Type 1 diabetes mellitus in the African population: epidemiology and management challenges

Edna S. Majaliwa[1, 3], B.E. Jerome Elusiyan[1, 4], Omotayo O. Adesiyun[1, 5], Paul Laigong[1, 6], A. Kayode Adeniran[1, 7], C. Muze Kandi[1, 8], Iroro Yarhere[1, 9], S. Mary Limbe[1, 10], Lorenzo Iughetti[1, 2]

[1] European Society Paediatric Endocrinology (ESPE) Fellowship Program, Nairobi, Kenya; [2] Department of Paediatrics, University of Modena and Reggio Emilia, Italy; [3] Muhimbili National Hospital, Dar-es-Salam, Tanzania; [4] Department of Paediatrics and Child Health, Obafemi Awolowo University, Ile-ife, Nigeria; [5] Department of Paediatrics, University of Ilorin, Ilorin, Nigeria; [6] Gertrude's Children's Hospital, Nairobi; [7] Federal Medical Centre, Asaba, Nigeria; [8] Muhimbili National Hospital, Dar-es-Salam, Tanzania; [9] Department of Paediatrics, University of Portharcourt Teaching Hospital, Portharcourt, Nigeria; [10] Aga Khan University Hospital, Nairobi, Kenya

Abstract. Type 1 Diabetes Mellitus (T1DM) is a growing concern worldwide; while there has been a great improvement in the knowledge, epidemiology and management of this condition in the developed worlds, there has been little or no improvement in sub-Saharan Africa. The true burden of this disease is not even known, but a difference in the pattern and outcome of T1DM in the sub-Saharan Africa compared to the western World seems to be present. Moreover, much of the available data is not population-based and is of limited value for making generalizations about Diabetes in children of Sub-Saharan Africa. Despite the limitations, there is evidence that these populations may be important for studying the aetiology and natural history of Type 1 diabetes. Effective management and/or prevention of diabetes and its complications in Sub-Saharan African children should adopt multidisciplinary approaches. In order to improve care for diabetes patients in developing countries, specialized clinics need to be established. (www.actabiomedica.it)

Key words: Diabetes mellitus, ketoacidosis, developing Countries

Introduction

Type 1 diabetes is one of the most frequent chronic diseases in children and globally represents a public health challenge. In the last quarter of the century diabetes has become a health problem in developing countries. In Africa this metabolic disorder is found in a wide variety of atypical forms. A survey of the published information on diabetes mellitus in African populations reveals that most group include several children and a significant number of teenagers. This shows that juvenile diabetes mellitus is not rare in African countries contrary to the widely held belief. Its burden is huge in developing countries due to the lack of basic means for reaching diagnosis and a reasonable glycemic control. Because of the scarcity of reliable epidemiological data, the natural history of type 1 diabetes, including its complications, is largely unknown (1). With the few data available on sub-Saharan African children, its incidence in Tanzania was estimated to be 1.5/100,000 (2), and an increase in incidence in Sudan from 9.5/100,000 in 1991 to 10.3/100,000 in 1995 has been reported (3). In the developed world many efforts have been made to reduce the chronic complications of diabetes, yet in the developing world, the incidence of these complications in children and adolescents is largely unknown, making their management more difficult. Information on chronic complications of diabetes in sub-Saharan Africa is scarce; however, its incidence has gone hand

in hand with the growing disease prevalence, demonstrating the importance of assessing complications. The few studies on chronic complications of diabetes in Africa have shown a high prevalence of acute and chronic complications (4, 5). All these studies have shown the difficulties in the management of these children hence very early complications of diabetes.

Diabetes Ketoacidosis (DKA) has been found in the range of 7-80% (4-8) in newly diagnosed patients and 25-90% (4, 6, 7, 9,) in children who have already been diagnosed with diabetes. This high prevalence of DKA is attributed to the lack of awareness among health workers and the community at large. Together with this a high prevalence of severe hypoglycaemia has been observed (25-55%) (5, 7, 9), which is most likely due to the lack of blood glucose monitoring at an individual and hospital level.

Long-term complications are not long-term in Africa, since children have developed complications as early as in prepubertal age. Moreover they range between 14-33% for nephropathy, and between 10-30% for retinopathy, as well as poor growth (7, 9, 10). The main reason may be the result of poor glycaemic control. In most studies the mean HbA1c has been above 10.5% (11, 12) with some studies having the mean HbA1c as high as 12.5 % (5). The only study with a reported mean HbA1c of 7.5 % (13), is from non sub-Saharan Africa.

This review attempts to put together the published data on T1DM in African children, to document the burden of the disease, to identify major challenges in its management in the sub region, and to offer solutions.

Epidemiology

The prevalence of T1DM varies from country to country in the African sub region. T1DM is not rare in African children (14, 15), and probably an important number of undiagnosed cases exist (15). The reported incidence and prevalence in the African population in the literature is shown in Table 1.

Most of these epidemiological data are from the Northern part of the continent with only one from West Africa and one from East Africa. The prevalence is generally less than 1/1000 while the incidence ranges between 1.5/100000 in Tanzania and 20/100000 in Morocco. In Ethiopia, it is said to account for 9.8% of patients attending Diabetes clinic in Addis Abeba (14). These prevalences and incidences however may be an underestimation, since most of them were performed decades ago and were mainly hospital based studies.

Table 1. Prevalence and incidence of Type 1 Diabetes mellitus in African countries

Country	Prevalence	Incidence
Sudan	0.95/1000[15]	10.1/100000[3]
Nigeria	0.33/1000[16]	-
Tunisia	-	6.76-6.95/100000[17]
Libya	-	8.3/100000[13]
Algeria	0.27/1000[18]	4.4/100000[18]
Tanzania	-	1.5/100000[2]
Morocco	-	20/100000[19]

In most of the series, prevalence was found to increase with increasing age (2, 15-19). Lester (20) found a mean age of presentation to be 10.1 years while Mongalgi et al. (21) found a mean age of 7 years. A study from Sudan found a bimodal age of 12-14 years and a smaller peak at 7 years (3). Increases in the incidence over the years in Algeria, Sudan, and Libya were reported (3, 13, 18).

T1DM was found to be more prevalent in girls than in boys in studies from Ethiopia, Sudan, Nigeria, and Libya (3, 15 20, 22, 23). However no sex differences in the series from Tunisia were observed while another study from Nigeria found it to be more prevalent in boys than in girls (4, 17). The studies from Nigeria found the prevalence to be higher in children from poor homes (24).

Ketoacidosis was documented to be the most common form of presentation in the series from Tunisia, Ethiopia, and Sudan (6, 20, 21). Mortality due to T1DM was also found to be very high with a rate of 42.6% from Sudan (6). There is generally a higher incidence of T1DM in children of black origin in the diaspora, compared to those living in the Continent; this was thought to be a reflection of differences in the level of white genetic admixtures or exposure to environmental diabetogenic agents (2, 24).

Challenges in the Management of Diabetes in Africa

Diabetes is a serious condition in itself, but it should also be considered as a risk factor for other conditions including blindness, renal failure, and micro and macro-vascular diseases. Because of the paucity of metabolic and clinical data, a clear understanding of the natural history of diabetes Mellitus in children and the classification of its subtypes has been hampered.

Since diabetes in children has been given less attention, we are likely to have more children that die early with complications. In the few studies available on diabetes in children, most of them show a high prevalence of complications at a very young age.

Another difficulty that we are faced with is that most of the children with diabetes are treated by an adult diabetologist. As a result, marked deficiencies in the provision of information to children with diabetes and their parents in a developing country are present. Therefore public-education strategies, consensus about treatment recommendations, use of more flexible insulin regimens, and devices for home monitoring are necessary. The treatment of T1DM is also very costly: in one study carried out in Tanzania (25) about 50% of the patients considered their disease as a big physical and psychological problem and the monthly cost for an average insulin-treated patient equaled to 25% of the minimal wage.

Major issues of importance related to Type 1 diabetes in African and other developing countries include late presentation, delayed and missed diagnosis, unavailability of insulin, and poor glycaemic control. In fact, the problem of missed diagnosis of childhood diabetes, although not unique to developing countries (26), is certainly much more common than in developed countries (27). In a Sudanese study, it was reported that 10% of children were not admitted at the time of diagnosis, but were admitted only after they developed DKA (28).

Most children present with DKA at the time of diagnosis (8,29), which can easily be misdiagnosed as cerebral malaria or meningitis in the busy emergency reception areas of most hospitals in Africa (27).

Health conditions in African countries are poor. Most of these countries are estimated by the World Bank to have a pro capite income of less than 11,115 USD (30), and a large percentage of families live below the poverty line of 1 USD per month. Access to health services is limited and living conditions are poor. On top of the rapid rise of diabetes, Africa already has a high burden of communicable diseases (CD) such as HIV/AIDS, Tuberculosis (TB), pneumonia, Malaria, maternal and perinatal conditions, and combined nutritional deficiencies. Diabetes like any other non communicable disease has not replaced the main burden of CDs in developing countries and therefore many developing countries are facing what has been called the double disease burden (31), hence more priorities are given to communicable diseases. The increasing prevalence and incidence of diabetes and its long-term complications in sub-Saharan Africa (SSA) may have a devastating human and economic toll if the trends remain unabated (1). However, many essential, individual and social obstacles such as poor education and illiteracy, low socio-economic status and lack of access to health care make the conversion of diabetes research in SSA uncertain. The low number of health care providers with the requisite knowledge, expertise and experience in the care of children with Diabetes is another major issue. There is also an inadequacy of the facilities for the treatment of these children. Where the facilities are available, there is lack of basic diagnostic and monitoring tools as well as an irregular supply of insulin.

The way forward

The way forward for the improvement of the care of African Children with T1DM should involve efforts aimed at addressing the various identified challenges. Comprehensive up-to-date data on the burden of the disease particularly in countries where this does not exist is necessary. Knowledge of the different patterns of presentation and peculiarities will help to fashion out a better and optimal approach in its management. This will entail a lot of coordinated research, which will require a lot of funding. Increased efforts by the various governments to improve the level of education of citizens and reduce poverty will also empower the patients to afford quality of care. Govern-

ments at various levels also need to improve the state of available infrastructures and improve the diagnostic capabilities of the managing physicians. Health ministries also need to accord priorities to the rapidly increasing burden of non-communicable diseases compared to the past when all efforts were focused only on infectious diseases. The aim of the National Health Insurance of the various countries should be expanded to include these children.

Efforts of non-governmental organizations such as the Diabetes associations at both a local and international level are of tremendous benefit. A capacity of creating better management is also necessary. This is why the efforts of the European Society of Paediatric Endocrinology to train African Pediatricians in endocrinology is a welcome development. It will then be up to the trained fellows to rise up to the challenges of improving the numerous children suffering from the burden of Diabetes Mellitus. A good starting point for them would probably be the creation of a Pan African society of Paediatric Endocrinology that will fashion out a course for the sub-specialty in the region. They will also need to be involved in advocacy.

Conclusions

Diabetes care in developing countries needs to address the specific background of the patient population, their needs, medical problems and social constraints. Active participation of patients, families, media, governmental and non-governmental organizations, and health workers may help to overcome some of the difficulties. In this regard, an effective management and/or prevention of diabetes and its complications in Sub-Saharan African children should adopt multidisciplinary approaches. In order to improve the treatment of diabetes patients in developing countries, specialized clinics need to be established.

References

1. Osei K, Schuster DP, Amoah AG, Owusu SK. Diabetes in Africa: pathogenesis of type 1 and type 2 diabetes mellitus in Sub- Saharan Africa: implication for transitional population. *J Cardiovascular Risk* 2003; 10: 85-96.
2. Swai AB, Lutale JL, McLarty DG. Prospective study of incidence of juvenile diabetes mellitus over 10 years in Dar es Salaam, Tanzania. *BMJ* 1993; 306: 1570-2.
3. Elamin A, Omer MI, Zein K, Tuvemo T. Epidemiology of childhood type I diabetes in Sudan, 1987-1990. *Diabetes Care* 1992; 15: 1556-9.
4. Akanji AO. Clinical experience with adolescent diabetes in a Nigerian teaching hospital. *J Natl Med Assoc* 1996; 88: 101-5.
5. Majaliwa ES, Munubhi E, Kaushik R, et al. Survey on Acute and Chronic Complications in Children and Adolescents With Type 1 Diabetes at Muhimbili National Hospital in Dar es Salaam, Tanzania. *Diabetes Care* 2007; 30: 2187-92.
6. Elamin A, Altahir H, Ismail B, Tuvemo T. Clinical pattern of childhood type 1 (insulin-dependent) diabetes mellitus in the Sudan. *Diabetologia* 1992; 35: 645-8.
7. Lester FT. The clinical pattern of diabetes mellitus in Ethiopians. *Diabetes Care* 1984; 7: 6-11.
8. Monabeka HG, Mbika-Cardorelle A, Moyen G. Ketoacidosis in children and teenagers in Congo. *Sante* 2003; 13: 139-41.
9. Obel AO. Epidemiology of diabetes mellitus in a referral hospital in a tropical developing country. *Tohoku J Exp Med* 1983; 141 Suppl: 207-10.
10. Mhando PA, Yudkins JS. The pattern of diabetic complications in African patients in Dar es Salaam. *Trop Geogr Med* 1980; 32 (4): 317-23.
11. Elbagir MN, Eltom MA, Rosling H, Berne C. Glycaemic control of insulin-dependent diabetes mellitus in Sudan: influence of insulin shortage. *Diabetes Res Clin Pract* 1995; 3: 43-52.
12. Onyemelukwe GC, Isah HS, Mba EC, Awunnor-Renner C, Mohammed I. Glycosylated haemoglobin (HbA1) for diabetic control in Africans; preliminary findings with the micro-column technique. *Trop Geogr Med* 1983; 35: 347-51.
13. Kadiki OA, Roaeid RB. Incidence of type 1 diabetes in children (0-14 years) in Benghazi Libya (1991-2000). *Diabetes Metab* 2002; 28: 463-7.
14. Lester FT Juvenile diabetes mellitus in Ethiopians. *Trans R Soc Trop Med Hyg* 1979; 73 (6): 663-6.
15. Elamin A, Omer MI, Hofvander Y, Tuvemo T. Prevalence of IDDM in school children in Khartoum, Sudan. *Diabetes Care* 1989; 12 (6): 430-2.
16. Afoke AO, Ejeh NM, Nwonu EN, Okafor CO, Udeh NJ, Ludvigsson J. Prevalence and clinical picture of IDDM in Nigerian Igbo schoolchildren. *Diabetes Care* 1992; 15: 1310-2.
17. Ben Khalifa F, Mekaouar A, Taktak S, et al. A five-year study of the incidence of insulin-dependent diabetes mellitus in young Tunisians (preliminary results). *Diabetes Metab* 1997; 23: 395-401.
18. Bessaoud K, Boudraa G, Deschamps I, Hors J, Benbouabdallah M, Touhami M. Epidemiology of juvenile insulin-dependent diabetes in Algeria (Wilaya of Oran). *Rev Epidemiol Sante Publique* 1990; 38: 91-9.

19. Vos C, Reeser HM, Hirasing RA, Bruining GJ. Confirmation of high incidence of type 1 (insulin-dependent) diabetes mellitus in Moroccan children in The Netherlands. *Diabet Med* 1997; 14: 397-400.
20. Lester FT. Childhood diabetes mellitus in Ethiopians. *Diabet Med* 1986; 3 (3): 278-80.
21. Mongalgi MA, el Bez M, Chakroun D, Jedidi H, Debbabi A. An analytic study of cases of childhood diabetes in a pediatric department in Tunis. *Ann Pediatr* (Paris) 1991; 38: 623-6.
22. Bella AF. A prospective study of insulin-dependent diabetic Nigerian Africans. *J Natl Med Assoc* 1992; 84: 126-8.
23. Kadiki OA, Reddy MR, Marzouk AA. Incidence of insulin-dependent diabetes (IDDM) and non-insulin-dependent diabetes (NIDDM) (0-34 years at onset) in Benghazi, Libya. *Diabetes Res Clin Pract* 1996; 32: 165-73.
24. Tull ES, Jordan OW, Simon L, et al. Incidence of childhood-onset IDDM in black African-heritage populations in the Caribbean. The Caribbean African Heritage IDDM Study (CAHIS) Group. *Diabetes Care* 1997; 20: 309-10.
25. Neuhann HF, Warter-Neuhann C, Lyaruu I, Msuya L. Diabetes care in Kilimanjaro region: clinical presentation and problems of patients of the diabetes clinic at the regional referral hospital-an inventory before structured intervention. *Diabet Med* 2002; 19: 509-13.
26. Ghannem H, Harrabi I, Gaha R, et al. Epidemiology of diabetes in a school children population in Tunisia. *Diabetes Metab* 2001;27: 613-7.
27. Rwiza HT, Swai ABM, McLarty DG: Failure to diagnose diabetic ketoacidosis in Tanzania. *Diabet Med* 1986; 3: 181-3.
28. Elamin A, Ghalib M, Eltayeb B, Tuvemo T. High incidence of type I diabetes mellitus in Sudanese children, 1991-1995. *Ann Saudi Med* 1997; 17: 478-80.
29. Elamin A, Altahir H, Ismail B, Tuvemo T. Clinical pattern of childhood type 1 (insulin-dependent) diabetes mellitus in the Sudan. *Diabetologi*a 1992; 35: 645-8.
30. http://shocklogic.webportalasp.com/espe2008/upload/World%20Bank%20list%20of%20Economies.pdf
31. World Health Organization. Preventing Chronic Diseases a Vital Investment. Geneva:World Health Organization, 2005

Accepted: July 18th 2008
Correspondence: Lorenzo Iughetti, MD, PhD
Dept Paediatrics
University of Modena and Reggio Emilia
Via del Pozzo 71 41100 Modena - Italy
E-mail: iughetti.lorenzo@unimore.it