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The Prevalence of Diabetes Mellitus Among Children in Lusaka Zambia, 2009-2019: A Hospital-Based Study

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Abstract:-
Background: The prevalence and socioeconomic burden of diabetes mellitus and associated co-morbidities are rising worldwide among children thereby raising a public health concern. Zambia is not exempted as evidenced by factors such as obesity and sedentary lifestyle amongst others.
Aim: The aim of this study was to determine the prevalence of diabetes mellitus (DM) among children in Lusaka, Zambia.
Methods: A 10-year retrospective cross-sectional design utilising quantitative methods involving a review of patient case files of children aged 18 years and below diagnosed with diabetes mellitus between January 2009 and December 2019 at the University Teaching Hospital (UTH) in Lusaka, Zambia was done.
Results: The total number of children that attended the University Teaching Children's Hospital during the study period was 150, 563 and of those, 745 were diagnosed with diabetes mellitus. This gave a case prevalence rate of 4.9/1000. Type 1 diabetes mellitus (T1DM) was the most prevalent (54%), followed by one which could not be specified and simply diagnosed as DM (41%) and the least was type 2 diabetes mellitus T2DM (5%). The mean age of the children at diagnosis was 11.3 (SD ± 4.03) with 94.7% of the children being ≥ 5 years old. More females in this study had DM 53 (62.1%) than their male counterparts 36 (37.9%). The mean weight of the children was 35.6 kilograms (SD ±1.98), while the mean height and BMI was 1.46 meters (SD ± 0.06) and 20.9 kg/m^2 (SD ± 1.93) respectfully. The mean for glycosylated haemoglobin (HbA1c) was 8.48% (SD ± 1.53) while that of random blood sugar (RBS) was 19.3 mmol/L (SD ± 0.85). The most common comorbidity was vision problems (28.6%) with polyuria (25%) being the most frequent clinical feature. Children with DM were mainly managed with insulin (100%) and some coupled with diet (63.2%) and exercise (3.2%).
Conclusion: The prevalence rate of DM among children and adolescents was relatively high. Nationwide awareness campaigns and prevention programmes about diabetes in childhood should be instituted and existing ones strengthened through concerted effort from the relevant stakeholders. A multidisciplinary approach through the involvement of Physiotherapists and nutritionists among other health professionals must be encouraged to stem this looming epidemic.

Keywords:- *Children, Prevalence, Prevention, Diabetes Mellitus, Lusaka, Zambia.*

I. INTRODUCTION

The burden of diabetes mellitus among the paediatric populations has posed a major public health concern (Ayoade et al., 2020; Mayer-Davis et al., 2018). Recent epidemiologic evidence has documented an increasing burden of the metabolic disorder among the paediatric age group with regards to the disease incidence, prevalence, morbidity and overall mortality (Mayer-Davis et al., 2018; Dabelea et al., 2017; Manna et al., 2016). Historically, type 1 diabetes mellitus (T1DM) was adjudged as the predominant paediatric age-group diabetes mellitus type. However, recent findings indicate an increasing trend of type 2 diabetes mellitus (T2DM) among the paediatric populations (Dabelea et al., 2017; Agbre-Yace, 2016; Dabelea et al., 2014; Majaliwa & Ramaiya, 2014; Diabéte, 2011). Etiologically, while TIDM undoubtedly has genetic attributes in association with some environmental triggers, the global overweight and obesity epidemic has been linked with the rising T2DM burden among the paediatric age-group population (Ayoade et al., 2020; Mayer-Davis et al., 2018). This has led to some studies to postulate an increase of T2DM of about 8% to 50% of all newly diagnosed cases of diabetes in children and teenagers, drastically surpassing type 1 diabetes in some regions (ADA, 2019; Cara, 2019; Manios et al., 2018; Kao & Sabin, 2016; Temneanu et al., 2016; Pulgaron & Delamater, 2015; Cline et al., 2014; Venditti et al., 2014).

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Diabetes has classically been defined as a group of metabolic diseases characterized by hyperglycemia which is increased concentration of blood glucose due to disturbances in glucose metabolism as a result of: (i) peripheral insulin resistance in muscle and adipose tissue; (ii) excessive hepatic glucose production (iii) impaired insulin secretion from the pancreas, (iv) or a combination of all three (ADA, 2021, ADA 2019; Yeow et al., 2019; Meetoo, 2014; Polikandrioti & Dokoutsidou, 2009). Symptoms of marked hyperglycemia include polyuria, polydipsia, weight loss, sometimes with polyphagia, and blurred vision. Impairment of growth and susceptibility to certain infections may also accompany chronic hyperglycemia especially in children (ADA, 2021, 2019). The American Diabetes Association (ADA, 2021, 2019; 2018), indicated that type 2 diabetes is diagnosed based on a fasting plasma glucose (FPG ≥126 mg/DL [7 mmol/L]) or the two-hour plasma glucose value following a 75g oral glucose tolerance test (>200 mg/DL [11.0 mmol/L]) or having an HbA1c of6.5%. Glycosylated haemoglobin (HbA1c) to which glucose is bound, is tested to determine average blood glucose levels over the past two to three months (ADA, 2018; IDF, 2017; 2015), as this is widely regarded as an accurate measurement for diabetes assessment. The diagnosis of T1DM is usually presumed in a lean child presenting with diabetes unless otherwise proven, whereas in an obese child, differentiating between T1DM and T2DM is essential for rational management (Dejkhamron et al., 2007).

In the USA, the estimated prevalence of T1DM in the population of youths <20 years increased significantly, from 1.48 per 1000 youths in 2001 to 1.93 in 2009 and 2.15 in 2017, with an average annual increase of 3.4% from 2001 to 2009 and 1.4% from 2009 to 2017 while T2DM in youths 9 to 19 years old also significantly increased, from 0.34 per 1000 in 2001 to 0.46 in 2009 and 0.67 in 2017, with an average annual increase of 3.7% from 2001 to 2009 and 4.8% from 2009 to 2017 (Lawrence et al., 2021). In Vietnam, the prevalence of diabetes and prediabetes among children aged 11-14 years old was 14/1000 (Phan et al., 2019). In China, a 14 multicenter hospital data-based study established that the prevalence of childhood diabetes doubled from 0.041/1000 in the first 5 years to 0.1/1000 in the latest 5 years with very limited data about this subject among the Chinese Population (Fu & Prasad, 2014). Some hitches have been noted in distinguishing the diagnosis of T1DM from T2DM among children, especially in middle and low-income countries. In Africa, an estimated 14.2 million people are reported to be living with diabetes (Aikins et al., 2019) and it is expected to increase to 34.2 million in 2040 (Mutabazi et al., 2019) especially if correct diagnostic measures are instituted. A sign of non-differentiation of T1DM from T2DM can be confirmed by a 10-year retrospective hospital review of case files in Sokoto, North-Western Nigeria which failed to differentiate the diagnosis of T1DM from T2DM among children though the prevalence of diabetes mellitus was 0.3 per 1000 cases (Ugege et al., 2013). Another similar case of a 9-year retrospective review of hospital records of paediatric patients managed for diabetes at Aminu Kano Teaching Hospital, in Kano, Northwest, Nigeria (Adeleke et al., 2010) reported a diabetes mellitus prevalence of 3.1 per 1000 cases. Conversely, higher prevalence rates of T1DM were reported in another hospital-based study in North-Central Nigeria of 10.1 per 1000 (John et al., 2013). This could be attributed to differences in geographical locations. Nonetheless, some studies have been done on the incidence of specifically T2DM. For instance, the mean annual age-standardized of T2DM incidence in Zhejiang, China was 1.96/100 000 in youth aged 5-19 years between 2007 and 2013 (Wu et al., 2017). The incidence calculated from a multi-ethnic, population-based study (The SEARCH for Diabetes in Youth Study) in the US was 7.0/100 000 person-years in youth aged 5-19 years between 2002 and 2003 (Dabelea et al., 2017). Moreover, the overall age-adjusted annual incidence of T2DM was 9.6/100 000 person-years in youth ≤ 19 years in US Virgin Islands, 2001-2010 (Washington et al., 2013). In Canada, it has been reported to be 1.54/100 000 person-years in children and adolescents <18 years (Amed et al., 2010), similar to the incidence of children < 15 years in Auckland, New Zealand (1.3/100 000) (Jefferies et al., 2012). Furthermore, the childhood incidence in England between 2004 and 2005 was substantially higher for blacks (3.9/100 000) and South Asians (1.25/100 000) compared with whites (0.35/100 000) (Wu et al., 2017). The prevalence rates of T2DM have also increased in many Sub-Saharan African (SSA) countries. For instance, it is reported that T2DM accounts for over 90% of all diabetes cases, although estimates for children are not yet known, there is growing evidence that it is now also affecting African children (Agbre-Yace et al., 2016; Tamunopriye & Iroro, 2015; Majaliwa & Ramaiya, 2014; Diabéte, 2011).

In Zambia, 221,390 was estimated to be the number of people with undiagnosed diabetes for those aged between 20-79 years old in 2015 (IDF, 2015). In addition, it was estimated that there were 10,535 diabetes-related deaths. However, there is still a paucity of literature on the prevalence of DM among children (Hapunda & Pouwer, 2017) despite the recent emergence of the disease globally.

The aim of this study was to determine the 10-year retrospective prevalence of diabetes mellitus among children at the University Teaching Hospital in Lusaka, Zambia from 2009 to 2019.

II. METHODS

A. Design

This was a 10-year retrospective cross-sectional design utilising quantitative methods. The current study was conducted at the University Teaching Hospital (UTH) – Children's Hospital in Lusaka Zambia where data on the presence of any type of DM was collected from existing patient records between January 2009 and December 2019.

B. Population and study sample

The population of this study involved all case files and registers for children at UTH retrieved from the Health Information System (HIMS) of the Children's Hospital. A complete enumeration of all reported cases of children aged between 0 to 18 years at UTH Children's Hospital between January 2009 and December 2019 was done.

C. Instrument of data collection

Data was collected from patient records and HIMS using a checklist. The tool was adopted and adapted based on a similar research study that was conducted in Saudi Arabia (Al-Musa, 2013). The checklist included demographic data of the patients, disease data on the current visit, clinical examination and laboratory investigations and lastly the plan of management (Al-Musa, 2013). The checklist was piloted for consistency, elimination of bias, ambiguity and study errors on 10 patient files at another hospital which automatically excluded these files from the main study.

D. Data collection procedure

Data was collected with the aid of two research assistants; physiotherapists by profession with competencies to perform the required tasks. The two were trained through a day's workshop on how to collect the relevant data using the checklist. Two health information system officers were present throughout data collection to provide assistance when the need arose. Monitoring how data was documented during data collection was ensured through self-checks for completeness, correctness and quality of data recorded. Screening for data abnormalities was done daily for 3 weeks after the collection of the filled-in checklists. This information was eventually entered into excel for cleaning and later exported to STATA version 13 software for analysis (StataCorp, 2013).

The diagnosis of DM was based on single random blood sugar (RBS) ≥11.1 mmol/L or fasting blood sugar (FBS) ≥ 7mmol/L and glycosylated haemoglobin (HbA1c) of ≥ 6.5 % in conjunction with typical symptoms of diabetes such as polydipsia, polyuria, polyphagia, weight loss, dysuria, hypernatremia, ketosis, ketonuria and glucosuria (ADA, 2018; IDF, 2017b; IDF, 2015; ADA, 2014). The peculiarities of the children with DM such as age, gender, weight, height, BMI, BP, presenting features, complications and comorbidities, laboratory features and management of the patients were also extracted.

E. Ethical approval

Ethical approval to conduct the study was granted by the University of Zambia Health Sciences Research Ethics Committee (UNZAHSREC) under reference number; IRB no: 00011000, IORG no: 0009227, FWA no: 00026270 and protocol ID: 20203101012. Further permission to conduct the study was sought from UTH Children's Hospital administration.

III. RESULTS

A. Prevalence and Types of Diabetes Mellitus

According to the HIMS records, a total 150, 563 children aged 0 to 18 years were attended to during the period under review and 745 were diagnosed with DM. However, only 95 files were available from a total of 745 files of children diagnosed with DM giving a 13% sample representation. This gave a case prevalence rate of 4.9/1000 for DM among children. A total of 650 (87%) of clinical files were missing; hence, clinical information on children about DM could only be obtained from 95 (13%) case files available using a data extraction checklist. Therefore, all clinical data presented was based on only the clinical files accessible and the availability of information in the files. Only 58 out of the 95 files available had a specific diagnosis of DM documented as T1DM (51, 54%), T2DM (5, 5%) and the rest (39, 41%) simply documented as DM as the diagnosis without differentiating the type. Figure 4.1 shows the types of DM among children at the UTH.

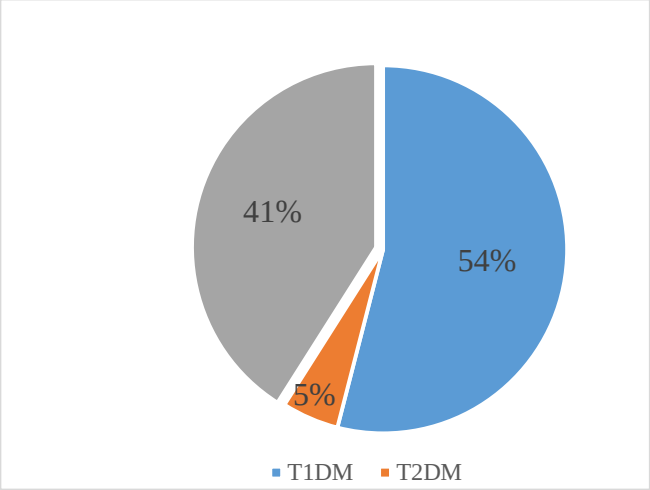

Fig 4.1 Types of diabetes mellitus

B. Demographic data

The age range of children with DM was 1 to 18 years and a mean age of 11.3 (SD ± 4.03) with 94.7% of the children being ≥ 5 years old. More females in this study had DM 53 (62.1%) than their male counterparts 36 (37.9%). Only 12 case files out of the 95 had recorded height and weight where BMI was ultimately calculated from. The weight of the children ranged from 8 to 88.7 kilograms and a mean weight of 35.6 kilograms (SD ±1.98), height ranged from, 1.04 to 1.74 meters and a mean of 1.46 meters (SD ± 0.06). The BMI ranged from 11.8 to 30.3 kg/m^2 with a mean BMI of 20.9 kg/m^2 (SD ± 1.93). Six (6) (50%) of the children were underweight, 1 (8.3%) had a normal weight, 3 (25%) were overweight and 2 (16.7%) obese.

C. Laboratory information

The systolic blood pressure of the children with DM ranged from 76 to 164 mmHg and a mean of 103.8 mmHg (SD ± 2.096), while the diastolic blood pressure ranged from 32 to 101 mmHg and a mean of 69.9 mmHg (SD ± 1.53). Nine (9) out of 95 files (9.5%) had glycosylated haemoglobin (HbA1c) documented. Random blood sugar and HbA1c were the two tests mainly used to diagnose DM. No records were observed where FBS was used. Glycosylated haemoglobin, ranged from 4.3 to 16.3% and a mean of 8.48% (SD ± 1.53). Only 3 (33.3%) out of the 9 files had an HbA1c higher than ≥ 6.5%. Eighty-six (86) files had RBS documented, 74 (86%) of the 86 files had an RBS ≥11.1 mmol/L. The documented RBS ranged from 5 to 32.7 mmol/L and a mean of 19.3 mmol/L (SD ± 0.85). Of the 49 files that had pH documented, only 1 (2%) had a pH of 7.38. The majority of the children 47 (96%) had a documented pH ranging from 5 to 7 while 1 (2%) child had a pH of 9. The mean pH of the children was 5.73 (SD ±0.12). The specific gravity (SG) test was documented

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in 49 files. The documented SG ranged from 1.001 to 1.030 and a mean of 1.009 (SD± 0.001). Of the files with documented SG, 25 (51%) fell within the normal range while 16 (32.7%) recorded an SG lower than 1.003. Seventy-seven (77) case files had ketosis documented. Out of the 77, 40 (52%) files had ketonuria. Eighty-two (82) case files had glycosuria documented and out of the 82 files and 70 (85%) registered the presence of glucosuria. A summary of the demographic information and laboratory tests performed on children with DM at UTH is presented in table 4.1.

Table 4.1 Demographic and laboratory data

Variable	Obs	Mean	Std. Dev.	Min	Max
Age	95	11.35	4.03	1.00	18.00
Weight	80	38.56	17.75	8.00	88.70
Height	12	1.46	0.22	1.04	1.74
BMI	12	20.90	6.70	11.80	30.30
Systolic pressure	70	108.30	17.54	76.00	164.00
Diastolic pressure	70	69.93	12.78	32.00	101.00
pH	49	5.73	0.86	5.00	9.00
Specific gravity	41	1.01	0.01	1.00	1.03
HbA1c	9	8.48	4.59	4.30	16.30
RBS	86	19.32	7.86	5.00	32.70

*BMI; Body Mass Index, *pH; Power of Hydrogen
*HbA1c; Glycosylated Haemoglobin, *RBS; Random Blood Sugar

D. Clinical Findings

Among comorbidities reported (n=52), vision problems accounted for 2 (28.6%), hyperthyroidism 1 (14.3%), retinopathy 1 (14.3%), acute kidney injury 1 (14.3%), diabetes ketoacidosis 1 (14.3%) and hypertension 1 (14.3%). The most frequent clinical features children with DM presented with were; polyuria (n=13, 25%) and polydipsia (n=11, 21.2%). The next most frequent clinical features were polyphagia and weight loss (n=4, 7.7% each), then abdominal pain (n=3, 5.8%), followed by dysuria, body weakness, vomiting, fever (n=2, 3.8% each). Hypernatremia, body sores, genital sore, diarrhoea, breathlessness, convulsions, mild pallor, dizziness and dehydration were infrequent features (n=1, 1.9% each). Table 4.2 shows the clinical features associated with DM.

Table 4.2 Clinical findings

Clinical feature	n	%
Polyuria	13	25.0
Polydipsia	11	21.2
Polyphagia	4	7.7
Weight loss	4	7.7
Abdominal pain	3	5.8
Dysuria	2	3.8
Body weakness	2	3.8
Vomiting	2	3.8
Fever	2	3.8
Hypernatremia	1	1.9
Body sores	1	1.9
Genital sore	1	1.9
Diarrhoea	1	1.9
Breathlessness	1	1.9
Convulsions	1	1.9
Mild pallor	1	1.9
Dizziness	1	1.9
Dehydration	1	1.9
Total	52	100

Documentation of the medical management of children with DM was indicated in 89 (93.7%) of the case files out of the 95 while 6 (6.3%) did not have any drug-related to the management of DM documented. The medical management of children with DM documented was all (100%) by insulin. Diet as part of management was documented in 60 (63.2%) files and only 3 (3.2%) had exercise prescribed.

IV. DISCUSSION

The prevalence of DM among children in this study was 4.9/1000 which is relatively high considering the amount of burden this rate puts on the country's already subdued health care system. The 4.9/1000 prevalence rate established in this study was similar to a study by Agbre-Yace et al. (2016) in Abidjan, Cote d'Ivoire where prevalence was reported at 4 per 1000 despite the study being population-based. On the contrary, the results in the current study were higher than a population-based study by Jasem et al. (2019) which reported prevalence rates ranging from 0.1 to 0.12 cases per 1000 children in three different geographical regions in Tanzania and those reported by Washington et al. (2013) which established the overall age-adjusted annual incidence of T2DM of 9.6/100 000 person-years in youth ≤ 19 years in US Virgin Islands between 2001 to 2010. The reported prevalence in the current study is also higher than those reported in similar hospital-based studies done in Uyo, South-south Nigeria, Abakaliki, South-eastern Nigeria and Sokoto North-eastern Nigeria, where prevalence rates were reported at 0.2/1000, (Ayoade et al., 2020), 0.33/1000 (Ugege et al., 2013) 0.1/1000 (Ibekwe & Ibekwe, 2011) respectively. In contrast, higher prevalence rates were established in a hospital-based study in North-Central Nigeria where DM rates were reported at 10.1 per 1000 (John et al., 2013). This could be attributed to differences in geographical locations. It is cardinal to note that higher prevalence rates reported in these studies could be due to the differences in the study designs as studies were not hospital but population-based (Jasem et al., 2019; John et al., 2013; Washington et al.,

2013). Literature affirms that variations in prevalence rates of DM exist around the world and this may be attributed to the research design, study period, DM diagnosis, geographic location and variations in the age of the study population (Ayoade et al., 2020; Jasem et al., 2019; Wu et al., 2017; John et al., 2013), racial, ethnic and cultural differences as it is hypothesised that DM is more prevalent among races and ethnic groups of low socioeconomic status (LSES) (Golden et al., 2019).

Only 58 out of 95 files had a diagnosis documented them, with 51 (54 %) being T1DM, 5 (5%) being T2DM and 39 (41%) simply documented as DM which is an unclassified diagnosis. Dejkhamron et al. (2007) postulated that features such as significant obesity, presence of acanthosis nigricans, negative islet-cell auto-antibodies, or elevated circulating concentrations of C-peptide are in favour of the diagnosis of T2DM. Further attempts at identifying the different types of DM in the clinical files proved futile as there was no documentation of acanthosis nigricans, absent data on autoantibodies and elevated circulating C-peptide concentrations which are imperative in distinguishing T2DM from T1DM.

The mean age of children with DM in this study was 11.3 ± 4.03 years, which is similar to various studies done in Nigeria which reported mean ages of 11.8 ± 3.1 years (Ugege et al., 2013), 11.4 years (Ibekwe & Ibekwe, 2011) and 10 ± 4.5 (Adeleke et al., 2010). Other studies documented a peak incidence between 10 to 14 years (Jasem et al., 2019; Umar et al., 2019; Ibekwe & Ibekwe, 2011) which coincides with the onset of puberty-induced hormonal impact on insulin sensitivity (Jeffery et al., 2012). Most of the DM cases were females (62.1%) which is in tandem with other studies that reported a female preponderance of DM (Ayoade et al., 2020; Umar et al., 2019; Idris 2018; Tamunopriye & Iroro, 2015; Ugege et al., 2013; John et al., 2013; Ibekwe & Ibekwe, 2011; Adeleke et al., 2010). This has been attributed to the increased susceptibility to puberty-induced hormonal autoimmune disorders common among females (Ngo et al., 2014).

Though HbA1c is widely regarded as an accurate measurement for diabetes assessment (ADA, 2018; IDF, 2017b; IDF, 2015; ADA, 2014), only 9 (9.5%) case files documented it. This may be mainly because most patients could not afford the cost of the test. Therefore, it was difficult to determine how often this parameter was used for the diagnosis of diabetes among children in addition to clinical signs and symptoms during the period of the study. Only 3 (33.3%) files had an HbA1c higher than ≥ 6.5% indicating that they had DM. Eighty-six (86) files had RBS documented, 74 (86%) of the 86 files had an RBS ≥11.1 mmol/L indicating that they had DM. The 6 (66.7%) and 12 (14%) patients who had an HbA1c lower than the normal 6.5% and an RBS lower than the normal 11.1 mmol/L respectively had other criteria fitting with the diagnosis, explaining why they were not excluded. Patients who had lower values also had other criteria fitting with the diagnosis and were therefore included.

In the current study, 39 (41%) children were only diagnosed non-specifically as DM neither belonging to T1DM nor T2DM nor any other type of DM. This showed how challenging it is to identify the type of diabetes among children especially in developing countries like Zambia which have not made much advancement in use of modern diagnostics. The lack of facilities to determine the C-peptide and auto-antibodies concentrations in the children contributed to the failure in making a clear diagnosis. Despite this challenge, 54% of the children were diagnosed with T1DM and 5% with T2DM. Fifty percent (50%) of the children with DM were underweight while 25% were overweight and 17% were obese. Dejkhamron et al. (2007) highlighted that the diagnosis of T1DM is presumed in lean children unless otherwise proven; whereas, in an obese child, the presence of acanthosis nigricans, negative islet-cell auto-antibodies, or elevated circulating concentrations of C-peptide are in favour of the diagnosis of T2DM. This could be the reason why most of the children were diagnosed as T1DM. Moreover, studies have asserted that in Africa, DM is frequently misdiagnosed or missed out completely often leading to high mortality among children (Ameyaw et al., 2017; Ogle et al., 2016; Ugege et al., 2013).

Ninety-six (96%) of the children had a pH ranging from 5 to 7 indicating that they had acidemia, while 2% child had a pH of 9 indicating alkalemia as the normal pH in the human body ranges from 7.35 to 7.45 with the average at 7.40 (Castro, 2020). Ketonuria was observed in 52% of the children indicating the presence of ketones in their urine while 85% had glucosuria indicating the presence of glucose in their urine. The abnormalities in the pH, as well as the presence of glucose and ketones, may be attributed to poor management and coping strategies of DM in children. Furthermore, 32.7% of the children had an SG lower than 1.003 which was lower than the normal of 1.003 to 1.030 (Baig, 2011). This may have been due to renal abnormalities leading to the secretion of over diluted urine.

The most prevalent clinical features at presentation were polyuria 25%, polydipsia 21.2%, polyphagia 7.7% and weight loss 7.7%, which are typical DM symptoms previously reported among children in various studies (Ayoade et al., 2020; Umar et al., 2019; Idris 2018; Tamunopriye & Iroro, 2015; Ugege et al., 2013; John et al., 2013; Ibekwe & Ibekwe, 2011; Adeleke et al., 2010). The most common comorbidity documented was vision problems. This however was not the case in most studies that reported infection to be the most frequent comorbidity (Ayoade et al., 2020; Ugege et al., 2013; Adeleke et al., 2010).

The children in the current study were managed by insulin (100%), diet 63.2% and exercise 3.2%. Less consideration for diet and even worse, exercise in the management of DM shows a lack of awareness of the importance of diet and exercise in the management of DM among health care workers. Furthermore, it can be deduced that management of DM among children at UTH-children's hospital may not be comprehensive. Therefore, coming up with preventive programs at an early age especially for children that may be at risk of the condition may go a long

way in reducing the disease burden and prevalence rates among children and consequently the adult population.

V. CONCLUSION

A concerted, comprehensive, multifaceted and multidisciplinary approach is required in order to prevent DM at an early age. This should be coupled with the integration of various intervention elements concurrently such as childhood diabetes education and awareness among other health care workers and the community, clearer healthy policies on childhood DM, social and community support as well as environmental factors. Furthermore, investments in modern equipment to aid in accurate diagnosis of DM must be made to curtail early morbidity and mortality of childhood diabetes in Zambia. Healthy lifestyles promoting physical activity/exercise and healthy nutrition must be highly encouraged through the utilisation of Physiotherapists (experts in exercise prescription) and nutritionists (experts in nutritional matters) in the health care system. The two health professions should be considered the best of both worlds in the evidence-based approach to the prevention and management of especially T2DM. Therefore, they should work in collaboration with other health professions in the prevention and management of not only T2DM but all forms of DM in order to reduce the prevalence and the burden of the disease.

LIMITATIONS

The study had some limiting factors that warrant mentioning and therefore, must be construed in that context. Firstly, there was a lot of missing data such as demographic information from the HMIS and the clinical files. This made it difficult to derive some vital information on childhood DM. Secondly, the lack of standard autoantibodies and elevated circulating C-peptide concentration tests could have led to failed classification, misclassification and misdiagnosis of DM. Finally, the study was hospital-based, hence the findings may not mirror the general childhood population in Zambia.

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