American Journal of Pediatrics
2025, Vol. 11, No. 1, pp. 1-6
https://doi.org/10.11648/j.ajp.20251101.11

Review Article

Glycemic Assessment of Type I Diabetic Children in the Dakar Region, Senegal

Niang Babacar[1], Mbaye Aminata[1,*], Boiro Djibril[2], Sow Amadou[2], Ndiaye Oulimata[1], Dina Obambi[3], Ly Fatou[4], Sy Khady[5], Mbaye Maimouna Ndour[2], Ndiaye Ousmane[1]

[1]Centre Hospitalier National d'Enfants Albert Royer, Dakar, Senegal
[2]Centre Hospitalier Abass Ndao, Dakar, Senegal
[3]Hôpital Pour Enfants Diamniadio, Dakar, Senegal
[4]Centre Hospitalier de Pikine, Dakar, Senegal
[5]Centre de Sante Philipe Maguilene Senghor, Yoff Dakar, Senegal

Abstract

Introduction: Type 1 diabetes (T1D) accounts for more than 90% of all cases of diabetes in children and adolescents. The aim of this study is to determine the level of glycemic control and to analyze the factors of poor control. Methodology: This is a prospective study conducted in five (5) pediatric departments in Dakar over a period of 6 months and including all children aged 0 to 18 years with type 1 diabetes. Glycemic balance was assessed with glycated hemoglobin (HbA1c). Results: During the study, two hundred (200) patients were included. The mean age at diagnosis was 12.15 years ±3.98 years [range 1.00 to 18.00 years]. Ketoacidosis was the main circumstance of discovery in 67.00% (134 individuals). The types of insulin used were human in 64% of cases. Among the patients who received therapeutic education (22), 39.33% were not educated by a qualified provider. There was a glycemic imbalance in 70.5% of patients. After an analytical study, there was no statistically significant difference between HbA1c and gender, geographical origin, socioeconomic and educational level of parents, duration of diabetes progression, physical activity and the therapeutic protocol used. However, therapeutic education had a positive influence on HbA1c. Conclusion: The glycemic control of diabetic patients in the Dakar region is very insufficient. This would be due to several factors including the insufficiency of therapeutic education. It is important to train providers in this fundamental aspect of diabetes management.

Keywords

Type 1 Diabetes, Glycemic Control, Therapeutic Education

[*]Corresponding author: drmbayeaminata@gmail.com (Mbaye Aminata)

Received: 26 November 2024; **Accepted:** 12 December 2024; **Published:** 16 January 2025

1. Introduction

Type 1 diabetes (T1D) is defined as a defect in insulin secretion resulting from autoimmune destruction of beta-cells endocrine pancreas. It represents more than 90% of all cases of diabetes in children and adolescents [1]. Good glycemic control is essential to prevent acute and chronic complications and reduce morbidity and mortality. The Diabetes Control and Complications Trial (DCCT) study demonstrated that glycemic control had a direct and significant effect on the control of T1D [2]. In our countries, this control is difficult to achieve, especially in children, due to socio-economic difficulties related to the availability of insulin and access to care. In Senegal, as in most low-income countries, achieving glycemic control in children with type 1 diabetes is a major management problem. This study is part of the CDiC (Changing Diabetes in Children) program, which promotes the availability of medications and care materials to achieve better glycemic control in children and adolescents with diabetes. The objective was to determine the level of glycemic control in children with T1D and to analyze the factors contributing to poor glycemic control.

2. Methodology

This is a descriptive and analytical cross-sectional study carried out in the pediatric departments of Albert Royer Hospital Center (ARHC), Abass Ndao Hospital Center (ANHC), Pikine Hospital Center (PHC), Diamniadio Children's Hospital (DCH) and the Philippe Maguill ène Senghor Health Center (PMS). These level 3 health facilities in the Senegal health pyramid are the focal points for all diabetic children in the Dakar region. As part of the CDiC project, these children are followed by pediatric endocrinologists or pediatricians trained in diabetology, in collaboration with therapeutic educators, dieticians and psychosocial assistants. The study lasted for a period of 6 months (April 2018-May 2019). All children aged 0 to 18 years with type 1 diabetes on insulin and followed in one of the 5 recruitment sites were included. Sociodemographic, clinical, therapeutic and evolutionary parameters were collected. Body mass index (BMI) was used to assess corpulence, which is normal between -2 and +2 SD, thin if <- 2 SD and overweight if > +2 SD. Growth retardation was defined as height <-2SD and normal height between -2SD and +2SD. Delayed puberty was defined as the absence of secondary sexual characteristics beyond 14 years in girls and 16 years in boys. The duration of diabetes progression extends from the date of diagnosis to the time of inclusion. Glycemic control was assessed using HbA1c. The patient was considered well controlled if HbA1c < 7.5%, moderately controlled if HbA1c between 7.5 and 9% and poorly controlled if HbA1c > 9%. Control was considered acceptable if HbA1c < 9%. The number of insulin injections per day allowed to determine two protocols: conventional (≤ 3 injections), intensive (> 3 injections) and basal bolus (combination of slow insulin in one or two injections per day with rapid insulin before each meal). The data were entered in Sphinx V5 and analyzed with Excel 2010 and Epi info 7.2. The Xi2 test was used to compare proportions, and the significance threshold of p was set at 0.05.

3. Results

A total of two hundred (200) patients were included. The mean age at diagnosis was 12.15 ± 3.98 years [range 1.00 to 18.00 years]. The distribution of patients by age is shown in Figure 1. The study population included 119 girls (59.50%) and 81 boys (40.50%), i.e. a sex ratio of 0.68. The socioeconomic level of the families was low in 39% of cases. The majority of patients were treated at Abass Ndao Hospital with 105 children (52.5%) and at Albert Royer Hospital with 81 children (40.5%). Anamnestic data revealed that 19% of patients had been hospitalized at least once in the previous 12 months for diabetic ketoacidosis, 47% of patients had a family history of diabetes, and 5% of patients had a history of type 1 diabetes in siblings. Ketoacidosis was the main cause of discovery of diabetes in 67% (134 individuals). Children not in school represented 22.5%, or 45 cases. Among the children in school, there were 15 school dropouts (9.68%). School absenteeism was noted in 59 cases (38.06%) and the mean number of days of absence per year was 4.83 ± 10.92 days [range 0 to 90 days]. In terms of corpulence, 23.5% of children were thin. Growth retardation was noted in 12% of cases. Among the pubertal children (N=51), 5 had delayed puberty (9.8%). Human insulins were used in 64% of cases, analogues in 19% and mixed insulins in 17%. The mean dose of insulin used was 0.82 ± 0.27 IU/kg/day, with extremes of 0.20 and 1.71. The median was 0.81. The mode was 1. The protocols used are presented in Figure 2. In our study, 22 patients did not receive therapeutic education (11% of cases). Among the patients who received therapeutic education, 39.33% (70 cases) were not educated by qualified personnel. The proportion of sedentary people was 10.5% (21 people). The mean duration of diabetes was 2.46 ± 2.76 years, with extremes of 1 month and 14 years. The median and mode were 1 year. Only 13% had good glycemic control and 29.5% had acceptable glycemic control. The distribution of children according to HbA1c levels is shown in Figure 3. After an analytical study, there was no statistically significant difference between HbA1c and sex, geographical origin, place of care, socioeconomic level, parental education level, duration of diabetes, physical activity and therapeutic protocol used.) However, therapeutic education and training of educators had a positive influence on HbA1c, with respective p values of 0.02 and < 0.001 (Table).

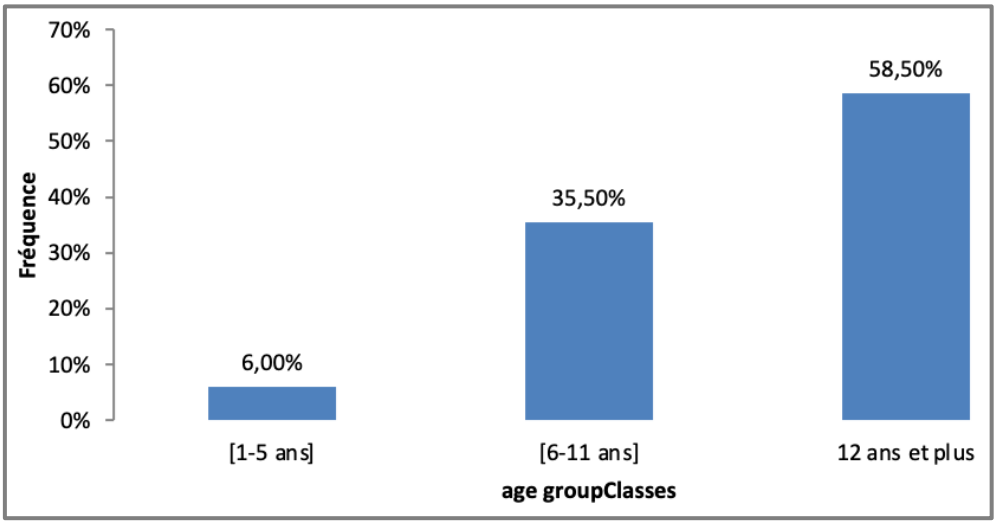

Figure 1. *Distribution of patients by age group.*

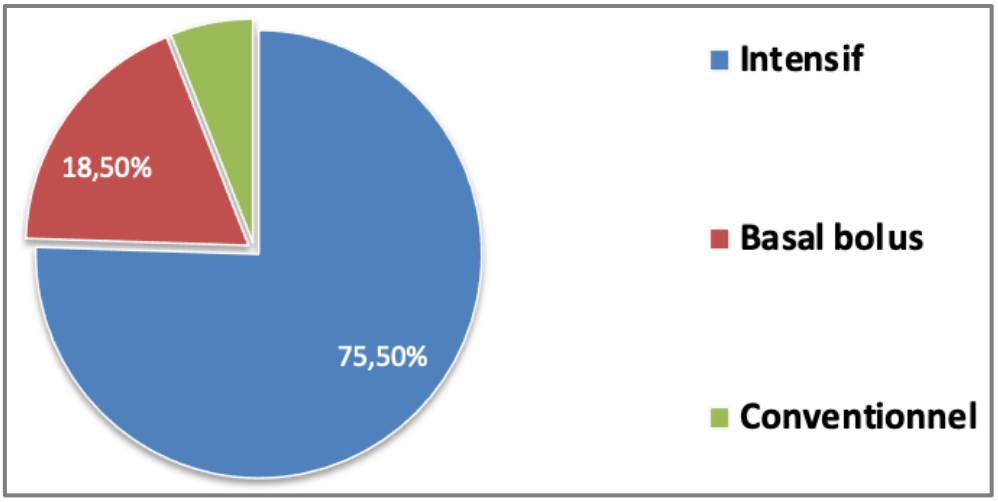

Figure 2. *Distribution of patients according to the insulin protocol used. (N=200).*

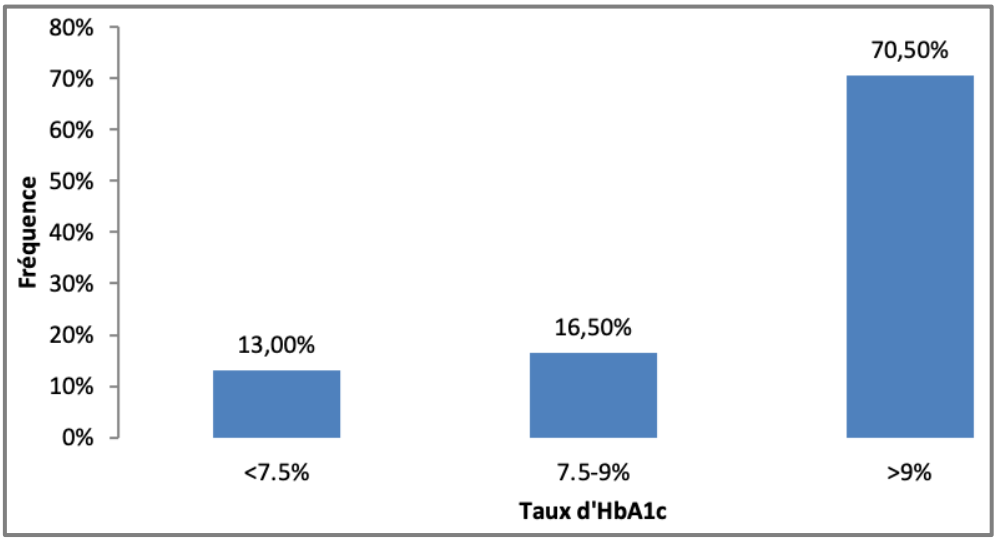

Figure 3. *Distribution of patients according to HbA1c level. (N=200).*

Table 1. *Factors associated with glycemic control.*

Settings	HbA1c rate				Total	p-value	Odds [95% CI]
	< 9%		≥ 9%				
	N	%	N	%			
Sex							
Female	33	27.73	86	72.27	119	0.5	
Male	14	73.7	5	26.3	19		
Support Sites						0.71	
CHAN	31	29.52	74	70.48	105		
CHNEAR	23	28.4	58	71.6	81		
Diamniadio	2	33.33	4	66.67	6		
Philippe Senghor	0	0	2	100	2		
Pikine	3	50	3	50	6		
Socio-economic level						0.06	
Low	26	33.33	52	66.67	78		
Moderate	15	18.29	67	81.71	82		
High	18	45	22	55	40		
Parents' education level						0.69	
No educated	21	33.33	42	66.67	63		
Primary level	11	23.4	36	76.6	47		
High school	13	28.26	33	71.74	46		
University	14	31.82	30	68.18	44		
Insulin protocol						0.22	
Basal bolus	12	32.43	25	67.57	37		
Conventional	6	50	6	50	12		
Intensive	41	27.15	110	72.85	151		
Therapeutic Education						0.02	4.7 [1.06-20.84]
Yes	57	32.02	121	67.98	178		
No	2	9.09	22	90.91	24		
Trained Educator						<0.001	35 [8, 22-151, 3]
Yes	55	50.93	53	49.07	108		
No	2	2.86	68	97.14	70		
Duration of diabetes development						0.63	
≥ 5 years	8	24.24	25	75.76	33		
< 5 years	51	30.54	116	69.46	167		

CHAN = Abass Ndao Hospital Center, CHNEAR = Albert Royer National Children's Hospital Center

4. Discussion

In our study, the mean age of diagnosis was 12.15 years. This is consistent with the literature that estimates the mean age of diagnosis of type 1 diabetes in children to be between 10 and 14 years [3]. Studies conducted in pediatric settings in Dakar [4] and Nairobi, Kenya [5] showed lower mean ages of 7.8 and 9.9 years, respectively. In our study, there was a female predominance; however, several studies have shown that there was no gender difference in the incidence of type 1 diabetes [3, 6, 7]. The socioeconomic status of patients was low in 39% of cases. In developing countries, particularly in Africa, poverty is an obstacle to good patient care. A study conducted in Mali in 2004 showed that one year of insulin treatment represented 40% of a family's income [8]. The CDiC project is part of this effort to facilitate access to care and help the most disadvantaged populations in the management of this pathology to achieve better glycemic control. School disruptions were frequent in our study. Diabetes stigmatizes children in their school environment and can be a source of absenteeism, delay or school dropout [9]. A family history of diabetes was found in 47% of cases. In the literature, a family history of diabetes is rarely found in type 1 diabetes unlike type 2 diabetes [10]. However, when diabetes is present in a child, the risk of a brother or sister developing diabetes is 5 to 6% [11]. In developing countries, ketoacidosis remains the main cause of discovery of type 1 diabetes as was the case in our study. This may be due to a delay in diagnosis linked to socio-economic factors. While in developed countries, ketoacidosis is much rarer and the most common finding is polyuria [12]. In our series, only 5.5% of cases were overweight. Unlike type 2 diabetes, obesity is not a risk factor for the onset of type 1 diabetes. The prevalence of obesity in type 1 diabetes reflects that of the general population. In contrast, diabetes is a risk factor for growth retardation and malnutrition in children and adolescents [13]. This explains the high incidence of growth retardation in our study. The intensive protocol was used in 75.5% of cases. Intensive treatment leading to an HbA1c of approximately 7% in the original DCCT study reduced the risk of retinopathy, nephropathy and neuropathy by 76%, 50% and 60%, respectively, compared with conventional treatment with an HbA1c of approximately 9% [14]. According to an American study [12], the intensive protocol allowed better glycemic control and considerably reduced cardiovascular complications.

In our study, only 29.5% of children with type 1 diabetes had acceptable HbA1c levels. This result corroborates some African studies showing mean HbA1c levels above 10.5% [15-18], sometimes even up to 12.5% [19]. Our results are comparable to those observed in Kenya, where 28% of children with type 1 diabetes had reasonable glycemic control [5].

Overall, glycemic control is poor in most African countries compared to data from Western study groups [20], with better economic conditions and better access to health services.

However, the insulin protocol used was not significantly associated ($p = 0.22$) with poor HbA1c control. Thus, regardless of the insulin or protocol used, if the treatment is well managed, glycemic control should be achieved. Therapeutic education had a positive impact on HbA1c reduction ($p = 0.02$), as did the qualification of the educator ($p < 0.001$). It is essential in the treatment of diabetes. The educator must teach diabetic patients to live with their disease on a daily basis, trying to make them autonomous. They must be able to inject their own insulin, adapt their doses, control their glycemia, respond to acute complications and maintain a healthy lifestyle. To achieve these goals, structured therapeutic education sessions must be set up and shared across all care sites. This education must be provided by staff trained in therapeutic education and adapted to the specific needs of each child.

5. Conclusion

Glycemic control of diabetic patients in the Dakar region is very inadequate. This is mainly due to insufficient therapeutic education. It is important to train health professionals in this fundamental aspect of diabetes management. The CDiC project is part of this approach and its dissemination throughout the country could contribute to better training providers and improving glycemic control of patients.

Abbreviations

T1D	Type 1 Diabetes
DCCT	The Diabetes Control and Complications Trial
SD	Standard Deviation
CDIC	Changing Diabetes in Children
HBA1C	Glycated Hemoglobin
ARHC	Albert Royer Hospital Center
ANHC	Abass Ndao Hospital Center
PHC	Pikine Hospital Center
DCH	Diamniadio Children's Hospital DCH
PMS	Philippe Maguill ène Senghor Health Center
BMI	Body Mass Index

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Boiro D. Diabetic ketoacidosis in children: Epidemiological, diagnostic and evolutionary aspects: About 74 cases in the pediatric department of the hospital center, Medical thesis, Dakar, 2013, No. 101.

[2] Hanaire H. Lessons from DCCT and EDIC: Glycemic control and insulin protocols, Research Group; 2015: 3-6.

[3] Wine cellar ITS, Irwin ML, Editor NS, Gray Metal. Correlates of overweight and obesity in 5529 adolescents with type 1 diabetes: The T1D Exchange Clinic Registry; 2017; 126, 68-78 https://doi.org/10.1016/j.diabres.2017.01.012

[4] Niang B, Faye PM, D ème/Ly I, Ba A, Thiam L, Thiongane A et al. Epidemiological and clinical profile in type 1 diabetic children in a Dakar hospital setting. Reverend CAMES. 2015; 3(2): 89-92 https://doi.org/10.31080/ASPE.2023.06.0630

[5] Ngwiri T, Were F, Predieri B, Ngugi P, and Lughetti L. Glycemic control in Kenyan children and adolescents with type 1 diabetes mellitus; IJOE; 2015 https://doi.org/10.1155/2015/761759

[6] Ghannem H, Harrabi I, Gaha R, Trabelsi L, Chouchen I, Essoussi AS et al. Epidemiology of diabetes in children in schools in Sousse, Tunisia. Methab for Diabetes. 2001; 27(5): 613-617.

[7] Yatsuya H, Kwaguchi L, Hatego E, Aoyama A. Sex differences in diabetes mellitus, WHO Bulletin, 2013; 91(9): 621-715.

[8] Togo AD Epidemiological, clinical and therapeutic aspects Medical thesis Bamako, University of Bamako 2010.

[9] Wildi S, Geiser C, Perrenoud L, Perolini M, Lazarevic C et al. Welcoming young diabetics at school, Continuing education: Pediatric endocrinology 2016; 27 (1).

[10] Rosenbloom AL, Silverstein JH, Amemiya S, ZeitlerP, Klingensmith G. Type 2 diabetes in children and adolescents. Pediatric Diabetes 2009: 10 (Suppl. 12): 17–32. https://doi.org/10.1111/j.1399-5448.2009.00584.x

[11] Philips JC. Type 1 diabetes: from genetic predisposition to a hypothetical environmental context, Rev Med Li ège 2012; 67: 5-6: 319-325.

[12] West NA, Lawrence J M., Maahs DM and Mayer-Davis E. Epidemiology of type 1 diabetes, Endocrinol Metab Clin North Am. 2010; 39(3): 481–497.

[13] Messaaoui A, Dorchy H. Growth of diabetic children. Rev Med Brux 2010; 31 (Supplement): S 77-80.

[14] Jaffiol C. Diabetes mellitus in Africa. Taurus. Acad. Natl Med. 2011, 195(6), 1239-1250.

[15] MN Elbagir, MA Eltom, EO Mahadi and C. Berne. "Pattern of long-term complications in Sudanese diabetics treated with insulin patients", Diabetes Research and Clinical Practice, vol. 30, no. 1, pp. 59–67, 1995. https://doi.org/10.1016/0168-8227(95)01146-3

[16] MN Elbagir, MA Eltom, H. Rosling, and C. Berne. "Glycemic control of insulin-dependent diabetes mellitus in Sudan: influence of insulin shortage," Diabetes Research and Clinical Practice, vol. 30, no. 1, pp. 43–52, 1995. https://doi.org/10.1016/0168-8227(95)01145-5

[17] GC Onyemelukwe, HS Isah and EC Mba. "Glycosylated haemoglobin (HbA1) for the control of diabetes in Africans; preliminary results of the microcolumn technique," Tropical and Geographical Medicine, vol. 35, no. 4, pp. 347–351, 1983.

[18] A. Gebre-Yohannes and SI Rahlenbeck, "Glycemic control and its determinants in diabetic patients in Ethiopia," Diabetes Research and Clinical Practice, vol. 35, no. 2-3, pp. 129-134, 1997. https://doi.org/10.1016/S0168-8227(96)01367-8

[19] ES Majaliwa, E. Munubhi, K. Ramaiya et al. "A survey of acute and chronic complications in children and adolescents with type 1 diabetes at Muhimbili National Hospital, Dar es Salaam, Tanzania," Diabetes Care, vol. 30, no. 9, pp. 2187–2192, 2007. https://doi.org/10.2337/dc07-0594

[20] HB Mortensen, KJ Robertson, HJ. Aanstoot et al. "Insulin management and metabolic control of type 1 diabetes mellitus in children and adolescents in 18 countries," Diabetic Medicine, vol. 15, no. 9, pp. 752–759, 1998. https://doi.org/10.1002/(sici)1096-9136(199809)15:9%3C752::aid-dia678%3E3.0.co;2-w