TREATMENT COST ANALYSIS IN PATIENTS WITH DIABETIC FOOT INFECTION: A RETROSPECTIVE STUDY

DİYABETİK AYAK ENFEKSİYONLU HASTALARDA TEDAVİ MALİYET ANALİZİ: RETROSPEKTİF BIR ÇALIŞMA

Handan ALAY [1]✉ Sinan YILMAZ[2] Fatma KESMEZ CAN[1] Zülal ÖZKURT[1] Zeynep Selin Vural[1] Ayşe ALBAYRAK[1] Kemalettin ÖZDEN[1] Esra ÇINAR TANRIVERDİ[3]

1. *Department of Infectious Diseases and Clinical Microbiology, Faculty of Medicine, Ataturk University, Erzurum, Turkey*
2. *Department of Public Health, Faculty of Medicine, Ataturk University, Erzurum, Turkey*
3. *Department of Medical Education, Faculty of Medicine, Ataturk University, Erzurum, Turkey*

ORCID: *0000-0002-4406-014X, 0000-0001-7784-3274, 0000-0001-8085-7589, 0000-0001-5554-8768, 0000-0002-3471-3135, 0000-0002-6177-4566, 0000-0003-3293-5671, 0000-0001-8857-3986*

E-mail*: alayhandan@gmail.com*

Received/Geliş Tarihi	Accepted/Kabul Tarihi	Published/Yayın Tarihi
29.05.2023	22.08.2023	31.08.2023

To cite this article / Bu makaleye atıfta bulunmak için:
Alay H, Yılmaz S, Can FK, Ozkurt Z, Sahin ZS, Albayrak A, Ozden K, Tanrıverdi EC. Treatment cost analysis in patients with diabetic foot infection: a retrospective study. Atatürk Üniversitesi Tıp Fakültesi Cerrahi Tıp Bilimleri Dergisi. 2023; 2(2):47-54

Abstract

Introduction: Diabetic foot infection (DFI) and diabetic foot ulcer (DFU) are widespread complications of diabetes. The management and treatment of DFU, an important public health problem, can result in a significant economic burden on health systems. The purpose of this study was to reveal the general cost dimension in patients hospitalized in our clinic for treatment and care with diagnoses of DFI. **Materials and methods:** One hundred seventy-nine patients followed-up with diagnoses of DFI in our clinic between 1 January, 2018, and 1 August, 2020, were included in this retrospective study. General cost totals including radiological imaging, laboratory tests, examination and consultation, bed costs, medical and surgical treatment (amputation, debridement), and dressing costs during patients' hospital stays were calculated. **Results:** The mean age of the 179 patients with DFI in this study was 61.5±10.9 years, and 122 (68.2%) were men. Mean duration of diabetes was 13.7±6.5 years. Based on the Infectious Disease Society of America classification, 55.9% of the cases with DFU were moderate, osteomyelitis was present in 41.3%, and 15.6% were receiving hyperbaric therapy. The general prevalence of amputation was 26.8%, with minor amputations representing 22.9%. Thirteen (7.3%) of the amputation cases had undergone more than one amputation. Repeat hospitalizations were observed in 54.7% of the patients during the study period. The general mortality rate was 2.8%. The mean treatment cost per capita among the patients with DFU was 9181.9±5155.3 Turkish lira. With the exception of the repeat hospitalization cases ($p<0.001$), no significant association was determined between per capita cost and any of the demographic and clinical variables investigated($p>0.05$ for all). **Conclusion:** There is a significant correlation between patients with repeated hospitalizations and cost. Awareness training programs including risk factors and foot care will contribute to a decrease in DFU development and related complications such as amputation in patients with diabetes mellitus.

Keywords: Diabetic foot infection, diabetic foot ulcer, cost

Özet

Giriş: Diyabetik ayak enfeksiyonu (DAE) ve diyabetik ayak ülserleri (DAÜ) diyabetin yaygın komplikasyonlarındandır. Önemli bir halk sağlığı sorunu olan DAÜ yönetimi ve tedavisi sağlık sistemlerinde önemli boyutlarda ekonomik yük oluşturmaktadır. Bu nedenle DAE tanısıyla kliniğimizde yatırılarak tedavi ve bakımı yapılan hastalardaki genel maliyet boyutunu ortaya koymayı amaçladık. **Materyal ve method:** Retrospektif olarak gerçekleştirilen bu çalışmada kliniğimizde 1 Ocak 2018 ile 1 Ağustos 2020 tarihleri arasında DAE tanısıyla takip edilen 179 hasta dahil edildi. Hastanede yattıkları süre içerisindeki radyolojik görüntüleme, laboratuvar tetkikleri, muayene ve konsültasyon, yatak masrafı, medikal ve cerrahi tedavi (ampütasyon, debridman), pansuman maliyetleri dahil olmak üzere genel maliyet toplamları hesaplandı. **Bulgular:** Çalışmaya dahil edilen 179 DAE'lu hastanın yaş ortalaması 61.5±10.9 yıl ve 122'si (%68.2) erkekti. Hastaların ortalama diyabet süresi 13.7±6.5 yıldı. DAÜ'li hastaların IDSA sınıflamasına göre %55.9'u orta derece olup, %41.3'ünde osteomiyelit bulunuyor ve %15.6'sı hiperbarik oksijen tedavisi alıyordu. Çalışmada genel amputasyon sıklığı %26.8 olup, %22.9'unu minör amputasyonlar oluşturuyordu. Amputasyonlu vakaların %7.3'ü (n=13) ise birden fazla amputasyon geçirmişti. Hastaların %54.7'sinin çalışma süresi kapsamında tekrarlayan hastane yatışları söz konusuydu. Vakalarda genel mortalite sıklığı ise %2.8 idi. DAÜ'li hastaların ortalama kişi başı tedavi maliyeti 9181.9±5155.3 TL idi. Kişi başı maliyet ile tekrarlayan hospitalizasyonu olan hastalar ($p<0.001$) hariç, incelenen değişkenlerin hiçbiri anlamlı ilişki göstermedi (tümü için $p>0.05$) **Sonuç:** Hastaneye tekrarlayan yatışı olan hastalarla maliyet arasında anlamlı bir korelasyon vardır. DAÜ oluşumuna neden olan risk faktörleri ve ayak bakımını içeren farkındalık eğitim programları DM'lu hastalarda DAÜ oluşumunu ve buna bağlı gelişen ampütasyon gibi komplikasyon oranlarının azalmasına katkı sağlayacaktır.

Anahtar Kelimeler: Diyabetik ayak enfeksiyonu, diyabetik ayak ülser, maliyet

1. INTRODUCTION

Diabetic foot infection (DFI) is one of the widespread complications of diabetes and is closely associated with morbidity, an increased risk of amputation, and high mortality (1). Several factors are involved in the development of diabetic foot ulcer (DFU). This particularly occurs as a result of weak glycemic control, neuropathy, and peripheral vascular disease or poor foot care (2). DFI develops as a result of complex interaction between these factors and the immune system (3).

DFIs lead to prolongation of hospital stays, impaired quality of life, morbidity, and even increased mortality rates in diabetic patients. Interestingly, DFU costs have been reported to be higher than the treatment costs for several forms of cancer (4). The management and treatment of DFU, an important health problem, impose a significant economic burden on health systems. The purpose of the present study was therefore to examine the general cost dimension in patients diagnosed with DFI hospitalized for treatment and care in our clinic in a center serving a large patient population in the east of Turkey.

2. MATERIAL AND METHOD

The data for patients followed-up with diagnoses of DFI at the Atatürk University Medical Faculty Infectious Diseases Clinic between 1 January, 2018, and 1 August, 2020, were included in this retrospective study. This study was started after the approval of the local ethics committee. One hundred seventy-nine patients whose records were suitable for the study, from the 414 individuals followed-up were enrolled. Patients' demographic characteristics, accompanying diseases, amputation status, and degrees of DFI were recorded. All ulcers were analyzed according to the severity of infection using the Infectious Disease Society of America (IDSA) and International Working Group on the Diabetic Foot (IWGDF) classification [5]. Grade 1, no symptom or sign of infection, Grade 2, local infection, Grade 3, local infection deeper than subcutaneous tissue without systemic inflammatory response symptoms (SIRS), and Grade 4, infections with SIRS. Patients with grade 2, 3, and 4 were included in the study. The patients with other relevant comorbid conditions requiring hospitalization (nephropathy, diabetic acidosis, etc.) were also excluded from the study.

Total general cost calculations were performed, including radiological imaging, laboratory tests, examinations and consultations, bed costs, medical and surgical treatment (amputation and debridement), and dressing costs during hospitalization. Cost calculations also included initial evaluations, and the diagnosis and treatment of underlying and accompanying diseases. Indirect costs, post-discharge treatment costs, post-amputation prosthesis, physiotherapy and wheelchair procurement are not included in the cost analysis.

All costs data were calculated in Turkish lira (TRY) then exchanged to US dollars using the Central Bank of the Republic of Turkey Exchange Rates-Banknotes (Converted to TRY) per year through 2018–2020. The exchange rate of US dollars to TRY for 2018, 2019, and 2020 were 4.81, 5.67, and 7.00, respectively.

Approval for the study was granted by the Ataturk University Medical Faculty Clinical Research Ethical Committee (no. B.30.2. ATA.0.01.00/368).

2.1. Statistical analysis

The study data were analyzed on SPSS version 22 software. Descriptive statistics were expressed as mean, standard deviation, number, and percentage. Compatibility with normal distribution was assessed using the Kolmogorov Smirnov Test, with graphing methods and z-values calculated for skewness and kurtosis coefficients.

3. RESULTS

The mean age of the 179 patients with DFI was 61.5±10.9 years, and 122 (68.2%) were men. The mean duration of diabetes was 13.7±6.5 years, and 36.65 % were active smokers or had histories of smoking. Patients had actively smoked for a mean 1.8±0.4 years. The three principal clinical features were peripheral neuropathy (34.4%), hypertension (21.1%) and cardiovascular diseases (15.5%). In terms of treatment for diabetes, 40.8% of patients were using insulin and 21.8% oral hypoglycemic (OH) medications. The patients' mean HbA1c level was 9.6±2.6. Based on the IDSA classification, 55.9% of the cases with DFU were moderate, osteomyelitis was present in 41.3%, and 15.6% were receiving hyperbaric oxygen therapy. The incidence of amputation was 25.8%, with minor amputations representing 22.9%. A history of more than one amputation was present in 7.3% (n=13) of cases. Soft tissue infection only was present in the remaining cases (73.2%). Repeated hospitalizations during the study period were present in 54.7% of patients. The general mortality rate was 2.8%. The patients' demographic and clinical characteristics are shown in Table 1, and Table 2.

The mean per capita treatment cost of the patients with DFU was 9181.9±5155.3 Turkish lira (TL). With the exception of patients with repeated hospitalizations ($p<0.001$), none of the variables exhibited a significant relationship with per capita treatment cost (for all $p>0.05$) (Table 3, 4).

Table 1: The patients' demographic characteristics

Variables		n (%)
Gender	**Female**	57 (31.8)
	Male	122 (68.2)
Education level	**Illiterate**	49 (27.4)
	Elementary/middle school	105 (58.7)
	High school	19 (10.6)
	University	6 (3.4)
Place of residence	**Village**	41 (22.9)
	District	55 (30.7)
	Urban center	83 (46.4)
Smoking status	**Smoker**	62 (34.6)
	Non-smoker	117 (65.4)
	Duration of smoking (years)	1.8±0.4

Table 2: The patients' clinical characteristics

Variables		n (%)
Clinical characteristics	**PNP**	122 (34.4)
	HT	75 (21.1)
	CVD	55 (15.5)
	Hypercholesterolemia	39 (11.0)
	PAD	32 (9.0)
	PVI	17 (4.8)
	Hemodialysis	15 (4.2)
Diabetes treatment	**Insulin**	73 (40.8)
	Oral hypoglycemic	39 (21.8)
	Insulin and oral hypoglycemic	67 (37.4)
IDSA	**Grade 2**	60 (33.5)
	Grade 3	100 (55.9)
	Grade 4	19 (10.6)
Osteomyelitis	**Yes**	74 (41.3)
	No	105 (63.1)
Hyperbaric therapy	**Yes**	28 (15.6)
	No	151 (84.4)
Amputation status	**None**	131 (73.2)
	Minor	41 (22.9)
	Major	7 (3.9)
Number of amputations	**Single**	35 (19.5)
	Multiple	13 (7.3)
Repeat hospitalization	**Yes**	98 (54.7)
	No	81 (45.3)
Mortality	**Yes**	5 (2.8)
	No	174 (97.2)

Table 3: The cost results according to the demographic characteristics of the patients

		General Cost Per Case		
		Mean±SD	**Median[Q1-Q3]**	**p**
Gender	Female	8366±9671.5	4875[2878.2-9449.2]	0.96
	Male	9563±16222.7	5177[2912.7-10133]	
Education level	Illiterate	9375±10944.4	7307[2883.1-10299.6]	0.681
	Elementary-middle school	9065±16659	4523.4[2908-9449.2]	
	High school	7919±7593.6	5971.2[3475.1-9929.8]	
	University	13647±16342.8	5857.7[5086.1-17819]	
Place of residence	Village	8255±7881.5	5648.1[2883.5-9974.1]	0.681
	District center	10361±21451.2	6016.7[3358.8-10133]	
	Urban center	8859±10867.7	4522.3[2643.8-9929.8]	
Diabetes treatment	Insulin	8998±9691.9	5571.9[3467- 10988.9]	0.369
	OH	6453±6097.6	4522.3[2562.5-8266.9]	
	Insulin+OH	10971±20763.7	5761.8[2883.5-10136.8]	
Smoking status	Smoker	9112±20655.4	4409.9[2608.7-7478.5]	0.91
	Non-smoker	9219±9787.6	5806.7[3111.2-10350.2]	

4. DISCUSSION

Cost analysis was performed for 179 patients with DFI over an approximately three-year period. No significant correlation was determined between total cost and patients' demographic characteristics, underlying diseases, degree of DFU, or amputation status. However, significant correlation with cost was determined in patients with repeated hospitalizations.

Diabetes mellitus (DM) is a chronic disease requiring lifetime resources in order to prevent complications developing over the course of time and for treatment. The costs entailed in diabetic foot lesions include interventions aimed at preventing foot ulcer development, treatments to shorten wound healing time, strategies to prevent amputation, the management of post-amputation disability, and patient care (6). Increasing numbers of individuals worldwide are being affected by DM, and patients' quality of life is compromised as a result of severe complications such as DFU and infection.

Various studies have reported amputation rates in DFUs in Turkey. In a study of 138 patients with DFI, Karagöz et al. reported a major amputation rate of 28.5% and a total amputation rate of 57% (7). Another study cited an amputation rate of 18% (8). The frequency of lower extremity amputation has been reported to be in decline over the last 30 years (9). However, there are also studies citing high amputation rates (10-12). The general amputation rate among patients with DFI in the present study was 26.8%, with a major amputation rate of 3.9%. A previous prospective study performed in our clinic determined an amputation rate of 28.5% among 137 patients followed-up due to DFI (13). Our clinic has been serving DFU patients on an intensive patients for approximately three years. Patients under follow-up are given instruction concerning wound care and prevention, and are informed about early presentation to health centers. Patients with DFI and repeated hospitalizations can thus be identified and treated early. This may explain our lower amputation rate compared to other studies. Awareness programs including the risk factors involved in DFU formation and foot care will contribute to reducing the development of DFU and rates of associated complication such as amputation in patients with DM.

Approximately half of DFUs become infected during treatment (14). Our mild, moderate, and severe DFU rates based on the IDSA-IWGDF classification system were 33.5%, 55.9% and 10.6%, respectively. In a study conducted in our country, DFIs were staged using the Wagner classification, and 15 of 63 patients were evaluated as stage 3 and 10 as stage 4 within a period of approximately one year. (15). According to an IDSA report using the IDSA-IWGDF system, 47% of cases were mild, 34% moderate, and 17.9% severe (5). The lower incidence of severe cases in the present study may be attributable to the earlier recognition of infection by patients and the prompt initiation of the necessary treatments.

Table 4: The cost results according to the clinical characteristics of the patients

		Mean Standard deviation	Median[Q1-Q3]	p
Hypercholesterolemia	Yes	8180±7836.5	5648.1[2912.7-9213.7]	0.532
	No	9461±15812.4	4908.5[2835.7-10065.1]	
Hemodialysis	Yes	8907±9914	5232.1[3130.7-11257.7]	0.807
	No	9207±14811.9	5140.2[2880.6-9985.6]	
CVD	Yes	11399±21788.4	6278.3[3111.2-13487.2]	0.166
	No	8199±9505	4908.5[2761-9557.2]	
HT	Yes	11545±20496.4	5806.7[2643.8-11938.9]	0.503
	No	7478±7193.5	4990.6[3125.4-9173.4]	
PAD	Yes	14472±28659.3	7447[3925.4-10844.8]	0.116
	No	8030±8515	4875[2793.3-9929.8]	
PVI	Yes	11632±14074.3	6540.2[4319.1-11257.7]	0.203
	No	8925±14501.2	5105.6[2793.3-9974.1]	
PNP	Yes	8408±9358.4	4908.5[2883.5-9449.2]	0.719
	No	10838±21676.1	5806.7[2931.6-10133]	
Amputation	None	9346±16284.7	4597.2[2412.8-10136.8]	0.091
	Minor	8986±7765.6	7118.5[4009.5-9929.8]	
	Major	7257±6054.7	4358.8[3468.7-8879.3]	
Number of amputations	1	7848±6625.8	5648.1[3577-9929.8]	0.107
	>1	11118±9380.6	8879.3[7067.8-9449.2]	
Osteomyelitis	Yes	11215±20177	5832.4[3358.8-10431.9]	0.166
	No	7749±8143.9	5086.1[2562.5-9004.7]	
IDSA	Grade 2	6814±7100.5	4475.3[2623.8-8498.1]	0.279
	Grade 3	10190±17446.6	5704.9[3011.9-10322.4]	
	Grade 4	11354±13948.3	6540.2[2951.1-11240.3]	

Hyperbaric therapy	Yes	17234±30614.1	6205.8[3969.7-17844.3]	0.061
	No	7689±8033.7	5039.2[2676.3-9213.7]	
Repeated hospitalization	Yes	12397±18569.7	7031[4009.5-13902.5]	*0.001*
	No	5292±4258.7	3824.9[2235.3-7415.5]	
Mortality	Yes	15482±19108.9	4009.5[2912.7-21871.6]	0.746
	No	9001±14319.5	5177[2883.5-9974.1]	

Table 5: Distribution of cost components by years

Cost components	**2018 (mean±SD)**	**2019 (mean±SD)**	**2020 (8 months) (mean±SD)**
Radiology	223.6±275.4	375.0±984.2	252.4±346.4
Tests	791.5±909.3	1073.6±1319.8	585.0±643.5
Examination/Consultation	75.2±95.6	102.2±128.5	57.4±51.0
Bed	1450.0±3029.7	1249.8±1488.0	848.4±1332.7
Other (dressings, local treatments, debridement)	3491.7±15632.2	2984.6±4289.4	2616.9±3100.6
Total	5963.6±16131.2	5736.0±6986.3	4314.3±4800.4

Several studies have investigated the economic outcomes of DFU and amputations. Although it is not possible to perform an exact comparison among such studies, diabetic foot cost rates in health spending appear to have risen significantly in recent years. The calculation of total costs resulting from extremity amputation should involve more than surgery and the care of hospitalized patients (6). They should also include outpatient services and topical wound treatments until full recovery, as well as the cost of workforce losses during the time that patients are not working. There are studies describing topical wound care and inpatient costs as the most important expenditures in patients with DFU (16, 17). Inpatient and topical wound care costs during hospitalization were included among the total cost results in the present study. However, topical care costs among discharged patients, physiotherapy, wheelchair provision, and costs arising from workforce losses were not included. Previous research and the present study show that diabetic foot lesions result in serious health spending. The total costs of the DFI patients in the present study, including beds, dressings, topical treatment, surgical debridement and amputation exceeded the cost involved for radiology, analysis, and examination/consultation (Table 5).

One study from Turkey reported a mean cost of $ 3880 (US dollars) for a patient with DFI hospitalized for treatment (7). Gonen et al. analyzed the costs for 80 patients and reported a mean per capita figure of $ 2573 (18). Another study calculated a mean cost of $ 976 per patient with diabetic foot (19). The primary risk factors for hospitalization and the development of complications in patients with DFU include an advanced degree of DFU and severe infection. Hospital stays are longer and direct costs higher in patients with moderate and severe infection in particular (20).

A Swiss study investigating DFI costs in 220 patients reported a mean healing time of 29 weeks in patients with no amputation requirement, and of 52 and 38 weeks in patients with minor and major amputation, respectively (6). A longer healing time was reported in minor compared to major amputations. The total cost per patient among those improving without amputation was $ 17,554, compared to $ 33,540 for patients with minor amputation and $ 30,135 for those with major amputation. Costs increased in patients with DFU as non-infected ulcers progressed toward infection, gangrene, and amputation (6). In the present study, treatment costs including local wound care, dressing, surgical debridement, and amputations in patients with DFI were greater than the radiology, analysis, examination/consultation costs. In addition, it was observed that the cost in patients without amputation was higher than in patients with amputation. We think that this situation causes a longer stay in the hospital and an increase in wound care costs, since most of our patients who require amputation do not accept surgical procedures. The decrease in treatment costs over the years may be attributable to the development of strategies aimed at preventing, the education of patients and relatives, and early detection and treatment of ulcer infection by the physician.

As a limitation of our study, Cost findings should now be further detailed through prospective studies that also evaluate the costs of transportation to health services, household spending, and financial losses caused by an inability to work, which are not reflected in national health calculations. In addition, the lack of cost analysis regarding the service received from an external center during hospitalization, external prescription, treatment cost after discharge, prosthesis after amputation, physiotherapy and wheelchair supply is another limitation of our study.

The care costs for diabetic foot exceed those of such major diseases as cancer, lung disease, and depression (21). It is estimated that by 2030 10% of the world population will be diabetic, and that that diabetic foot costs will also rise as a result (22). In conclusion, direct costs (such as diagnosis, treatment, and wound care) during inpatient treatment in patients with DFI are rising on a daily basis. In order to reduce the costs entailed by diabetic foot, the development of the condition must be prevented by providing awareness training concerning DFU and DFI for patients, relatives, and healthcare providers.

Funding: No financial support was received for the study.
Conflict of interest: None

5. REFERENCES

1. Raspovic KM, Wukich DK. Self-reported quality of life and diabetic foot infections. J. Foot. J. Med 2017; 376: 2367–2375.
2. Singer AJ, Tassiopoulos, Kirsner RS. Evaluation and Management of Lower-Extremity Ulcers. N Engl J Med 2018; 378(3): 302-303.
3. Lauri C, Leone A, Cavallini M, Signore A, Giurato L, Uccioli L. Diabetic Foot Infections: The Diagnostic Challenges. J Clin Med 2020; 9(6): 1779.
4. Armstrong DG, Boulton AJM, Bus SA. Diabetic foot ulcers and their recurrence. N Engl J Med 2017; 376: 2367–2375.
5. Lavery LA, Armstrong DG, Murdoch DP, Peters EJ, Lipsky BA. Validation of the Infectious Diseases Society of America's diabetic foot infection classification system. Clin Infect Dis 2007; 44: 562–565.

6. Ragnarson Tennvall R, Apelqvist J. Health-Economic Consequences of Diabetic Foot Lesions. Clinical Infectious Diseases 2004; 39(2): 132-139.
7. Karagöz G, Kadanalı A, Öztürk S, Öztürk S, Çakar ŞE, Çomoğlu Ş, Doğan F. The analysis of the cost and amputation rates of hospitalized diabetic foot infection patients. Int J Diabetes Dev Ctries 2017; 37(2): 201–205.
8. Tabur S, Eren MA, Çelik Y, Dağ OF, Sabuncu T, Sayiner ZA, Savas E. The major predictors of amputation and length of stay in diabetic patients with acute foot ulceration. Wien Klin Wochenschr 2015; 127: 45–50.
9. Hoffstad O, Mitra N, Walsh J, Margolis DJ. Diabetes, lowerextremity amputation, and death. Diabetes Care 2015; 38: 1852–1857.
10. Lawrence SM, Wraight PR, Campbell DA, Colman PG. Assessment and management of inpatients with acute diabetes-related foot complications: room for improvement. Intern Med J 2004; 34(5): 229–233.
11. Nather A, Bee CS, Huak CY, Chew JL, Lin CB, Neo S, Sim EY. Epidemiology of diabetic foot problems and predictive factors for limb loss. J Diabetes Complications 2008; 22(2): 77–82.
12. Rezende KF, Nunes MA, Melo NH, Malerbi D, Chacra AR, Ferraz MB. In hospital care for diabetic foot: a comparison between the estimated cost and the SUS reimbursement. Arq Bras Endocrinol Metabol 2008; 52(3): 523–530.
13. Alay H, Yılmaz S, Kesmez Can F, Parlak M. An evaluation of risk factors affecting amputation in patients with diabetic foot infection. J Health Sci Med 2021; 4(1): 49-54.
14. Lavery LA, Armstrong DG, Wunderlich RP, Boulton AJM, Tredwell JL. Diabetic foot syndrome: evaluating the prevalence and incidence of foot pathology in Mexican Americans and non-Hispanic whites from a diabetes disease management cohort. Diabetes Care 2003; 26:1435–1438.
15. Bozkurt F, Tekin R, Çelen MK, Ayaz C. Wagner classification and culture analysis of diabetic foot infection. Dicle Tıp Dergisi. 2011; 38(1): 31 - 34.
16. Apelqvist J, Ragnarson Tennvall G, Persson U, Larsson J. Diabetic foot ulcers in a multidisciplinary setting: an economic analysis of primary healing and healing with amputation. J Intern Med 1994; 235: 463–471.
17. Ragnarson Tennvall G, Apelqvist J, Eneroth M. Costs of deep foot infections in patients with diabetes mellitus. Pharmacoeconomics 2000; 18: 225–238.
18. Gonen MS, Cakir M, Gonulalan G, Ozturk M, Ipekci SH, Kosker A, Karalezli MN, Eryaman I, Durgut K, Keskin M, Seyhan N. The problems and cost-effectiveness analysis of diabetic foot infections. Turk J Endocrinol Metab 2012; 16: 10–13.
19. Keskek SO, Kirim S, Yanmaz N. Estimated costs of the treatment of diabetic foot ulcers in a tertiary hospital in Turkey. Pak J Med Sci 2014; 30: 968–971.
20. Bao X, Yang C, Fang K, Shi M, Yu G, Hu Y. Hospitalization costs and complications in hospitalized patients with type 2 diabetes mellitus in Beijing. China J Diabetes 2017; 9(4): 405-411.
21. Tchero H, Kangambega P, Lin L, Mukisi-Mukaza M, Brunet-Houdard S, et al. Cost of diabetic foot in France, Spain, Italy, Germany and United Kingdom: A systemetic review. Ann Endocrinol (Paris) 2018; 79(2): 67-74.
22. Struijs JN, Baan CA, Schellevis FG, Westert GP, van den Bos GA. Comorbidity in patients with diabetes mellitus: impact on medical health care utilization. BMC Health Serv Res 2006; 6: 84.