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RESEARCH ARTICLE

PREDICTIVE FACTORS OF GOOD METABOLIC CONTROL IN CHILDREN WITH TYPE I DIABETES

L. Saadaoui[1], S. Kebabi[1], C. Nahi[1], Z. Tnacheri Ouazzani[1], N. Benani[2] and Z. Imane[1]

1. Pediatric Diabetes Unit, Children's Hospital of Rabat.
2. The House Of The Young Diabetic.

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Abstract

Introduction: The management of children with type 1 diabetes has been revolutionized first by the discovery of insulin and then by the development of new technologies. Nevertheless, the majority of patients still do not reach their glycemic target.

The main objective of this study is to determine the predictive factors of good metabolic control in children with type I diabetes, in order to develop tailored approaches to improve the quality of management and prevent disease-related complications.

Materials and Methods : Prospective analytical and descriptive study spread over 6 years from January 2015 to January 2021 including type 1 diabetic children diagnosed between 2015 and 2019 and followed up at the "House Of The Young Diabetic"in collaboration with the diabetes department of the children's hospital (P2). Clinical and epidemiological data were obtained from patient's medical records and the Free diab database.

Results : The number of patients meeting the inclusion criteria was 542. A mean A1C in the target range was associated in bivariate analysis with patient age (p=0.003), parental socioeconomic and academic level (p=0.001), adhesion to health coverage (p=0.001), initial HbA1C value (p=0.001), number of self-monitoring of blood glucose (p=0.001), and treatment regimen (p=0.001). In multivariate analysis, the association was statistically significant for 5 parameters: socioeconomic level (ß 0.10; 95%CI 0.10-0.26; p 0.03), parents' academic level (ß 0.15; 95%CI 0.24-0. 5; p=0.002), adhesion to health coverage (ß 0.12; 95%CI 0.18-0.46; p=0.001), initial A1C level (ß 0.16; 95%CI 0.15-0.38; p<0.001) and number of self-monitoring of blood glucose (ß 0.46; 95%CI 0.21-0.3; p<0.001).

Conlusion: Our study demonstrates parameters related to good glycemic control that need to be taken into account to develop new management strategies for children with type 1 diabetes.

Introduction:-

Type 1 diabetes (T1DM), especially when it starts in early childhood, becomes a major family concern. As with any chronic disease, the patient must be managed as a whole, and it is necessary to support the child's family to ensure

Corresponding Author:- L. Saadaoui
Address:- Pediatric Diabetes Unit, Children's Hospital of Rabat.

good adherence to treatment and optimal management. Therefore, the identification of factors that may influence glycemic control is essential to develop new strategies to better manage these patients and prevent the development of short and long term complications. According to data from the literature, factors associated with poor glycemic control are: age and female gender, duration of disease, socioeconomic status, ethnicity, BMI, injection treatment regimen (vs. pump), and psychological factors, all of which are interrelated and probably interdependent [1, 2]. The objective of this study is to verify the impact of these factors on metabolic control in a population of T1DM followed at the pediatric diabetes unit at the children's hospital (P2).

Patients and Methods:

A prospective analytical and descriptive study was conducted at the pediatric diabetology unit at the children's hospital (P2) at Ibn Sina University Hospital in collaboration with the "House ofthe young diabetics", over a period of 06 years, from January 2015 to January 2021. We included (after informed consent from patients and their legal representatives) type 1 diabetics aged <18 years, diagnosed during the period between 2015 and 2019, who were regularly followed up in consultationby pediatric endocrinologists. Type 2 or Mody-type diabetics and patients lost to follow-up were excluded from the study. Epidemiological, clinical, and paraclinical data were collected from the patients' medical records and the Free diab database.

The primary endpoint of the study was glycemic control, represented by the mean of A1C values collected during follow-up. Satisfactory glycemic control was defined by an A1C strictly below 7.5% (According to the 2018 ISPAD guidelines the A1C goal is defined as A1C <7% but in children who benefit from new technologies).

Statistical analysis:

The variables collected were analyzed descriptively: mean, standard deviation, for quantitative parameters and frequency, 95% confidence interval (CI) for qualitative parameters. Relationships between two variables were analyzed by chi-square test. The identification of factors predictive of good diabetes control was done in two steps: first, the search for factors significantly related to good glycemic control by chi-square test and calculation of odds ratios (Odds-Ratio [OR]), then linear regression introducing the significantly related variables in order to assess the specific share of each factor, adjusted on the others.

All statistical analysis was performed using SPSS version 21 software.

Results:-

Epidemiological and anthropometric characteristics of patients:

We evaluated 860 records; only 542 patients met the inclusion criteria of which 48.6% were girls. The mean age was 7.6 years ±4.1. The majority of patients belonged to a middle socio-economic level (60.2%), and 64.2% would sign up for social security coverage. Concerning the parents' academic level, 43.5% were of low level. The initial A1C achieved at the discovery of diabetes showeda major glycemic imbalance in 67.1% of cases (A1C>10%). The treatment regimen consisted of a conventional regimen in 65.1% of cases compared to 34.9% who were under intensivetherapy. Self-monitoring of blood glucose was practiced by most of the patients 88.6% of the cases, 62.7% of them performed more than 4 capillary blood glucose tests/day, and only 0.9% used an instantaneous interstitial glucose measurement system, such as the Free Style. (Table 1).

The mean A1C during follow-up was 8.2% ±1.6 ranging from 5.2% to 14%. The rate of patients with good glycemic control (HbA1C <7.5%) was 36.7% (n=199), and 27.3% were in major glycemic imbalance (Figure 1).

Parameters	**Patients(n=542)**		
	N		**%**
SexMale Female	278 264		51.3 48,7
• **Age(years)**			
1-9	349		64,3
10–14	165		30,4
15–18	28		5
The mean age±standard deviation**7.6±4,1**			
Socio-economic level			

Low	162		30
Middle	327		60.6
High	51		9.4
• **Social security coverage**			
Without	194		35.8
RAMED	130		24
Mutualist	218		40,2
• **Parents' educational level**			
Low<primary	236		43.7
Middle	166		30.7
High	138		25.6
• **Initial A1C**			
<8%	28		5,1
8-10%	150		27,8
>10	364		67,1
Insulin regimen			
Conventional therapy	352		65.1
Basal bolus	189		34.9
Number of glucose measurements			
<4	203		37.5
≥ 4	339		62.5

Table 1:- Epidemiological and anthropometric characteristics of the study population.

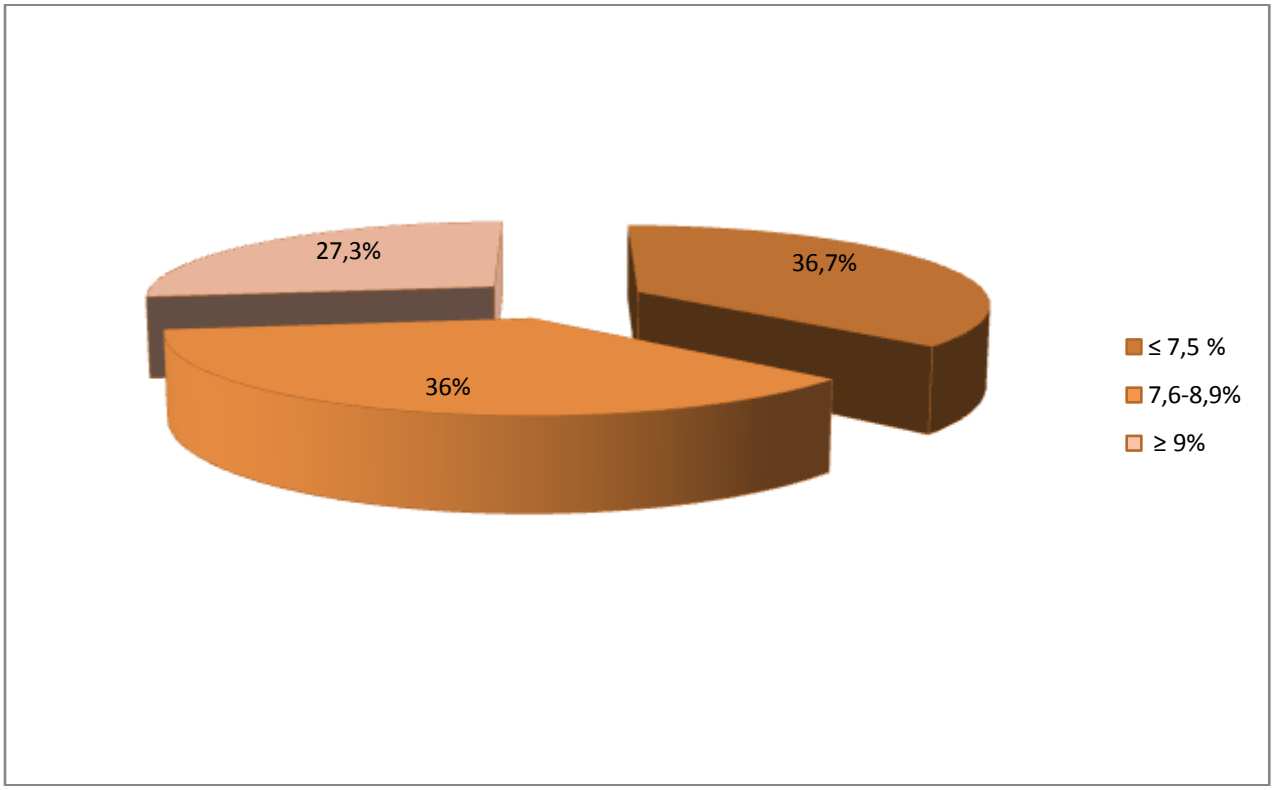

Figure 1:- Distribution of patients according to mean A1C during follow-up.

Predictive factors for good glycemic control:

First, the relationship between each factor and glycemic control was tested in bivariate analysis. The predictive factors of good glycemic control were: Patient age (73.3% of patients achieving their glycemic targets were <10 years old) (p=0.003), middle socioeconomic level (p=0.001), adherence to social security coverage (p=0.001), a

good level of education of the parents (p=0.001) initial A1C value (p=0.001), number of self-monitoring of blood glucose (p=0.001), and treatment regimen (p=0.001).

Multivariate analysis using linear regression to assess factor-specific risk adjusted for other factors revealed the same variables, excluding age and treatment regimen (Table II).

The variables	Standardized coefficients	95,0% confidence interval		P value. 5%
Age	-,007	-,016	,027	,429
sex	-,146	-,033	,040	,213
Socio-economic level	,203	,102	,268	,037
Social security coverage	,033	,118	,156	**,001**
Parents' educational level	,186	,024	,122	**,002**
Initial HbA1C	,160	,150	,380	**,001**
Number of glucose measurements	,304	,218	,350	**,001**
Interstitial glucose measurement	,755	,183	,039	,231
Insulin regimen	,128	-,118	,004	,933

Table II:- Predictive factors of good metabolic control, multivariate analysis.

Discussion:-

This study examined the various factors that may influence glycemic control in children with type 1 diabetes. Multivariate analysis showed a strong and significant association between the socio-economic and educational level of the parents, adherence to social security coverage, number of daily glucose measurements, baseline A1C, and glycemic control. These results were consistent with the literature. In a systematic review, Gloaguen et al demonstrated that demographic factors such as ethnicity and socioeconomic status can have a direct impact on A1C levels [1]. The impact of age and sex has been studied by many series, the results were controversial, some concluded a significant association between female sex, age between 7 and 19 years, and high A1C [3,4,5,6,7], and others were consistent with our results by demonstrating a non-significant association [8,9,10].

In pediatric patients with T1DM, parental involvement in the management is crucial [11]. Good knowledge and perception of the disease by parents improves glycemic control [12] as demonstrated in our study.

The choice of treatment regimen depends on several factors: age, duration of diabetes, lifestyle, metabolic control goals, and most importantly, patient and family preferences. Intensive insulin therapy, and the insulin pump, is currently the reference in terms of insulin regimen, as it contributes to good metabolic control without increasing the hypoglycemic risk [13, 14] and delays the occurrence of long-term complications [15]. Nevertheless, our results do not show superiority of the intensified regimen over the conventional regimen in terms of glycemic control. The DCCT study confirmed that an improvement in long-term glycemic control is not only related to the treatment regimen, but above all to a multidisciplinary approach including psychological support and extensive education allowing the patient and his family to actively participate in the management of the disease [16].

Most patients in our series were performing glucose monitoring. In fact, the number of blood glucose measurements was associated with good glycemic control. These results were comparable to data from the German-Austrian pediatric database showing that in 27,000 young people with T1DM, aged 0-18 years; a decrease in A1C of 0.20% was associated with each additional daily blood glucose measurement [17]. Continuous glucose monitoring is now an innovative technique to overcome the main limitations of conventional self-monitoring. Its use in poorly controlled children and adolescents allows a significant improvement in HbA1c without increasing the number of hypoglycemic episodes [18].

A significant association between a high initial A1C value at diagnosis and subsequent poor glycemic control during follow-up was identified by the present study; however this association remains to be confirmed by further randomized studies.

Overall, we demonstrated encouraging results in terms of the percentage of patients with good glycemic control, which was 36.7%, compared with some data in the literature that reports a rate between 17 and 23% [19].

Conclusion:-

The identification of factors influencing glycemic control is necessary in order to predict patients at risk of glycemic imbalance, and to establish adapted strategies involving, in addition to the medical and paramedical body, the different actors, namely the Ministry of Health, the civil society and the Ministry of National Education, for a better management of the type 1 diabetic child.

From all the above, we suggest:

1. The generalization of social coverage: Morocco is already on the right track by launching its plan to generalize social coverage to cover 22 million people by the end of 2022, which will allow the generalization of the prescription of intensive insulin therapy.
2. The fight against illiteracy and school dropout: since a good percentage of parents are either illiterate or have a primary school education.
3. The introduction of new technologies on the Moroccan market, especially in the field of glycemic monitoring (blood glucose measurement systems).
4. Psychological support and social assistance from the moment of diagnosis and throughout the follow-up.

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