Economic burden of diabetes care: The economic burden on health systems of low and middle-income African countries

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Abstract

Background: There has been recognized documented increase in diabetes prevalence worldwide and even regions with known low prevalence of diabetes such as Africa, started to register increase in prevalence of diabetes. The overstretched health care systems in most African countries faces many challenges to offer resources for the rapidly growing health problems such as Diabetes Mellitus.

Objective: To assess the magnitude of economic burden of diabetes care in low- and middle-income African countries.

Method: Literature review using systematic approach was conducted for the evidence on the cost of diabetes in low- and middle-income African countries. Search was conducted mainly through PubMed. Other search engines such as Google Scholar, and University of South Wales library were used. Search terms were carefully used. Found results were filtered used selective criteria for inclusion and exclusion. Data from included studies was extracted using multiple sheets. Results were presented in tables and discussed for their meanings.

Results: Twenty-four (24) articles were selected based on defined selection criteria. There is variation in the annual national direct cost between countries. Indirect costs per patient were higher than direct costs per patient for diabetes care in studies that calculated both. Outpatient costs varied between studies. Cost of drugs, diagnostic, medical supply and consultation costs are the common included outpatient costs. In studies that included total costs and drug costs, the drug costs consumed a significant portion of total cost. The large burden of diabetes care cost fell on individuals within low-income countries.

Conclusion: There is a considerable economic burden associated with diabetes mellitus. Future research should focus on standardization of the methodologies for cost calculation, enhancing the interpretation of study findings and facilitating comparisons between studies.

Key words: Diabetes, Cost of care,
Low and middle income countries.

Introduction

Diabetes Mellitus was considered a costly disease due to its prolonged nature that is associated with many serious complications (1). Cho et al – 2017 (2) stated that the total global healthcare expenditure due to diabetes for people in the age group 20–79-years was estimated at to be $US727 billion in 2017. This number is expected to rise in 2045 to be $US776 billion (1.75 billion / year) with an approximately 7% increase during a period of 28 years (2).

The rising pattern of the prevalence of Diabetes Mellitus and the early mortality due to diabetes increased the financial costs over families and governments (3) with noticeable press on the already over-strained healthcare systems in African countries (4). IDF stated that 6 – 16% of the total healthcare budgets were allocated to diabetes with the lowest budget for diabetes care being in the African region (5) (2). The IDF estimates that Africa spends 7% of its healthcare budget on diabetes care (2).

The cost of non-communicable diseases such as diabetes has considerable impact on the macro and microeconomics. At the level of macro-economics, the long-term cost of care could have impacts on work resources and productivity, accumulation of capital and Gross Domestic Product (GDP) (6). At the level of the micro economy, the cost of diabetes care could represent a real threat to the household's financial capacity. Even, relatively small expenditures on health expenses can be financially disastrous for poor households. In many low-income countries and some middle-income countries, out of pocket payments are the predominant way to pay for health care (7). In the absence of other mechanisms it may absorb the risk of sudden need to pay such items as insurance systems and with the increasing of level of poverty in these countries, catastrophic health care expenditure can result (8). It is very interesting to note that in Germany where the GDP is US$ 32,860 per capita, only 11.3% of all medical expenses is paid by households and the rest by social health insurance or by the government. The picture is inverted in the Democratic Republic of the Congo, one of the low-income countries, where GDP per capita is only US$ 120, where 90% of the money spent on health care is paid directly by households to providers (WHO, 2007).

There are important points when looking into the cost of diabetes care in Africa. The number of diabetic patients is rising and mostly affects young adults. This has the power to affect the economic output and has negative effects in the social security of many families within the region (9). Health care systems in African countries depend deeply on out of pocket (OOP) expenses to cover diabetes care and it was found to be the lowest spending in comparison with other regions in the world (4).

Methodology

1. Literature review

A literature review was conducted using a systematic approach to answer the research question. The systematic approach aims to consider all available and eligible evidence based on inclusion and exclusion criteria.

2. Search strategy

Personal computer search was conducted to identify studies for inclusion. The literature search was undertaken in PubMed and University of South Wales library. Additional searches were also undertaken in Google Scholar. Key words were carefully selected to ensure that all relevant material was included and to avoid including unnecessary articles. Assess ment for eligibility through full text review to determine if the inclusion and exclusion criteria were satisfied. Articles were then downloaded for a full-text review.

3. Key terms for search

The key words used in the search were carefully selected to cover all necessary materials and avoid unnecessary articles. The medical subject heading (MeSH) terms used for search were cost of illness and diabetes and the terms used in the search were ''Burden of illness'' ,''cost'', ''cost analysis'', ''cost of disease'', ''cost of illness'', ''disease burden'', ''economic burden'', ''healthcare cost'' ,''health expenditures'', ''Africa'', ''south africa'' ''sub-Saharan africa'' , '','' african countries'' and ''african country (name of country added)''. All searches were done in April 2019.

4. Inclusion and exclusion criteria

The following inclusion criteria were selected:

- Papers published between 2005 and 2016.
- Papers in English language; as the researchers do not have access to English translation services for non-English papers.
- Systematic review published in peer-reviewed journals; Secondary studies represent summary and statistical analysis of collective selected studies based on research question. This increased the sources of studies included in the research. Primary studies were included if they were relevant to the research question.
- Papers that reported original research findings on diabetes COI or health expenditure data.

List of abbreviations:

ADA	*American Diabetes Association*
COI	*Cost of Illness*
GDP	*Gross Domestic Product*
GDPD	*Gross Domestic Product deflator index*
GNI	*Gross National Income*
ICER	*Incremental Cost-Effectiveness Ratio*
ID	*International Dollar*
IDF	*International Diabetes Federation*
LMICs	*Low- and Middle-Income Countries*
NGOs	*Non-Governmental Organizations*
NCDs	*Non-Communicable Diseases*
OOP	*Out of Pocket*
WHO	*World Health Organization*

• Papers covered at least one African country as defined by the United Nations (table 1a).
• Studies included low- and middle-income African countries by the World Bank classification
• Studies included human participants.

The following exclusion criteria were selected:
• Papers reported only costs related to diabetes prevention.
• Studies that did not provide original research or details on how costs were calculated. This was to exclude studies not included the process of cost calculation. Original research means research with defined methodology and results either primary or secondary.
• Conference abstracts or poster presentations as the details of the studies cannot be found to judge on their eligibility.
• Animal studies.
• Studies that do not have full text. Those studies with no full text will remain obscure and cannot be assessed for their quality and relevance to the research question. In addition, data cannot be extracted from them.
• Studies included a cost- effective analysis of drug intervention and treatment. Such studies do not consider the total cost (direct, indirect and intangible costs) of economic burden of diabetes care on health care systems, which is identified, measured and expressed in monetary terms.
• Studies conducted in non-African and / or high-income countries.

Data extraction
Data extraction is an important process where the data from the selected studies are extracted and presented in tables for analysis. Two tables were created to accommodate these data. The first table was created to represent data such as year of publication, research objectives and type of estimated cost. Cost was grouped as out-patient cost, in-patient cost, cost of drugs and joint cost. Joint cost was used when in-patient and out-patient are not separated. It also included indirect costs such as loss of work, disability and premature mortality.

Whenever the costs were not mentioned clearly in a study, data from the study was used where possible to calculate the cost to improve the comparability of costs across the studies. Purchasing Power Parity (PPP) is a popular metric used by macroeconomic analysts. It compares economic productivity and standards of living between countries.

The costs which were reported in local currency were converted to international dollars using Purchasing Power Parity (PPP) by using the following equation:
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Value in international dollars = value in national currency / PPP exchange rate.

To estimate the PPP exchange rate, a web based tool developed as a joint initiative between the Campbell and Cochrane Economics Methods Group (CCEMG) and the Evidence for Policy and Practice Information and Coordinating Centre (EPPI-Centre) was used (10). Cost was first adjusted to inflation in their costing original year and local currency and then adjusted for inflation to give target year cost by using inflation factor. Gross Domestic Product deflator index (GDPD values) was used to adjust the original price to a target price year. The GDPD values are a measure of the change over time in prices within an economy. This can be viewed as a measure of general inflation within an economy over time, which takes account of inflation across a broad range of economic sectors. GDPD values are obtained from the International Monetary Fund (IMF) World Economic Outlook Database 'GDP deflator index' dataset (11). This dataset contains GDPD values for 184 countries (currencies) from 1980 onwards (International Monetary Fund, 2018). It is updated biennially in April and October and each new release dataset is imported into the database underlying this web-based tool (11).

Due to the lack of detail in published original, some modulations were done. In studies where the year of data collection was not clear, the date of publication was used. In extended studies where the study extended for more than a year, the final year in which the study concluded was used.

The second table was created to assess the quality of each study. There are many checklists developed to evaluate the economic studies, many of them focus on cost benefit studies, cost effective studies and cost utility studies (12). For COI studies, there are some checklists that have been used (13), (14). In this research, the ten points check list for economic evaluation which was developed by Drummond (15) and later adopted to COI studies by Molinier et al (14) and several COI studies (16) (17) that used it, were adopted.

Results

The initial search strategy detected a total of 356 articles, from which 15 duplicates were excluded. Of the remaining 431 articles, 282 were removed during the first level of title screening and 19 removed during the second level of abstract screening leaving 40 articles for full text evaluation. Of the 40 studies that underwent full text review, 16 were excluded for one of the following reasons: was a literature review of diabetes (not costs), did not provide patient specific costs or presented costs that had been calculated in another included study, or a cost–effective study that compared different interventions. Twenty-four studies were identified that met the inclusion criteria (Table 1).

All studies in this review provided good information to calculate per capita costs. Some studies (n=4) even showed national costs of diabetes (18), (19), (20). In Nigeria, national costs of diabetes was found to be in a range of I$ 3.5 billion – I$ 4.5 billion per annum (18),(20) In Morocco it was higher than Nigeria; the calculated national cost (direct and indirect costs) ranged from I$ 5.9 – I$ 8.2 billion per annum (19).

In this review, direct cost involved medical and non-medical cost. Tables 5 a, b and c, showed details of the costs. The tables gathered costs based on outpatient, inpatient and combined gathered costs. Some studies (n=11) showed outpatient costs per individual per annum (21) , (18) , (22) , (23) ,(24) , (25) , (20) ,(26) , (27) , (28). An interesting point is that calculation of cost used various data, so the results should not be used for direct comparison of costs between countries, as the data sources were different.

For direct cost, the most common used data from health care items was drug costs, then diagnostic costs, used medical supply and consultation costs. Through the review, outpatient costs differed through included studies, so to make comparison easier, this cost was presented as per capita costs. Interestingly, it found that there is no linear increase in costs through 2002 – 2016 for individual country estimates. There was no specific explanation for this finding. For example, in Nigeria the direct per capita cost in 2004 was I$ 1143 while in 2012 it was I$ 616. More research is recommended to focus on this point to find explanation for this finding.

The studies included in the review showed wide variation in costs between countries and this was attributed to the differences in costing methods and cost items included in the calculation. In studies when the costing methods and costs items were similar, it was noticed that Burkina Faso had the higher outpatients cost, followed by Mali, Benin and Guinea (21) .

In addition, it was noticed that the cost of hospitalization varies considerably within and between countries. For example, in South Africa the cost in 2005 was I$ 1813 and raised to I$ 6871 in 2009.

Out of pocket, (OOP) expenditure was mentioned as challenge for health care flow in some studies. It could obstruct access to health care services and leave the health problems to grow to a complicated status (29) which could lead to catastrophic health expenditure and subsequent impoverishment. The WHO – African region -2014 (30) expenditure atlas, showed that catastrophic health expenditure is low in countries where OOP expenditure < 20% of total health expenditure (30). Based on the WHO – African region (2014) expenditure, South Africa was the only country in which OOP expenditure was <20%. This finding reflects that diabetes is a chronic disease and needs frequent and continuous access to health care services.

Drug cost it was noticed, was mentioned separately in the majority of studies included in this review. It was found that in studies mentioned both drug costs and cost of treatment, drug cost composed the significant part, for example, it was 14% - 90% in Nigeria, 64% in Ethiopia, 53% in Sudan, 4% - 7% in South Africa and 5% in Uganda . Variation in methodology, number of participants and different treatment costs may create variation in the percentage of cost of drugs from the total treatment cost such as in Nigeria and South Africa. In addition, it was noticed that some costs were mentioned separately in most of the studies. Diagnostic costs (n=12), transportation (n=9) and consultation costs (n=7) were among costs mentioned separately in the studies included in this review.

In some studies (n=3) which showed separately the cost associated with type 1 diabetes and type 2 diabetes, they showed that the direct costs of type 1 diabetes was higher than type 2 diabetes (18). Although, this was a significant finding, still the bulk of diabetes mellitus cases was from type 2 (85 – 90% of diabetes) while type 1 constituted 5 – 10% of the diabetes mellitus bulk.

Some studies included in this review (n=5), calculated the cost of certain complications (21), (18), (31), (32), (33). Among these studies, there are some studies (n=3) which concentrated primarily on calculating the cost related to diabetic foot ulcer (31), (32), (33).

The cost of diabetic foot ulcer varied based on the stage of ulcers. Interestingly, two studies (n=2) showed that presence of complications increased the costs of diabetes care (31), (32). Such findings pointed to the importance of pre-action and presented evidence to the decision-makers to create plans for preventing future complications to decrease the cost of care.

Studies showed that the highest burden of diabetes was among patients of low socio-economic status (24), (27). Three studies investigated the relation of age to cost of care. In Nigeria, Ipingbemi and Erhun (27), showed that the mean of outpatient cost of diabetes was highest among those in the age group 60-69 years. In Sudan, Elrayah-Eliadarous et al (23) also showed that the cost was highest in those > 60 years. In Zimbabwe, Mutowo et al (34) found that hospitalization costs were lower in those > 65 years. Alouki et al (21) and Elrayah-Eliadarous et al (23) found that cost of care in public sector was less than cost in private sector. Lack of guidelines and standards for practice could create variation in practice and variation in cost of care.

Discussion

Over the last two decades, numerous economic studies of diabetes have showed that diabetes mellitus is attributed to a huge economic burden. This research aimed to identify the evidence and summarize the findings concerning the economic burden.

The findings found through the twenty-four (n=24) selected studies included in this research pointed to a huge annual economic burden of diabetes in Africa. The majority of these costs were related to patients and reflected large pressure on the accessibility and continuity of the health care services (4). Unfortunately, these costs will increase with the presence of complications (32). It was expected from other studies that direct costs were always higher than indirect costs but an interesting finding from two studies included in the research showed that indirect costs are higher than direct costs. These findings were

contrary to findings identified by Seruing et al (35) who found that direct cost related to diabetes care was higher than indirect cost. Seuring and colleagues' finding was based on a total of twenty-six (n=26) studies while the finding in this research was based on two studies.

Seuring et al (35) in their systematic review stated that there are some studies included in their search that did not specify the type of diabetes. The same happened in this research where some studies did not identify the types of diabetes.

The uncertainty on specification type of diabetes make it difficult to compare differences on cost of care between type 2 diabetes which is the most common in Africa (5) and which can be prevented (36) and type 1 diabetes. Nevertheless, three studies (n=3) included in this research showed that the cost of type 1 diabetes care is higher than the cost of type 2 diabetes care. The cost ratio (cost of type 1 diabetes / cost of type 2 diabetes) was found to be in the range of 1.8 – 5.66 in this research. Ng et al (37), found that the cost ratio ranged between 1.5 – 4.4 in their systematic review.

For the cost ratio for diabetes with complications vs no complications, it was found in the range of 1.08 – 4.38 in this research while in Ng et al it was found in the range of 1.9 -2.1.

In this research, studies showed total treatment costs; the drug cost constituted the large part of these costs. This finding was noticed also by Yesudian et al (38) who found that drug cost participates by 50% in the total cost care. The explanation for this finding could be the habit of the physician to prescribe branded drugs. The change of habit to write generic drugs may help in Africa to reduce the drug cost (39).

Through the studies included in this research, findings showed that diabetes care affects heavily the low-income groups (27). Yesudian et al (38), also made this finding. Most of the studies in this research were prevalence based which was found by many as the most suitable approach for COI studies measuring cost of chronic diseases (13). Yesudian et al, and Ng et al adopted the same approach in their systematic review (38), (37).

Policymakers used COI studies as a tool for education or source for information to support their decision-making processes. It is crucial that COI studies be adequately designed to assess the economic burden of diabetes. The design of such studies should also account for the variability in costs identified and the results need to be interpreted carefully. Therefore, it is recommended the development and implementation of guidelines to standardize study methodology for COI studies.

Limitations

Exclusion of articles not written in English, is one of the limitations that may introduce some bias into this research. Omitted articles not written in English nor had English translation may led to omission of relevant data.

The checklist used in this research to assess the quality of included papers, does not give weighting scores on the various items included in the list and rely on the subjective view of the researcher. As a result, all items were given equal scoring although some items influence results more than others do.

Conclusion

In spite of data limitations, the estimates reported in this research showed that diabetes imposes a substantive economic burden on low and middle African countries. Among total cost of care, drug cost represents the largest burden on total cost estimation. These results ring the bell for more polices to reduce this burden on individuals and decrease the cost of drugs. As the prevalence of diabetes in Africa is expected to rise, these costs are also expected to rise.

Standardization of cost calculation was an important missed issue through studies included. Different methods for calculation were noticed which reflected negatively on comparing between results. COI studies are crucial for decision makers to help them through providing information to design plans to decrease this burden. Future research should work on standardizing the methodology of estimation costs of care. Further research within countries and through countries is recommended to provide more data on diabetes care costs.

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Table 1

Authors	Year of publication	Year of costing	Number of African countries	Region	Type of cost	Perspective	DM type	Sample size	Epidemiological approach	Study focus	Cost data source
Abdulgani ya and Fola (20)	2014	2010	1	Western Africa	Direct	Health system/ patient	Type 2	101 - 1000	Prevalence	General cost	Hospital or medical centre
Alouki et al (21)	2015	2015	>1	Western Africa	Direct	Family/ patient	Type 2	na	Prevalence	General cost	Hospital or medical centre
Boutayeb et al (19)	2013	2013	1	northern Africa	Indirect cost	Not specified	Type 1&2	>1000000	Prevalence	General cost	Various data source
Cavanagh et al (31)	2012	2010	1	Eastern Africa	Direct	Health system/ patient	Not specified	na	Prevalence	Diabetic foot ulcer	Hospital or medical centre
Danmusa et al (32)	2016	2014	1	Western Africa	Direct	Not specified	Type 2	1-100	Prevalence	Diabetic foot ulcer	Hospital or medical centre
Elrayah-Eliadarous et al (23)	2010	2005	1	Northem Africa	Direct	Not specified	Type 2	101-1000	Prevalence	General cost	patients
Enwere, Salako and Falade (39)	2006	2000-2005	1	Western Africa	Direct	Not specified	Not specified	101-1000	Prevalence	drugs	Hospital or medical centre
Fadare, Olamoyegun and Gbadegesin (40)	2015	2013	1	Western Africa	Direct	Family/patient	Type 1&2	101-1000	Prevalence	General cost	Patients plus hospital
Feleke and Enquselassie (41)	2007	2000 -2	1	Eastern Africa	Direct	Not specified	Type 1&2	101-1000	Prevalence	General cost	Hospital or medical centre
Ipingbemi and Erhum (27)	2015	2009-10	1	Western Africa	Direct	Family/patient	Type 2	1-100	Prevalence	General cost	Hospital plus other government institution

Kirigia et al (42)	2009	2005	>1	WHO African region	Indirect cost	societal	Type 1&2	>1000000	Prevalence	General cost	WHO publications and various individual country services
Labhardt et al (43)	2011	2011	1	Central Africa	Direct	Family/patient	Type 2	101-1000	Prevalence	Drugs	Not clear
Mutowo et al (34)	2016	2012-13	1	Southern Africa	Direct	societal	Type 2	1-100	Prevalence	General cost	Various data source
Mwavua et al (44)	2016	2012	1	Eastern Africa	Direct	Not specified	Type 2	101-1000	Prevalence	General cost	patients
Ncube-zulu and Danckwerts (45)	2014	2009	1	Southern Africa	Direct	Not specified	Not specified	101-1000	Prevalence	General cost	Hospital or medical centre
Ogbera et al (33)	2006	2003-4	1	Western Africa	Direct	Family/patient	Type 1&2	1-100	Prevalence	Diabetic foot ulcer	Not clear
Ogle et al (22)	2015	2013-15	>1	Central Africa	Direct	Family/patient	Type 1	Not specified	Prevalence	General cost	Hospital or medical centre
Okoronkwo et al (24)	2015	2015	1	Western Africa	Direct	Family/patient	Type 2	101-1000	Prevalence	General cost	patients
Pepper et al (46)	2007	2005	1	Southern Africa	Direct	Not specified	Not specified	1-100	Prevalence	General cost	Hospital or medical centre
Quaye et al (26)	2015	2009	1	Western Africa	Direct	Health system/institution	Type 1&2	101-1000	Prevalence	General cost	Hospital or medical centre
Settumba et al (47)	2015	2011	1	Eastern Africa	Direct	Health system/institution	Not specified	Not specified	Prevalence	General cost	Hospital or medical centre

Suleiman, Fadeke and Okumanjo (18)	2006	2003-4	1	Western Africa	Direct	Not specified	Type 1&2	1-100	Prevalence	General cost	Hospital or medical centre
Suleiman and Festus (48)	2015	2011-12	1	Western Africa	Direct	societal	Type 1&2	101-1000	Prevalence	General cost	Not clear