ISSN: 2085-675X (Print)
ISSN: 2354-8770 (Electronic)

Jurnal Kefarmasian Indonesia
Available online at https://jkefarind.com/index.php/jki
Original Research Article
JKI

Socioeconomic and Clinical Profile of Diabetic Foot Ulcer Patients with National Health Insurance during Pandemic COVID-19 in Indonesia

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ARTICLE INFO

Article history:
Received 16 August 2024
Revised 31 January 2025
Accepted 16 February 2025
Published online 28 February 2025

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DOI: https://doi.org/10.22435/jki.v15i1.6679

Citation: Fitrianingsih, Sauriasari R, Yunir E, Saptaningsih AB. Socioeconomic and Clinical Profile of Diabetic Foot Ulcer Patients with National Health Insurance during Pandemic COVID-19 in Indonesia. Jurnal Kefarmasian Indonesia. 2025;15(1):21-33

ABSTRACT

During the COVID-19 pandemic, the mandatory lockdown and government policy in prioritizing COVID-19 patients affected patients with diabetic foot ulcers (DFU). Most DFU patients experienced difficulties visiting hospitals and covering the cost of treatment, which led to changes in patient characteristics, poor clinical outcomes, and higher total costs. This study aimed to determine the sociodemographic and clinical outcomes profile of DFU patients under National Health Insurance (NHI-DFU) during the COVID-19 pandemic and their effect on the total direct medical cost. This cross-sectional study enrolled all JKN-DFU hospitalized patients at the National Referral Hospital, Cipto Mangunkusumo Hospital (RSCM), Jakarta, Indonesia, during COVID-19 pandemic (March 2nd, 2020, to December 2022). We used electronic health records, electronic billing, and foot registry systems. Participants were over 18 years old in a single admission period. Statistical analysis used Mann-Whitney and Kruskal-Wallis; Post hoc used the Mann-Whitney test. There were 158 JKN-DFU patients with predominated criteria: female patients (55.1%), aged over 60 years old (55.1%) with a mean age of 59.3 ± 11.0 years, unemployed (63.9%), intermediate educated (41.8%), Jakarta residents (68.4%), and mostly severe infection (63.3%). The total cost was much higher than INA-CBG's coverage. The occupation (p=0.048), length of stay (LOS) (p=0.001), and amputation status (p<0.001) significantly affected total cost. Civil servants, longer LOS, and major amputation status leading higher total costs.

***Keywords*:** Clinical profile; Covid-19; Diabetic foot ulcer; National Health Insurance; Socioeconomic

INTRODUCTION

Diabetic Foot Ulcer (DFU) is a complication of diabetes that carries a high risk of increasing mortality and morbidity rates[1], affecting patients' quality of life through pain, immobility, and limitations in social interactions, as well as impacting healthcare resources.[2,3] The global prevalence of diabetes is estimated to increase by 46% from 2021 to 2045, with the number of

ISSN: 2085-675X (Print)
ISSN: 2354-8770 (Electronic)

diabetes patients reaching 537 million, according to data from the International Diabetes Federation in 2021.[4] This raises concerns as more than 1 million diabetes patients each year are at risk of losing a limb (amputation) every 20 seconds, primarily due to infections and the progressive nature of diabetic foot ulcers.[5,6] DFU patients require greater access to healthcare services because if this condition is not managed correctly, it can accelerate the progression of DFU and weaken the patient's condition. However, this was not the case during the COVID-19 pandemic. Various internal and external factors triggered problems in the proper management of DFU treatment, including socioeconomic factors and their impact on DFU[7] as well as their relation to socioeconomic position (SEP).[8] Data from SUSENAS in March 2019 reported that 9.4% of Indonesia's population (25 million people) were living below the poverty line and this increased by 30% during the pandemic.[9] Thus, these socioeconomic issues have a significant impact on the treatment of DFU patients. Delays in DFU treatment due to postponed and restricted access to healthcare services during the COVID-19 pandemic have affected patients' characteristic and their quality of life. As reported by a previous study at Dr Cipto Mangunkusumo National General Hospital, during the COVID-19 pandemic period (March 1, 2020 - February 28, 2021), there were characteristic of DFU patients who were hospitalized with severe infections, longer waiting time-to-surgery positively correlated with an elevation rate of major amputation by 19.2%, rising from 20.2% before the pandemic to 39.4% during the pandemic.[10]

The COVID-19 pandemic caused health, economic, and societal disruptions, devastating most countries worldwide.[11] Indonesia was one of the countries affected by the COVID-19 pandemic, experiencing negative growth in all aspects. However, Indonesia has shown resilience and has been gradually recovering more quickly in response to the global changes brought by the COVID-19 pandemic. Indonesia ranks first in the number of diabetes cases in Southeast Asia.[4] Based on The Indonesia Basic Health Research report in 2018, 8.5% of Indonesia's population was diagnosed with diabetes mellitus (DM).[12] Additionally, less than 15% of DFU cases were reported in Southeast Asia, with a recurrence rate of less than 14%.[13] This indicates a significant increase in DFU cases during the COVID-19 pandemic. Even before the COVID-19 pandemic, managing diabetes and its complications was already a significant issue due to many inequalities, including healthcare facilities, access to healthcare services, the number of healthcare resources, and the availability of equipment and medications,[14,15] especially for DFU cases. Moreover, these problems became even more challenging during the COVID-19 pandemic. Various complementary reports from the WHO and the World Bank stated that the global COVID-19 pandemic, which lasted almost three years, significantly impacted the quality of life, particularly in accessing healthcare services and the ability to pay for treatment. The solution lies in changing healthcare standards. The fundamental definition of Universal Health Coverage (UHC), as initiated by the World Health Organization (WHO), is a form of equality for population groups, whether social, economic, demographic, or geographic.[16,17]

Since 2014, Indonesia has adopted UHC through a national health program called Jaminan Kesehatan Nasional (JKN), which covers all healthcare costs for the Indonesian people.[18,19] About 225.9 million (83%) of Indonesia's population has become JKN members, providing JKN the largest single-payer healthcare insurance system in the world, with increasingly significant challenges ahead.[20,21] The main goal of JKN is to improve equitable access to healthcare services without limitations. One of the services provided by JKN covers the costs of treatment and care for diabetes patients, especially DFU patients.[22] These DFU patients require comprehensive additional care and collaboration across various specialties, leading to higher costs for DFU treatment.[7] However, the healthcare costs covered by JKN are insufficient to fully cover the treatment expenses for DFU patients. As a national

referral hospital in Indonesia, RSCM serves as the primary healthcare facility and initiator in implementing the JKN program.

DFU remains a significant challenge and requires collaboration from all aspects for proper and comprehensive management to achieve good clinical outcomes for patients. Equity in healthcare services is crucial to achieving health policy goals in Indonesia. The mandatory lockdown, especially during the COVID-19 pandemic, poses big challenges to our government's policy and management of DFUs in hospitals. Based on previous study there are significant changes in the patient characteristics who were hospitalized during COVID-19 pandemic.[10] Therefore, more extensive studies are needed to summarize and assess DFU patients comprehensively. Studies related to the socioeconomic profile, including the clinical and sociodemographic characteristics of DFU patients and the economic evaluation of their treatment in Indonesia, particularly JKN patients, have yet to be widely reported and are still very limited. As a national referral hospital, RSCM requires extensive input from various studies to obtain a comprehensive overview of the clinical characteristics of DFU patients with JKN treated at RSCM, their clinical outcomes, and overall management. Thus, the results of this research are expected to contribute positively to the government as policymakers in evaluating the management and treatment costs of DFU patients. Our study aims to determine the sociodemographic and clinical outcomes profile of DFU patients under National Health Coverage (JKN-DFU) during the COVID-19 pandemic and their effect on the total direct medical cost.

METHODS

This is a cross-sectional study conducted at Dr. Cipto Mangunkusumo Hospital (RSCM), a national referral hospital located in Jakarta, Indonesia, from March 2020 to December 2022. A total of 158 DFU patients with JKN were involved in this study. Secondary data were taken from medical records, electronic health records (EHR), the hospital integrated system (HIS), and the foot registry system in the division of metabolic endocrine. Both primary and secondary diagnoses of DFU were accessed from electronic health records. This study has been registered with the number LB.02.03/2.6.1/1420/2022 and approved by the ethical committee of RSCM-Faculty of Medicine Universitas Indonesia, number KET-1192/UN.F1/ETIK/PPM.00.02/2022.

Population and sample

The population of this study consisted of DFU inpatients. The inclusion criteria were that participants were DFU with JKN inpatients hospitalized in RSCM during the period from March 2020 to December 2022; were aged over 18 years old; and included all grades of ulcer with one period of in-hospital admission. The exclusion criteria included incomplete medical and financial data, patients not classified as DFU and JKN, incomplete clinical data, and patients not registered in the foot registry system.

Sociodemographic data

The sociodemographic includes age, sex, occupation, education, family status, and residence. The clinical profile includes type of diabetes, ulcer grades, the severity of infection, duration of diabetes, duration of foot ulcer, body mass index (BMI), smoking status, comorbidities and laboratory findings. We also include the antibiotic use during hospitalization. The condition of diabetes mellitus (DM) refers to ADA 2019 and PERKENI guidelines, where fasting blood glucose is ≥126 mg/dL, plasma glucose examination is ≥200 mg/dL 2 hours after an oral glucose tolerance test (TTGO) or marked by prolonged high blood glucose levels requiring intervention such as nutritional status change or medication adjustment that may lead to hyperglycemia. The initial HbA1c value upon hospital admission >6.5% (48 mmol/mol) suggests that diabetes onset preceded hospitalization.[23] In this study, the HbA1c value >7% is categorized as uncontrolled glycemia.[24,25] According to the European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines, BMI is

ISSN: 2085-675X (Print)
ISSN: 2354-8770 (Electronic)

calculated based on the patient's weight and height to determine body surface area.[26] Participants are categorized as follows: underweight (<18.5 kg/m^2), normal (18.5 – 22.9 kg/m^2), overweight (≥ 23kg/m^2) for the Asian population,[27] obese (≥ 25 kg/m^2).[26] The ulcer degrees and severity of infections refers to the International Working Group on the Diabetic Foot (IWGDF) and

Infectious Diseases Society of America (IDSA) guidelines.[28] A leukocyte count over 12.000 mm^3 characterizes Leukocytosis. Severe condition is classified as high ulcer grade (≥ grade 3), whereas non-severe infections classified as ulcer grade 1 and 2, with severity of infection were uninfected and mild to moderate group.

Data analysis

Statistical data analysis was performed using IBM SPSS software (version 25.0, Chicago, IL, USA). Sociodemographic data, clinical profiles, total costs, socioeconomic evaluations, and clinical outcomes were presented descriptively. Total costs were determined as the total direct medical cost expensed in management DFU. Categorical independent variables were transformed into nominal scales and presented as counts (numbers) and percentages. Continuous data were presented as mean ± standard deviation (SD). The nonparametric test used Mann-Whitney and Kruskal Wallis to analyze and compare the difference in direct costs in means between sociodemographic and clinical outcomes. The significant value is $p<0.05$ which interprets the differentiation among variables.

RESULTS AND DISCUSSION

A total of 158 JKN-DFU patients were hospitalized during the COVID-19 pandemic period. Sociodemographic data and clinical characteristics of JKN-DFU patients are presented descriptively in Table 1. The proportion of female patients among JKN-DFU (55.1%) and the average age of patients was 59.3 ± 11.0 years (Mean ± SD), with 55.1% categorized as elderly. Of these, 63.9% were housewives, retirees, and unemployed individuals. Furthermore, the patient's education level was predominantly intermediate (senior high school to diploma) (41.8%), and 72.8% were married. More than 50% of JKN-DFU patients residence in Jakarta (68.4%).

Table 1. Sociodemographic characteristics of the JKN-DFU patients

Variables	Category	Value (N = 158)	
		n	%
Sex	Male	71	44.9
	Female	87	55.1
Age	(Mean ± SD) (years)	59.3 ± 11.0	
	Adult (>18 to 59 years)	71	44.9
	Elderly (≥ 60 years)	87	55.1
Occupation	Civil servants	5	3.2
	Private company employee	21	13.3
	Others	31	19.6
	Unemployee (housewifes, retired, unemployment)	101	63.9
Level of Education	Primary (Elementary - Junior School)	43	27.2
	Intermediate (Senior High School – Diploma)	66	41.8
	Advanced (Bachelor – Postgraduated)	23	14.6
	Others	26	16.5
Marital Status	Married	115	72.8
	Widow/Widower /Unmarried	43	27.2
Residence	Jakarta	108	68.4
	Satellite Jakarta (Bodetabek)	19	12.0
	Non Jabodetabek	31	19.6

Notes: Satellite Jakarta (Bodetabek) was the city surrounding Jakarta (over 30 to 50 km), called Bogor, Depok, Tangerang, and Bekasi. Jabodetabek has been abbreviated Jakarta, Bogor, Depok, Tangerang, and Bekasi.

Clinical characteristics of JKN-DFU patients (Table 2) were dominated by type 2 diabetes mellitus (98.7%), with high-grade ulcer (≥grade 3) (56.3%) and severe infection (63.3%). The duration of diabetes was over

ISSN: 2085-675X (Print)
ISSN: 2354-8770 (Electronic)

five years (55.1%), with an average duration of foot ulcer of 39.3 ± 46.8 days (Mean ± SD) and duration of foot ulcer (> 20 days) (57.0%). The average Body Mass Index (BMI) of JKN-DFU patients was 25.2 ± 5.2 (kg/m2) (Mean ± SD), categorizing as obesity ≥ 25 kg/m² with a proportion of 47.5%. The majority of JKN-DFU patients had no history of smoking (65.2%). The comorbidities included hypertension (53.2%), Peripheral Artery Disease (PAD) (50.6), dyslipidemia (30.4%), and Coronary Artery Disease (CAD) (12.7%).

Table 2. Clinical profile of the JKN-DFU patients

Variables	Category	Value	
		n	%
PEDIS Grade Ulcer	Very Low – Moderate (< Grade 3)	69	43.7
	High (≥ Grade 3)	89	56.3
Severity of infection	Uninfected	9	5.7
	Mild - moderate	49	31.0
	Severe	100	63.3
Type of Diabetes	Type 1	2	1.3
	Type 2	156	98.7
Duration of diabetes	(Mean ± SD) (years)	8.7 ± 7.2	
	≤ 5 years	71	44.9
	> 5 years	87	55.1
Duration of foot ulcer	n (%) = 155 (96.9) , (Mean ± SD) (days)	39.3 ± 46.8	
	< 10 days	29	18.4
	≥ 10 – 20 days	34	21.5
	> 20 days	90	57.0
Body Mass Index	(Mean ± SD) (Kg/m²)	25.2 ± 5.2	
	Underweight	6	3.8
	Normal	56	35.4
	Overweight ≥ 23 Kg/m²	21	13.3
	Obesity	75	47.5
Smoking status	Smoker	55	34.8
	Non-smoker	103	65.2
Comorbidities	Hypertension , n (%) = 151 (95.6)	84	53.2
	Dyslipidemia , n (%) = 133 (84.2)	48	30.4
	Peripheral Artery Disease (PAD), n (%) = 149 (94.3)	80	50.6
	Coronary Artery Disease (CAD), n (%) = 141 (89.2)	20	12.7
Antibiotic during hospitalization	Yes	155	98.1
	No	3	1.9
Leukocyte	n (%) = 156 (98.7), (Mean ± SD) (mm³)	20,977.6 ± 10,393.5	
	≤ 12,000 mm³	26	16.5
	> 12,000 mm³	130	82.3
Random blood glucose	n (%) = 157 (99.4), (Mean ± SD) (mg/dL)	257.1 ± 162.5	
	< 200 mg/dL	73	46.2
	≥ 200 mg/dL	84	53.2
HbA1C	n (%) = 111 (70.3), (Mean ± SD) (%)	8.8 ± 2.5	
	≤ 7%	31	19.6
	> 7%	80	50.6
Length of Stay (LOS)	(Mean ± SD) (days)	19.7 ± 11.0	
	< 20 days	96	60.8
	≥ 20 days	62	39.2
Amputation status	Major Amputation	44	27.8
	Minor Amputation	36	22.8
	Non amputation	78	49.4

Clinical outcomes evaluated included Length of stay (LOS), amputation status, and also economic outcomes of managing DFU. On average, JKN-DFU patients were hospitalized for 19.7 ± 11.0 days (Mean ± SD), with 60.8% having a LOS less than 20 days. More than 50% of patients underwent amputation, with major amputations accounting for 27.8% and minor amputations for 22.8%. Nearly all JKN-DFU patients (98.1%) received antibiotic therapy during hospitalization. The clinical laboratory results (Table 2) show that the initial leukocyte count

ISSN: 2085-675X (Print)
ISSN: 2354-8770 (Electronic)

upon admission was 20,977.6 ± 10,393.5 (mm^3) (Mean ± SD), with 82.3% of patients having a leukocyte count over 12,000 mm^3. The blood glucose level at admission was 257.1 ± 162.5 (mg/dL) (Mean ± SD). The initial HbA1C value was 8.8 ± 2.5 (%) (Mean ± SD), with 50.6% of patients having HbA1C > 7%.

Our findings show that healthcare service costs, specifically actual costs, are dominated by procedural costs of IDR 24.5 million per patient (Table 3), accounting for 39% (Figure 1). Subsequently, the cost breakdown is as follows: drug and medical supply costs of IDR 18.8 million (27%), diagnostic examination costs of IDR 12.7 million (18%), room costs of IDR 8.4 million (12%), health professional consultation costs of IDR 2.5 million (4%), and administrative costs of IDR 24,551 (less than 1%). The average daily cost spent on managing DFU patients is IDR 3,505,260 per patient per day.

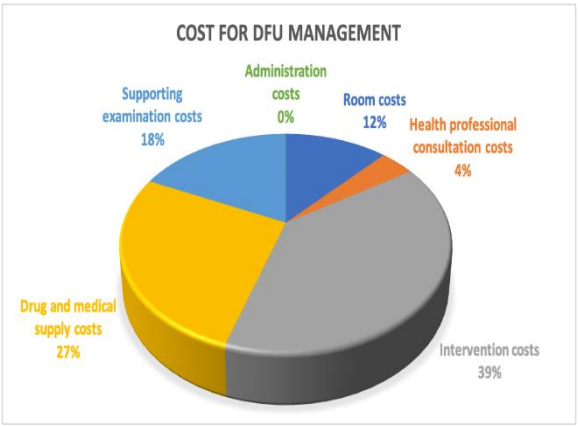

Figure 1. Cost for DFU Management

The following evaluation focuses on the socioeconomic and clinical outcomes of JKN-DFU patients (Table 4). Patients under 60 years old spent a higher proportion of treatment costs, amounting to IDR 72,443,121 per patient, while male patients need IDR 73,088,325 per patient. Among JKN-DFU patients, those in civil service professions and with advanced education levels (Bachelor's to postgraduate) incurred higher treatment costs of IDR 107,548,131 and IDR 88,556,224 per patient, respectively. Married patients spent higher treatment costs compared to unmarried ones, totalling IDR 73,942,633 per patient. Demographically, patients residing in the satellite Jakarta cities incurred significant treatment costs amounting to IDR 91,488,771. Based on clinical outcomes, patients hospitalized for more than 20 days and those undergoing major amputations incurred higher treatment costs of IDR 106,767,872 and IDR 99,120,442, respectively.

Table 3. Total actual costs of the JKN-DFU patients

Variables	Total costs (IDR)	Mean ± SD (IDR) (per patient)
Room costs	1,333,378,000	8,439,101 ± 8,752,964
Health professional consultation costs	395,664,000	2,504,202 ± 3,773,281
Intervention costs	4,208,867,693	24,515,070 ± 25,686,113
Drug and medical supply costs	2,970,277,228	18,799,223 ± 21,850,974
Supporting examination costs	2,008,249,806	12,710,442 ± 9,563,281
Administration costs	3,879,000	24,551 ± 11,675
Total actual costs	10,921,548,726	69,123,726 ± 63,419,987
Average daily costs (per patient per day)	3,505,260	

Notes: IDR (Indonesian Rupiah)

In this cross-sectional study, we highlight the significant role of socioeconomic factors, clinical profiles, total costs, clinical outcomes, and their evaluations on the expenditures incurred by JKN-DFU patients hospitalized at RSCM during the COVID-19 pandemic. Based on the sociodemographic conditions (Table 1), the average age of patients was 59.34 years, with a higher proportion being elderly females. These findings are consistent with previous studies at RSCM[29] and Fatmawati General Hospital[30] as well as several other studies where the age criteria ranged from 57 to 59 years.[10,31]

ISSN: 2085-675X (Print)
ISSN: 2354-8770 (Electronic)

Table 4. Evaluation of socioeconomic and clinical outcome of the JKN-DFU patients

Variables	Category	N	Mean IDR (per patient)	SD IDR (per patient)	Min IDR (per patient)	Max IDR (per patient)	p-value
Age	<60 years	71	72,443,121	81,202,518	10,618,036	537,724,696	0.429[a]
	>60 years	87	66,414,795	44,261,210	10,061,430	234,029,381	
Sex	Male	71	73,088,325	80,605,659	10,061,430	537,724,696	0.517[a]
	Female	87	65,888,249	45,062,371	10,618,036	268,768,707	
Occupation	Civil servants	5	107,548,131	75,714,546	37,826,271	223,358,321	**0.048**[b*]
	Private employee	21	91,922,126	80,220,761	22,100,405	320,643,765	
	Others	31	56,297,243	37,568,439	10,061,430	148,788,966	
	Unemployee	101	66,418,108	64,292,483	10,618,036	537,724,696	
Education	Basic	43	56,867,848	28,425,780	18,785,349	128,118,769	0.345[b]
	Intermediate	66	67,706,354	58,281,621	10,618,036	320,643,765	
	Advanced	23	88,556,224	70,493,652	20,382,127	306,560,000	
	Others	26	75,800,721	100,196,111	10,061,430	537,724,696	
Marital status	Married	115	67,321,874	54,150,740	10,061,430	320,643,765	0.844[a]
	Unmarried	43	73,942,633	83,923,784	19,016,556	537,724,696	
Address	Jakarta	108	64,299,341	51,262,129	10,061,430	320,643,765	0.153[a]
	Satellite Jakarta	19	91,488,771	68,293,295	30,418,129	268,768,707	
	Non Jakarta	31	72,223,655	92,019,351	20,382,127	537,724,696	
LOS	< 20 days	96	44,811,882	25,294,808	10,061,430	165,783,169	**<0.001**[a*]
	≥ 20 days	62	106,767,872	83,576,204	19,016,556	537,724,696	
Amputation	Major	44	99,120,442	95,648,669	22,100,405	537,724,696	**0.001**[b*]
	Minor	36	60,522,840	39,820,294	18,785,349	223,358,321	
	Non amputee	78	56,172,142	40,650,515	10,061,430	234,029,381	

Notes: [a]Analysis with Mann-Whitney; [b]Analysis with Kruskal-wallis; Post hoc Mann-Whitney Test

However, there is still controversy regarding the number of females versus males hospitalized due to DFU. Studies by Yunir et al.[10] and Pemayun et al.[32] suggest that there is no significant difference between genders. Therefore, a multicenter study by Dinh and Veves (2008) reported that women have an equal risk of developing diabetic foot complications if neuropathy is present.[29]

During the COVID-19 pandemic, most JKN-DFU patients (63.9%) hospitalized were non-working individuals, including housewives, retirees, and those unemployed. Another socioeconomic aspect was the predominance of intermediate education levels (senior high school to diploma). Throughout COVID-19, many workers experienced job losses due to the global economic downturn.[33] Patients residing in satellite areas surrounding Jakarta and outside Jakarta faced limited access to testing and care, which could lead to delays in DFU treatment and worsen patient conditions.[34] Moreover, during COVID-19, many patients faced barriers to hospital visits due to fear of COVID-19 infection risks, reduced availability of healthcare facilities due to system collapse, and inadequate supporting transportation facilities due to physical distancing measures. Consequently, hospitals were compelled to modify their management and healthcare service systems by reducing elective surgeries, decreasing visitations, and

ISSN: 2085-675X (Print)
ISSN: 2354-8770 (Electronic)

limiting patient referrals back to hospitals. They also rotated available healthcare personnel and intensified COVID-19 tracing efforts.[10]

Our study results indicate that during the COVID-19 pandemic, JKN-DFU patients admitted generally presented with high ulcer grades and severe infections characterized by elevated leukocyte counts, high blood glucose levels, and HbA1c levels. These findings align with the study by Yunir et al.[10] on DFU patients treated before and during the pandemic. The use of antibiotics during hospitalization in our study was notably high, reflecting patients' initial conditions upon admission, either to manage severe infections or comorbidities that could exacerbate their condition and trigger other infectious diseases. The majority of patients were diagnosed with Type 2 diabetes with a duration of more than five years, a history of ulcers lasting more than 20 days, and a significant number were non-smokers. We found that mobility issues were prevalent among patients, affecting their nutritional intake patterns and contributing to increased obesity. These results are consistent with studies by Pratama[29] and Yunir et al.[25], which reported that DFU patients with infections commonly have poor nutritional status. The social distancing measures during COVID-19 had a negative impact on JKN-DFU patients with comorbidities such as hypertension, dyslipidemia, and peripheral arterial disease (PAD). Furthermore, during the pandemic, hospitals allocated healthcare personnel to COVID-19 wards and implemented COVID-19 PCR testing requirements for all patients admitted to hospitals, whether for surgery or other treatments.[35] The surge in patient queues for PCR testing resulted in treatment delays because PCR testing at that time required significant time, thereby delaying surgical procedures. Additionally, many healthcare personnel involved in patient care were confirmed positive for COVID-19, reducing the available workforce for patient treatment.[10]

From a hospital admission perspective, the COVID-19 pandemic has influenced the clinical outcomes of JKN-DFU patients treated during this period, with an average length of stay of 19.72 days. This result is consistent with findings from Yunir et al.[25] The majority of patients were hospitalized for less than 20 days, mainly due to reduced admission rates during this period. Due to the missing data on COVID-19 status, we did not report early admission of COVID-19 status in our study. However, during the COVID-19 pandemic, patients were required to undergo a PCR test with a negative result before receiving treatment in the hospital. Patients who were confirmed positive for COVID-19 during treatment were moved to isolation wards and readmitted once they tested negative for COVID-19. Furthermore, hospital policies regarding the limitation of bed capacity to accommodate COVID-19 patients also affected the duration of hospital stays for other patients. Each bed and room in the hospital was allocated to prioritize patients suffering from COVID-19.[36]

Currently, there was no significant difference in the proportion of patients undergoing amputation compared to those who did not. The primary issue was concern regarding quality of life, leading patients to refuse amputation despite receiving approval for the procedure from clinicians or fears of exposure to COVID-19. Additionally, lockdown regulations and hospital policies prioritizing COVID-19 patient care resulted in reduced numbers and delayed scheduling of surgical procedures.[10] Based on previous studies, DFU patients commonly experience neuropathic conditions that increase the risk of high-amputation rates and recurrent foot ulcers, often associated with long-standing diabetic ulcer duration.[25,37]

In this study, we did not identify the bacterial profile from clinical data. Recent studies at RSCM reported that gram-negative pathogens are the most common pathogens infecting DFU patients. *Pseudomonas aeruginosa*, *Klebsiella*

pneumonia and *Escherichia coli* were the most frequent of gram-negative pathogens. Meanwhile, *Staphylococcus aureus*, *Enterococcus faecalis* and *methicillin-resistant Staphylococcus epidermidis* (MRSE) were the most frequent Gram-positive pathogens.[29,38] However, a multicenter study in the UK (CODIFI) reported that wound healing was higher when the pathogen causing the infection was gram-positive (HR 1.53; 95% CI 0.98-2.40) compared to gram-negative bacteria.[39]

The total costs that appears as daily rates per patients reimbursed by JKN. From cost analysis (Figure 1) indicate that the majority of costs are dominated by intervention costs. From the hospital's perspective, these incurred costs greatly exceed the budget allocated by the national health insurance, thus making it insufficient to cover the entire treatment costs for JKN-DFU patients. According to the latest INA-CBG'S tariff regulations, for JKN-DFU patients undergoing severe foot procedures/amputation with inpatient first-class care at RSCM, the coverage is only up to IDR 42.3 million per patient during hospitalization, while lower-class care also coverage at lowest. However, JKN-DFU patients treated during the COVID-19 pandemic period require treatment costs estimated to exceed IDR 65 million during hospitalization.

In our study, the evaluation results of socioeconomic status and clinical outcomes show that the proportion of treatment costs for JKN-DFU patients under 60 years old is relatively high, with males as the majority. This is consistent with several other studies reporting that males have higher mobility and productivity at a younger age. Gender differences here are related to concerns about foot care and self-care.[40] Men tend to suffer from chronic diseases more frequently, indicating a lack of concern about disease risks. In contrast, women are generally more cautious and attentive to their health, resulting in higher hospitalization rates but lower treatment costs. During the COVID-19 pandemic, there was a lower tendency among men to use masks compared to women, thereby increasing their potential exposure to COVID-19.

Based on occupation types (Table 4), the total costs for JKN-DFU patients at the hospital appear to be higher for patients as civil servants than private employees, others, and unemployees, especially those with advanced education levels. Statistically, there is a significant difference between occupation groups and total costs ($p=0.048$). This aligns with previous studies indicating a relationship between occupation type.[33] However, we can not prove the relationship between education level and total cost statistically. However, cost calculations show that the advanced education group required higher total costs than others. Individuals with higher education and adequate employment demonstrate higher compliance and awareness in seeking treatment at hospitals or other healthcare facilities during the COVID-19 pandemic.[33] The proportion of married compared to unmarried patients did not show significant differences in total costs. However, patients outside Jakarta exhibited significantly higher treatment costs than those in Jakarta.

The total cost of treatment for JKN-DFU patients at the hospital appears to be higher in patients with LOS over 20 days than in patients with a shorter LOS of less than 20 days. There is a significant difference in total costs between these length of stay groups, with $p<0.001$. This indicates that during the COVID-19 pandemic, patients' conditions worsened due to infections and comorbidities.[10] Consequently, treatment delays slowed patients' healing progress and led to poor clinical outcomes. The study's findings are a wake-up call that the cost of major amputations is nearly twice as much as for non-amputated patients. The total costs of treatment JKN-DFU patients at the hospital appear to be higher in patients with major amputation than in non-amputee patients. We highlight the substantial financial burden of major amputations in total costs ($p=0.001$). Meanwhile, from the post hoc test using Mann-Whitney, we get the comparison between the major amputation

ISSN: 2085-675X (Print)
ISSN: 2354-8770 (Electronic)

and non-amputation groups corresponding to total cost ($p<0.001$), which further emphasizes the need for preventive measures. Therefore, the sociodemographic and clinical characteristics significantly influence the total direct medical costs of DFU patients, making prevention a crucial aspect of healthcare management.

The limitation of this study is its single-hospital setting, leading to low external validity. However, the internal validity of this study is stringent. The data for this study was obtained from the foot registry in RSCM, a comprehensive database created by the endocrine, metabolic, and diabetes Department of Internal Medicine at RSCM - Faculty of Medicine Universitas Indonesia, which provides a robust foundation for our research.

To the best of our knowledge, this is the first study to evaluate the socioeconomic status of JKN-DFU patients and provide a clinical profile of JKN-DFU patients during the COVID-19 period. This study compares the difference of direct cost between sociodemographic and clinical outcomes variables. Previous studies have compared patient characteristics before and after the pandemic at RSCM but did not provide a socioeconomic overview. However, we have not yet conducted an analysis and assessment of indirect costs or compared socioeconomic groups comprehensively.

CONCLUSION

We highlighted that during the COVID-19 pandemic, the JKN-DFU patients who were hospitalized had a relation to the total costs incurred by hospitals, with civil servants, longer lengths of stay, and major amputation status leading higher total costs. Our findings on socioeconomic and clinical outcomes measures to total cost should benefit policymakers in evaluating the INA-CBG's tariff in DFU management. It is recommended that future studies comprehensively analyze the income levels and indirect costs incurred by JKN-DFU patients during hospitalization, as well as their clinical outcomes.

Abbreviations

Bodetabek : Bogor, Depok, Tangerang and Bekasi cities; COVID-19: Coronavirus disease 2019; DFU: diabetic foot ulcer; IDR: Indonesian Rupiah; INA-CBG'S tariff: Indonesian-Case Based Groups tariff; Jabodetabek: Jakarta, Bogor, Depok, Tangerang and Bekasi cities; JKN-DFU : Jaminan Kesehatan Nasional-Diabetic Foot Ulcer; LOS : length of stay; NHI: National Health Insurance; PCR : Polymerase Chain Reaction

Ethics Approval and Consent to Participate

This study has been registered with the number LB.02.03/2.6.1/1420/2022 and approved by the ethical committee of RSCM-Faculty of Medicine Universitas Indonesia, number KET-1192/UN.F1/ETIK/PPM.00.02/2022.

Conflict of Interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

Acknowledgments

This work was funded by The Ministry of Education and Culture, Research and Technology - Directorate of Research and Development, Universitas Indonesia, for their financial support through Penelitian Pascasarjana-PDD Grant No. NKB-1085/UN2.RST/HKP.05.00/2023.

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