Iran J Public Health, Vol. 54, No.10, Oct 2025, pp.2139-2150

Review Article

The Economic Cost of Type 2 Diabetes in Indonesia: A Systematic Review

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(Received 10 Mar 2025; accepted 21 Jun 2025)

Abstract

Background: Type 2 diabetes (T2D) imposes a growing economic burden in Indonesia, driven by rising prevalence and associated complications. This review synthesizes current evidence on the economic costs of T2D in Indonesia to inform policy decisions aimed at alleviating these financial impacts.

Methods: A systematic review was conducted using the PRISMA guidelines and the PICOS framework, analyzing studies from major databases including PubMed, ProQuest, EBSCO, ScienceDirect, and Google Scholar published from 2019-2025. Studies included addressed both direct costs and/or indirect costs related to T2D in Indonesia, and reported annual or monthly per-patient costs.

Results: Six studies were included in the analysis, representing a diverse geographical coverage and various healthcare facilities, with the majority being tertiary facilities. The average annual direct cost per patient with complications reached USD 1,607.7, compared to USD 427.3 for patients without complications, a difference of 3.8 times. Limited indirect cost data show USD 35.2 for patients with complications versus USD 20.5 for cases without complications. Hospitalization, medications, and medical procedures are the main cost drivers. Only three studies reported indirect costs, indicating a potential underestimation of the total economic burden.

Conclusion: T2D complications increase healthcare costs by nearly four times. These findings support a shift in policy towards prevention, expansion of screening through insurance, and strengthening of primary services. Standardized methodologies and the inclusion of indirect costs are needed for more accurate study comparisons and policy guidance.

Keywords: Type 2 diabetes; Economic cost; Direct cost; Indirect cost

Introduction

Type 2 diabetes (T2D) has become a major public health challenge in Indonesia, currently affecting approximately 19.5 million adults and placing the county among those with the highest prevalence rates in the western pacific region (1,2). Data from the national health survey reveal a consistent upward trend in diabetes prevalence over the past two decades (5.7% in 2007, 6.9% in

DOI: https://doi.org/10.18502/ijph.v54i10.20118

2013, 8.5% in 2018 and 11.7% in 2023) (2–5). This alarming trend reflects the broader global diabetes epidemic, which affected 463 million people in 2018 and is projected to reach nearly 700 million by 2045, leading to a significant global economic burden primarily due to T2D and its complications (6,7)

T2D significantly impacts individual health and the economic burden on patients, health systems, and society (8–10). The ever-increasing prevalence of T2D, especially in developing countries, has led to a surge in healthcare costs and a decline in productivity, making it a serious challenge to global public health (11–13).

The economic cost of T2D varies significantly across different countries, influenced by factors such as age, type of hospital, and disease complications (14–16). A systematic review shows that the annual cost per T2D patient ranges from USD 87 to USD 9,581, with significant differences in health systems and economies between countries (12).

This burden encompasses direct costs, such as expenses for treatments and medications, and indirect costs, such as lost productivity (17–19). In developed countries, drug costs often represent the most significant contributor to direct costs, while T2D complications, such as diabetes-related foot disease, add substantial economic burden (20,21). Projections in Germany show a significant increase in the economic cost of T2D, with an estimated total cost of USD 79 billion by 2040 (7), demonstrating the escalating financial impact in developing economies.

While several studies have examined aspects of T2D costs in Indonesia (22,23), these investigations remain fragmented, focus on specific healthcare settings, or employ different methodologies, making it difficult to obtain a comprehensive national picture of the economic burden. To our knowledge, no prior systematic reviews have comprehensively synthesized the economic costs of T2D across Indonesian healthcare settings, despite the country's significant diabetes burden and diverse healthcare landscape.

As a middle-income country with a large population, an increasing prevalence of diabetes, and a complex healthcare system combining public and private providers under the national health insurance scheme (JKN), understanding the economic cost of T2D in Indonesia is essential. This information will be invaluable for policymakers who currently face critical knowledge gaps, including the lack of standardized cost data across different healthcare settings (public vs. private), regional variations in treatment costs (urban vs. rural), and the economic impact of specific T2D complications within Indonesia's healthcare system.

Therefore, this study aimed to conduct a systematic review following PRISMA guidelines to identify, evaluate, and synthesize all available evidence on the economic costs of T2D in Indonesia. By collecting and analyzing existing evidence, this study will provide a comprehensive overview of the financial burden of T2D in Indonesia, identify gaps in the existing literature, and provide evidence-based recommendations for healthcare policy development and resource allocation in Indonesia's diabetes management programs.

Methods

Search Strategy

The systematic search was conducted using five electronic databases: PubMed, ProQuest, EBSCO, ScienceDirect, and Google Scholar. Studies published between January 2019 and January 2025 were included, with the final search conducted on January 31st, 2025. Both English and Bahasa Indonesia language studies were included to ensure comprehensive coverage of relevant literature in the Indonesian context.

The search strategy employed a combination of Medical Subject Headings (MeSH) terms and free-text keywords using Boolean operators (AND, OR). The search terms included: ("cost of illness" OR "economic burden" OR "cost analysis" OR "medical cost" OR "healthcare cost" OR "economic impact" OR "productivity loss") AND ("diabetes mellitus type 2" OR "type 2 diabetes" OR "T2D" OR "non-insulin dependent diabetes") AND ("Indonesia" OR "Indonesian"). Additional searches were conducted using

equivalent terms in Bahasa Indonesia: ("beban ekonomi" OR "biaya penyakit" OR "analisis biaya" OR "biaya medis") AND ("diabetes mellitus tipe 2" OR "diabetes tipe 2") AND "Indonesia".

To minimize publication bias, manual searches were conducted in gray literature sources including reports from IDF, BPJS Kesehatan and academic theses. Reference lists of included studies were also manually searched for additional relevant publications.

Study Selection Criteria

Studies were selected using the PICOS framework (Population: individuals with T2D in Indonesia; Intervention: healthcare services or cost-related aspects; Comparison: with or without complications, or across healthcare settings; Outcome: direct and/or indirect costs, including annual or monthly per-patient expenditures; Study design: observational and economic evaluation studies) and followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure the systematic and comprehensive identification of relevant literature. Studies were included if they reported direct and/or indirect costs of T2D and its complications specifically in the Indonesian population. Eligible studies include research conducted in various healthcare facilities, including hospitals, primary healthcare facilities, community health centers, and home care services. Only studies published in English or Indonesian between 2019 and 2025 with available full-text articles are considered for inclusion in this review.

Studies are excluded if they only report cost components partially, such as only treatment costs without a comprehensive economic analysis of the overall disease burden, or do not report annual or monthly costs per patient. Research that only focuses on type 1 diabetes mellitus or gestational diabetes is also excluded, as well as studies conducted outside Indonesia or those not specific to the Indonesian population context. Additionally, case reports, editorials, letters to the editor, and narrative reviews are excluded due to their methodological limitations in cost analysis. Studies that do not have clear cost data, adequate methodology descriptions, or are identified as duplicate publications from the same dataset are also excluded from the final analysis.

Screening and Selection Process

The two-stage screening process was conducted by two independent reviewers (Reviewer 1 and Reviewer 2). In the first stage, titles and abstracts are selected based on inclusion and exclusion criteria. In the second stage, the full-text articles are reviewed to determine final eligibility. Disagreements between reviewers are resolved through discussion, and if consensus is not reached, a third independent reviewer (Author 3) is consulted for the final decision using a majority voting system.

Data Extraction

Data extraction was carried out systematically using a standard Excel template specifically designed for this review to ensure consistency and completeness. The study characteristics collected include author/year, study design, level of healthcare service, insurance coverage, geographical region, sample size, reported complications, and data source. Additionally, data related to cost components such as direct costs and indirect costs as well as cost methodologies like study perspective, Weighted Mean, cost difference (USD), and Cost Ratio are also extracted. All cost data in Rupiah (IDR) are converted to US Dollars (USD) using the average annual exchange rate from Bank Indonesia and adjusted to 2021 USD values using the Consumer Price Index to account for inflation.

Data Synthesis and Analysis

Due to the significant heterogeneity in study design, target population, and cost calculation methods, narrative synthesis was used instead of quantitative meta-analysis for a more meaningful interpretation of cost data. Cost information is presented descriptively and classified based on main categories: direct costs and indirect costs, as well as categorized by type of healthcare facility to facilitate comparison. Subgroup analysis is

conducted based on key characteristics such as the type of facility (primary care vs. hospital), the presence of diabetes complications, geographical regions in Indonesia, and the cost calculation methods.

Quality Assessment

The methodological quality of all included disease cost studies was assessed using the checklist from Drummond et al., adapted by Ganasegeran et al. (20,24) for economic study evaluation. The assessment includes the appropriateness of study design, reliability and validity of data, completeness of cost identification, accuracy of measurement methods, valuation techniques, rigor of analysis, and generalization of results to the T2D population in Indonesia. The assessment is conducted by three independent evaluators to minimize bias. Initial disagreements were resolved through discussion and consensus, or by majority decision if consensus was not reached. Studies are not excluded based on quality scores, but are weighted according to methodological rigor in result synthesis, ensuring that study limitations are considered while maximizing the use of evidence.

Protocol Registration and Reporting

This systematic review was registered with PROSPERO (Registration number: CRD42024596395) and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement.

Results

Search Result

The initial search identified 3,145 records. Finally, 6 studies were included in this systematic review (Fig. 1).

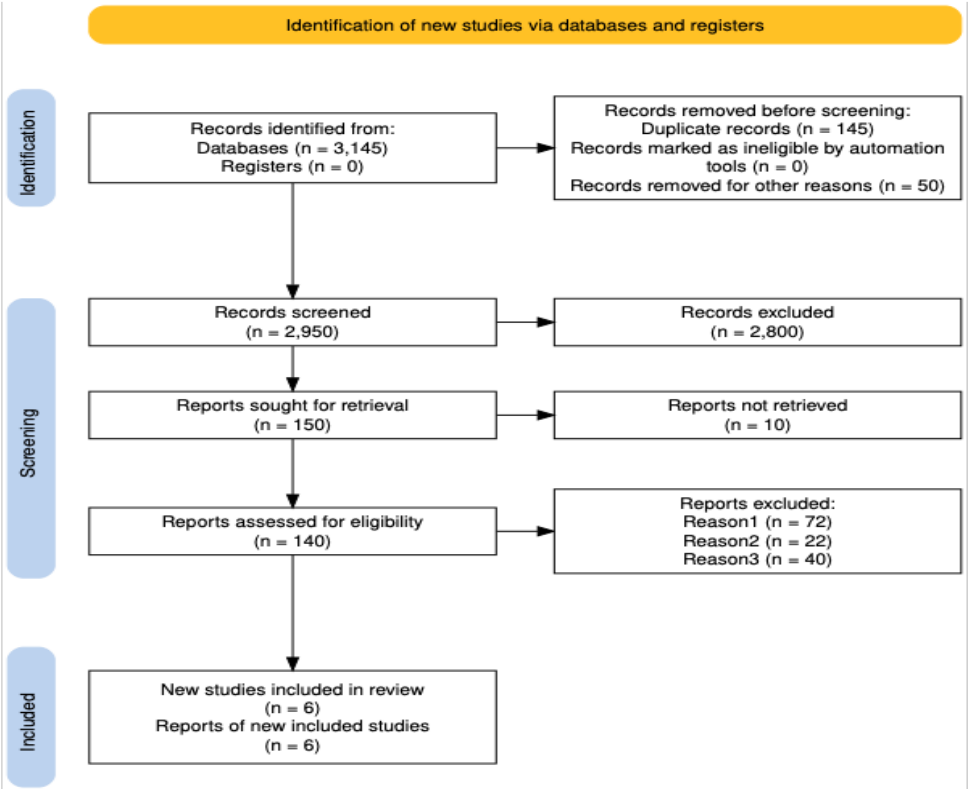

Fig. 1: Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) flowchart of the study selection (25)

General Characteristics of the Studies

Based on Table 1, of the 6 articles analyzed, all the research was conducted in Indonesia with a varied geographical distribution including national coverage (n=2), provincial (n=2), multi-site urban (n=1), and local (n=1). The majority of the studies were conducted in tertiary healthcare facilities (n=4), followed by primary level (n=1) and mixed (n=1). From the aspect of insurance coverage, 2 articles explicitly mention the use of JKN, 1 article uses a combination of JKN and out-of-pocket, while 3 other articles do not specifically mention health insurance status.

The most commonly used research method is retrospective observational studies (n=3), followed by cross-sectional studies (n=2) and retrospective cohort studies (n=1). For the data collection approach, the majority used a retrospective approach through databases or medical records (n=4), while 2 articles used a combination of direct interviews with patients and secondary data. The cost-of-illness approach used in the articles shows variation, with 2 articles using the prevalence-based approach (23,26) and the others not explicitly mentioning the approach used.

Table 1: General characteristics of the studies included in the review

Ref	Author/year	Study Design	Region/ Setting	Sample Size	Diabetes Complication	Data Source
(22)	Tertiary (National Database)	JKN (insured)	National (JKN claims)	812,204	Cardiovascular diseases (CVD), nephropathy, neuropathy, cerebrovascular diseases, retinopathy, peripheral vascular diseases, iatrogenic hypoglycemia	Jaminan Kesehatan Nasional (JKN) Database
(28)	Tertiary (public hospital)	Not specified	Provincial (West Java)	134	Kidney disease and peripheral vascular disease (PVD)	Patient's medical records
(27)	Tertiary (public hospital)	Not specified	Provincial (Yogyakarta)	123	Neuropathy, retinopathy, nephropathy, hypertension, and heart disease	Patient's medical records
(23)	Mixed (population-based)	Mixed (JKN & OOP)	National	5,483,100	Diabetic Retinopathy (D.R.)	the National Basic Health Survey and patient interviews for cost estimation
(26)	Tertiary (8 hospitals)	Not clearly specified	Multi-site (urban hospitals)	2,550	Hypertension and Dyslipidemia	Combination of face-to-face interviews, patient medical records, and hospital records
(29)	Primary (15 Puskesmas)	Not specified	Local (Surabaya)	218	Does not explicitly mention specific complications	Interview-based cost measurement using a list of questions

The sample sizes in the studies show a very wide variation, ranging from 123 patients (27) to 812,204 patients (22). Research with the largest sample size used the national JKN database, while studies with smaller samples were generally conducted through primary data collection at

specific healthcare facilities. From the aspect of reported complications, the majority of articles listed microvascular complications such as neuropathy, nephropathy, and retinopathy (n=4), while macrovascular complications such as cardiovascular and cerebrovascular diseases were mentioned in 3 articles. Only 1 article listed acute complications in the form of iatrogenic hypoglycemia (22).

The data sources used in the study show a significant degree of heterogeneity. The JKN database was used as the primary data source in 1 article (22), patient medical records were used in 2 articles (27,28), while a combination of various data sources such as national surveys, patient interviews, and hospital medical records was used in 3 other articles. This variation reflects the researchers' adaptation to data availability and specific research objectives, but it also indicates potential heterogeneity in the quality and validity of the collected data.

Direct and Indirect cost for T2D

Based on Table 2, the research perspectives used show quite a diverse variation, with the hospital perspective being the most dominant (n=3), followed by the health insurance perspective (n=1), patient perspective (n=1), and societal perspective (n=1). For the annual direct costs per patient with complications, the cost range varies significantly from USD 900 (23) to USD 3,981.01 (27). Meanwhile, the direct costs for patients without complications range from USD 119.99 (29) to USD 604.91 (28). Indirect costs were only reported in 3 articles, with complicated patients showing costs of USD 50 (23) and non-complicated patients at USD 20.47 (29).

Table 2: The Annual Direct and Indirect cost per Patient for T2D in Indonesia

Ref	Perspective	Annual Direct Cost/patient (range)		Annual Inirect Cost/patient (range)	
		With complication (USD)	Without Complication (USD)	With Complication (USD)	Without Complication (USD)
(22)	Health Insurance	930 (533 - 1,308)	421 (275 - 604)	-	-
(28)	Hospital	1,483.28 (556.37 - 2,712.91)	604.91 (518.01 - 834.33)	-	-
(27)	Hospital	3,981.01 (343.59 - 9,702.26)	-	-	-
(23)	Patient	900 (12.8 - 6,514.4)	-	50 (8 - 186)	-
(26)	Societal	-	119.99 (0 - 295.17)	-	20.47 (0 - 54.37)
(29)	Hospital	1062.2 (630.8 - 1493.6)		145.6 (81.3 - 209.9)	

The cost conversion provided into USD using the 2021 exchange rate of IDR 14,268 per USD

From the synthesis analysis in Table 3, the weighted average direct cost per patient per year with complications reaches USD 1,607.7 (range USD 533 - 9,702.26), while for patients without complications it is USD 427.3 (range USD 145.6 - 604.91). The difference in average costs between patients with and without complications reached USD 1,180.4 with a cost ratio of 3.8, indicating that patients with complications bear almost 4 times the cost compared to patients without complications. For indirect costs, the available data is very limited with a weighted average for patients with complications of USD 35.2 and without complications USD 20.5, with a cost ratio of 1.7.

Table 3: Synthesis of Direct and Indirect Costs for T2D

Cost Type	Weighted Mean (USD/year/ patient)	Range (USD)	Selisih (USD)/ Cost Ratio	Key Observations
Direct Cost – With Complication	1,607.7	533 – 9,702.26	1,180.4 / 3.8	The highest costs were recorded in Putri et al.'s (2019) study; the large differences between studies reflect variations in perspectives and service facilities.
Direct Cost – Without Complication	427.3	145.6 – 604.91		Lower than complications; the lowest value comes from Kristina et al. (2020).
Indirect Cost – With Complication	35.2	8 – 186	14.7 / 1.7	Only reported by Sasongko et al. (2020); values vary depending on patient productivity.
Indirect Cost – Without Complication	20.5	0 – 54.37		Only available in two studies; lower values indicate smaller indirect economic burden without complications.

Components of direct and indirect costs

Based on Table 4, the most frequently mentioned direct cost components in the research are hospitalization and inpatient care (n=6), followed by doctor visits (n=4), medications (n=4), and laboratory tests (n=4). The components of medical procedures and screenings are each mentioned in 3 articles, while transportation and food/consumption are only mentioned in 2 articles. For indirect costs, the component of productivity loss is included in 4 articles, but no article comprehensively includes all components of indirect costs. The majority of the articles (n=3) only included direct cost components without incorporating indirect costs, while only 3 articles included a combination of both direct and indirect costs.

Table 4: Direct and indirect cost components for T2D

Ref	Direct Cost						Indirect Cost		
	Hospitalization	Doctor Visit	Medications	Laboratory Tests	Medical Procedures	Screening	Transportation	Meals/ Consumables	Productivity Loss
(22)	√	√	√	√	√	-	-	-	-
(28)	√	√	√	√	√	-	-	-	-
(27)	√	√	-	-	√	√	√	-	√
(23)	√	√	-	-	√	√	√	-	√
(26)	√	√	√	√	-	-	√	√	√
(29)	√	-	√	-	-	-	√	√	√

Methodological of the Economic Studies

Based on the evaluation of the quality of methodology in Fig. 2 using standard criteria for cost-of-illness studies, all studies (n=6) provided a clear definition of the disease under investigation, adequately explained the methods used, and con-

sistently presented the research results. For the aspect of accurate cost unit assessment and analytical cost source analysis, the majority of studies showed good quality (n=5) with only 1 study rated as partial. However, there are several areas that require improvement, namely in terms of accurate activity data assessment, adequate cost disaggregation, and meticulous epidemiological source description, where each of these aspects shows 1 study with a partial assessment and the rest of good quality. The weakest aspects are the testing of key assumptions in sensitivity analysis and the application of discounting to costs, where none of the studies performed these two methodological aspects.

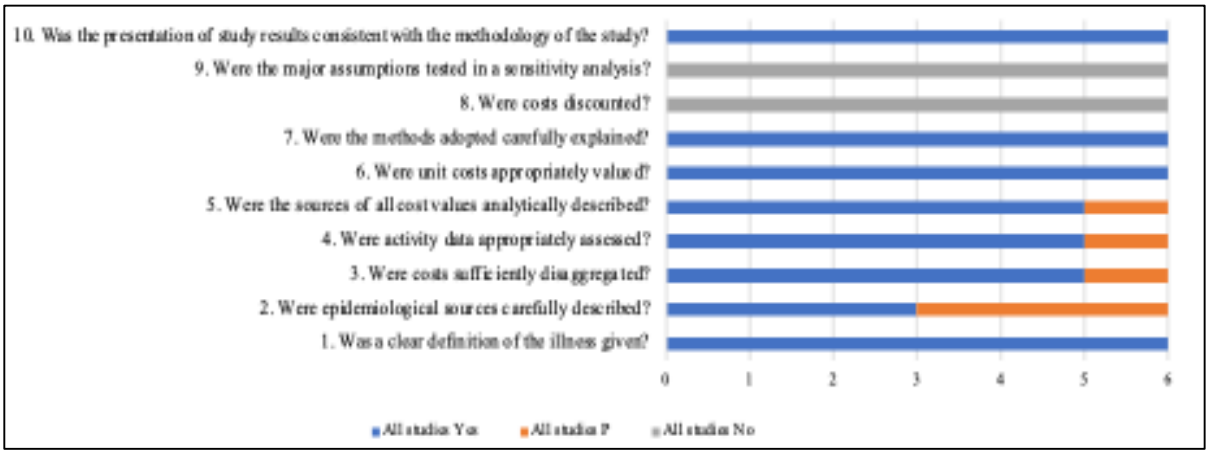

Fig. 2: The methodological quality of the economic evaluation of all studies

Discussion

The results of this systematic review indicate that the six studies analyzed originated from Indonesia, with geographical coverage ranging from national to local, the majority conducted in tertiary healthcare facilities. Some studies involved JKN participants, while others did not explicitly mention insurance status. The dominant research methods are retrospective and cross-sectional observational studies, with the main data sources being medical records and interviews. Sample sizes vary significantly, from hundreds to hundreds of thousands of respondents. The reported complications are primarily microvascular and macrovascular, with one study noting acute complications. Variations in data sources reflect differences in research objectives as well as potential heterogeneity in data quality.

The economic burden caused by T2D in Indonesia is very significant, especially due to the accompanying complications. The average annual direct cost per patient with complications reaches USD 1,607.7, nearly four times that of patients without complications (USD 427.3). Indirect costs, although reported only to a limited extent, show a similar pattern, with an average of USD 35.2 for patients with complications and USD 20.5 for patients without complications. This difference reflects that complications are the main drivers of cost escalation, not merely the initial diagnosis of diabetes itself.

These findings are in line with data from the International Diabetes Federation (IDF) in 2021 reported the global cost of diabetes treatment at USD 323.8 per person (30). A study conducted by a research team from Airlangga University further supports these findings, indicating that the economic burden by T2D in Indonesia is quite significant. The estimated annual treatment cost perpatient ranges from USD 12.16 to USD 428.89 (31).

In addition, according to the BPJS Kesehatan report, in 2018 approximately USD 455.7 million was allocated for the treatment of participants diagnosed with diabetes mellitus (DM). This amount increased to around USD 497.7 million in 2019. The upward trend continued, reaching approximately USD 525.8 million in 2022. Furthermore, the average treatment cost per participant over the past five years (2018–2022) ranged from approximately USD 63.96 to USD 161.87, based on the 2021 exchange rate (32).

If compared to the global literature, these findings are generally in line with studies in other developing countries such as Bangladesh (9), Saudi Arabia (6) and Turkey (33), which show that complications such as nephropathy, cardiovascular disease, and diabetic ulcers are the largest contributors to the costs in managing T2D. In other words, complications in diabetes mellitus patients lead to higher medical expenses compared to those without complications. However, the context in Indonesia has its own complexities. The JKN system, which is not yet fully universal, the limited availability of primary care facilities, and the slow referral process are factors that exacerbate the financial burden on patients.

Next, the most dominant components of direct costs include hospitalization, medication use, medical procedures, and laboratory tests. This is consistent with findings from international studies that show the components causing the increase in medical costs are treatment costs, hospitalization costs, or both (34–36). In patients with diabetes mellitus with complications, more and varied medications are needed to manage both DM and its complications. The cost of hospitalization for DM patients with complications is also higher because procedures/treatments are needed to address the DM complications experienced (37). From those articles, the more complications experienced, the higher the costs incurred, or if the patient has chronic and acute complications or a combination of microvascular and macrovascular complications, the costs required will be greater (35,36).

Meanwhile, indirect costs arise from the loss of productivity due to work absenteeism, long-term caregiving by family members, and transportation costs, especially for patients in remote areas who need to access tertiary healthcare services in major cities. Other finding conducted by by a research team from Airlangga University also supports this by reporting that indirect costs such as transportation and loss of income further increase the economic burden for JKN participants with chronic diseases, including diabetes. Geographic conditions and limited primary facilities exacerbate patients' access to services, which ultimately increases those indirect costs. Therefore, strengthening primary services and improving health access in remote areas become important strategies to reduce the indirect cost burden on diabetes patients. (31).

Methodologically, studies in Indonesia are still lagging behind countries like Germany or Spain, which have incorporated social costs and quality of life into their economic analyses (7,19). Only two out of six studies included indirect costs, and none estimated intangible costs such as psychological stress, loss of quality of life, or family burden. This indicates an underestimation of the overall economic burden of T2D.

Moreover, the majority of studies were conducted in Java or urban areas, with very minimal representation from remote regions and eastern Indonesia. This has the potential to create geographical bias in cost estimation, as patients in remote areas tend to have limited access to healthcare services, long travel distances, and higher poverty levels, which can indirectly increase costs. This disparity is also not widely discussed in existing studies, thereby narrowing our understanding of the equity dimensions in the cost burden of T2D. Another limitation of the studies reviewed includes the lack of sensitivity analysis, variations in time frames and cost units (per year, per visit, per patient), as well as the lack of analysis on social determinants such as education level, income, and occupation.

Evidence-Based Policy Recommendations

The documented pattern of cost increases provides strong evidence for specific policy interventions. The increase in costs by up to 3.8 times due to complications strongly supports investment in prevention and early detection programs. Based on the cost differences found, we recommend a subsidized HbA1c screening program for high-risk populations (pre-diabetes, family history), with a target annual screening cost of around USD 15-25 per person to prevent complications that could cost more than USD 1,180 per year. Expanding JKN coverage for complication screenings, particularly including annual retinopathy screenings (estimated cost USD 25-40) to prevent costs due to blindness exceeding USD 8.9 million nationally, as reported by Kristina et al. Community-based diabetes management programs in rural areas, by addressing transportation barriers through mobile clinics and telemedicine services, have the potential to reduce indirect costs by 40–60% for populations in remote areas.

Implications for the Healthcare System and Future Research Directions

These findings demand a shift from tertiary services to primary prevention-based diabetes care in Indonesia. The current approach, which focuses on treating complications in referral hospitals, actually reinforces the cycle of rising costs. Strengthening primary services, especially in underserved areas, has become an urgent clinical and economic need.

Future research needs to adopt a broader methodological approach, considering community perspectives to capture the full economic burden of T2D. Standardization of cost estimates, measurement of productivity in the informal sector, and a more geographically diverse study population are needed. Longitudinal studies from diagnosis to complications can reveal the trajectory of costs and the effectiveness of interventions.

The integration of digital health technology, which is highly relevant to the archipelagic geography of Indonesia, is a cost-saving pathway that has yet to be extensively explored. Telemedicine services and mobile-based interventions have the potential to reduce direct costs (transportation, accommodation) and indirect costs (lost work time), while also improving access to healthcare services in remote areas.

Conclusion

The economic burden of T2D in Indonesia is very large, with a sharp increase in costs due to complications, demanding an immediate and comprehensive policy response. Available evidence supports a shift in strategy towards prevention, universal financial protection, and equitable geographical access to healthcare services. However, significant improvements in the methodology of economic evaluation research are urgently needed to comprehensively measure the impact of T2D and guide the optimal allocation of resources within Indonesia's diverse healthcare system.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Acknowledgements

We would like to express our deepest gratitude to Universitas Hasanuddin for their support in providing access to data and resources necessary for this study.

Conflict of Interest

The authors declare that there is no conflict of interests.

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