	62461102.547	2	31230551.273	0.682	*0.512*
Error	1787160906.363	89	45824638.625		
Total	4220427194.967	93			
Corrected Total	2015827248.128	92			

R Squared = 0.113 (Adjusted R Squared = 0.045)

Sig.: Significance

df: Difference of Freedom

f: f-value

Table 7. The Relation Between the Costs of Surgery and Diabetic Ulcer

Dependent Variable: Cost					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	167953426.603[a]	2	83976713.302	1.818	0.176
Intercept	3576573.853	1	3576573.853	0.077	0.782
Diabetic Ulcer	166878503.157	1	166878503.157	3.612	0.065
Surgery	1748187.386	1	1748187.386	0.038	*0.847*
Error	1847873821.524	90	46196845.538		
Total	4220427194.967	93			
Corrected Total	2015827248.128	92			

R Squared = 0.083 (Adjusted R Squared = 0.037)

Sig.: Significance

df: Difference of Freedom

f: f-value

Table 8. The Relation Between the Education Status and the Cost of Diabetic Ulcer

Dependent Variable: Cost					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	327211290.199[a]	4	81802822.550	1.841	0.141
Intercept	550976.431	1	550976.431	0.012	0.912
Diabetic Ulcer	154470925.342	1	154470925.342	3.476	0.070
Education Status	161006050.982	3	53668683.661	1.208	*0.320*
Error	1688615957.928	88	44437262.051		
Total	4220427194.967	93			
Corrected Total	2015827248.128	92			

R Squared = 0.162 (Adjusted R Squared = 0.074)

Sig.: Significance

df: Difference of Freedom

f: f-value

Table 9. The Relation Between the Income Status and the Cost of Diabetic Ulcer

Dependent Variable: Cost					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	238232712.924[a]	3	79410904.308	1.742	0.174
Intercept	1977995.097	1	1977995.097	0.043	0.836
Diabetic Ulcer	174476016.259	1	174476016.259	3.828	0.058
Income Status	72027473.706	2	36013736.853	0.790	*0.461*
Error	1777594535.204	89	45579347.057		
Total	4220427194.967	94			
Corrected Total	2015827248.128	92			

R Squared = 0.118 (Adjusted R Squared = 0.050)

Sig.: Significance

df: Difference of Freedom

f: f-value

DISCUSSION

The number of people with diabetes and diabetes-related complications has been rapidly increasing worldwide despite the advances in medical science. The World Health Organization estimates that diabetes, which is likely to increase in prevalence in the future, will impose a substantial economic burden on states due to both the treatment of diabetes itself and its long-term complications, including renal, ocular, cardiac, and nervous system problems (1). While calculating the cost of diabetes, there are two components to take into account; direct costs (the follow-up, the treatment of diabetes, and the medication) and indirect costs (work-related absenteeism, presenteeism, and diabetes-related disability) (2). The data from the SII in 2021, in Turkey has showed that there have been approximately 12 million patients with diabetes under universal health coverage whose diabetes care has been covered by the SII. The SII has reported to incur 8.6 billion ₺ in expenditures for the treatment of these patients in 2021. 2.6 ₺ billion of this total cost was for the treatment and complications and 5.4 billion ₺ was for the medications. 550 million ₺ was for glucometers and insulin pen needles, and 14 million ₺ was for insulin pumps, pump sets, and reservoirs (3). Given this economic burden, resources are limited in the face of this increase in expenditures. In 2019, the International Diabetes Federation (IDF) published the

ninth edition of its diabetes atlas. The atlas, which analyzes the current status of diabetes and projects future trends and estimates that, by 2045, Turkey will be one of the top ten countries in terms of the population with diabetes (4). According to the atlas, in 2019, diabetes-related health expenditure for the European region, including Turkey was approximately 161.4 billion $, and the region had the third largest expenditure on diabetes of all IDF regions. As a result of the intensity of the treatmet for diabetes in the European region, diabetes has become responsible for a large share of total health expenditure, ranging from 4.2% in Ireland to 23.8% in Turkey (5). In the world, the age group with the largest diabetes-related health expenditure, which is 177.7 billion $, has been those aged between 60 and 69 years. This group is followed by those aged between 50 and 59 years and between 70 and 79 years at an amount of 173.0 billion $ and 171.5 billion $, respectively (4). The reason behind this large expenditure that has been observed in older age groups is due to almost certainly the higher frequency of diabetes-related complications in later stages of life. In 2019, a slightly higher diabetes-related health expenditure was seen in women than in men, at an amount of 382.6 billion $ versus 377.6 billion $, respectively. Although some studies have suggested that diabetes and related complications are more common in women, our study has not found any relation between gender and ulcers or the cost of ulcers. In our study, most of the patients in the diabetic hand and foot ulcer groups are male and obese individuals. This might be explained by insufficient physical exercise and non-adherence to diet suggestions. Also, in general, the male population has higher economic and social interactions than woman in our country, which might be the cause of this result. According to our findings, the overall frequency of regular physical exercise is low in both the diabetic hand and foot ulcer groups, which are consisted mostly of the patients with non-regular physical exercise. Furthermore, it is determined that the majority of the patients has not received any information about diabetes within the previous year. It is suggested that an efficient education process for the patients about diabetes might have a positive impact on the cost-effective control of the disease. Diabetes-related chronic kidney disease is associated with significant additional health expenditure. In a study conducted in the USA between 1999 and 2002, mean annual healthcare costs were 49% higher among people with diabetes and clinical nephropathy than among those with no nephropathy. For people with diabetes and who were undergoing dialysis, the mean annual healthcare cost increased 2.8 times when it is compared with the end-stage renal disease patients who were not on dialysis (6,7). In this study, the presence of renal failure is not found to be related with the development of diabetic hand and foot ulcers or with the cost of existing ulcers. Moreover, although the presence of CRF is known to contribute to mortality in patients with diabetic ulcers, it is seen that it hasn't been resulted in mortality in any patient included in this study. People with diabetes who have foot ulcers bear health expenditures five times higher than those without foot ulcers. When it is compared to people with diabetes without foot ulcers, the cost of care for people with diabetes and foot ulcers is 5.4 times higher in the year of the first episode (8). A single-center study conducted in 2014, by Gençalioğlu, has reported that the cost of the treatment for the patients hospitalized with diabetic foot ulcers was 2203 $ per person on average (1$: 2.18 ₺) (9). A study titled "Problems in Diabetic Foot Infections and Cost Analysis for 2012" by Gönen has reported that the cost for per patient has been 2144.6 ± 2046.6 $, which is consistent with our study (1$: 1.8 ₺, based on the exchange rate for 2012) (10). Until the 90s, complications in diabetic patients were mostly related to the lower limbs. However, during the last two decades, several reports have demonstrated an increasing prevalence of diabetic hand ulcers, which are mostly observed in tropical countries and can be quite dangerous. Thus, the effect of diabetes on upper limbs is no longer limited to decreased joint mobilization, Dupuytren's contracture, neuropathy, nerve entrapment, and trigger finger (11). The condition, first described by Gill et al. and named as 'tropical diabetic hand syndrome,' typically affects women with type 2 diabetes and the patients in the fifth or sixth decade of their lives (12,13,14). Turkey is also located in a tropical region and is humid due to the effect of the Mediterranean climate. It can be concluded that it makes diabetic hand complications inevitable in our country. This study, unlike previous reports, has found that most of the patients presenting with a diabetic hand are male, but the age of onset is usually the sixth decade, which is consistent with the results in the literature. This might be attributed to the overrepresentation of men in Turkey in both social life and employment, making the upper limbs in men more vulnerable to pathogens when they are compared to women. Other risk factors for tropical hand infections

include poor control of diabetes or poor compliance, low socioeconomic status, minor trauma, and delayed treatment (13,15). In this study, the patients with diabetic hand ulcers have been checked for glucose levels for the past three months in order to determine their diabetes control status. Mean HbA1c levels are found to be higher in patients with diabetic hand ulcers, which supports previous reports that poor diabetes control is correlated with the development of hand infections. Although delayed treatment and low socioeconomic status are known to complicate hand infections, 64% of the patients with hand infections in our study are in a middle or high income group (quintiles 3-5). Moreover, 78% of them had their residence at a distance of less than 3 km from the nearest healthcare facility. This seems to point at low awareness of diabetic hand infections and delayed treatment in Turkey. Our experience also indicates that due to the low awareness of the diagnosis of diabetic hand ulcers among healthcare professionals, the initiation of an appropriate treatment for patients is usually preceded by a number of different treatments prescribed by other healthcare professionals, resulting in delayed referral to our clinic. Moreover, tropical diabetic hand infections have been claimed to be more common among patients with end-stage renal failure (15). In our study, the relation between the presence of CRF and diabetic hand ulcers is not statistically significant. However, in 86% of the patients with diabetic hand ulcers, the ulcer started in the limb with fistula. This might be explained by the steal phenomenon occurring in the limb with fistula, which reduces the blood flow distally. In their study, Bajaj et al. have reported that diabetic hand infections might be fatal (16). In this study, the clinical course ended with mortality in two patients with diabetic hand infection. In these patients, the site of onset was at the proximal level of the limb, and they had no glycemic control. Poor glycemic control leading to peripheral neuropathy might play a more significant role in the pathogenesis of hand sepsis (17). In addition to peripheral neuropathy, peripheral vascular disease also acts as a risk factor for diabetic foot infections (18,19). However, in this study, it has been found that diabetic hand ulcers might develop without vascular pathology in the affected limb. It might be explained by the fact that the hand plays a more active role in social activities and thus has less tolerance to neuropathy. Indeed, reduced sensation in the hand can complicate common and otherwise harmless hand injuries. In the present study, 72% of the patients who presented with a diabetic hand did not report a history of trauma. In 1977, a study with a limited number of patients (20) conducted by Mann et al. has reported that hand infections are more associated with type 2 diabetes. Francel et al., on the other hand, have suggested that diabetic hand infections are associated with type 1 diabetes (21). In our study, it is seen that there has been no relation between the type of diabetes and costs or ulcer development. Thus, the role of the type of diabetes in the pathogenesis of hand ulcers remains equivocal. Diabetic hand infections usually involve a polymicrobial infection, but a monomicrobial one is also possible. The bacterial isolates can be both Gram-positive and Gram-negative with Klebsiella, Pseudomonas, and Staphylococcus species being the most common (22). In this study, unlike the literature, candida species have been identified in patients with diabetic hand infection. Candida thrive in a warm, humid environment, and a reduced immune response or other conditions can allow an infection to develop. Since the hands and fingers are more involved with water, fungal infections should also be considered in diabetic hand infections. S. aureus is one of the most prominent pathogens in diabetic foot ulcers, warranting targeted empiric therapy in all patients. P. aeruginosa is becoming one of the most prominent Gram-negative pathogens in diabetic foot ulcers and is the second-most common pathogen behind S. aureus (23,24). In this study, the growths in tissue cultures of patients with foot ulcers have been compatible with the literature. The main limitation of the present study is the absence of analysis on the direct and indirect costs of diabetes. Moreover, in an attempt to understand the basic economic burden of diabetes, the study has excluded the patients who received specialized wound care products. It is known that complications of diabetes are more costly than diabetes itself. Thus, hand ulcers, like foot ulcers, should be recognized as a serious and costly complication of diabetes, and measures should be taken to develop preventive strategies. In addition to its impact characterized by premature mortality and lower quality of life due to related complications, diabetes imposes a significant economic impact on countries, health systems and, when healthcare needs to be funded 'out-of-pocket,' for individuals and their families. Although diabetic hand infections are less costly and cause fewer major amputations, it is a clinical condition that should be given at least as much attention as diabetic foot ulcer due to its atypical localized onset and the reproductive potential of different microorganisms.

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Declarations

The authors have no conflicts of interest to declare. The authors declared that this study has received no financial support.

This study was approved by the clinical research Ethics Committee of the Kartal Dr. Lütfi Kırdar Training and Research Hospital (Date: 29.05.2023, Number: 2023/514/250/23).

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