

Increasing Incidence and Prevalence of Type 1 Diabetes in Children Under 20 Years of Age between 1999-2019 in Sub-Saharan Africa: A Systematic Review

Daniel Ganu*

Department of Public Health, Adventist University of Africa, Nairobi, Kenya

*Corresponding author: Ganu D, Professor, Department of Public Health, Adventist University of Africa, Nairobi, Kenya, Tel: +254 736656843; E-mail: ganud@aia.ac.ke

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Abstract

Much consideration has been given to the rising prevalence of type 2 diabetes mellitus in children in the adult population. However, substantial evidence indicates that the incidence of type 1 diabetes mellitus in children is also increasing. This study sought to provide a critical look at the incidence and trends of Type1 diabetes for the period of 20 years (1999–2019) in children under 20 years of age in Sub Saharan Africa. A retrospective study of the literature search was performed in published articles in the past 20 years to provide the incidence and trend of Type 1 Diabetes in children under 20 years of age. Review of literature revealed that there is a steady increase in incidence and prevalence of Type 1 Diabetes Mellitus (T1DM) in children under 20 years of age in the sub-Saharan Africa region. There is still some variation in the incidence and prevalence of T1DM by age and geographic location. The reasons for these variations are still not conclusive. The rising frequency of Type 1 diabetes in sub-Saharan Africa implies that there is a need for constant monitoring of incidence thereby adopting prevention strategies to combat the diabetes problem in children.

Keywords: *Increasing incidence; Trend; Type 1 diabetes; Systematic review*

1. Introduction

The incidence of Type 1 Diabetes Mellitus (T1DM) also known as insulin-dependent, juvenile or childhood-onset diabetes is a common chronic disease that affects children. An initial incidence reported by Karvonen et al. [1] described that T1DM in children less than 14 years of age in 50 countries globally is totaling 19,164 cases among children of 75.1 million. Worldwide, T1DM is a challenging endocrine and metabolic conditions among children. The latest edition of the Diabetes Atlas stated that an estimated 1,106,500 adolescents are living with T1DM and 132,600 are newly diagnosed each year worldwide [2]. Although the development of Type 2 Diabetes Mellitus (T2DM) in children and adolescents has appealed to many researchers, T1DM remains the prevalent form during childhood in many countries [3]. The most common autoimmune condition in children and youth is T1DM [4].

Hereditary and environmental factors are important in regulating the risk factor for each individual. Incidence of T1DM differs extensively between different countries and ethnic populations. For example, Finland has an incidence of 64/100,000 in children less than 15 years per year. Type 1 diabetes is accumulating by 3%-5% per year worldwide [5]. The collaborative study of the EURODIAB with 44 countries in Europe showed a yearly rate rise in the incidence of 3%-4% with the greatest rate of the increase occurring in children aged 0-4 year [6]. It has been found that T1DM in children and the prevalence in the United States of America and Canada and the Caribbean is 0.062%, compared with 0.012% in Africa [7]. The occurrence of T1DM is increasing in many countries, particularly in developing countries and in younger children. In Finland, T1DM diagnosis in children under 15 years of age increased from 31.4/100000 in a year in 1980 to 64.2/100 000 in a year in 2005 [8].

This disease is a developing worry in the world and while there has been much advance in the understanding and management of T1DM in the industrialized countries, there has been less improvement in Sub-Saharan Africa. The T1DM diagnosis in children and adolescents can clearly be missed. Studies suggest that about 30% of children who have been diagnosed with the condition have had some related medical conditions before the diagnosis, signifying that doctors are likely to miss the diagnosis [9]. The diabetes leadership forum has reported that in 2010 that an estimated 37,500 children below the age of 14 have been diagnosed with T1DM in sub-Saharan Africa and 6,100 new cases will be diagnosed [10]. The adolescent may die from diabetes that has not been diagnosed or has been mistaken for other diseases in sub-Saharan Africa. Diagnosis and care of T1DM for children in Sub Saharan Africa is problematic to achieve especially, in low and middle-income countries because governments have not seen the disease as one of the critical healthcare priorities. The disease although, affects many children in the region, yet governments in sub-Saharan Africa have not put stringent measures to curb the menace of the condition.

The complicated form of the disease which is polyuria and polydipsia usually is seen in older children and adolescents in sub-Saharan Africa, but parents can also misinterpret these symptoms. Doctors are likely to miss diagnosis because they may fail to consider the diagnosis as a cause of the initial report signs and symptoms and may again fail to ask about complications in children with other indicative signs and symptoms [9]. The most common form of diabetes in sub-Saharan Africa in children is still Type 1 diabetes. If insulin therapy is not given, the sick person of T1DM will ultimately die of the condition. The life expectancy in many sub-Saharan countries where T1DM is predominant in children, life expectancy is usually less than 1 year after diagnosis [11]. This paper, therefore, seeks to review the increasing incidence and age at which T1DM is diagnosed from age 0 to 20 years of age for a 20-year period in the Sub Saharan African region.

2. Methodology

2.1 Method of locating articles

This is a secondary research paper, which reviewed the findings of literature that has already been published on this topic. A methodical review of articles published on diabetes in Sub Saharan Africa from 1999-June 2019 on children below 20 years of age. The data search was limited to studies published between 1999-2019. The following combined keywords search terms were used in the search: "T1DM in children," "the increasing incidence of T1DM in children," "age at T1DM diagnosis in children;" "T1DM in children in sub-Saharan Africa." The search was done utilizing mostly Medline and Embase bibliographic database. The Cochrane collaboration database and other sources such as EBSCO, JSTOR, and Emerald were also used. Grey literature, from sources including the websites of International Diabetes Federation, World Diabetes

Foundation, Center for Disease Control, the World Bank, and the World Health Organization were also reviewed. Sub-Saharan Africa is defined as all mainland African countries south of the Sahara including Madagascar.

2.2 Inclusion criteria

The search was limited to published articles between 1999 and 2019 and the age of the children was also limited to 0-20 years. The data obtained were from prevalence and incidence studies, hospital-based studies, registry reports, hospital statistics, government estimates, and the likes. eligibility criteria were established before commencing the review. Data were included in the systematic review if they meet the following criteria:

- 1. Cross-sectional study, case-control, hospital-based clinical studies, and randomized control trials.
- 2. The reported incidence of type 1 diabetes in children age 0-20 years of age.
- 3. Studies published between 1999 and 2019.
- 4. Only fully published articles reviews.
- 5. Reports, letters, editorials, commentaries, case studies, etc. were excluded from the study.

A preliminary review was performed by title and abstract to remove articles that were clearly not relevant to the study or did not meet eligibility criteria. Two other reviewers independently reviewed the remaining articles in full text, and they each noted whether the article should be included or excluded and if so, the reason for exclusion. If an article had multiple reasons for exclusion, the primary reason was chosen for exclusion in the order in which they were listed in the inclusion and exclusion criteria (FIG. 1).

2.3 Exclusion and exclusion criteria

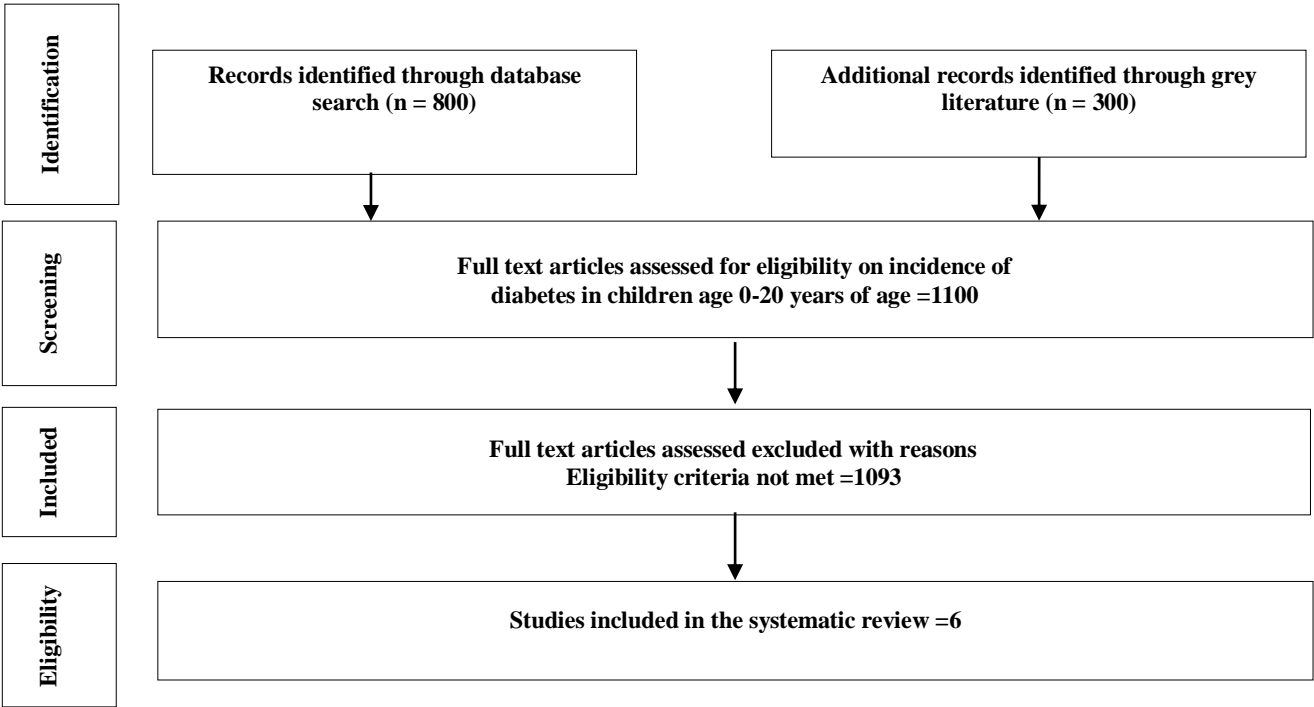


FIG 1. Diagram showing exclusion criteria of the study.

3. Results

3.1 Incidence and prevalence of type 1 diabetes in children below 20 years of age

Data availability for the top ten countries in sub-Saharan Africa for T1DM in children under 20 years of age was highest for Nigeria with an incidence rate in children in 2014 as 2.2/1000 (TABLE 1 below). The lowest countries in the top ten were Tanzania, Uganda, Chad, Senegal, Mali, Democratic Republic of Congo and Cote d'Ivoire with an incidence rate of 0.2/1000 [12]. The occurrence estimates indicate an estimate of 13.8/1000 prevalence for children under 20 years in Nigeria in 2014 [12]. Diabetes studies in low-income countries in Africa may underrate true incidence as new cases are usually missed and misdiagnosed. Dependable data are lacking therefore, the validity of the estimates of numbers of children with type 1 diabetes in sub-Saharan Africa may be questionable and therefore may not be totally relied upon (TABLE 1).

TABLE 1. Top 10 countries in the sub-Saharan region with prevalence and incidence cases of T1DM among children under 20 years in 2014.

No.	Country	Incidence Case per 1000s	Prevalence Rate per 1000s
1	Nigeria	2.2	13.8
2	Ghana	0.3	1.8
3	Cameroon	0.3	1.7
4	Cote d'Ivoire	0.2	1.5
5	Dem. Rep. of Congo	0.2	1.5
6	Mali	0.2	1.3
7	Senegal	0.2	1.1
8	Chad	0.2	1.1
9	Uganda	0.2	1.0
10	Tanzania	0.2	0.7

Source: Peer et al. [12]

The frequency of diabetes occurrence in Sub Saharan Africa varies. In some studies, the frequency ranges from less than 3% in countries like Tanzania, Kenya, and Mozambique to less than 10% in most sub-Saharan countries. Between 1999 to 2011, studies have documented rates as high as up to 10% in Sudan, the Democratic Republic of Congo, Zimbabwe, and Swaziland [13]. Hall, Thomsen, Henriksen and Lohse [14] also found that type 1 diabetes prevalence was low and ranged from 4 per 100,000 in Mozambique to 12 per 100,000 in Zambia between 1999-2011. In table 2 below, Beran et al [15] found that the prevalence rates of T1DM range from 12/100,000 (0.012%) in Zambia to 0.4% in Cote d'Ivoire between the period of 2005-2016 in a population studied [16]. This indication showed that prevalence cases of T1DM are still rising up steadily. Between this period, minimal research has been carried out on the incidence of the disease for children under 20 years of age in the sub-Saharan region. According to Peer et al. [12], it is estimated that type 1 diabetes affects about 39,000 people in the African region in 2013, and 6.4 incidences per 100,000 were diagnosed in children less than 14 years of age, as seen in TABLE 2.

TABLE 2. Incidence and prevalence of type 1 diabetes in children less than 20 years of age.

Author	Country	Type of Study	Age	N	Year	Incidence	Prevalence
Alemu et al. [17]	Ethiopia	Cross sectional	-	1029	2009	2.1/100,000	-
Beran, Yudkin and de Courten [15]	Mozambique	Cross sectional	0-19	-	2005	-	3.5/100,000
Beran, Yudkin and de Courten [15]	Zambia	Cross sectional	0-19	-	2005	-	12/100,000
Umar [18]	Nigeria	Case control	0-16	18	2016	-	2.3/1000
Agbre-Yace et al. [16]	Cote d'Ivoire	Cross Sectional	2-19	687	2016		0.4% of Study pop
Ameyaw, Asafo-Agyei, Thavapalan, Middlehurst and Ogle [19]	Ghana	Clinical	0.9-19.9	160	2017	84.9% of study pop	-

4. Discussion

The T1DM possess a serious threat to children and the risk facing these children are microvascular and macrovascular complications. These occur in a form of retinopathy, nephropathy, neuropathy, cardiovascular and cerebrovascular diseases. Deshpande, Harris-Hayes and Schootman [20] have said that one of the serious causes of disability in the sub-Saharan Africa is a long-term chronic complication of Diabetes. Childhood diabetes may present with complications such as polyuria, polydipsia, and polyphagia, along with nausea and blurred vision, all of which are as a result of hyperglycemia. These complications have of cause resulted in huge economic cost for the region even though the economic costs, in general, is hard to analyze. The economic cost has caused an increased level of morbidity and mortality in the region. As a result, life expectancy is affected greatly in the region.

In the sub-Saharan Africa region, in 2013, Nigeria had the highest incidence of T1DM among children under 20 years of age [12]. In a study conducted by Umar [18], among children, between 13 months to 15 years indicated a hospital prevalence of 2.3/1000 per year. In Nigeria, the prevalence of T1DM in Kano, a northern region of the country was 2.3/1000 in 2016, Umar [18] and in 2013, it was 10.1/1000 [21]. On the other hand, a cross-sectional study done among children between the age of 0-19 years in 2005 in a section of Zambia found a prevalence rate of 12/100,000 [15].

More research clinical research is needed in the sub-Saharan countries for children to be able to determine the accurate picture of incidence and prevalence of T1DM among children in the region. The challenge in most countries in sub-Saharan African is documentation of the pattern of incidence and prevalence of the condition. This is coupled with the problem of

missed diagnosed and also non-diagnosed of the disease. This is noted in countries such as Nigeria and Ghana. The prevalence of T1DM in children below 20 years of age in Kenya is totally unknown.

The incidence and prevalence of T1DM in children in Cameroon are low and this could be due to a few children being diagnosed and also may survive long after the diagnosis. There is also the challenge of limited published data on diabetes in young. The IDF Atlas indicate an incidence of T1DM of 2.9/100,000 in children below 15 years per annum and prevalence of 18.0/100,000 in children below 15 years in Ghana, an estimated 1,800 children in the country. It is likely that In Ghana, children with diabetes could die before they are diagnosed and probably during the first incident of Diabetic Keto Acidosis or early in continuing management [22]. As a result of limitations in study methods and design, many diabetic studies have not provided reliable data. The IDF gave an estimate of a total of almost 39,000 prevalent cases of children with T1DM in Sub-Saharan Africa in 2013 [12].

The diagnosis of T1DM in children in sub-Saharan Africa is poor. Those who have been diagnosed may have a life expectancy of less than one year [23]. Data on the incidence of T1DM in children in the age range of 0-20 years in the Sub Saharan Africa region is extremely inadequate and non-existence. Moreover, research is needed to improve the description of those susceptible to T1DM in the sub-Saharan Africa region. This will aid in the formulation and implementation of appropriate health policies that will ensure high-quality care and also reduce morbidity and mortality in the region. It is very difficult to live with T1DM as a child, due to situations such as poverty, ignorance, and poor access to quality treatment. This can result in severe complications causing premature deaths.

Children with T1DM if managed well can enjoy the quality of life and personal independence. The T1DM is a challenging condition in youth which accounts for about 85% of all diabetes cases in children less than 20 years of age globally [24]. In terms of T1DM management, these include the use of insulin and continuous glucose monitoring for improved treatment. Lifestyle changes are one of the most serious factors driving the increase of diabetes in sub-Saharan Africa. Other factors may include urbanization, increase in income, the fallen levels of physical activity, and diets [25]. Also, such a step will help decrease the financial burden on those with T1DM, their families, and communities. Even though the total number of children with T1DM in sub-Saharan Africa is low compared to the world, effort should be made by African Leaders and Healthcare practitioners in the sub-Saharan countries to arrest the increasing incidence.

5. Conclusion

The rising incidence of T1DM in sub-Saharan Africa indicates the need for continuous monitoring of incidence by using consistent approaches in order to plan for prevention. Although, the finding in this study may not be the true reflection of the actual incidence and prevalence with all the limitations of the study. The diagnosis of T1DM may have been missed, or children may have already died before they reached the hospital. However, a meaningful strength of this study is that it was performed over a relatively long period. Another inadequacy of this study is that approximations have focused on children under 20 years of age and therefore do not account for the proportion of people with disease onset after this age. More research is needed by researchers to document meaningful data about T1DM in sub-Saharan Africa especially for children under 20 years of age.

REFERENCES

1. Karvonen M, Viik-Kajander M, Moltchanova E, et al. Incidence of childhood type 1 diabetes worldwide. Diabetes Mondiale (DiaMond) Project Group. Diabetes Care. 2000;23(10):1516-26.
2. International Diabetes Federation. IDF Diabetes Atlas. 8th ed. Brussels: International Diabetes Federation, Belgium; 2017.
3. Ma RCW, Chan JCN. Diabetes: incidence of childhood type 1 diabetes: a worrying trend. Nat Rev Endocrinol. 2009;5(10):529-30.
4. Giuseppe D, Chiara R, Ramora T, et al. Autoimmune Disorders Associated to Type 1 Diabetes Mellitus in Children and Adolescents. In: Huang FP, editor. Autoimmune Disorders - Current Concepts and Advances from Bedside to Mechanistic Insights. Rijeka: InTech, Croatia; 2013.
5. Ogle G, Middlehurst A, Silink M, et al. Pocketbook for Management of Diabetes in Childhood and Adolescence in Under-Resourced Countries. Brussels: International Diabetes Federation, Belgium; 2017.
6. EURODIAB ACE Study Group. Variation and trends in incidence of childhood diabetes in Europe. Lancet. 2000;355(9207):8736.
7. International Diabetes Federation. IDF Diabetes Atlas. Brussels: International Diabetes Federation, Belgium; 2003.
8. Weets I, Rooman R, Coeckelberghs M, et al. The age at diagnosis of type 1 diabetes continues to decrease in Belgian boys but not in girls: a 15-year survey. Diabetes Metab Res Rev. 2007;23(8):637-43.
9. Edge JA, Keya A, Hamden A. Type 1 diabetes in children. British Med J. 2011;342(294):294.
10. Phiri EC, Msiska G, Kululunga LI, et al. Patient's Knowledge Assessment on Diabetes and SelfCare Practices Among Older Adolescents with Type 1 Diabetes Mellitus in Malawi. Eur Sci J. 2017;13(33):429.
11. World diabetes foundation. In developing countries where health care capacity is inadequate, type 1 diabetes can be a death sentence for a vulnerable child. 2019.
12. Peer N, Kengne AP, Motala AA, et al. Diabetes in the Africa Region: an update. Diabetes Res Clin Pract. 2014;103(2):197-205.
13. Pastakia SD, Pekny CR, Manyara SM, et al. Diabetes in sub-Saharan Africa - from policy to practice to progress: targeting the existing gaps for future care for diabetes. Diabetes Metab Syndr Obes. 2017;10:247-63.
14. Hall V, Thomsen RW, Henriksen O, et al. Diabetes in Sub Saharan Africa 1999-2011: Epidemiology and public health implications. a systematic review. BMC Public Health. 2011;11:564.
15. Beran D, Yudkin JS, de Courten M. Access to care for patients with insulin-requiring diabetes in developing countries: case studies of Mozambique and Zambia. Diabetes Care. 2005;28(9):2136-40.
16. Agbre-Yace ML, Oyenui EE, Oduwole AO, et al. Prevalence of diabetes mellitus among children and adolescents in the district of Abidjan in Cote d'Ivoire: a population-based study. J Diabetes Metab Disord. 2016;15:38.
17. Alemu S, Dessie A, Seid E, et al. Insulin-requiring diabetes in rural Ethiopia: should we reopen the case for malnutrition-related diabetes? Diabetologia. 2009;52(9):1842-5.
18. Umar UI. Pattern of presentation of Type 1 diabetic patients in Kano, Nigeria. Niger J Basic Clin Sci. 2016;13(2):85-8.
19. Ameyaw E, Asafo-Agyei SB, Thavapalan S, et al. Clinical profile of diabetes at diagnosis among children and adolescents at an endocrine clinic in Ghana. World J Diabetes. 2017;8(9):429-35.

20. Deshpande AD, Harris-Hayes M, Schootman M. Epidemiology of diabetes and diabetes-related complications. *Physical Therapy*. 2008;88(11):1254–64.
21. John C, Abok I, Yilgwan C. Clinical profile of childhood type 1 diabetes in Jos, Nigeria. *Afr J Diabetes Med*. 2013;21(1):148-51.
22. Patterson C, Guariguata L, Dahlquist G, et al. Diabetes in the young - a global view and worldwide estimates of numbers of children with type 1 diabetes. *Diabetes Res Clinical Pract*. 2014;103(2):161-75.
23. Niba LL, Aulinger B, Mbacham WF, et al. Predictors of glucose control in children and adolescents with type 1 diabetes: results of a cross-sectional study in Cameroon. *BMC Res Notes*. 2017;10(1):207.
24. Liese AD, D'Agostino RB, Hamman RF, et al. The burden of diabetes mellitus among US youth: prevalence estimates from the SEARCH for Diabetes in Youth Study. *Pediatrics*. 2006;118(4):1510-8.
25. Mbanya JCN, Motala AA, Sobngwi E, et al. Diabetes in sub-Saharan Africa. *Lancet*. 2010;375(9733):2254-66.