Cost of illness of type 2 diabetes mellitus from the patient’s perspective: a study from several primary healthcare centres and a hospital in Yogyakarta, Indonesia

Dwi Endarti*1, Anna Wahyuni Widayanti1, Ehga Ayodya Rahmawati2, Nellatul Khaer2, Siti Rahayu3
1Department of Pharmaceutics, Faculty of Pharmacy, Universitas Gadjah Mada, Yogyakarta, Indonesia
2Faculty of Pharmacy, Universitas Gadjah Mada, Yogyakarta, Indonesia
3Moyudan Primary Health Center, Sleman District Health Office, Indonesia

ABSTRACT

Diabetes mellitus is a major health problem that had a consequence of high cost related to treatment and disease impact. This study aimed to estimate the cost of illness related T2DM from the perspective of patients. This study applied a prevalence-based cost of illness study from the perspective of patients. Data of direct medical costs, direct non-medical costs and indirect costs were collected by interviewing patients. The study involved patients covered by the national health insurance scheme as study respondents, which consisted of 96 patients visiting three public primary healthcare centres and 35 patients visiting a private secondary hospital in Yogyakarta Province, Indonesia. From the perspective of patients in Yogyakarta-Indonesia, the total cost of illness of T2DM within three months period was IDR 95,458 (USD 6.58) for patients at PHCs and IDR 340,159 (USD 23.46) for patients at the hospital, which were about 2% to 7% of the minimum wage rate. Indirect cost was the highest contribution of cost of illness (IDR 40,436/USD 2.79 to IDR 398,836/USD 17.63) and followed by direct medical cost (IDR 32,349/USD 2.23 to IDR 44,157/USD 3.05) and direct non-medical cost (IDR 22,673/USD 1.56 to IDR 40,334/USD 2.78). Cost of illness from out of pocket patients in this study was led by visits to other health facilities (the health facilities outside of study site) for obtaining health service related to T2DM disease. This study anticipated that T2DM had a consequence to out of the pocket cost of treatment and further productivity lost of patients and their caregivers.

*Corresponding Author
Name: Dwi Endarti
Phone: +6282134538856
Email: endarti_apt@ugm.ac.id

INTRODUCTION

Diabetes mellitus (DM), a chronic disease caused by insufficient production or ineffectively usage of insulin in the body, is a significant health problem (World Health Organization, 2016). Among types of DM, type 2 diabetes mellitus (T2DM) was the most prevalence in the world accounted for 90% (IDF, 2019). The prevalence of DM in the world in the year 2017 was 425 million. Meanwhile, Indonesia ranked for the 6th most cases in the world with the prevalence of 10.3 million (IDF, 2017). DM, along with its complications, requires lifetime and costly treatment. International Diabetes Federation
(IDF) estimated about 12% of global expenditure was spent for DM which accounted for US$673-US$1,622 billion in the year 2015, approximately US$1,622-US$2,886 per person (IDF, 2015).

In Indonesia, the government covers the treatment costs of DM for patients suits to the Universal Health Coverage (UHC) regulation (Agustina et al., 2019). UHC aims to lower the out of pocket expenditure (OOPE) that cause financial hardship (World Health Organization, 2017). Regardless, there is still OOPE spent by household under the health insurance schemes. The study in the United States revealed that the OOPE represented 11.8% of total national health expenditures (Catlin et al., 2015). Other studies in Mexico described that medicines represent 66% of health OOPE even after a series of policy reforms (Wirtz et al., 2012). In Indonesia, the health-seeking behaviours of the people might lead to OOPE for health such as self-medication and going to traditional/alternative/religious healers (Widayanti et al., 2020).

Cost of illness study (COI) aims to assess the economic burden of health problems (Larg and Moss, 2011). COI studies provide information such as for researchers use COI data in cost-effectiveness studies and for policymakers look for information from COI to allocate resources for healthcare spending (Durand-Zaleski, 2008). The perspectives in COI study may measure costs to society, the healthcare system, third-party payers, employers, the government, and patients and their families which differ the costs categories included in the analysis (Sam and Philip, 2009). COI is classified into incidence-based, which measures lifetime costs and prevalence-based, which measures costs concurrently (Larg and Moss, 2011). The transferability of the COI results is limited to a special setting (Brodzsky et al., 2019).

Many COI studies related to DM have been conducted around the world and varied considerably in their study design, perspective and included cost categories. However, the studies agreed on the conclusions that there is a considerable economic burden related to DM (Ng et al., 2014; Afroz et al., 2018). Previous COI studies related to DM in Indonesia considered only the direct medical cost from the perspective of the healthcare provider in the analysis (Baroroh and Urifiya, 2017; Anggriani et al., 2019). Our study aimed to estimate COI related T2DM from the perspective of patients and include the direct medical cost, direct non-medical cost, and indirect cost in the analysis. We also analyzed the factors of patients’ characteristics associated with the costs.

**MATERIALS AND METHODS**

**Study design**

This study applied a prevalence-based cost of illness study from the perspective of patients. Data of direct medical costs, direct non-medical costs and indirect costs were collected by interviewing patients. The interview was conducted at one time using the recall method in which the patients were asked to answer a structured questionnaire related to costs for receiving the healthcare in the previous three months. The duration of 3 months was set following a maximum allowable recall period of 3 months as applied in the previous similar study (Chatterjee et al., 2011).

**Study participants**

Participants of this study were T2DM patients who visited outpatient service at three primary healthcare centres (PHCs) and one secondary private hospital in Yogyakarta province, Indonesia during January – Maret 2020. The sample size was determined following the previous COI study, which was at least 30 patients in each health facility for an interview (Nadib et al., 2019). In our study, we interviewed 96 patients in PHCs and 35 patients in the hospital. A convenience sampling technique was applied in this study. The inclusion criteria were patients under National Health Insurance (NHI) scheme, diagnosed with T2DM, aged 18 years old and older, visiting the selected health facilities for outpatient service, have been receiving treatment for at least three months, able to communicate and complete the interview. The exclusion criteria were women with pregnancy.

**Study instrument**

The study instruments have consisted of a structured questionnaire to guide the interview and collect the data regarding patients sociodemographic, direct medical cost, direct non-medical cost, and indirect cost. The instruments were modified from those used in the previous study and from literature. Questionnaire for direct medical cost from the perspective of the patient included administration cost, healthcare professional cost, laboratory test cost, drug and medical item costs that spent from the patient by out of pocket (Neumann et al., 2016). Direct non-medical cost consisted of meal and transportation costs of patients and their caregiver. Cost components of indirect cost consisted of productivity loss of patients and their caregivers due to patients’ treatment (Jo, 2014). The study respondents were asked to mention the related costs spent when their visiting the healthcare facilities in the previous three months included healthcare facilities...
in which they were interviewed and other health facilities.

**Data Analysis**

Data of patients' characteristics as well as data of costs based on their categories and components, were analyzed using descriptive analysis. The productivity lost was measured using a human capital approach with following calculation methods: the number of days lost of patients and their caregivers due to patients' treatment was multiplied by the amount of daily wage based on real income (Oyando et al., 2020). Costs were presented as cost per patient per certain period (3 months), cost per visit, and unit cost per cost components. Associations between patients' characteristics and costs were analyzed using bivariate analysis employing Man Whitney or Kruskal Wallis tests given the data was not normally distributed. A confidence interval of 95% was applied in the statistical analysis. All costs were presented in Indonesia's currency (IDR) in year 2020 (1 USD = 14,500 IDR).

**Ethical aspect**

The study gained ethical approval from Medical and Health Research Ethics Committee (MHREC) Faculty of Medicine, Public Health and Nursing Universitas Gadjah Mada Number: KE/FK/0986/EC/2019 and permissions from the PHSc and hospital in which the data collection was taken.

**RESULTS**

**Characteristics of respondents**

Table 1 describes the characteristics of respondents interviewed in this study. Most of the respondents were female both in PHCs (86.46%) and hospital (68.57%), aged 45 – 65 years old both in PHCs (63.54%) and hospital (68.57%), married both in PHCs (78.13%) hospital (85.71%), unemployed both in PHCs (56.25%) and hospital (51.43%), had the distance of the home to health facilities <2 km for respondents in PHCs and 2 – 5 km for respondents in hospital and had the duration of illness < 5 years for respondents in PHCs and > 10 years for respondents in hospital.

**Cost of illness per 3 months-period**

Table 2 describes the cost of illness of T2DM patients per patients for three months based on the interviews. This analysis was to inform the burden of T2DM to patients within a specific period time which was three months. There was no direct medical cost at the study site of PHCs, indicating no additional costs from patients out of pocket. Meanwhile, for direct medical cost at the study site of the hospital, there was a small amount of direct medical cost. There were direct medical costs for visiting health facilities outside study sites both for patients interviews in PHCs and hospital. The proportion of the direct medical cost for visiting other health facilities was much higher (92%) compared to the direct medical cost at a study site based on interviews of patients in a hospital. As for the direct non-medical costs and indirect costs, the costs were higher for visiting the study site than other health facilities. Patients visited the study sites routinely. Meanwhile, occasionally visited other health facilities for obtaining health services.

Among the three cost categories of cost of illness, indirect costs were the highest cost spent by patients which were IDR 40,436 (USD 2.79) and IDR 398,836 (USD 17.63) for patients in PHCs dan hospital respectively and followed by direct medical costs which were IDR 32,349 (USD 2.23) and IDR 44,157 (USD 3.05) for patients in PHCs dan hospital respectively and lastly direct non-medical costs which were IDR 22,673 (USD 1.56) and IDR 40,334 (USD 2.78) for patients in PHCs dan hospital respectively. The most significant component of direct medical costs was the drug cost (56 - 92%), the biggest component of the direct non-medical cost was patient's transportation cost (21 – 55%), and the biggest component of the indirect cost was patients’ productivity cost (51 – 93%). There were no administration costs in this study because the costs were covered by health insurance.

**Cost of illness per health service visit**

Table 3 presents the cost per visit of health service both in PHCs and in hospital. Interviews with 96 patients in PHCs obtained 320 visits to PHCs-study site and 78 visits to other health facilities. Meanwhile, interviews with 35 patients in hospital obtained 85 visits to the hospital-study site and 33 visits to other health facilities. The costs were presented based on the classification of the cost categories and the cost components.

Consistent with cost per 3 months, there was no additional out of pocket cost for health service in PHCs study site. The mean additional cost from patients’ out of pocket for receiving health service at hospital-study site was IDR 1,536 (USD 0.11) per visit. Meanwhile, the mean direct medical costs for obtaining health service at other health facilities outside the study sites were IDR 39,310 (USD 2.71) per visit and IDR 42,879 (USD 2.96) per visit based on interviews of patients at PHCs and hospital, respectively. As for the direct non-medical cost per visit, the mean costs per visiting the health facilities of study sites were IDR 5,838 (USD 0.4) and
Table 1: Characteristics of respondents

| Characteristics       | PHCs (N=96) |        | Hospital (N=35) |        |
|-----------------------|-------------|--------|-----------------|--------|
|                       | n           | %      | n               | %      |
| **Sex**               |             |        |                 |        |
| Female                | 83          | 86.46  | 24              | 68.57  |
| Male                  | 13          | 13.54  | 11              | 31.43  |
| **Age group**         |             |        |                 |        |
| <45 years old         | 3           | 3.13   | 0               | 0      |
| 45-65 years old       | 61          | 63.54  | 24              | 68.57  |
| >65 years old         | 32          | 33.33  | 11              | 31.43  |
| **Marital status**    |             |        |                 |        |
| Married               | 75          | 78.13  | 30              | 85.71  |
| Single                | 21          | 21.88  | 5               | 14.29  |
| **Occupation**        |             |        |                 |        |
| Employed              | 27          | 28.13  | 8               | 22.86  |
| Unemployed            | 54          | 56.25  | 18              | 51.43  |
| Retired               | 15          | 15.63  | 9               | 25.71  |
| **Monthly income (IDR)** |         |        |                 |        |
| 0                     | 54          | 56.25  | 20              | 57.14  |
| <3,000,000            | 27          | 28.13  | 3               | 8.57   |
| ≥3,000,000            | 15          | 15.63  | 12              | 34.29  |
| **Distance from home to health facility (km)** | | | | |
| <2                    | 56          | 58.33  | 8               | 22.86  |
| 2-5                   | 36          | 37.50  | 22              | 62.86  |
| >5                    | 4           | 4.17   | 5               | 14.29  |
| **Duration of illness (years)** | | | | |
| <5                    | 44          | 45.83  | 7               | 20.00  |
| 5 - 10                | 34          | 35.42  | 11              | 31.43  |
| >10                   | 18          | 18.75  | 17              | 48.57  |

PHCs=Primary Health Centers; N=Total number of respondents in the health facilities; n=Number of respondents in each group of characteristics.

IDR 12,970 (USD 0.89) at PHCs and hospital, respectively. Besides, the mean of direct non-medical costs for visiting other health other facilities was IDR 4,449 (USD 0.31) and IDR 9,372 (USD 0.65) based on patients' interview at PHCs and hospital, respectively. Finally, the mean of indirect cost per visit for patients and their caregiver for visiting the health facilities of study sites were IDR 11,582 (USD 0.80) and IDR 61,212 (USD 4.22) at PHCs and hospital, respectively. Meanwhile, the mean indirect costs for visiting other health facilities were IDR 3,320 (USD 0.23) and IDR 113,498 (USD 7.83) based on patients’ interviews at PHCs and hospital, respectively.

**Unit Cost**

Table 4 shows the unit cost of cost component per case of a health service visit. Not all health service visits had consequences to either direct medical cost, direct non-medical cost or indirect cost from patients’ perspective. There were only 8% and 4% visits to the hospital-study site that had a consequence of directing medical cost, especially the cost of drug and medical supplies, respectively. Drug cost analyzed in this study was limited to drug-related to DM and its complications, for instance, antidiabetes drugs, antihypertensive drugs, and antihypercholesterolemia drugs. The additional direct medical cost spent by a patient for health service at hospital-study site was for anti-hypercholesterolemia drugs which were also as a part of T2DM therapy and medical device (insulin needle) that not covered by the health insurance.

Based on interviews of patients at PHCs, there were 27% visits to other health facilities had a consequence to drug cost, and 17% visits to other health facilities had a consequence to healthcare professional cost. The direct medical cost spent at other health facilities based on interviews of patients at PHCs was including costs of antidiabetic drug,
Table 2: Cost of illness per patient (3 months-period)

| Costs categories and components | PHCs (N=96) | | | Hospital (N=35) | | |
|---------------------------------|------------|------------|------------|----------------|------------|------------|
|                                 | Mean cost | SD | % | Mean cost | SD | % |
|                                 | (IDR)      |   |   | (IDR)      |   |   |
| **Direct medical cost at a study site** | | | | | | |
| Drug                            | -          | - | 0.00 | 3,429      | 13,140 | 91.95 |
| Medical supplies                | -          | - | 0.00 | 300        | 1,775  | 8.05 |
| Healthcare professionals        | -          | - | 0.00 | -          | -     | 0.00 |
| Laboratory                      | -          | - | 0.00 | -          | -     | 0.00 |
| Total                           | -          | - | 0.00 | 3,729      | 13,179 | 8.44 |
| **Direct medical cost outside study site** | | | | | | |
| Drug                            | 18,286     | 138,794 | 56.53 | 36,714      | 217,205 | 90.81 |
| Medical supplies                | -          | - | 0.00 | -          | -     | 0.00 |
| Healthcare professionals        | 11,979     | 102,275 | 37.03 | -          | -     | 0.00 |
| Laboratory                      | 2,083      | 20,412  | 6.44  | 3,714       | 16,465  | 9.19 |
| Total                           | 32,349     | 171,961 | 100.00 | 40,429      | 217,182 | 91.56 |
| **Direct non-medical cost at study site** | | | | | | |
| Patient’s transportation        | 9,024      | 21,319  | 47.51 | 17,198      | 29,344  | 54.60 |
| Patient’s meal                  | 9,813      | 20,621  | 51.67 | 10,929      | 16,520  | 34.70 |
| Care giver’s transportation     | -          | - | 0.00 | 1,300       | 5,131   | 4.13 |
| Care giver’s meal               | 156        | 1,531   | 0.82  | 2,071       | 8,009   | 6.58 |
| Total                           | 18,992     | 31,025  | 83.77 | 31,498      | 39,048  | 78.09 |
| **Direct non-medical cost outside study site** | | | | | | |
| Patient’s transportation        | 3,058      | 16,643  | 83.09 | 4,627       | 22,770  | 52.37 |
| Patient’s meal                  | 615        | 3,501   | 16.71 | -          | -     | 0.00 |
| Care giver’s transportation     | 8          | 57      | 0.22  | 4,210       | 22,810  | 47.65 |
| Care giver’s meal               | -          | - | 0.00 | -          | -     | 0.00 |
| Total                           | 3,681      | 17,023  | 16.23 | 8,836       | 45,560  | 21.91 |
| **Total direct non-medical cost** | 22,673     | 34,858  | 100.00 | 40,334      | 63,869  | 100.00 |
| **Indirect cost at study site** | | | | | | |
| Patient’s productivity loss     | 34,459     | 105,626 | 91.39 | 137,777     | 189,942 | 92.68 |
| Care giver’s productivity loss  | 3,245      | 23,120  | 8.61  | 10,879      | 41,198  | 7.32 |
| Total                           | 37,704     | 107,077 | 93.24 | 148,656     | 201,942 | 58.14 |
| **Indirect cost outside the study site** | | | | | | |
| Patient’s productivity loss     | -          | - | 0.00 | 54,265      | 148,173 | 50.71 |
| Care giver’s productivity loss  | 2,732      | 21,093  | 100.00 | 52,747      | 312,057 | 49.29 |
| Total                           | 2,732      | 21,093  | 6.76  | 107,012     | 336,811 | 41.86 |
| Total indirect cost             | 40,436     | 112,507 | 100.00 | 255,668     | 398,836 | 100.00 |

PHCs = Primary Health Centers; N = Total number of respondents in the health facilities; n = Number of respondents in each group of characteristics; SD = Standard of deviation; IDR = Indonesia rupiah
Table 3: Cost of illness per health service visit

| Costs categories and components | PHCs | Hospital |
|---------------------------------|------|----------|
|                                 | Mean cost (IDR) | SD | % | Mean cost (IDR) | SD | % |
| **Direct medical cost at a study site** | | | | | | |
| Drug                            | 0 | 0 | 0 | 1,412 | 4,853 | 91.93 |
| Medical supplies                | 0 | 0 | 0 | 124 | 650 | 8.07 |
| Healthcare professionals        | 0 | 0 | 0 | 0 | 0 | 0 |
| Laboratory                      | 0 | 0 | 0 | 0 | 0 | 0 |
| Total                           | 0 | 0 | 0 | 1,536 | 4,860 | 100 |
| **Direct medical cost outside study site** | | | | | | |
| Drug                            | 22,222 | 51,025 | 56.53 | 38,939 | 93,576 | 90.81 |
| Medical supplies                | 0 | 0 | 0 | 0 | 0 | 0 |
| Healthcare professionals        | 14,557 | 34,111 | 37.03 | 0 | 0 | 0 |
| Laboratory                      | 2,532 | 22,502 | 6.44 | 3,939 | 7,882 | 9.19 |
| Total                           | 39,310 | 58,563 | 100 | 42,879 | 92,208 | 100 |
| **Direct non-medical cost at a study site** | | | | | | |
| Patient’s transportation        | 2,707 | 6,580 | 46.37 | 7,082 | 10,972 | 54.60 |
| Patient’s meal                  | 3,084 | 6,501 | 52.83 | 4,500 | 5,788 | 34.70 |
| Care giver’s transportation     | 0 | 0 | 0 | 535 | 3,272 | 4.12 |
| Care giver’s meal               | 47 | 483 | 0.80 | 853 | 2,952 | 6.58 |
| Total                           | 5,838 | 9,522 | 100 | 12,970 | 14,540 | 100 |
| **Direct non-medical cost outside study site** | | | | | | |
| Patient’s transportation        | 3,692 | 10,264 | 82.99 | 4,907 | 12,902 | 52.36 |
| Patient’s meal                  | 747 | 2,710 | 16.79 | 0 | 0 | 0 |
| Care giver’s transportation     | 10 | 63 | 0.23 | 4,465 | 13,029 | 47.64 |
| Care giver’s meal               | 0 | 0 | 0 | 0 | 0 | 0 |
| Total                           | 4,449 | 10,547 | 100 | 9,372 | 25,917 | 100 |
| **Indirect cost at a study site** | | | | | | |
| Patient’s productivity loss     | 10,608 | 33,639 | 91.59 | 56,732 | 74,897 | 92.68 |
| Care giver’s productivity loss  | 974 | 7,292 | 8.41 | 4,480 | 26,580 | 7.32 |
| Total                           | 11,582 | 34,118 | 100 | 61,212 | 83,872 | 100 |
| **Indirect cost outside the study site** | | | | | | |
| Patient’s productivity loss     | 0 | 0 | 0 | 57,554 | 78,765 | 50.71 |
| Care giver’s productivity loss  | 3,320 | 14,466 | 100 | 55,944 | 75,154 | 49.29 |
| Total                           | 3,320 | 14,466 | 100 | 113,498 | 72,189 | 100 |

PHCs=Primary Health Centers; N=Total number of health service visits in the health facilities; SD=Standard of deviation; IDR=Indonesian rupiah
Table 4: The unit cost of the cost component

| Cost components                  | PHCs       | Hospital   |
|----------------------------------|------------|------------|
|                                  | n = 320    | n = 85     |
|                                  | %          | Mean (IDR)| Mean (IDR) | SD  | Mean (IDR) | SD  |
| Direct medical cost at a study site | 0 0 0 0   | 7 8       | 17,143      | 3,891 | 0             |
|                                  | 0 0 0 0   | 3 4       | 3,500       | 0   | 0             |
|                                  | 0 0 0 0   | 0 0       | 0 0         | 0   | 0             |
| Direct medical cost outside study site | 0 0 0 0   | 0 0       | 0 0         | 0   | 0             |
|                                  | 21 27     | 22,222    | 51,025      | 5 15 | 257,000      | 0   |
|                                  | 0 0 0 0   | 0 0       | 0 0         | 0   | 0             |
|                                  | 13 17     | 14,557    | 34,111      | 0 0 | 0             |
|                                  | 1 1       | 2,557     | 22,502      | 10 30 | 13,000      | 9,487 |
| Direct non-medical cost at a study site | 213 67     | 3,914     | 7,418       | 79 93 | 7,620       | 11,202 |
|                                  | 107 33    | 9,224     | 8,368       | 43 51 | 8,895       | 5,193  |
|                                  | 0 0 0 0   | 0 0       | 0 0         | 0   | 0             |
|                                  | 3 1       | 5,000     | 7 8         | 10,357 | 2,673      |
| Direct non-medical cost outside study site | 51 65     | 5,716     | 12,351      | 32 97 | 5,060       | 13,077 |
|                                  | 6 8       | 9,833     | 2,714       | 0 0 | 0             |
|                                  | 2 3       | 400       | 0           | 0 20 | 7,367       | 16,230 |
|                                  | 0 0 0 0   | 0 0       | 0 0         | 0   | 0             |
| Indirect cost at a study site    | 47 15     | 72,226    | 57,448      | 36 42 | 133,950     | 53,143 |
|                                  | 6 2       | 51,923    | 14,746      | 5 6 | 76,154       | 89,517 |
| Indirect cost outside the study site | 0 0 0 0   | 0 0       | 12 36       | 158,272 | 25,643      |
|                                  | 0 0 0 0   | 0 0       | 12 36       | 153,846 | 0         |

PHCs=Primary Health Centers; N=Total number of health service visits; n=number of visits that had a consequence of costing; SD=Standard of deviation; IDR=Indonesian rupiah

herbal medicine, supplements, blood glucose test, and diabetic foot ulcer care. Based on interviews of patients at the hospital, there were 15% of visits to other health facilities had a consequence to drug cost and 30% of visits to other health facilities had to consequence to laboratory cost. The most significant direct medical cost spent on receiving health service at other health facilities based on patients’ interviews at the hospital was the cost for herbal medicines which was IDR 257,000 (USD 17.72).

Regarding the direct non-medical cost, the proportion of patients and their caregivers required transportation and meal costs were higher for patients interviewed in hospital compared to PHCs. The transportation cost of patients and meal cost of caregivers for visiting hospital-study site was about twice higher than those for visiting PHCs-study site. As for the patients’ meal cost was nearly the same for patients visiting hospital-study site and PHCs-study site. So too, for indirect cost, the proportion of patients and their caregivers bore indirect cost were higher for patient interviewed in hospital compared to PHCs.

Association between patients’ characteristics and cost of illness

Tables 5 and 6 present the associations between
Table 5: Association between patients’ characteristics and cost of illness in PHCs

| Characteristics          | PHCs             |                      |                      |                      |                      |
|--------------------------|------------------|----------------------|----------------------|----------------------|----------------------|
|                          | n                | Mean of DMC (IDR)    | p                    | Mean of DNMC (IDR)   | p                    |
|                          |                  | Mean of IC (IDR)     |                      |                      |                      |
|                          |                  |                      |                      |                      |                      |
| Sex                      |                  |                      |                      |                      |                      |
| Female                   | 83               | 37,187               | 0.859                | 24,754               | 0.192                |
|                          |                  | 31,756               | 0.039*               |                      |                      |
| Male                     | 13               | 1,462                |                      | 9,354                |                      |
|                          |                  | 95,858               |                      |                      |                      |
| Age group (years old)    |                  |                      |                      |                      |                      |
| <45                      | 3                | 4,833                | 0.488                | 20,078               | 0.486                |
|                          |                  |                      |                      |                      |                      |
| 45-65                    | 61               | 11,328               |                      | 18,924               |                      |
|                          |                  |                      |                      |                      |                      |
| >65                      | 32               | 75,000               |                      | 30,062               |                      |
|                          |                  |                      |                      |                      |                      |
| Marital status           |                  |                      |                      |                      |                      |
| Married                  | 75               | 6,073                | 0.445                | 19,236               | 0.282                |
|                          |                  | 47,566               | 0.47                 |                      |                      |
| Single                   | 21               | 126,190              |                      | 34,946               |                      |
|                          |                  | 14,970               |                      |                      |                      |
| Occupation               |                  |                      |                      |                      |                      |
| Employed                 | 27               | 11,833               | 0.104                | 14,777               | 0.174                |
|                          |                  | 124,950              | 0.000*               |                      |                      |
| Unemployed               | 54               | 51,593               |                      | 28,930               |                      |
|                          |                  | 7,275                |                      |                      |                      |
| Retired                  | 15               | -                    |                      | 14,360               |                      |
|                          |                  | 7,692                |                      |                      |                      |
| Monthly income (IDR)     |                  |                      |                      |                      |                      |
| 0                        | 54               | 51,593               | 0.883                | 28,930               | 0.131                |
|                          |                  | 7,275                | 0.000*               |                      |                      |
| <3,000,000               | 27               | 9,759                |                      | 12,636               |                      |
|                          |                  | 49,872               |                      |                      |                      |
| >3,000,000               | 15               | 3,733                |                      | 18,213               |                      |
|                          |                  | 142,832              |                      |                      |                      |
| Distance from home to health facility (km) |   |                      |                      |                      |                      |
| <2                       | 56               | 27,955               | 0.362                | 18,364               | 0.001*               |
|                          |                  |                      |                      |                      |                      |
| 2 – 5                    | 35               | 5,429                |                      | 23,838               |                      |
|                          |                  |                      |                      |                      |                      |
| >5                       | 5                | 270,000              |                      | 62,780               | -                    |
| Duration of illness (years) |            |                      |                      |                      |                      |
| <5                       | 44               | 4,591                | 0.398                | 23,551               | 0.058                |
|                          |                  | 55,432               | 0.187                |                      |                      |
| 5 – 10                   | 34               | 9,809                |                      | 12,623               |                      |
|                          |                  | 26,471               |                      |                      |                      |
| >10                      | 18               | 142,778              |                      | 39,509               |                      |
|                          |                  | 30,158               |                      |                      |                      |

*p-value significant at 95% Confidence Level. n=Number of patients in each group of characteristics; DMC=Direct medical cost; DNMC=Direct non-medical cost; IC=Indirect cost

patients’ characteristics, and either direct medical cost, direct non-medical cost. There were none of the patients’ characteristics of sex, age, marital status, occupation status, monthly income, distance from home to a health facility, and duration of illness had a significant association with direct medical cost (p>0.05). There were significant associations between distance from home to the health facility, and direct non-medical cost of patients interviewed in PHCs and hospital, in which the more distance, the more direct non-medical cost (p<0.05). There were significant associations between patients’ characteristics of sex, occupation status, monthly income and indirect cost based on patients’ interviews in PHCs and hospital (p<0.05). The mean indirect costs were higher in male patients compared to female, higher in employed patients compared to unemployed and retired, and higher in patients with high monthly income compared to lower monthly income.

DISCUSSIONS

This cost of illness study was conducted applying the prevalence-based approach to estimate the economic burden of T2DM disease within three months of the period based on patients’ interviews at one time to explore the costs within three previous months using recall method. Most of the respondents who were T2DM patients were female. This finding was similar to the study conducted in public health facilities in Kenya in which the majority...
Table 6: Association between patients’ characteristics and cost of illness in hospital

| Characteristics       | n  | Hospital Mean of DMC (IDR) | p     | Hospital Mean of DNMC (IDR) | p     | Hospital Mean of IC (IDR) | p     |
|-----------------------|----|---------------------------|-------|-----------------------------|-------|---------------------------|-------|
|                       |    |                           |       |                             |       |                           |       |
| **Sex**               |    |                           |       |                             |       |                           |       |
| Female                | 24 | 62,354                    | 0.793 | 51,998                      | 0.061 | 184,135                   | 0.008*|
| Male                  | 11 | 4,455                     |       | 14,886                      |       | 411,741                   |       |
| **Age group (years old)** |    |                           |       |                             |       |                           |       |
| <45                   | n.a| n.a                       | n.a   | n.a                         | n.a   |                           |       |
| 45-65                 | 24 | 64,396                    | 0.174 | 27,947                      | 0.254 | 254,647                   | 0.612 |
| >65                   | 11 | -                         |       | 67,360                      |       | 257,895                   |       |
| **Marital status**    |    |                           |       |                             |       |                           |       |
| Married               | 30 | 51,167                    | 0.945 | 38,257                      | 0.873 | 294,433                   | 0.141 |
| Single                | 5  | 2,100                     |       | 52,800                      |       | 23,077                    |       |
| **Occupation**        |    |                           |       |                             |       |                           |       |
| Employed              | 8  | 7,500                     | 0.720 | 19,125                      | 0.792 | 432,692                   | 0.000*|
| Unemployed            | 18 | 80,306                    |       | 44,315                      |       | 113,034                   |       |
| Retired               | 9  | 4,444                     |       | 51,225                      |       | 383,581                   |       |
| **Monthly income (IDR)** |    |                           |       |                             |       |                           |       |
| 0                     | 20 | 72,275                    | 0.767 | 43,283                      | 0.428 | 101,731                   | 0.000*|
| <3,000,000            | 3  | 17,000                    |       | 29,667                      |       | 211,538                   |       |
| ≥3,000,000            | 12 | 4,083                     |       | 38,086                      |       | 523,263                   |       |
| **Distance from home to health facility (km)** |    |                           |       |                             |       |                           |       |
| <2                    | 8  | 9,938                     | 0.328 | 5,342                       | 0.001*| 218,788                   | 0.921 |
| 2 – 5                 | 22 | 66,636                    |       | 36,932                      |       | 280,857                   |       |
| >5                    | 5  | -                         |       | 111,291                     |       | 203,846                   |       |
| **Duration of illness (years)** |    |                           |       |                             |       |                           |       |
| <5                    | 7  | 14,357                    | 0.822 | 20,659                      | 0.539 | 417,582                   | 0.499 |
| 5 – 10                | 11 | 10,091                    |       | 42,541                      |       | 150,350                   |       |
| >10                   | 17 | 78,471                    |       | 47,008                      |       | 257,145                   |       |

*p-value significant at 95% Confidence Level. n=Number of patients in each group of characteristics; DMC=Direct medical cost; DNMC=Direct non-medical cost; IC=Indirect cost

of T2DM patients as female (58.9%) (Oyando et al., 2020). According to the previous study in Nigeria, it was mentioned that man was more active than woman hence might stimulate sensitivity of insulin, and those physical activities were related to DM disease (Ekpenyong et al., 2012). When comparing the age of respondents, most of them were at the age of 45-65 years old. This finding was in line with the previous study in United Arab Emirates in which the most prevalence of DM was at the age of 40-60 years old (59%) (Al-Maskari et al., 2010). Based on marital status, most of the respondents were married, which was under the previous study conducted in Vietnam in which most T2DM patients were married (80.4%) (Le et al., 2017). Comparing the duration of the disease which was grouped into three groups: <5 years, 5 – 10 years, and >10 years; most of the patients visiting PHCs had a duration of T2DM <5 years (45.83%), meanwhile most of the patients visiting hospital had a duration of T2DM >10 years (48.57%). This indicated the T2DM patients visiting the hospital had a longer duration of disease and might also more severe. Most of the patients of T2DM in Kenya had a duration of disease >5 years (47.9%) (Oyando et al., 2020). In contrary, T2DM patients from another study at a hospital in Thailand was the majority had the duration of disease between 1 – 5 years (55.6%) (Chatterjee et al., 2011).

In this study, the cost of illness of T2DM was estimated from the perspective of patients. Therefore, the costs were including the direct medical cost from patients’ out of pocket, direct non-medical cost spent by patients and their caregivers for obtain-
ing health service at health facilities, and indirect cost measured from productivity loss of patients and their caregivers for obtaining health service at health facilities. This study showed that the average cost of illness of T2DM from patient's perspective within three months was about IDR 95,458 (USD 6.58) for patients at PHCs and IDR 340,159 (USD 23.46) for patients at the hospital. When comparing that cost of illness with the average of society’s monthly income in Yogyakarta Province which was represented by the minimum provincial wage rate of Yogyakarta (IDR 1,704,608 / USD 117.56 per month), the cost of illness of T2DM in Yogyakarta per patient monthly was about 2% to 7% of average society income. Even though the nominal cost of illness was not much, however, T2DM is a chronic disease that required treatment and cost for a lifetime, hence the cost of illness might become an economic burden to patients. A past study in Thailand revealed that the average cost of illness per diabetic patient was USD 881.47 in 2008, which was 21% of the per capita GDP of Thailand. That study included the cost of informal care, which contributed sizeably to the total cost of illness (28%) (Chatterjee et al., 2011).

Based on systematic reviews of 8 cost of illness study of T2DM in low and lower-middle-income countries, the annual average cost of illness of T2DM ranged from USD 29.91 to USD 237.38, consisted of direct costs ranged from USD 106.53 to USD 293.79, and indirect costs ranged from USD 1.92 to USD 73.4 per person per year. That study mentioned that hospitalization cost was the major contributor to direct costs followed by drug costs (Afroz et al., 2018). Our study result was in line in which drug cost was the highest among direct medical cost. However, in our study, there were no patients receiving inpatient service since the hospital study site was a secondary level of a health facility.

Cost of illness from out of pocket patients in this study was led by visits to other health facilities for obtaining health service related to T2DM disease. This was relevant with finding from the previous study that Indonesian people had health-seeking behaviour through self-medication with biomedicine bought over the counter and with traditional/alternative home remedies, going to traditional/alternative/religious healers in addition to current health service provided by the national health system in which the population covered by the universal health coverage (Widayanti et al., 2020). There was a scrumy amount of out of pocket spending by patients for obtaining health service at the hospital. The expenditure was for drug and medical device-related to T2DM treatment that not covered by the health insurance and as volition of the patients.

Findings from this study revealed that indirect cost was the most significant proportion of the cost of illness of T2DM and followed by direct medical cost and direct non-medical cost. This result was in line with the previous study conducted in Germany in which the indirect cost was most significant than direct medical cost (€ 4,103 versus € 3,352) (Ulrich et al., 2016). On the other hand, the previous study conducted in Vietnam revealed that direct medical cost contributed the biggest proportion to cost of illness (USD 127.30) and followed by indirect cost (USD 84.40) and direct non-medical cost (USD 34.40) (Le et al., 2017). However, that study applied societal perspective, which included all direct medical cost in the analysis. In contrast, our study applied patient’s perspective that included only direct medical cost spent from patients’ out of pocket or the costs that not covered by the health insurance.

Direct non-medical cost in this study was significantly associated with the distance from home to a health facility. Usually, primary health care was closer to the patients’ residence, and the hospital was farther. The farther the distance, the more cost of transportation required. Modes of transportation might affect the cost of transportation as well, for instance travelling to health facility using private or public vehicle would have a different consequence of transportation cost. The previous study conducted in Korea revealed that transportation cost burden is higher among older, low-income, disabled, or geographically isolated populations (Jang et al., 2020).

This study found that male patients had a higher indirect cost compared to female patients. This finding was similar to the study result conducted in Mali and China (Bermudez-Tamayo et al., 2017; Wang et al., 2010). Generally, men had more activities/occupation to produce income compared to women, hence had more risk to lose income due to obtaining health services for their disease, in the other word the productivity lost was higher in men. In this study, employed patients had significantly higher indirect cost compared to retired and unemployed patients. This because the indirect cost was calculated based on the real income of patients. This was in line with the study result conducted in Ghana (Amon and Aikins, 2017).

The same time consumed by patients for obtaining health services had more impact on productivity lost to employed patients compared to retired and unemployed patients. Similarly, the monthly income of patients in this study was significantly associated with the indirect cost. The more monthly
income, the more productivity lost of patients due to visiting health facilities for T2DM treatment.

Results of this study stated that direct medical cost was not significantly associated with any of the patients’ characteristics. This finding was in contrary to several other past studies. Elderly and duration of disease were among the risk factors of T2DM complication that lead to increasing of treatment cost (Al-Maskari et al., 2010; Afroz et al., 2019).

Single patients had 16% more risk for T2DM disease progression compared to married patients that impact on increasing of treatment cost (Liu et al., 2018). Occupation status influenced on time for T2DM diagnose hence affecting disease severity and treatment cost (Acharya et al., 2016). Patients with high income could afford the higher cost for diabetes-related treatment-seeking such as health healthcare professional consultation, diabetes-related medicines, diabetes-related food and supplement, and diabetes test tool (Kumar et al., 2008). Finally, our study had a limitation on the sample size and sampling techniques that could not represent the whole population of Indonesia. This study also used interview method to collect information from patients and or their caregivers in which the interview was taken only at one time per patient using recall method to memorize the T2DM health-seeking related within three months. Thus the recall bias in data collection might occur.

CONCLUSION

This study anticipated that T2DM had a consequence to out of the pocket cost of treatment and further productivity lost of patients and their caregivers. From the perspective of patients in Yogyakarta-Indonesia, the total cost of illness of T2DM within three months period was IDR 95,458 (USD 6.58) for patients at PHCs and IDR 340,159 (USD23.46) for patients at the hospital, which were about 2% to 7% of the minimum wage rate. Indirect cost was the highest contribution to the cost of illness and followed by direct medical cost and direct non-medical cost.

ACKNOWLEDGEMENT

The works in this publication were part of the thesis of Ehga Ayodya Rahmawati and Nellatul Khaherduring their studies in Faculty of Pharmacy, Universitas Gadjah Mada. We thank Universitas Gadjah Mada for funding support of this study.

Funding Support

Universitas Gadjah Mada funded this study through the RTA program year 2020 (grant number: 732/UN1.PIIII/KPT/HUKOR/2020).

Conflict of Interest

The authors declare that they have no conflict of interest.

REFERENCES

Acharya, L. D., Rau, N. R., Udupa, N., Rajan, M. S., Vijayanarayana, K. 2016. Assessment of cost of illness for diabetic patients in South Indian tertiary care hospital. Journal of Pharmacy And Bioallied Sciences, 8(4):314.

Afroz, A., Alam, K., Ali, L., Karim, A., Alramadan, M. J., Habib, S. H., Magliano, D. J., Billah, B. 2019. Type 2 diabetes mellitus in Bangladesh: a prevalence based cost-of-illness study. BMC Health Services Research, 19(1):601.

Afroz, A., Alramadan, M. J., Hassain, M. N., Romero, L., Alam, K., Magliano, D. J., Billah, B. 2018. Cost-of-illness of type 2 diabetes mellitus in low and lower-middle income countries: a systematic review. BMC Health Services Research, 18(1):972.

Agustina, R., Dartanto, T., Sitompul, R., Susiloretni, K. A., Suparmi, Achadi, E. L., Taher, A., Wirawan, F., Sungkar, S., Sudarmona, P., Shankar, A. H., Thabrany, H. 2019. Universal health coverage in Indonesia: concept, progress, and challenges. The Lancet, 393(10166):75–102.

Al-Maskari, F., El-Sadig, M., Nagelkerke, N. 2010. Assessment of the direct medical costs of diabetes mellitus and its complications in the United Arab Emirates. BMC Public Health, 10(1):679.

Amon, S. K., Aikins, M. K. S. 2017. Economic burden of type 2 diabetes mellitus complications among patients in the eastern region of Ghana: A descriptive cross-sectional cost-of-illness study. Diabetes Management, 7(5):367–76.

Anggriani, Y., Purwanggana, A., Pontoan, J., Restinia, M. 2019. The impacts of the health policy reform under the national health insurance on medicine use and treatment cost: A study on type-2 diabetic Mellitus patients in Jakarta. Indonesia. Journal of Applied Pharmaceutical Science, 9(12):78–87.

Baroroh, F., Urfiyya, Q. A. 2017. The Direct Medical Cost of Diabetes Mellitus Type 2 Therapy on Inpatients of Hospital X Indonesia. Advanced Science Letters, 23(12):12474–12477.

Bermudez-Tamayo, C., Besançon, S., Johri, M., Assa, S., Brown, J. B., Ramaiya, K. 2017. Direct and indirect costs of diabetes mellitus in Mali: A case-control study. PLOS ONE, 12(5):e0176128.

Brodszky, V., Beretékzy, Z., Baji, P., Rencz, F., Péntek, M., Rotar, A., Tachkov, K., Mayer, S., Simon, J.,...
Niewada, M., Hren, R., Gulácsi, L. 2019. Cost-of-illness studies in nine Central and Eastern European countries. *The European Journal of Health Economics,* 20(51):155–172.

Catlin, M. K., Poisal, J. A., Cowan, C. A. 2015. Out-of-Pocket Health Care Expenditures, By Insurance Status, 2007–10. *Health Affairs,* 34(1):111–116.

Chatterjee, S., Riewpaiboon, A., Piyauthakit, P., Riewpaiboon, W., Boupaijit, K., Panpuwong, N., Archavanuntagul, V. 2011. Cost of diabetes and its complications in Thailand: a complete picture of economic burden. *Health & Social Care in the Community,* 19(3):289–298.

Durand-Zaleski, I. 2008. Why cost-of-illness studies are essential and inform policy. Sage Publications Sage UK: London, England.

Ekpenyong, C. E., Akpan, U., Ibu, J. O., Nyebuk, D. E. 2012. Gender and age-specific prevalence and associated risk factors of type 2 diabetes mellitus in Uyo metropolis. *Diabetologia Croatica,* 41(1):17–23.

IDF 2015. Diabetes atlas. 7th ed. Brussels: International Diabetes Federation, Accessed on: 15 Sep 2020.

IDF 2017. Diabetes atlas. 8th ed. Brussels: International Diabetes Federation, Accessed on: 15 Sep 2020.

IDF 2019. Diabetes atlas. 9th ed. Brussels: International Diabetes Federation, Accessed on: 15 Sep 2020.

Jang, S. Y., Seon, J. Y., Oh, I. H. 2020. Influencing Factors of Transportation Costs Regarding Healthcare Service Utilization in Korea. *Journal of Korean medical science,* 35(35):290–290.

Jo, C. 2014. Cost-of-illness studies: concepts, scopes, and methods. *Clinical and molecular hepatology,* 20(4):327–364.

Kumar, A., Nappal, J., Bhartia, A. 2008. The direct cost of ambulatory care of type 2 diabetes in the middle and high-income group populace of Delhi: the DEDICOM survey. *The Journal of the Association of Physicians of India,* 56:667–674.

Larg, A., Moss, J. R. 2011. Cost-of-Illness Studies. *PharmacoEconomics,* 29(8):653–671.

Le, N. T. D., Pham, L. D., Vo, T. Q. 2017. Type 2 diabetes in Vietnam: a cross-sectional, prevalence-based cost-of-illness study. *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy,* 10:363–74.

Liu, M., Lv, X., Li, Y., Li, J., He, Y. 2018. Prevalence and control status of diabetes and related risk factors among 4196 Chinese male older elderly aged ≥ 80 years. *International Journal of Gerontology,* 12(2):122–128.

Nadjib, M., Setiawan, E., Putri, S., Nealon, J., Beucher, S., Hadinegoro, S. R., Permanasari, V. Y., Sari, K., Wahyono, T. Y. M., Kristin, E., Wirawan, D. N., Thabrany, H. 2019. Economic burden of dengue in Indonesia. *PLOS Neglected Tropical Diseases,* 13(1):e0007038.

Neumann, P. J., Sanders, G. D., Russell, L. B., Siegel, J. E., Ganiats, T. G. 2016. Cost-effectiveness in health and medicine. Oxford University Press.

Ng, C. S., Lee, J. Y., Toh, M. P., Ko, Y. 2014. Cost-of-illness studies in diabetes mellitus: A systematic review. *Diabetes research and clinical practice,* 105(2):151–163.

Oyando, R., Njoroge, M., Nguihu, P., Sigilai, A., Kirui, F., Mbui, J., Bukania, Z., Obala, A., Munge, K., Etyang, A., Barasa, E. 2020. Patient costs of diabetes mellitus care in public health care facilities in Kenya. *The International Journal of Health Planning and Management,* 35(1):290–308.

Sam, K. G., Philip, M. 2009. Pharmacoeconomics: cost of illness studies. *Hygeia,* 1(1):464–473.

Ulrich, S., Holle, R., Wacker, M., Stark, R., Icks, A., Thordand, B., Peters, A., Lasy, M. 2016. The cost burden of type 2 diabetes in Germany: results from the population-based KORA studies. *BMJ Open,* 6(11).

Wang, W., Fu, C., Zhuo, H., Luo, J., Xu, B. 2010. Factors affecting costs and utilization of type 2 diabetes healthcare: a cross-sectional survey among 15 hospitals in urban China. *BMC Health Services Research,* 10(1):244–244.

Widayanti, A. W., Green, J. A., Heydon, S., Norris, P. 2020. Health-Seeking Behavior of People in Indonesia: A Narrative Review. *Journal of Epidemiology and Global Health,* 10(1):6.

Wirtz, V. J., Santa-Ana-Tellez, Y., Servan-Mori, E., Avila-Burgos, L. 2012. Heterogeneous Effects of Health Insurance on Out-of-Pocket Expenditure on Medicines in Mexico. *Value in Health,* 15(5):593–603.

World Health Organization 2016. Global report on diabetes. Geneva, Accessed on: 15 Sep 2020.

World Health Organization 2017. Tracking universal health coverage: 2017 global monitoring report. Accessed on: 15 Sep 2020.