Jurnal Manajemen dan Pelayanan Farmasi (JMPF)
(Journal of Management and Pharmacy Practice)
ISSN-p : 2088-8139 | ISSN-e : 2443-2946

Direct Medical Costs of Diabetes and the Foot Ulcer Outpatients in A General Hospital, Yogyakarta

Eka Kartika Untari[1,5], Tri Murti Andayani[2*], Nanang Munif Yasin[3], Rizka Humardewayanti Asdie[4]

1. Doctoral Graduate Program, Faculty of Pharmacy, Universitas Gadjah Mada, Yogyakarta, 55281, Indonesia
2. Department of Pharmacology and Clinical Pharmacy, Faculty of Pharmacy, Universitas Gadjah Mada, Sekip Utara, Yogyakarta, 55281, Indonesia
3. Faculty of Pharmacy, Universitas Gadjah Mada, Sekip Utara, Yogyakarta, 55281, Indonesia
4. Department of Internal Medicine, Faculty of Medicine, Pubic Health, and Nursing, Gadjah Mada University-dr. Sardjito Hospital, Jalan Kesehatan Sekip no.1, Yogyakarta, 55281, Indonesia
5. Pharmacy Department, Medical Faculty of Tanjungpura University, Pontianak, West Kalimantan, 78115, Indonesia

ARTICLE INFO
Submitted : 12-11-2023
Revised : 02-09-2024
Accepted : 16-05-2025

Published : 30-06-2025

Corresponding Author:
Tri Murti Andayani

Corresponding Author Email:
trimurtia@ugm.ac.id

ABSTRACT

Background: In addition to the financial burden that Diabetes Mellitus (DM) places on diabetics and their families due to the complications of Diabetic Foot Ulcers (DFU), treatment costs are escalating. Along with the costs associated with diabetic impairments, direct medical costs may contribute significantly to the financial burden of diabetes.

Objectives: This study aimed to determine expenditures associated with DFU, identify cost-influencing factors, and compare the costs of patients with DFU and those without ulcers.

Methods: To achieve this objective, this study employed a cross-sectional design and included 198 medical records of DM patients who met the following criteria: age range of 18 to 60 years; type 1 or type 2 DM; receipt of anti-diabetics; payment information; absence of autoimmune or end-stage chronic disease; and absence of corticosteroid. The significance of the cost difference between DFU and non-ulcer patients was evaluated using parametric and non-parametric tests as well as linear regression analysis to determine the cost-influencing factors.

Results: This study included 188 patients with type 2 diabetes and ten patients with type 1 diabetes. A total of 131 people with diabetes did not have ulcers, while 67 had a history of DFU. The average direct medical expenses for patients with DFU are IDR 760,146.32, compared to IDR 542,51.24 for patients without ulcer.

Conclusion: The presence of ulcers and glycemic conditions had an effect on the direct costs; insulin use also affected the direct costs. The direct costs of diabetic ulcer were significantly higher than non-ulcer, and they were predominantly affected by insulin prescribing.

Keywords: Diabetic foot; Diabetes; Direct Medical Costs; Insulin

INTRODUCTION

According to World Bank data for 2021, 10.6%, or 19.5 million, of the 537 million Diabetes Mellitus (DM) patients worldwide are expected to live in Indonesia, placing it fifth among the top ten countries with the most DM patients. Based on data from the International Diabetes Federation for 2021, the following is presented. [1,2] The IDF estimated that the number of DM patients is projected to increase until 2030, necessitating the implementation of regulations or initiatives to reduce the incidence of DM and its complications. [1] Diabetes is considered a catastrophic illness since therapy consumes the household's income. [2,3] Therefore, the IDF estimates that Indonesia will receive 250 USD in total DM costs per person in 2021. As a result, the direct medical costs for DM patients with a good quality of life range from IDR 489,000 to IDR 687,000 per month, according to

research carried out across Indonesia. [4,5] Moreover, the cost of diabetes is covered by the country, the healthcare system, the patients, and their families. [1,6]

Numerous studies have estimated the economic cost of diabetes using direct and indirect medical expenditures. While indirect costs account for the disease's effect on productivity, direct medical costs encompass all expenses associated with the treatment of diabetes, such as prescriptions, hospitalisations, and the management of complications. [7] Visual impairment, kidney failure, stroke, coronary heart disease, and amputation resulting from diabetic foot ulcer cases are complications of diabetes that increase treatment costs due to hospitalisation and loss of productivity. [8] One of the manifestations of complications was diabetic foot; people with diabetes mellitus may have the ulcer approximately 15%-25% of their lifetime. [9,10] The prevalence of diabetic foot ulcers was significantly correlated with inadequate glycemic management, which leads to microvascular and macrovascular complications. While macrovascular conditions were caused by insufficient blood flow to the extremities, microvascular conditions were caused by peripheral nerve damage, which manifests as neuropathy. [11]

Depending on a number of factors, including the price of antidiabetics, the average monthly cost of outpatient therapy for type 2 DM patients without complications ranges from IDR 247,309 to IDR 686,753. The cost of comorbidity management, the type of antidiabetics, and the cost of antidiabetes all affected the average monthly outpatient treatment expenditures for patients with type 2 diabetes who also have complications, which range from IDR 128,143 to IDR 1,174,342 [5]; however this information is undefined regarding amount of costs in treating diabetic ulcer. After diabetes with stroke complications, which expensed for 74.79% of all diabetic complication treatment expenditures, diabetic foot complications result in the second-highest medical costs. [12] The primary financial burden associated with managing diabetes was considered to be the cost of anti-diabetics and the medications used to treat complications. [13] Specifically, the information of incurred costs for outpatient care with diabetes ulcer is yet minor and varying. Some papers merely found the associating factors of costs burden inpatient care of diabetic foot following the presence of complications or concordance disease, surgery procedures, and nonetheless the admission duration. [14,15]

It is crucial that physicians, healthcare professionals, and legislators implement strategies to reduce the development of diabetes complications given the disease's substantial clinical and economic consequences. [8] Considering diabetes and its complications result in numerous economic and human losses, it is necessary to investigate the factors influencing the direct medical costs of diabetes mellitus and the costs associated with diabetic foot as a consequence of diabetes progression. Hence, this study aimed to quantify the increase in expenditures caused by DFU, compare the direct medical costs of DM patients with and without diabetic foot, and identify the factors that affected the diabetes medical cost. Moreover, identifying factors that affect the direct cost will assist in predicting the amount of direct medical cost of treating both diabetes with or without ulcer, and expectantly can be the beneficial reference to reduce the costs burden.

METHODS

Study design

A cross-sectional investigation was conducted on the medical records of diabetic patients who visited the endocrinology outpatient clinic at a general hospital in Yogyakarta.

Population and samples

Outpatients diagnosed with type 1 or type 2 DM who visited an endocrinology polyclinic between the ages of 18 and 60 and for whom direct medical cost data was available and who received antidiabetic prescriptions met the inclusion criteria. DM patients with comorbid end-stage or autoimmune diseases receiving corticosteroids or medications that can affect blood sugar levels were excluded. The accumulation of data that collected on October and November 2022 yielded a minimum sample size of 196 individuals, despite the fact that 198 participants were sampled consecutively for this study. Using the following formula, the number of samples was determined. [16]

Data collection

The collected data included gender, age, type of diabetes mellitus, insulin use, number of diagnoses (comorbidities), and blood sugar levels. In addition, the direct medical costs incurred when treating patients, i.e., costs for administration and registration, physician services, prescriptions, laboratories, consumable medical supplies, and diabetic foot procedures from hospital perspective, are included in the direct medical costs data

which were obtained from medical records and financial receipts or payments. The expenditures listed were the patient's monthly medical expenses for one visit.

Data Analysis

There was no discount applied to adjust the direct costs due to the frame time of collecting data was only for one month and the costs value are not changing to this day. Using Microsoft Excel, data on social characteristics, diagnoses, blood sugar levels, medications, and payment (direct medical costs) factors were collected and statistically analysed using statistical data analysis software. When evaluating data on direct medical costs, Indonesian Rupiah (IDR) units were used. After grouping cost factors based on the characteristics and history of the ulcer, the total, average, and standard deviation of medical expenses are calculated. To estimate the magnitude of the difference in direct medical costs between patients with diabetic foot ulcer and patients without a history of diabetes foot, patient social and clinic characteristics (glycemic level, comorbidity number, and insulin use) were analyzed statistically. For cost data with a normal distribution, the t-independent difference test was performed, whereas the Mann-Whitney test was utilised for non-normally distributed cost data. If the *p*-value was less than 0.05, there was a significant difference between the medical costs of DFU patients and non-injured patients. The statistical investigation was conducted with a 95% level of confidence. The statistical analysis was performed using multiple linear regression. In the final modelling, the prospective factors had a significance level of less than 0.25. The statistical analysis was followed by a multivariate analysis employing multiple linear regression tests to identify factors that influenced the direct medical costs of diabetes.

RESULTS AND DISCUSSION

This study conducted on medical record data from 198 patients who visited the endocrinology polyclinic. From table I, the number of DFU patients was 33.83% of the total sample of 198 people. There were slightly more female patients (53.53%) than male patients, but the proportion of male patients who experienced DFU was higher (19.19%) than the proportion of female patients who experienced ulcers (14.64%). Another study conducted at a Jakarta Type A Hospital found that 60% of diabetic patients, both with and without foot ulcers, were female. [17] The number of female patients suffering from DM was higher, but male patients who dominate the condition of DM with wounds are thought to do so because female patients have a good level of health perception and responsibility, and in such a manner they try to prevent the disease from getting complicated. [18]

Direct medical costs collected in this study include medical costs when patients visit the endocrinology polyclinic. The average direct medical cost of patients with DFU was higher than that of patients without injuries. The average direct medical cost for male patients with ulcer was IDR 768,738.15, and for patients without DFU, namely IDR 526,162.59, it was significantly different (p 0.607 > 0.05). In female patients, it was also shown that patients with DFU had a higher average cost (IDR 745,044.83) compared to patients without injuries (IDR 558,693.17). Direct medical costs between female patients who experienced injuries were not significantly different (p 0.027 < 0.05) than those without ulcers. In general, the average direct medical costs for patients with DFU were higher by gender, and there was a significant difference between the average costs for female patients with Diabetic Lower Extrimities (DLE) injuries and patients without injuries. In 2013, research by Mursalin and Soewondo estimated direct medical costs for male patients at IDR 2,418,957 per year, with no significant difference for female patients at IDR 2,394,665. [19] Additionally, the findings from 15 years of follow-up study in Taiwan revealed that the annual health costs of women were 1.06 times higher than men. [20]

The number of type 2 diabetes patients with DFU (n = 121) and without DFU (n = 67) was distributed differently. More than 50% of type 2 DM patients without DFU represented the patient population, although there were no type 1 DM patients with DFU. Limin et al. (2017) determined that 90.9% of the participants had type 2 diabetes based on their study results. [21] The average direct medical cost for those with type 1 diabetes is IDR 820,750.9; for individuals with type 2 diabetes without injuries, IDR 518,152.09; and for individuals with type 2 diabetes who have DFU, IDR 760,146.32. The mean of direct medical costs was not significantly different between individuals with type 1 and type 2 diabetes. Medical costs were higher in type 1 DM patients due to the biggest direct medical cost component was prescribing, and the use of insulin was the main treatment for type 1 DM where in every treatment visit the patient receives an insulin prescription which was more expensive than oral hypoglycemics.

Table I. DM Direct Medical Costs based on Characteristic and Ulcer Presence of 198 Diabetics Patients

Characteristics	Non-ulcer (n)	Direct Costs		DFU (n)	Direct Costs		P
		Total	Average ± SD		Total	Average ± SD	
Gender							
Male	54	28,469,289	526,162.59 ± 289,899.11	38	29,212,050	768,738.15 ±294,013.19	0.607[a]
Female	77	43.019.374	558.693,17 ±308683,78	29	21.606.300	745,044.83 ± 529,486	0.027[b]
Age (mean)	48.45	70,903,913	541,25.24 ±300,081.79	52.88	51,689,950	760,146,324 ±406,481.55	0.569[a]
DM Type							
1	10	8,207,509	820,750.9 ± 203,473.12	0	0	0	0.386[a]
2	121	62,696,404	518,152.09 ±295,634.99	67	51,689,950	760,146.32 ±406,481.54	
Glycemic Control							
Controlled	64	33,617,013	525,265.83 ± 286,176.12	26	17,179,300	660,742.31± 206,665.47	0.031[a]
Uncontrolled	59	34,795,400	589,752.54± 312,702.45	38	31,805,900	836,997.37± 503,682.35	0.004[a]
No Data	8	2,491,500	311,437.50± 206,266.24	4	2704750	676,187.50± 188,216.87	0.017[b]
Number of Complications and/or Comorbidities							
1	32	16,405,859	535,741.97 ± 290,657.56	3	2,350,250	783,416.67 ± 342,056.21	0.908[b]
2	37	22,647,430	599,694.05 ± 364,297.99	19	13,371,950	703,786.84 ± 213,427.43	0.270[a]
3	29	13,004,874	448,739.78 ± 238,789.04	16	10,916,800	673,853.33 ± 307,853.24	0.521[a]
4	18	9,502,800	527,933.33 ± 268,870.83	17	12,853,650	756,097.05 ± 297,751.27	0.613[a]
5	7	5,184,100	740,585.71 ±266,186.79	8	8,080,500	1,010,062.5± 960,600.67	0.817[b]
6	5	2,547,500	509,500 ± 373,310.28	5	4,116,800	823,360± 170,084.72	0.358[b]
7	2	1,305,000	652,500 ± 321,662.87			Between group (ANOVA)	0.053[a]
8	1	306,350	-				
Insulin Utilize							
Yes	96	59,886,263	623,815.24± 291,380.55	55	44,780,000	814,181.82± 424,056.79	0.001[a]
No	35	11,017,650	314,790,0± 187,181.29	13	6,909,950	531,354.62± 208,107.83	0.001[a]

Remarks: a = T-Independent test; b= Mann-Whitney test

Based on glycemic conditions, patients with DFU typically spend more on average than patients without ulcer. At both controlled and uncontrolled blood sugar levels, it was known that the average direct medical costs for patients with and without injuries differed significantly. According to Table I, diabetic patients with ulcers and inadequate glycemic control incur the greatest medical cost impact at IDR 836,997.37. This could be the result of additional costs for the foot ulcer procedures component and laboratory tests as a consequence of a foot injury. The clinical outcome in the form of poor glycemic control requires further investigation to avoid increasing

disease complications. [23] A study by Ratnasari (2020) in type 2 DM patients who were treated as an outpatient calculated the direct medical costs incurred by patients with uncontrolled glycemic conditions that were larger (IDR 526,923) and significantly different from the group of patients whose blood sugar was controlled (IDR 389,407). [4]

Among diabetes conditions may be associated with microvascular and macrovascular complications. In this study, the severity of complications was determined by the number of DM diagnoses. The presence of other diseases influences the expenses incurred, including the cost of medications, doctor's comissions and laboratory examinations, and the management of foot ulcers. Similar to the test results comparing direct medical costs for patients with and without DFU or injuries which had the same number of complications and/or comorbidities diagnoses; hence, there was no significant difference in direct medical costs between DM patients with and without injuries. From table I, one disease number means there was only diabetes mellitus that diagnosed by doctor; moreover, two to seven indicates the amount of diseases particularly diabetes with its complications and/or other comorbid disease. The table I shows a fairly statistically significant difference in the direct medical costs (*p* 0.053) for patients with one to six diagnoses. Overall, out of a total of 5 diagnoses, patients without DFU had the greatest average direct medical costs (IDR 740,585.71), followed by patients with DM and an average wound (IDR 1,010,062.5), respectively. With conditions ranging from those without complications to those with microvascular complications, macroscopic complications, and both microvascular and macrovascular complications, direct medical costs rise. [19] The ANOVA test was carried out to compare the overall cost differences between groups with the number of diagnoses obtained with a significance value close to <0.05 (*p* 0.053), therefore, the average direct costs between groups were nearly significant. A research in the United Arab Emirates compared the direct medical costs of DM patients in 2004, found that the presence of microvascular complications increased the cost of treatment by 2.2 times; macrovascular 6.4 times; and both complications 9.4 times. [22] The complications caused the highest direct medical costs were hypertension, dyslipidemia, and stroke. [22,23]

Patients were classified based on whether or not insulin was prescribed, there were differently significant in direct medical costs between DFU and non-ulcer patients (*p* 0.001 < 0.05). The average cost for patients who have wound and take insulin on prescription is IDR 814,181.82, whereas the average cost is IDR 314,790 for conditions without wounds and no insulin prescription. The consequences of ulcer lead to increased costs in addition to prescribing insulin to achieve controlled glycemic, also due to diabetic foot wound procedures, use of consumable medical supplies, and additional examinations. A cross-sectional study by Kristina in 2019 involving 8 hospitals in Indonesia calculated an amount of 985.5 – 1,195.3US$/year of direct medical costs were carried in the group of diabetic patients receiving insulin and insulin combinations on prescription. [23]

The components of direct medical costs on this study include prescribing costs, costs for using medical consumable supplies, doctor services, diabetic procedures, laboratory costs, and administrative and registration costs. The average direct medical cost for patients with a larger DFU was IDR 760,146.32, while the condition without injury costs were IDR 541,251.24. This data was continued for statistical analysis, showing that there was a significant difference (p 0.000 <0.05). Patients with ulcer were performed diabetic foot procedures during their visits to the polyclinic. The procedures on diabetic foot included mild, moderate, and severe procedures, depending on the degree and severity of ulcer. There were additional charges over those procedures which lead to higher the costs. The previous study in Singapore which using data from 2013 to 2017, determined that each patient in Singapore who suffered an injury spent an average of 10,142 Singapore dollars (SGD) per year. [26] In the South Asian Region, the annual treatment costs for minor diabetic ulcer with nephropathy and vascular complications ranged between 246 and 502 US dollars, while the annual treatment costs for major ulcer with amputation and coronary vascular disorders ranged between 2,087 and 4,597 US dollars. [24] The costs for diabetic foot procedures differ depending on the degree of injury, the lowest costs were for mild diabetic foot procedures, and the highest were for severe diabetic foot procedures. Severe diabetic foot procedures also require more consumable medical supplies than moderate and mild ulcer degrees, consequently the more severe the degree of the wound, the greater the costs incurred for the consequences of treating the wound. In Singapore, the average cost of treating injuries was 4776 SGD; for minor amputations 14845 SGD; and major amputations of 42730 SGD. [25]

Amongst patients with ulcer, the laboratory charges of IDR 282,115.38 were significantly greater than those of DM patients without ulcer (p 0.032 < 0.05), which was IDR 39,166.7. The components of prescribing costs, doctor services, administration, and registration were no significant difference between DM patients without injuries and with injuries. The DFU patients not only undergo measurement of blood sugar levels tests, but microorganism cultures, gram staining, and pedis Magnetic Resonance Imaging (MRI) were also performed

Table II. Direct Medical Costs Comparison between DFU and non-ulcer based on Cost Categories in Indonesian Rupiah (IDR)

Cost Components	Non-ulcer (n=131)	Costs Average ± SD	N	% of Total Cost	DFU (n=67)	Costs Average ± SD	N	% of Total Cost	*P*
Medicines (prescriptions)	52.956.054	404.244,57± 295.563,88	131	74,82	27.436.950	402.040,44 ±239.219,556	67	52,42	0.679[b]
Consumable Medical Supplies	0	0	0	0	1.808.000	15.721,74± 4685,83	113	3,45	-
Doctor's Fee	14.995.000	112.744,36± 10.416,809	133	21,19	9.080.000	110.731,71± 14.057,245	82	17,35	0.23 [b]
Diabetic Ulcer Procedure	0	0	0	0	9.442.500	185.147,05± 23710,6082	51	18,04	-
Laboratory	1.260.000	39.166,67± 32.219,167	30	1,78	3.667.500	282.115,38± 599.315,488	13	7	0.031 [b]
Patient Admission	1.563.000	6.413,93± 4.309,62	131	2,21	901.000	6.543,8± 4.439,57	67	1,72	0.943 [b]
Total	70.774.054	541.251,24± 300.081,787	-	100	52.335.950	760.146,32± 406.481,545	-	100	0.000 [a]

Remarks: a = T-Independent test; b= Mann-Whitney test

Table III. Bivariat Results Test of Factor Candidate-affected Direct Medical Costs of Diabetes Mellitus

Variable	Bivariate Tests	*p*
Age	Correlation	0.764
Diagnose Number	Correlation	0,130*
Medicine/prescribing cost	Correlation	0,780
Ulcer presence	T-independent	0,000*
Gender	T-independent	0,966
Glycemic Control	ANOVA	0,017*
Insulin Utilize	T-independent	0,000*

Remarks: * *p<0,25*

Table IV. Final Modelling of Multivariate Test of Factors-affected Diabetes Direct Medical Costs

Factor	*Unstandardized β*	*Std. Error*	*Coefficient β*	*R Square*	*p*
(Constant)	542061,856	143031,909	-	0.247	*0.000*
Ulcer presence	-194701,193	46679,272	-0,261		0.000
Glycemic Control	-81631,424	36896,366	-0,139		0.028
Insulin Utilize	297228,389	52506,567	0,357		0.000

to assist in the selection of antibiotics and assess the severity of wounds involving infection and inflammation in the foot bone. Treatment of diabetic wound conditions required additional costs in the form of using consumable medical materials and the services of the diabetic foot procedure itself. Consumable medical materials were materials that were used only once and were sterile for diabetic foot procedures, including debridement or minor to major surgery. The medical supplies used were folded gauze, tampons, and sterile equipment for diabetic foot procedures.

The biggest component of direct medical costs in DM patients without ulcer and with ulcer was prescribing costs, respectively spending 74.82% and 52.42% of the total costs. The average cost incurred for prescribing in patients without injuries was IDR 404,244.57, and in patients with DFU IDR 402,040.44. Table II also describes the components of direct medical costs that are only borne by DM patients with DFU, including the average of consumable medical supply utilisation of IDR 15,721.71 and the cost of procedures on foot ulcers of IDR 185,147.05. These two components accounted for, respectively, 3.45% and 18.04% of the total direct medical

costs of diabetic foot wounds. In line with some studies that medications account for the largest proportion of direct medical expenses. [23,26] In accordance with the American Diabetes Association's recommendations for diabetes management, the prescribing of metformin and other antidiabetics groups (sulfonylurea, glitazone, and insulin) as well as lifestyle modifications can be implemented to achieve good glycemic control; thus, the prescription costs become the largest cost component of medical expenses. [26,27] Moreover, a patient's visit to a specialist in internal medicine, sub-section of Medical Endocrinology; a specialist in Tropical Infectious diseases; and a General Practitioner which determines the payment for medical services. The registration fee comprises patient enrollment and administrative expenses for the polyclinic of internal medicine.

The objective of a linear regression test was to identify the variables or factors that influence the direct medical costs of diabetes. In this study, age and gender were analyzed as patient characteristics, while clinical characteristics included the presence or absence of a DFU history, glycemic control, and number of diagnoses. This analysis included prescription costs and insulin utilization, in line with several studies, these two factors accounted for a significant portion of the cost of DM treatment. In the linear regression test ($p < 0.25$), the variables of number of diagnoses, history of presence or absence of DFU, glycemic control, and insulin use were profoundly considered as prospective factors. These four prospective factors were continued into the linear regression analysis by considering the *p*-value obtained to be less than 0.05 to be included in the linear equation.

Multivariate modeling utilizing linear regression revealed that injury history, glycemic control, and insulin use were factors that influenced the direct medical costs of treating diabetes mellitus. Since the calculated R square value is 0.247, it was presumed that these three variables could account for the 24.7% increase in direct medical costs. The greatest value of the beta coefficient was in the insulin utilisation variable, which was equal to 0.357; thus, the use of insulin was the dominant factor influencing direct medical costs (Table IV).

According to the unstandardized beta value depicted in table IV, direct medical costs will decrease in the absence of injury or DFU history. The presence of the ulcer variable was negative, which means that as the potential for injury increases, the direct medical costs will increase by IDR 194,701.193. Likewise, with the glycemic control variable, which has a negative value, the more it reaches an uncontrolled condition, the more direct medical costs IDR. 81,631.424. In the insulin utilisation variable, it was significant that the increasing use or prescription of insulin would increase the cost of IDR 297,228.389. Similarly, the controlled blood sugar level will reduce costs while insulin use will increase direct medical expenses. In accordance with the findings of Mursalin and Soewondo (2013), the insulin use variable was the most influential factor on the cost in this study. [19] In 2017, the ADA also included the cost of insulin as a factor in diabetes-related expenditures; insulin use is a standard ADA recommendation for preventing diabetes complications. [13,26,28]

This study describes the direct medical costs incurred by DM patients during a single visit to the polyclinic, but does not include indirect or intangible costs, which are typically endured by the patient or their families. This research can provide as an illustration of the magnitude of the direct medical costs of diabetic foot injuries as compared to non-injury conditions, identify the components of direct medical costs incurred in DFU as compared to non-injury conditions, and identify the magnitude of the influencing factors by taking injury history; insulin utilization; and glycemic control status into regression formula as consideration. However, the degree of cost may be varied due to the patient conditions and comorbidities, characteristics of hospital, and insurance type. There was a different charge between hospital status (teaching with non-teaching hospital; and urban with rural hospital). Either the different socioeconomic or insurance conditions may have an influence for medical costs. [14] Moreover, the medical costs of treating ulcer were possibly greater than it was calculated which caused by the patient visited other health care to manage their injuries. Hence, these informations also as the lack of study which might particularly predict for the same settings.

CONCLUSION

Direct medical costs between patients with injuries and without injuries were significantly different, the difference in costs was 140% or 1.4 times higher in DFU. There was a significant difference in average costs between diabetic foot patients in the good glycemic control group and those with poor glycemic control compared to non-ulcer patients. The cost of prescription in DFU was 52.42%, and non-ulcer was 74.82% of the total cost. The component of direct medical costs that differed significantly in the DFU and wound groups was laboratory costs. Factors that influence the amount of direct medical costs in DM include a history of injury, glycemic control, and use of insulin.

ACKNOWLEDGEMENT

This study is part of dissertation research series that it is funded by Indonesia Endowment Funds for Education (Pusat Layanan Pembiayaan Pendidikan/ Puslapdik) and Center for Education Financial Services (Lembaga Pengelola Dana Pendidikan/LPDP), hence the author deliver acknowledgement.

STATEMENT OF ETHICS

This study conducted after receiving ethical approval from the Gadjah Mada University Faculty of Medicine, Public Health, and Nursing Research Ethics Committee (KE/FK/1434/EC/2022). The ethical approval letter was released on November 22nd, 2022.

REFERENCES

1. IDF. *Diabetes Atlas 10th Edition*. International Diabetes Federation; 2021. https://diabetesatlas.org/atlas/tenth-edition/
2. Choi JW, Choi JW, Kim JH, Yoo KB, Park EC. Association between chronic disease and catastrophic health expenditure in Korea. *BMC Health Serv Res*. 2015;15(1):26. doi:10.1186/s12913-014-0675-1
3. Xu K, Evans DB, Kawabata K, Zeramdini R, Klavus J, Murray CJ. Household catastrophic health expenditure: a multicountry analysis. *The Lancet*. 2003;362(9378):111-117. doi:10.1016/S0140-6736(03)13861-5
4. Ratnasari PMD, Andayani TM, Endarti D. Analisis Outcome Klinis Berdasarkan Kualitas Hidup dan Biaya Medik Langsung Pasien Diabetes Melitus Tipe 2. *J Sains Farm Klin*. 2020;7(1):15. doi:10.25077/jsfk.7.1.15-22.2020
5. Baroroh F, Solikah WY, Urfiyya A. ANALISIS BIAYA TERAPI DIABETES MELITUS TIPE 2 DI RUMAH SAKIT PKU MUHAMMADIYAH BANTUL YOGYAKARTA. 2016;(2).
6. Peters ML, Huisman EL, Schoonen M, Wolffenbuttel BHR. The current total economic burden of diabetes mellitus in the Netherlands. *Neth J Med*. 2017;75(7).
7. Bommer C, Heesemann E, Sagalova V, et al. The global economic burden of diabetes in adults aged 20–79 years: a cost-of-illness study. *Lancet Diabetes Endocrinol*. 2017;5(6):423-430. doi:10.1016/S2213-8587(17)30097-9
8. Blonde L, Umpierrez GE, Reddy SS, McGill JB, Berga SL, Bush M, Chandrasekaran S, DeFronzo RA, Einhorn D, Galindo RJ, Gardner TW. American Association of Clinical Endocrinology clinical practice guideline: developing a diabetes mellitus comprehensive care plan—2022 update. Endocrine Practice. 2022 Oct 1;28(10):923-1049.
9. Zhang P, Lu J, Jing Y, Tang S, Zhu D, Bi Y. Global epidemiology of diabetic foot ulceration: a systematic review and meta-analysis. *Ann Med*. 2017;49(2):106-116. doi:10.1080/07853890.2016.1231932
10. Yazdanpanah L, Shahbazian H, Nazari I, Arti HR, Ahmadi F, Mohammadianinejad SE, Cheraghian B, Hesam S. Incidence and risk factors of diabetic foot ulcer: a population-based diabetic foot cohort (ADFC study)—two-year follow-up study. International journal of endocrinology. 2018;2018(1):7631659.
11. Blair M. Diabetes Mellitus Review. *Urol Nurs*. 2016;36(1):27-36. doi:10.7257/1053-816X.2016.36.1.27
12. Wu H, Eggleston KN, Zhong J, et al. How do type 2 diabetes mellitus (T2DM)-related complications and socioeconomic factors impact direct medical costs? A cross-sectional study in rural Southeast China. *BMJ Open*. 2018;8(11):e020647. doi:10.1136/bmjopen-2017-020647
13. American Diabetes Association. Economic Costs of Diabetes in the U.S. in 2017. *Diabetes Care*. 2018;41(5):917-928. doi:10.2337/dci18-0007
14. Hicks CW, Selvarajah S, Mathioudakis N, et al. Trends and determinants of costs associated with the inpatient care of diabetic foot ulcers. *J Vasc Surg*. 2014;60(5):1247-1254.e2. doi:10.1016/j.jvs.2014.05.009
15. Jodheea-Jutton A, Hindocha S, Bhaw-Luximon A. Health economics of diabetic foot ulcer and recent trends to accelerate treatment. *The Foot*. 2022;52:101909. doi:10.1016/j.foot.2022.101909
16. RL Schaeffer, Mendenhall W, Otto L. *Elementary Survey Sampling*. Duxburry Press; 1990.
17. Priyanto MH, Legiawati L, Saldi SRF, Yunir E, Miranda E. Comparison of vitamin D levels in diabetes mellitus patients with and without diabetic foot ulcers: An analytical observational study in Jakarta, Indonesia. *Int Wound J*. 2023;20(6):2028-2036. doi:10.1111/iwj.14066
18. Zhu X, Lee M, Chew EA, Goh LJ, Dong L, Bartlam B. "When nothing happens, nobody is afraid!" beliefs and perceptions around self-care and health-seeking behaviours: Voices of patients living with diabetic lower extremity amputation in primary care. International Wound Journal. 2021 Dec;18(6):850-61.

19. Mursalin M, Soewondo P. Analisis Estimasi Biaya Langsung Medis Penderita Rawat Jalan Diabetes Mellitus Tipe 2 di RSUD Dr. Abdul Aziz Singkawang Tahun 2013. *J Ekon Kesehat Indones*. 2017;1(2). doi:10.7454/eki.v1i2.1770
20. Chen HY, Kuo S, Su PF, Wu JS, Ou HT. Health Care Costs Associated With Macrovascular, Microvascular, and Metabolic Complications of Type 2 Diabetes Across Time: Estimates From a Population-Based Cohort of More Than 0.8 Million Individuals With Up to 15 Years of Follow-up. *Diabetes Care*. 2020;43(8):1732-1740. doi:10.2337/dc20-0072
21. Jia L, Parker CN, Parker TJ, et al. Incidence and risk factors for developing infection in patients presenting with uninfected diabetic foot ulcers. Jan YK, ed. *PLOS ONE*. 2017;12(5):e0177916. doi:10.1371/journal.pone.0177916
22. Al-Maskari F, El-Sadig M, Nagelkerke N. Assessment of the direct medical costs of diabetes mellitus and its complications in the United Arab Emirates. *BMC Public Health*. 2010;10(1):679. doi:10.1186/1471-2458-10-679
23. KRISTINA SA, Endarti D, ANDAYANI TM, WIDAYANTI AW. Direct and Indirect Cost of Diabetes Mellitus in Indonesia: A Prevalence Based Study with Human Capital Approach. *Int J Pharm Res 09752366*. 2021;13(1).
24. Walker IF, Garbe F, Wright J, et al. The Economic Costs of Cardiovascular Disease, Diabetes Mellitus, and Associated Complications in South Asia: A Systematic Review. *Value Health Reg Issues*. 2018;15:12-26. doi:10.1016/j.vhri.2017.05.003
25. Lo ZJ, Surendra NK, Saxena A, Car J. Clinical and economic burden of diabetic foot ulcers: A 5-year longitudinal multi-ethnic cohort study from the tropics. *Int Wound J*. 2021;18(3):375-386. doi:10.1111/iwj.13540
26. Zhuo X, Zhang P, Hoerger TJ. Lifetime Direct Medical Costs of Treating Type 2 Diabetes and Diabetic Complications. *Am J Prev Med*. 2013;45(3):253-261. doi:10.1016/j.amepre.2013.04.017
27. ADA. 9. Pharmacologic Approaches to Glycemic Treatment: *Standards of Medical Care in Diabetes—2022*. *Diabetes Care*. 2022;45(Supplement_1):S125-S143. doi:10.2337/dc22-S009
28. ADA. 7. Diabetes Technology: *Standards of Medical Care in Diabetes—2022*. *Diabetes Care*. 2022;45(Supplement_1):S97-S112. doi:10.2337/dc22-S007