

Prevalence and factors associated with school failure in children with type 1 diabetes

Rozpowszechnienie niepowodzeń szkolnych i związane z nimi czynniki u dzieci z cukrzycą typu 1

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Abstract

Introduction: Type 1 diabetes mellitus (T1DM) is a health problem that can be difficult for young people to accept. The aim of this study is to determine the prevalence and characteristics of school failure in children with T1DM and to identify the associated factors.

Material and methods: This is a retrospective study conducted in the endocrinology department of the Farhat Hached Hospital in Sousse, regarding T1DM patients, by analysing their school and career paths according to their clinicobiological and social data. School failure was defined in our study by the presence of at least one year's repetition and/or exclusion from school.

Results: Our study included 70 patients. School failure was recorded in 71.4% of cases. School drop-out was observed in 47.1% of patients. The reasons for school drop-out were iterative hospitalizations in 31.4% of cases and glycaemic instability with hyper/hypoglycaemic fluctuations in 17.1%. Multivariate analysis showed that the risk factors significantly associated with school failure were, respectively, number of hospitalizations for ketosis ≥ 5 ($p = 0.037$) and higher mean HbA1c at the last consultations ($p = 0.001$). Use of functional insulin therapy ($p = 0.031$) and use of insulin analogue ($p = 0.004$) were significantly protective factors.

Conclusions: The risk of school failure in T1DM is real and should not be underestimated. Socioeconomic factors such as lack of financial resources, limited family support, and an unfavourable social environment can contribute to school avoidance.

Key words: type 1 diabetes, school, insulin therapy, microangiopathy.

Introduction

In 2011, the World Health Organization (WHO) reported that 356 million people worldwide had diabetes, representing 5% of the global population [1]. This number is expected to rise to 552 million by 2030 [2]. Type 1 diabetes mellitus (T1DM), formerly known as juvenile diabetes or insulin-dependent diabetes, represents 10% of all cases of diabetes, and in half of the cases it occurs before the age of 20 years [3]. The prevalence of this type of diabetes is around 13.5 cases per 100,000 children under the age of 15 years [4]. In Tunisia, the incidence of T1DM is low (2.2 per 1000 inhabitants in 2021) compared to other European countries. In France, the incidence of T1DM in the age group of 0–19 years, in 2021, was estimated at 27.1 per 1,000 inhabitants [5]. Recently reports from all over the world suggest that the COVID-19 pandemic may be contributing to an increase in the incidence of new-onset diabetic ketoacidosis among children [6].

Type 1 diabetes mellitus is an invisible pathology, but it can be difficult for young people to accept. Growing up with the disease can also complicate social and family relationships [7]. One of the challenges of the transition period with adolescents is to gradually give them the means to assume responsibility for their own care [8]. The transition period is experienced differently from one individual to another and from one family to another, depending on the context in which they live. All these variables mean that children and adolescents find themselves taking responsibility further upstream than their age would suggest, which will have a direct or indirect impact on their school career [9].

Statistics in the literature reveal the impact of the disease on schooling, in terms of absenteeism, regression of results, and, more seriously, avoidance or dropping out of school [10, 11]. All this underlines the importance of the patient's environment, family, and peers in reinforcing appropriate strategies, whether

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in terms of practical disease management, psychological support, or advice on school and professional help.

Aim of the study

The aim of this study is to determine the prevalence and characteristics of school failure in T1DM children and to identify associated factors.

Material and methods

This is a retrospective observational study with descriptive and analytical aims, which took place in the Endocrinology Department of Farhat Hached Hospital in Sousse during the period from January 2015 to January 2020.

Our study included children over 10 years of age, with active schooling at the time of diagnosis, followed up at the Endocrinology Department of Farhat Hached Hospital, and suffering from T1DM according to the diagnostic criteria adopted by the American Diabetes Association (ADA) [12].

According to these recommendations, T1DM is defined as a state of hyperglycaemia at any time of the day greater than 2 g/l in the presence of symptoms, or fasting blood glucose greater than or equal to 1.26 g/l, tested twice in the absence of symptoms, associated with autoimmune disorder, defined by positivity of at least 1 of 3 autoantibodies: glutamate decarboxylase (anti-GAD), tyrosine phosphatase (anti-IA-2), and zinc transporter-8 (anti-ZnT8).

Children with other intercurrent illnesses compromising school performance were not included in our study, i.e. cognitive impairment (mental retardation, neurological impairment) and motor handicap. Children on long-term corticosteroid therapy were also excluded.

We used a questionnaire based on medical records, combined with direct interviews with patients, specifying sociodemographic and clinical data.

School failure was defined in our study by the presence of at least one year's repetition and/or exclusion from school. The socioeconomic status was assessed according to the average income of both parents.

The average glycated haemoglobin (HbA1c) one year before the last visit was calculated.

In order to analyse factors associated with school failure, this dependent variable was defined by the interruption of his or her studies or having to repeat at least one year. In univariate analysis, we compared percentages using Pearson's chi-square test. A p -value < 0.05 indicates statistical significance. Significant variables were analysed by logistic regression to determine significant predictors. Statistical analysis was performed using SPSS version 23.0.

Ethical standards

The Bioethical Committee of the Faculty of Medicine of Sousse approved the study, and the agreement number is FMSS-BEC-2023-056. Given the retrospective design of the

study, acquiring explicit consent from the patients was not within the scope of the research methodology.

Informed consent was obtained from the children's parents. Each participant was informed of the purpose of the study. The study was conducted with strict respect for medical confidentiality.

Results

Our study included 70 patients, with a M/F sex ratio of 0.8. The mean age of patients at the time of inclusion was 15.54 ± 5.51 years, with extremes ranging from 11 to 22 years. The mean age at diagnosis of T1DM was 7.36 ± 4.41 years. Age was less than 5 years in 47.1% of cases.

In our study, repeating a year was recorded in 71.4% of cases, and dropping out of school in 47.1% of patients.

The socioeconomic level was medium in 42.9% of patients. Only 17.1% of patients had a high socio-economic level. This variable was not associated with academic results in our patients.

All patients underwent insulin protocols, with 38.6% of our patients treated with human insulin and 61.4% with analogues. The use of human insulin was significantly associated with school failure compared with insulin analogues ($p = 0.042$). Among the patients, only 68.6% were regularly self-monitoring. The absence of self-monitoring was also significantly associated with school failure ($p < 10^{-3}$). Self-titration was performed by only 55.7% of patients. Only 41% of patients achieved an HbA1c target of 7%.

The mean of the last HbA1c assay in patients reporting school failure was significantly higher than in patients without school failure (10.31 ± 2.42 vs. 8.4 ± 1.47 , $p < 10^{-3}$).

We found that 30% had microangiopathic complications. These were mainly diabetic retinopathy (in 8.6% of cases) and microalbuminuria (in 7.1%). There were no cases of macroangiopathy in the population. There was an increase in school drop-out in complicated patients than in healthy diabetics ($p = 0.05$). The number of ketotic decompensations was not associated with risk of school failure ($p = 0.092$) (Table I).

Multivariate analysis adjusted to the diabetes type variable showed that the risk factors significantly associated with school failure were, respectively, a number of hospitalizations for ketosis ≥ 5 with an OR 6.24, 95% CI: 1.11–35.03, $p = 0.037$, and a higher mean HbA1c at last consultations with an OR 2.48, 95% CI: 1.43–4.29, $p = 0.001$.

The following factors were significantly protective against school failure: the use of functional insulin therapy with an OR 0.02, 95% CI: 0.001–0.69, $p = 0.031$, and the use of analogue insulin as a treatment with an OR 0.05, 95% CI: 0.007–0.37, $p = 0.004$ (Table II).

Discussion

Children newly diagnosed with T1DM and their families should receive intensive diabetes education from an interprofessional paediatric diabetes care team [13]. This team should include either an endocrinologist or a paediatrician knowledgeable

Table I. Comparison of school failure according to diabetes-related clinical criteria

Variables	School failure n (%)	p-value
Duration of diabetes		
≤ 5 years	24 (72.7)	0.5
≥ 5 years	29 (78.4)	
Diabetes complications		
Yes	23 (88.5)	0.05
No	30 (68.2)	
Treatment		
Human insulin	24 (88.9)	0.042
Insulin analogue	29 (67.4)	
Self-monitoring of blood glucose		
Yes	23 (59.0)	< 10 ⁻³
No	30 (96.8)	
Number of hospitalizations for ketosis		
[0–4]	25 (67.6)	0.092
≥ 5	28 (47.2)	

able in diabetes management, a dietician, a nurse specialized in diabetes education, a social worker, and a mental health professional, to help them acquire the skills and knowledge needed to manage this disease [14].

Contrary to data published prior to the 2000s, it is now accepted that most children with T1DM achieve an educational level similar to that of their peers, despite more frequent absenteeism or behavioural problems [15, 16].

The family environment is thought to be the most significant determinant of educational success, and its impact is far greater than the cognitive effects that glycaemic imbalance can have on diabetic children [7, 17].

In our study, 71.4% of patients repeated a year, and 47.1% dropped out of school. These are alarming numbers, given that half of these children drop out of school before graduation. Our results are clearly superior to those of other European studies, or even those from the Gulf States, which estimate school drop-out at around 20 to 30% [11, 18, 19]. Even if the drop-out rate is lower, virtually all studies confirm the relationship between poor school performance and the presence of T1DM in children [16, 20, 21]. These results are also much more significant than the literature, which cites the example of an American study that observed only 25% grade repetition in affected children [11].

Table II. Factors associated with school failure

Variables	OR (95% CI)	p-value
Functional insulin therapy protocol		
No	0.02 (0.001–0.69)	0.031
Yes		
Number of hospitalizations for ketosis		
≤ 4	6.24 (1.1–35.03)	0.037
≥ 5		
Type of treatment		
Human insulin	0.05 (0.007–0.37)	0.004
Insulin analogue		
High average of latest HbA1c	2.48 (1.43–4.29)	0.001

OR – odds ratio; CI – confidence interval; HbA1c – glycated haemoglobin

As identified in our cohort, self-monitoring and tight glycaemic control over a long period of time were associated with school perseverance. Our results confirm this by showing a significant association between school dropout and poor glycaemic control. Our data are comparable with numerous studies, notably that of Glaab *et al.*, who found an association between school failure and absenteeism rates positively correlated with current-year HbA1c increases [22].

This is explained by the absence of symptoms pointing to a glycaemic imbalance that tends to let the child concentrate on their school activity. Improved metabolic control reduces both the onset and progression of diabetes-related complications in adults and adolescents with T1DM [23]. Knowledge of glycaemic targets by the diabetic child and their parents, and consistent target values set by the healthcare team, have been associated with improved metabolic control [24]. However, clinical judgment is needed to determine which children can reasonably and safely achieve these target values, and to do so without risk of severe or recurrent hypoglycaemia. The results of a large multicentre observational study have shown that HbA1c targets ≤ 7% can be safely achieved without increased risk of severe hypoglycaemia in school-aged children [25]. In some follow-up studies, episodes of severe hypoglycaemia have been associated with deterioration in cognitive functions, such as memory and learning disorders, while other studies have shown that chronic hyperglycaemia and glycaemic variability in young children (mean age 10 years) were associated with structural changes in white matter and deterioration in overall cognitive performance [15, 26, 27].

We found that functional insulin therapy was a protective factor against school failure. This is logically explained by the better management of diabetes that this protocol enables in terms of instant self-adaptations, reduced complications, and freedom of physical or culinary activities. Numerous studies concur with our findings, demonstrating the efficacy of this insulin management protocol and its protection against hypoglycaemia and complications that can impair school performance [28, 29]. We note that analogues have also been associated with better glycaemic control and less impact on school performance [30, 31]. Analogues offer comfort of use of the injection pen. Some clinic-based studies of the pump in school-age children and adolescents have shown that younger age, HbA1c level at pump initiation, and number of daily boluses may be associated with improved or near-normal school performance [32].

The presence of diabetic comorbidities adversely affects school results. It should not be forgotten that these complications are exacerbated by the child's physiological and psychological growth [33]. A literature review published in 2018 showed that children with T1DM, whose mean duration was 8 years, had an age-adjusted prevalence of diabetic nephropathy of 5.8%, retinopathy of 5.6%, and peripheral neuropathy of

8.5% [34]. Early detection and treatment of other associated autoimmune diseases, particularly hypothyroidism, can prevent worsening school performance due to the psychological damage they cause.

These hormones are necessary for further brain maturity and organized learning [35].

As for addiction, it is well established that alcohol consumption is a risk factor for complications in T1DM (notably hypoglycaemia) [36].

Conclusions

Parents and teachers need to be aware of the additional difficulties faced by children with diabetes and give them all the support and resources they need to succeed at school. Diabetic children must also be encouraged to manage their diabetes and take steps to keep their glycaemic levels normal. Finally, diabetic children should be encouraged to communicate with their teachers and classmates, and to ask for extra help if necessary. By implementing prevention and management strategies, we can reduce the risk of school failure among T1DM patients.

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