Perfusion, Extent, Depth, Infection and Sensation (PEDIS) classification system to assess the severity of Diabetic Foot Wounds in the Homecare setting

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ABSTRACT

Introduction: The prevalence of diabetic foot ulcers in Indonesia is twice the global prevalence. An initial assessment of the severity of the wound is necessary to recognize early signs of skin damage and provide the right decision to begin wound treatment. The purpose of this research was to use the PEDIS classification system to assess the severity of diabetic foot Ulcers in the homecare setting. Methods: This was a quantitative descriptive study on diabetic foot ulcers patients in independent practice and homecare in Makassar City in July–October 2023. Data were collected using the PEDIS classification observation sheet which consists of perfusion measured using vascular doppler to assess peripheral artery disease in the form of a combination of waves and ABI values, extended uses the length x width, depth of skin layers involved, infection assess signs and symptoms of infection and sensation using monofilament test 10g at three points of plantar neuropathy of the foot. Results: 36 samples were found during the research period. The general severity of the injury was grade 2. Almost all patients were non- peripheral artery disease. The wound extenth was >3 cm2, and the depth of skin involved includes superficial, tendon and bone, the level of infection was limited to local infection. Almost all patients were found to experience loss of sensation in the feet. Conclusions: The PEDIS classification system can be used to assess the severity of diabetic foot ulcers in a homecare setting. However, it must be carried out by trained personnel.

Keywords: Degree Of Severity; Diabetic Foot Ulcers; Home Care Setting

INTRODUCTION

Diabetes mellitus(DM) continues to increase every year, both in the world and in Indonesia. Based on International Diabetes Federation (IDF) data, an increase in new cases of DM in Indonesia from 2017 to 2021 amounted to 9,189 cases (IDF, 2017, 2021). DM was included in the top 10 causes of death globally (WHO, 2020) and diabetic foot Ulcers (DFU) were the most common complications in DM patients causing lower limb amputation(Lipsky et al., 2020). DFU is a type of chronic wound that is difficult to heal and contributes to lower extremity amputation and death (Atosona & Larbie, 2019; Costa et al., 2017; Jupiter et al., 2015). The prevalence of DFU in Indonesia is 12–16.2%(Pemayun & Naibaho, 2017; Yusuf et al., 2016), which is greater than the global prevalence of 6.3% (Zhang et al., 2017). DFU requires long-term care and is a burden not only to patients but also to society, with considerable health costs (Nurhanifah, 2017).

Globally, the economic burden for DFU cases is 11% (Zhang et al., 2017).

The COVID-19 pandemic period has had a varied impact across the country regarding visits and amputations due to DFU(Miranda et al., 2022). In Indonesia, Covid-19 patients have had a more severe infection, higher rates of osteomielitis, and higher incidences of major amputation(Yunir et al., 2022). There are various negative impacts caused by DFU so it is important to find a standardized and efficient approach in dealing with DFU. DFU patients using triase systems based on severity and accompanying diseases were assessed to be effective in determining remote control during the COVID-19 pandemic(Meloni et al., 2020). Ideally, DFU patients can be divided between patients who can be treated at home and those who need to be referred to advanced health services and require multidisciplinary collaborative treatment based on severity. Non-severe DFU can be treated at home(Yan et al., 2022). So patient sorting is also expected to have an impact on reducing the number of patients treated in hospitals so that it can reduce the burden of inpatient health costs due to DFU complications.

A classification system is needed to categorize the severity of DFU as an initial step in identifying the risk of DFU complications. Since no classification system could specifically be used to assess the severity of DFU in the home care setting previously while it is necessary to recognize the early signs of skin damage and give the right decision to start managing DFU. There are several classification systems introduced to classify the severity of DFU and Wagner is reported to be a good predictor of the incidence of lower extremity amputation(Jeon et al., 2017). Wagner, which is most widely used to describe the extent and severity of DFU, unfortunately does not describe ischemia and treatment initiatives (Rosyid, 2017). The International Working Group of the Diabetic Foot(IWGDF) developed a classification system to defend DFU objectively and coul be a medium of communication between service providers(Chuan et al., 2015). DFU severity was assessed based on sub categories: Perfusion, Extent, Depth, Infection, and Sensation(PEDIS)(Chuan et al., 2015). PEDIS is highly relevant to the pathogenesis and development of DFU (Rosyid, 2017). The PEDIS scoring system was also reported to have good diagnostic accuracy compared to the SINBAD and Wagner scoring systems (Chuan et al., 2015). Apart from that, the PEDIS items are the closest to the simplicity of a Triage system that can be adopted based on severity (Meloni et al., 2020). Therefore this study aimed to use the PEDIS classification system in determining the severity of DFU in the home care setting.

MATERIALS AND METHODS

This research was a prospective descriptive study with a quantitative approach. The partipants in this study were patients with DFU who were undergoing treatment at home care setting in Makassar City. Sampling used the accidental sampling technique, namely the process of taking respondents to be sampled based on samples that happened to be met by researchers during the study period and met the inclusion criteria. The inclusion criteria in this study were: 1) age > 18 years; 2) currently undergoing treatment in practice in independent nursing or home care setting in July–October 2023. Meanwhile, the exclusion criteria in this study were: 1) not willing to be a respondent; 2) not able to communicate. Based on data from ETN Center Indonesia, an independent home care-based nursing practice and one of the wound care centers in Makassar City, the number of DFU patients recorded in the last 6 months was 43 patients. The sample size was determined using the Slovin formula, namely 39 samples. This research upholds research ethics and ethical approval where before measurements are carried out the researcher first explains the problem, objectives, benefits and risks that may arise clearly, then the researcher asks for the respondent's consent, if the respondent is willing they will be asked to sign informed consent.

The research instrument was an observation sheet containing the respondent's personal data, including name, age, gender, address, occupation, marital status, ethnicity, religion, education level, ; the patient's DM history, including DM duration, therapy, therapy compliance, smoking history, and glycemic index at the time of study and wound history includes the duration of the wound and previous treatment. A respondent explanation sheet, consent sheet to ask for participant consent, and a PEDIS observation sheet consisting of: perfusion, Extent, depth, infection, and sensation. In the PEDIS classification system, DFU was assessed based on 5 categories, including (Radi et al., 2020; Registered Nurses' Association of Ontario, 2011):(1) Perfusion: perfusion was determined by a combination of physical examination and noninvasive vascular studies. Clinical signs were based on the absence of dorsal pedal pulsation or the posterior tibial artery of the involved leg. For non-invasive measures assessed on the ankle-brachial index (ABI) using a vascular doppler. The ABI value gives an indication of blood flow to the legs, ABI values above 1.3 and below 0.9 are abnormal and indicate Peripheral Artery Disease(PAD)(Schaper et al., 2023)(Table 1). The ABI value for the non- Peripheral Artery Disease (non-PAD) category is between 0.9-1.3(Hinchliffe & Azuma, 2023),(2) Area:

estimated by multiplying the diameter of the longest length by the longest width measured perpendicularly and expressed as cm². (3) Depth: depth is assessed based on the layers of skin involved/affected. (4) Infection: The diagnosis of infection was based mainly on the presence or absence of symptoms and signs of inflammation, the presence of secretions(Pus).(5)Sensation: Sensation was evaluated with 10g monofilament. Examination was carried out at three points of neuropathy, namely on, Dorsal hallux, metatarsal1 dan metatarsal5(Q. Zhang et al., 2018). Protective sensation is no loss if the patient correctly answers on two out of three applications; Loss with two out of three incorrect answers(Schaper et al., 2023). Before using the PEDIS classification system, a forward translation was carried out by an expert in the field of DFU care who was able to speak English and whose mother language was Indonesian. To make it easier to classify PEDIS, the Score table system was used(Chuan et al., 2015).

Table 1. PEDIS Score

Grade	perfusion	Extent	Depth	Infection	Sensation	Score
1	No PAD*	Skin intact	Skin intact	None	No loss	0
2	PAD, No CLI*	<1 cm2	Superficial	Surface	Loss	1
3	CLI*	1–3 cm2	Fascia, muscle, tendon	Abscess, fasciitis, septic arthritis		2
4		>3 cm2	Bone or joint	SIRS		3

*PAD, peripheral arterial disease; CLI, critical limb ischemia

The data was analyzed using IBM SPSS Statistics 22 to get the percentage of each degree in each PEDIS classification item.

RESULTS

Partisipant dan demographic data

36 paetisipan were successfully recruited during the study period, July–October 2023. Mean age (57.42 ± 11.71). Female (20/36, 55.6%) and male (16/36, 44.4%) The majority ethnic group is Bugis (19/36, 52.8%), and the religion is Islam 36/36(100%). The majority of people have completed elementary school(12/36, 33.3%) and work as a housewife(16/36, 44.4%). Marital status: married (34/36, 94.4%). History of DM > 10 years (15/36, 41.7%) and duration <5 years (12/36, 33.3%), glicemic index at the time of assessment <200 mg/dl(24/36, 66.7%), the therapy used was generally oral drugs (26/36, 72.2%), and the average adherence to therapy (21/36, 58.3%). no smoking (24/36, 66.7%).

Table 2. Demographic data and DM history

Demographic data	Total	
	n=36	Percentage (%)
Age(Year) (Mean±SD)	(57.42±11.71)	
Gender		
Male	16	44.4
Female	20	55.6
Ethnic		
Bugis	19	52.8
Makassar	13	36.1
Java	4	11.1
Religion		
Islam	36	100.0
Education		
No school	3	8.3
Elementary	12	33.3
Junior high	3	8.3
Senior high	10	27.8
Bachelor	3	8.3
Master	5	13.9
Work		
ASN	5	13.9
self-employed	6	16.7
Housewife	16	44.4
Teacher	3	8.3
Retired	2	5.6
Employee	1	2.8
Laborer	1	2.8
Farmer	2	5.6
Marital status		
Marry	34	94.4
Not merried	1	2.8
widow/ widower	1	2.8
DM duration		
< 5 year	12	33.3
≥ 5 year	9	25.0
> 10 year	15	41.7
Glycemic Index		
< 200 Mg/dl	24	66.7
≥ 200 Mg/dl	12	33.3
Therapy		
Oral	26	72.2
Insulin	3	8.3
Traditional	2	5.6
Oral dan insulin	3	8.3
Oral dan traditional	1	2.8
Diet	1	2.8

Compliance Therapy

Obedient	21	58.3
Not obey	15	41.7
Smoking History		
Smoke	12	33.3
Not Smoke	24	66.7

The status of the condition of the wound for which the PEDIS classification was assessed Most lasted > 3 months(13/36, 36.1%). The majority of previous treatment was self-care at home(17/36, 47.2%) before deciding to use care services in independent practice and home care (Table.3).

Tabel 3. DFU history

DFU characteristics	Total	
	n=36	%
Duration of wound		
< 21 days	8	22.2
< 1 month	5	13.9
≥ 1 month	10	27.8
> 3 month	13	36.1
Previous treatment		
Take care of yourself	17	47.2
Hospital	8	22.2
Debridement	1	2.8
Public health center	3	8.3
Prctice	5	13.9
Witch doctor	2	5.6

The severity of DFU based on the PEDIS classification system, perfusion was grade 1(Non-PAD)(32/36, 88.9%), the average extent was grade 4(>3 cm^2)(19/36, 52.8%), depth, infection and sensation were generally in grade 2(Superficial, local infection dan almost loss of sensation or peripheral neuropathy(19,13,29/36, 52.8%, 36.1% and 80.6%)

Table 4. Characteristics of DFU patients based on Grade dan Item of PEDIS

Item PEDIS	Total	
	n=36	%
Perfusion		
Grade 1(No PAD)	32	88.9
Grade 2(PAD, no CLI)	4	11.1
Grade 3(CLI)	0	0.0
Extent		
Grade 1(Skin intact)	0	0.0
Grade 2(<1cm^2)	10	27.8
Grade 3(1-3cm^2)	7	19.4
Grade 4(>3cm^2)	19	52.8
Depth		
Grade 1(Skin intact)	0	0.0

Grade 2(Superficial)	19	52.8
Grade 3(Fascia,muscle tendon)	11	30.5
Grade 4(Bone joint)	6	16.7
Infection		
Grade 1(None)	9	25.0
Grade 2(Surface)	13	36.1
Grade 3(Abscess, fasciitis, septic arthritis)	8	22.2
Grade 4(SIRS)	6	16.7
Sensation		
Grade 1(No loss)	7	19.4
Grade 2(Loss)	29	80.6

DISCUSSION

Demographic status

More women than men suffer from DFU.This is different from global data where patients with DFU are reported to be higher in men than in women(Jeon et al., 2017; Zhang et al., 2017). The majority of women experienced severe DFU although gender is not significantly associated with the severity of DFU(Vahwere et al., 2023). However, in other studies it was reported that male gender was mentioned as a factor that influences the severity of DFU(Jalilian et al., 2020). The average age of DFU patients is in the middle age category according to the WHO, with a DM duration of >10 years. Age between 45-64 years is categorized as middle age, at this age they tend to have a poor lifestyle and glucose control and tend to experience larger and deeper wounds(Tong et al., 2020). Age over 60 years is significantly associated with the presence of diabetic peripheral neuropathy (DPN)(Kisozi et al., 2017). Duration of DFU(Smith-Strøm et al., 2017), smoking history(Jalilian et al., 2020) and Age is significantly associated with the severity of DFU(Vahwere et al., 2023). Old age, longer duration of diabetes, and history of smoking were also associated with the incidence of DFU(Zhang et al., 2017). Infection rates and smoking also worsen DFU(Tong et al., 2020).

Characteristics of DFU patients based on PEDIS

The good news is that on average DFU patients do not experience PAD, in contrast to the findings of Hao, et.al, 2014, the majority of DFUs with PAD(Hao et al., 2014). The age characteristics of DFU patients who experience PAD are significant, with an average age of 65 years with a DM duration of >10 years(Hao et al., 2014), so that the average age of the sample was 57 years and the DM duration was >10 years in this study, they did not experience PAD, although it might lead to it. New findings have shown that 80.6% of patients with DFU experience loss of sensation in the feet. A history of having experienced

a foot wound is significantly associated with peripheral neuropathy(Kisozi et al., 2017). Loss of taste sensation was a problem experienced by many DM patients with DFU. Neuropathy is one of the causes of DFU(Santoso et al., 2021; Soares et al., 2012). Patients with severe neuropathy were twice as likely to develop more severe DFUs(Vahwere et al., 2023).

The degree of severity is based on the PEDIS Grade

DFU severity level based on PEDIS items on perfusion: Grade 1, Extent : Grade 4, Depth, Infection and sensation DFU each at Grade 2. If adjusted to the Triage system introduced by Meloni, 2020, then in general the results of DFU severity assessment are based on The PEDIS classification recommends that no hospitalization is required, treatment can be carried out with outpatient care and telemedicine follow-up(Meloni et al., 2020). The PEDIS classification system is easy to use, clear definitions and few categories for practitioners with less DFU management experience (Stang & Young, 2018) however several obstacles were encountered in the data collection process, namely that there were wounds that affected the entire leg so that perfusion and sensation measurements could not be carried out. on injured feet, apart from that the use of standard golden tools such as the ABI and monofilament test requires expertise. Thus, this study fails to recommend PEDIS as an appropriate classification system in the home care setting. Compared with the latest SINBAD classification system with more complete assessment items, simpler definitions and scores, this system is recommended as the latest DFU classification system by the IWGDF(Monteiro-Soares et al., 2023). The different objectives in the DFU classification system mean that there is no classification system that can be used generally (Wang et al., 2022). Despite the advantages of SINBAD, research into its use in home care settings and suitability for triage systems for patient management is still needed.

CONCLUSIONS

The PEDIS classification system can be used to assess the severity of DFU but must be carried out by trained people.

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