Analysis of risk factors for amputation in patients with diabetic foot ulcers: a cohort study from a tertiary center

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ABSTRACT

Objective: This study aimed to analyze risk factors for amputation (overall, minor and major) in patients with diabetic foot ulcers (DFUs).

Methods: 407 patients with DFUs (286 male, 121 female; mean age = 60, age range = 32-92) who were managed in a tertiary care centre from 2009 to 2019 were retrospectively identified and included in the study. DFUs were categorized based on the Meggit-Wagner, PEDIS, S(AD)SAD, and University of Texas (UT) classification systems. To identify amputation risk-related factors, results of patients with DFUs who underwent amputations (minor or major) were compared to those who received other adjunctive treatments using Chi-Square, one-way analysis of variance (ANOVA) and Spearman correlation analysis.

Results: The mean C-reactive protein (CRP) and White Blood Cell (WBC) values were significantly higher in patients with major or minor amputation than in those without amputation. The mean Neutrophil (PNL), Platelets (PLT), wound width, creatinine and sedimentation (ESR) values were significantly higher in patients with major amputation compared to other groups of patients. Elevated levels of High-density lipoprotein (HDL), Hemoglobin (HGB) and albumin were determined to be protective factors against the risk of amputation. Spearman correlation analysis revealed a positive-sided, strong-levelled, significant relation between Wagner grades and amputation status of patients.

Conclusion: This study has identified specific factors for major and minor amputation risk of patients with DFUs. Especially infection markers such as CRP, WBC, ESR and PNL were higher in the amputation group. Most importantly, Meggit Wagner, one of the four different classification systems used in the DFUs, was determined to be highly associated with patients’ amputation risk.

Level of Evidence: Level IV, Prognostic Study

Introduction

Diabetic foot ulcers (DFUs) are among the most important complications of diabetes mellitus (DM), with vital consequences for both patients and healthcare systems. Diabetic foot ulcers are difficult to treat and constitute the most common diabetic complication resulting in hospitalization and leading to foot loss every 30 seconds globally.¹

Diabetic foot ulcers have a special syndrome among chronic wounds, and the treatment of both acute and chronic DFUs relies primarily on surgical procedures.² Various surgeries, such as resection arthroplasty, metatarsal osteotomies, and metatarsal head resections, are used in the case of failed nonoperative treatments for DFUs.³ Major amputations are generally performed above the ankle, while minor amputations are restricted to the toe or foot level.⁴

Diabetic foot ulcer classifications are especially important in terms of treatment standardization and disease prognosis.¹ First proposed by Meggitt in 1976 and then improved by Wagner in 1981, Meggitt-Wagner is the most well-known diabetic foot classification system and is largely based on wound depth.⁶ The University of Texas (UT) diabetic foot classification system is based on diabetic foot disease’s association with infection, ischemia, and wound depth.⁵ The International Working Group of the Diabetic Foot developed a research-oriented system proposing that all foot ulcers be classified according to the 5 categories of the so-called PEDIS system: perfusion, extent/size, depth/tissue loss, infection, and sensation.⁶ Finally, the size (area and depth), sepsis, arteriopathy, and denervation (S(AD) SAD) system is a more recent classification proposed to address problems considered too simple to be specific or too complicated to be included in other systems. Size (area and depth), sepsis, arteriopathy, and denervation are key elements.⁷

Treatments following DFU diagnosis are often accompanied by amputation surgery, and 5-year mortality rates can reach up to 74% in diabetic foot patients. It is crucial to state that this ratio is notably higher than 5-year survival rates for breast, prostate, and colon cancer patients.¹¹ Beyaz et al.¹² found that the life expectancy of DFU patients requiring amputation for untreatable foot problems was under 3 years. With
this in mind, the current study focuses on identifying factors associated with the risk of both minor and major amputation in patients with DFUs.

Materials and Methods

Data source
This study retrospectively analyzed a total of 407 patients with diabetic foot disease followed up in Istanbul University, Istanbul Faculty of Medicine, Department of Underwater and Hyperbaric Medicine between January 2010 and September 2019. Each patient signs a consent form stating that their data can be used for research when they come to the clinic. However, our study is based on retrospective data analysis without individual patient characteristics; particular consent could not be obtained for the study.

Cohort selection
First, 56 potential risk factors were identified according to the recommendations of 3 experts and used to determine amputation risk in patients with DFUs. Out of 9824 total patients with DFUs, 407 patients with known outcome at follow-ups were selected for inclusion in the study. Clinical parameters for these patients were retrieved from the hospital information system database, patient files, and epicrisis records of inpatient files. A form was created to collect the data. Two healthcare professionals specialized in DFUs were consulted to classify the wounds at the times of patients’ admission into hospital. Wounds were classified according to the Meggitt-Wagner, PEDIS, UT, and S(AD) SAD classification systems, which constituted the most laborious process in the study. The senior research scientist made the final decision in case of disagreement on classification. In this way, data were gathered retrospectively following diabetic foot diagnosis and treatment, and gathered data were manually transferred from the form to a digital environment.

Statistical analysis
We used the Shapiro-Wilk test to evaluate the normality distributions of continuous variables of general patient characteristics and parametric tests for statistical associations. Shapiro-Wilk results indicate normally distributed values for age, hemoglobin (HGB), and low-density lipoprotein (P ≥ .05) only. However, because our sample size was greater than 30, the lack of normal distribution for other values does not pose a statistical problem, as the sums and means are assumed to be normal, according to central limit theorem, especially when n > 100.114

The data set included missing values that were impossible to fill using any method. A chi-square test (χ²) of association between categorical variables and overall amputation status was used for discrete variables. A one-way analysis of variance (ANOVA) was used to detect statistically significant differences between the means of 3 or more independent groups. Homogeneity of the variances was tested using the Levene homogeneity test. The Tukey’s HSD (Honestly Significant Difference) test was used in the presence of variance homogeneity (P ≥ .05) and the Tamhane’s test was used in cases of no homogeneity (P < .05).

Correlation analysis was performed to determine the direction of the relationship between significant factors associated with amputation according to chi-square test (χ²) and ANOVA results and evaluated using the Spearman rho correlation coefficient.

All statistical analyses were performed using Statistical Package for Social Sciences 22.0 software. A P-value ≤ .05 was considered to be statistically significant.

Results

Details regarding the general characteristics of patients evaluated are available in Table 1. Table 2 outlines the categorization and breakdown of DFU patients according to the PEDIS, S(AD) SAD, Meggitt-Wagner, and UT systems.

Differences between the distributions of categorical variables were evaluated by the Chi-square test, which found a significant relationship between amputation stages of the patients and some specific factors. The results for statistically significant variables (P ≤ .05) are provided in Table 3.

One-way analysis of variance results indicate significant differences in body mass index (BMI), wound width, white blood cells (WBCs), C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), HBG, albumin, neutrophil (PNL), platelets (PLT), creatinine, and high-density lipoprotein (HDL) values between patients with different amputation statuses (P ≤ .05) (see Table 4, results are provided for statistically significant variables only). Mean CRP and WBC values were significantly higher in patients with either major or minor amputation compared to those without, according to Tamhane multicomparison test. Additionally, patients with major amputation had significantly higher mean wound width, creatinine, and ESR values than those with minor or no amputation. Mean PNL values of patients with major amputation and mean PLT values of patients with minor amputation were both significantly higher than for those without amputation.

Moreover, nonamputee patients had significantly higher mean HGB and albumin values than those with either minor or major amputation, significantly higher mean HDL values than those with major amputation, and significantly higher BMI values than those with minor amputation, based on Tukey HSD multicomparison test.

A Spearman rho correlation test using patient features and amputation status found a positive-sided, normal-leveled relationship between PEDIS peripheral arterial disease grades, PEDIS infection grades, gangrene, and amputation status as well as a positive-sided, strong-leveled, and significant relationship between Wagner grade (r=0.674, P ≤ .01) and amputation status (see Table 5, only results for statistically significant variables are given in the table).

Discussion

Since diabetic foot is a multifactorial disease with serious consequences when improperly treated, advance determination of factors associated with amputation risk is important for disease prognosis.
A study evaluating existing risk factors and clinical results in patients who underwent amputation resulting from DFUs found that Wagner grade 4 plus DM and DFU durations were significantly higher in the major amputation group compared to the minor amputation group. The major risk factors leading to major amputation were age, Wagner classification, duration of DM and DFU, and CRP level. While our study found a significant relationship between Wagner grades, CRP values, and major amputation risk, neither DM or DFU duration nor age showed a significant correlation with major amputation.

The use of hyperbaric oxygen therapy (HBOT) in DFU prognosis has been addressed in a limited number of studies. A study was conducted to predict possible disease outcome in 1006 patients receiving HBOT for DFUs, and 73.8% of these patients recovered (the scar tissue was granulated or completely healed). Similarly, our study found a recovery rate of 86%, with or without amputation. Moreover, in previous study, renal failure has been strongly associated with poor disease outcome; these results were corroborated with the findings of our study, which found renal failure and dialysis to increase amputation risk. On the other hand, we found a positive-sided, weak-leveled, and significant relationship between previous amputation history and amputation risk. One of the most striking previous findings suggests that HBOT may be an important adjunctive therapy for healing lower extremity lesions, especially in patients with Wagner grade 3 or higher. However, we found a positive correlation between HBOT treatment and amputation status. Unlike previous studies, we also found a significant connection between negative pressure wound therapy and overall amputation status.

### Table 1. Descriptive statistics of the categorical variables used in the data set

| Variables | Number and percentage of patients with DFUs \(n=407\), \(n (%)\) |
|-----------|--------------------------------------------------|
| Gender    |                                                 |
| Male      | 286 (70.3)                                       |
| Female    | 121 (29.7)                                       |
| Age       |                                                 |
| Under the age of 65 | 271 (66.6)                                      |
| 65 and above | 136 (33.4)                                      |
| Type of diabetes mellitus |                                              |
| Type 1    | 16 (3.93)                                        |
| Type 2    | 391 (96.1)                                       |
| Hypertension | 282 (69.3)                                       |
| Smoking status | 153 (38.0)                                       |
| Insulin usage | 346 (85.0)                                       |
| Oral antidiabetic agent | 181 (44.5)                                       |
| Recurrent DFUs | 241 (59.2)                                       |
| Previous amputation history |                                             |
| None      | 250 (61.4)                                       |
| Minor amputation | 138 (33.9)                                      |
| Major amputation | 19 (4.7)                                        |
| Renal failure | 77 (18.9)                                        |
| Previous vascular surgery history (bypass plus angioplasty with or without stent) | 191 (46.9)                                     |
| Dialysis  | 43 (10.6)                                        |
| Charcot foot | 61 (15.0)                                        |
| Osteomyelitis | 232 (57.0)                                       |
| Neuropathy | 351 (86.2)                                       |
| Retinopathy | 82 (20.1)                                        |
| Coronary artery disease | 200 (49.1)                                      |
| Asthma/Chronic Obstructive Pulmonary Disease (COPD) | 49 (12.0)                                       |
| Angiotensin-Converting Enzyme (ACE) Inh. usage | 88 (21.6)                                       |
| Statin usage | 70 (17.2)                                        |
| Canaglifozin usage | 7 (1.7)                                           |
| HBOT treatment | 233 (57.2)                                      |
| NPWT treatment | 195 (47.9)                                       |
| Debridement | 247 (60.7)                                       |
| Vascular intervention (bypass plus angioplasty) | 77 (18.9)                                       |
| Growth factor treatment | 22 (5.4)                                          |
| Recovery  | None (\(n=57\)) (14.0)                              |
| Exitus    | Present (\(n=350\)) (86.0)                                        |
| Overall amputation status |                                             |
| None      | None (\(n=393\)) (96.6)                                         |
| Present   | Present (\(n=14\)) (3.4)                                          |
| Minor and major amputation status |                                             |
| None      | None (\(n=228\)) (56.0)                                         |
| Minor     | Minor (\(n=148\)) (36.4)                                          |
| Major     | Major (\(n=31\)) (7.6)                                          |

DFU: diabetic foot ulcer; HBOT: hyperbaric oxygen therapy; NPWT: negative pressure wound therapy.
Another study aimed to determine the major predictors of amputation and length of stay in patients with DFUs using Wagner grades and general characteristics of 55 patients. White blood cell and CRP levels were significantly higher and ESR was higher in the lower extremity amputation (LEA) group. In line with our results, Wagner grade and severity of infection were significantly higher in the LEA group compared to the non-LEA group.

Another prospective study aimed to assess the predictive value of baseline and post-treatment levels of acute-phase reactants in the outcome of 165 patients with DFUs. Limb ischemia, osteomyelitis, presence of gangrene, ulcer depth, a 1-SD increase in baseline, post-treatment CRP levels, ESR rates, WBC, and a 1-SD decrease in post-treatment albumin levels were strongly associated with increased risk of amputation. Likewise, we found that acute-phase reactants such as CRP, ESR, WBC, and PNL, as well as gangrene and ulcer depth classified by both Wagner and PEDIS systems, were associated with increased amputation risk. Similarly, albumin had a negative, weak-leveled, and a significant relationship with amputation status in our study.

Previous studies have linked infection severity with major amputation risk. We found that Wagner grades 3 (45.3%) and 4 (46.4%) and UT grade 3D (n = 135; 33.2%) were more common in the overall amputation group. Similarly, elevated values for these 2 wound classification grades have also been shown to increase the risk of amputation. Few studies comparing the SAD classification system with others are available in the literature. When classified according
to SAD, especially in terms of area, depth, and sepsis grades, the wounds of patients in the current study fall into SAD grade III, which has high risk of poor outcome.

Being male is identified as an important risk factor for amputation in many studies. Correspondingly, most of the patients in our study were male. The presence of osteomyelitis has been associated with the risk of amputation in many studies, including ours. Furthermore, many studies have found that insulin treatment is a significant risk factor for ulceration and mortality. Our results also corroborated the relationship between insulin use and amputation risk. Peripheral arterial disease and gangrene status have been found to be important risk factors in numerous studies. Platelet, on the other hand, was not a predictive variable in models created in many previous studies but remained a significant factor in our study. Parallel to our results, PLT was found to be a predictive factor in many cohorts. Patients with amputation had increased PLT counts over nonamputee DFU patients in a Chinese tertiary care hospital. Some factors, such as elevated HDL and HGB levels, seem to be protective against the risk of amputation. Similar to previous findings, mean HGB and HDL values of patients without amputation were significantly higher than those with minor or major amputation.

### Table 3. The results of chi-square tests between categorical variables and overall amputation status of patients

| Variables                                | Overall amputation status* |         |         |         |         |         |
|------------------------------------------|----------------------------|---------|---------|---------|---------|---------|
|                                          | None                       | Present |         |         |         |         |
|                                          | n                          | %       | N       | %       | χ² (P)  |         |
| Insulin usage                            | None                       | 42      | 18.4    | 19      | 10.6    | 4.796 (.029*) |
|                                          | Present                    | 186     | 81.6    | 160     | 89.4    |         |
| Osteomyelitis                            | None                       | 161     | 70.6    | 14      | 7.8     | 161.315 (.001**) |
|                                          | Present                    | 67      | 29.4    | 165     | 92.2    |         |
| Gangrene                                 | None                       | 219     | 96.1    | 78      | 43.6    | 140.015 (.001**) |
|                                          | Present                    | 9       | 3.9     | 101     | 56.4    |         |
| Neuropathy                               | None                       | 51      | 22.4    | 5       | 2.8     | 32.381 (.001**) |
|                                          | Present                    | 177     | 77.6    | 174     | 97.2    |         |
| Previous amputation surgery history      | None                       | 157     | 68.9    | 93      | 52      | 14.915 (.001**) |
|                                          | Minor                      | 59      | 25.9    | 79      | 44.1    |         |
|                                          | Major                      | 12      | 5.3     | 7       | 3.9     |         |
| Renal failure                            | None                       | 194     | 85.1    | 136     | 76      | 5.425 (.020*) |
|                                          | Present                    | 34      | 14.9    | 43      | 24      |         |
| Retinopathy                              | None                       | 196     | 86      | 129     | 72.1    | 12.039 (.001**) |
|                                          | Present                    | 32      | 14      | 50      | 27.9    |         |
| Coronary artery disease                  | None                       | 129     | 56.6    | 78      | 43.6    | 6.784 (.009*) |
|                                          | Present                    | 99      | 43.4    | 101     | 56.4    |         |
| Previous vascular surgery history        | None                       | 131     | 57.5    | 85      | 47.5    | 4.002 (.045*) |
|                                          | Present                    | 97      | 42.5    | 94      | 52.5    |         |
| Dialysis                                 | None                       | 210     | 92.1    | 154     | 86      | 3.912 (.048*) |
|                                          | Present                    | 18      | 7.9     | 25      | 14      |         |
| Wagner grades                            | Grade 1                    | 58      | 25.4    | 0       | 0       | 185.513 (.001**) |
|                                          | Grade 2                    | 116     | 50.9    | 70      | 39.1    |         |
|                                          | Grade 3                    | 17      | 7.5     | 92      | 51.4    |         |
| PEDIS peripheral arterial disease grades | Grade 1                    | 95      | 41.7    | 17      | 9.5     | 113.043 (.001*) |
|                                          | Grade 2                    | 116     | 50.9    | 70      | 39.1    |         |
|                                          | Grade 3                    | 17      | 7.5     | 92      | 51.4    |         |
| PEDIS wound depth grades                 | Grade 1                    | 84      | 36.8    | 3       | 1.7     | 160.175 (.001*) |
|                                          | Grade 2                    | 86      | 37.7    | 19      | 10.6    |         |
|                                          | Grade 3                    | 58      | 25.4    | 157     | 87.7    |         |
| PEDIS infection grades                   | Grade 1                    | 4       | 1.8     | 0       | 0       | 96.114 (.001*) |
|                                          | Grade 2                    | 76      | 33.3    | 2       | 1.1     |         |
|                                          | Grade 3                    | 136     | 59.6    | 124     | 69.3    |         |
|                                          | Grade 4                    | 12      | 5.3     | 53      | 29.6    |         |
| HBOT treatment                           | None                       | 120     | 52.6    | 54      | 30.2    | 20.675 (.001**) |
|                                          | Present                    | 108     | 47.4    | 125     | 69.8    |         |
| NPWT treatment                           | None                       | 153     | 67.1    | 59      | 33      | 46.844 (.001*) |
|                                          | Present                    | 75      | 32.9    | 120     | 67      |         |
| Debridement                              | None                       | 122     | 53.5    | 38      | 21.2    | 43.795 (.001**) |
|                                          | Present                    | 106     | 46.5    | 141     | 78.8    |         |
| Vascular surgery (bypass plus angioplasty)| None                       | 201     | 88.2    | 129     | 72.1    | 16.925 (.001*) |
|                                          | Present                    | 27      | 11.8    | 50      | 27.9    |         |
| Recovery                                 | None                       | 14      | 6.3     | 43      | 24      | 28.624 (.001**) |
|                                          | Present                    | 214     | 93.7    | 136     | 76      |         |

HBOT, hyperbaric oxygen therapy; NPWT, negative pressure wound therapy; PEDIS, perfusion, extent/size, depth/tissue loss, infection, and sensation.

*Chi-square (χ²) test, **P ≤ .05, ***P ≤ .001.

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Table 4. Comparison of numerical values based on amputation status of patients

| Variables                      | None          | Minor         | Major         | F       | P        |
|--------------------------------|---------------|---------------|---------------|---------|----------|
|                                | SD            | SD            | SD            |         | ≤0.001** |
| BMI (kg/m²)                    | 29.33         | 26.78         | 5.08          | 28.04   | 5.72     |
| Wound width (cm²)              | 24.46         | 26.46         | 41.88         | 26.79   | 57.42    |
| WBC (10³/μL)                   | 10.19         | 11.75         | 5.42          | 13.00   | 4.87     |
| CRP (mg/L)                     | 48.80         | 97.80         | 11.49         | 118.42  | 72.94    |
| ESR (mm/h)                     | 64.36         | 93.31         | 34.90         | 110.77  | 29.89    |
| Hemoglobin (g/dL)              | 11.60         | 2.05          | 1.99          | 9.73    | 2.12     |
| Albumin (g/dL)                 | 3.91          | 3.60          | 3.62          | 3.26    | 0.64     |
| PNL (10³/μL)                   | 6.89          | 7.81          | 4.19          | 9.18    | 4.65     |
| PLT (10³/μL)                   | 307.91        | 348.93        | 134.61        | 313.9   | 101.39   |
| Creatinine (mg/dL)             | 1.45          | 1.46          | 1.36          | 3.23    | 2.30     |
| HDL (mg/dL)                    | 36.84         | 42.85         | 12.01         | 24.15   | 11.86    |

Table 5. Spearman rho correlation analysis in the assessment of the relation between features and amputation stage

| Variables                      | Amputation status (major, minor, and no amputation) |
|--------------------------------|---------------------------------------------------|
|                                | r        | P        |
| Insulin usage (n = 407)        | 0.120    | ≤0.01**  |
| BMI (kg/m²)                    | -0.203   | ≤0.001** |
| Previous amputation surgery history (n = 407) | 0.171 | ≤0.001** |
| Renal failure (n = 407)        | 0.159    | ≤0.001** |
| Previous vascular surgery history (n = 407) | 0.121 | ≤0.01** |
| Dialysis (n = 407)             | 0.114    | ≤0.01**  |
| PEDIS peripheral arterial disease grades (n = 407) | 0.526 | ≤0.001** |
| Wound width (cm²) (n = 405)    | 0.343    | ≤0.001** |
| PEDIS wound depth grades (n = 407) | 0.619 | ≤0.001** |
| PEDIS infection grades (n = 407) | 0.493 | ≤0.001** |
| Osteomyelitis                  | 0.625    | ≤0.001** |
| WBC (10³/μL) (n = 391)         | 0.199    | ≤0.001** |
| CRP (mg/L) (n = 395)           | 0.377    | ≤0.001** |
| Creatinine (mg/dL) (n = 383)   | 0.083    | ≤0.001** |
| ESR (mm/h) (n = 395)           | 0.416    | ≤0.001** |
| Hemoglobin (g/dL) (n = 377)    | -0.293   | ≤0.001** |
| Albumin (g/dL) (n = 245)       | -0.302   | ≤0.001** |
| PNL (10³/μL) (n = 328)         | 0.151    | ≤0.001** |
| PLT (10³/μL) (n = 331)         | 0.146    | ≤0.001** |
| HDL (mg/dL) (n = 193)          | -0.215   | 0.03**   |
| Neuropathy (n = 407)           | 0.281    | ≤0.001** |
| Gangrene (n = 407)             | 0.589    | ≤0.001** |
| Retinopathy (n = 407)          | 0.191    | ≤0.001** |
| Coronary artery disease (n = 407) | 0.154 | ≤0.02** |
| Wagener grades (n = 407)       | 0.674    | ≤0.001** |
| HBO2 treatment (n = 407)       | 0.217    | ≤0.01**  |
| NPWT treatment (n = 407)       | 0.328    | ≤0.01**  |
| Debridement (n = 407)          | 0.318    | ≤0.01**  |
| Vascular surgery (n = 407)     | 0.217    | ≤0.01**  |
| Recovery (n = 407)             | -0.120   | ≤0.01**  |

Table 5. Spearman rho correlation analysis in the assessment of the relation between features and amputation stage

Although previous studies have found a variety of factors associated with the amputation risk of diabetic foot, different factors can be revealed via data analysis of each country’s demographic characteristics. Causes of amputation may vary among different populations. For instance, while peripheral vascular disease is the main cause of amputation in developed countries, trauma, infections, malignancies, and uncontrolled diabetes are among the main causes in developing countries. Amado et al. evaluated improvement in the management of diabetes and its complications based on the evolution of hospitalization rates for DFUs and LEA in individuals with diabetes in France and found that the incidence of serious complications of diabetes, such as amputation, decreased in tandem with a marked improvement in hospital management. Critically, one of the major causes of amputation reported in developing countries was inconsistency in treatment methods from one hospital to another.

Our study has many strengths. First, the clinic providing the data is managed by a multidisciplinary team that invites various field experts each week and organizes a chronic wound council. Thus, DFU patients are treated using the most appropriate methods in line with the opinions of medical faculty from a wide variety of disciplines. Second, this clinic treats diabetic foot patients who could not be treated in other hospitals across Turkey. Moreover, we classify DFUs according to 4 different classification systems: Meggitt-Wagner, PEDIS, UT, and S(AD) SAD. We believe that our findings on various risk factors for amputation will provide insight to experts dealing with the treatment of DFUs.

The limitations of this study stem from its retrospective and unblinded nature, which leads to missing values in the data set. Also, data entry was performed by a single user. Although the data set used in the study appears relatively small, it is more than sufficient when compared to similar studies since our patients had long hospital stays. These research findings may lead to further studies and advancements in the treatment of DFUs.

The prevention of diabetes and its complications, especially the interruption of DFU-related amputations, is crucial and essential for public health. It is critical to determine in advance those factors associated with diabetic foot, which is a multifactorial disease. This study determined both the factors associated with amputation risk and those which reduce this terrible complication of diabetes.

Ethics Committee Approval: Ethical committee approval was received from the Ethics Committee of Istanbul University, (Approval No: 713).

Informed Consent: N/A.

Author Contributions: Concept - D.D., Ş.A., Ç.S.E.; Design - D.D., Ş.A., Ç.S.E.; Supervision - Ş.A., T.O., X.T., Ç.S.E.; Materials - Ş.A.; Data Collection and/or Processing - D.D., Ş.A., T.O.; Analysis and/or Interpretation - D.D., Ş.A., T.O., X.T., Ç.S.E.; Literature Review - D.D., Ş.A., T.O., X.T., Ç.S.E.; Writing D.D., T.O., X.T.; Critical Review - D.D., Ş.A., T.O., X.T., Ç.S.E.

Declaration of Interests: The authors have no conflicts of interest to declare.
Funding: This research is produced from the first author’s doctoral thesis, which has been entitled “Prediction of Amputation Risk of Patients with Diabetic Foot by Artificial Intelligence Techniques,” supervised by Assoc. Prof. Çağlak EROL (Ph.D.) from Istanbul University, Institute of Science. This thesis research program is also funded by The Scientific and Technological Research Council of Turkey (TÜBİTAK) 2214-A International Research Fellowship Programme for Ph.D. Students and French Government Research Fellowships in Turkey, organized by Campus France Paris. Thus, joint research activities carried out with Professor Xavier Tannier from Sorbonne Université/INSERM/Laboratoire d’Informatique Médicale et d’Ingenierie des Connaissances en e-Santé (LIMICS). The LIMICS laboratory has allocated additional funding for the publication of this article.

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