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A strategy for an interdisciplinary intervention on children with diabetes: a pilot study

Strategie de intervenţie interdisciplinară asupra copilului cu diabet: studiu pilot

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Abstract

Background. Specialists draw attention to the alarming incidence of type 1 diabetes mellitus during childhood, registering over 140,000 young people with this disease in Europe.

Aims. The aim was to explore a strategy based on motor, psychological, social and nutritional interventions addressed to children with type 1 diabetes mellitus, besides specific medical care, in order to improve their overall well-being.

Methods. This study comprised 11 children aged between 5 and 12 years and their families. For the motor intervention, the experiment included extracurricular physical activity once per week. The assessments consisted of Matorin and Eurofit tests. For the psychological intervention, our goal was to identify the emotional challenges that children with diabetes had to face. In this respect, the Man test was applied. For the social intervention, we conducted a social survey based on two questionnaires: one for the parents of children with diabetes, and one for the classmates of a child. For the nutritional intervention, counseling sessions for parents were conducted. The nutritionist's reports and the medical records were analyzed.

Results. The applied physical exercises were the only extracurricular physical activity performed by the subjects, with 3 exceptions. Ninety percent of children drew the entire silhouette, 10% drew only the torso. The parents rarely faced social problems. The report on nutritional counseling activities highlighted a major difficulty in carrying out this approach.

Conclusions. The strategy was effective in fulfilling the specific medical diabetes care and indirectly increasing the well-being of the subjects.

Keywords: diabetes, children, physical activity.

Rezumat

Premize. Specialiştii atrag atenţia asupra incidenţei alarmante a diabetului zaharat de tip 1 la copii, înregistrându-se peste 140.000 de tineri cu această afecţiune în Europa.

Obiective. Obiectivul principal al acestui studiu a fost de a explora o strategie interdisciplinară bazată pe intervenţii de ordin motric, psihologic, social şi nutriţional, adresată copiilor cu diabet zaharat tip 1, alături de îngrijirea medicală de specialitate, în vederea creşterii calităţii vieţii acestora.

Metode. Cercetarea a inclus 11 copii, cu vârste cuprinse între 5 şi 12 ani şi familiile acestora. Pentru intervenţia motrică, experimentul a presupus desfăşurarea de activităţi motrice extracurriculare o dată pe săptămână. Evaluarea s-a realizat prin intermediul testelor Matorin şi Eurofit. Pentru intervenţia psihologică, scopul nostru a fost de a identifica dificultăţile de natură emoţională cu care se confruntă copilul cu diabet. În acest sens, a fost aplicat testul Omului. Pentru intervenţia socială, s-au desfăşurat două anchete pe bază de chestionar: una adresată părinţilor copiilor cu diabet şi alta adresată colegilor de clasă ai unuia dintre subiecţii cercetării. Pentru intervenţia nutriţională, au fost organizate şedinţe de consiliere şi analizate rapoartele elaborate de către nutriţionist.

Rezultate. Programul de exerciţii fizice aplicat a constituit singura formă de activitate extracurriculară desfăşurată de către subiecţi, cu excepţia a 3 dintre aceştia. Nouăzeci la sută din copii au desenat corpul în întregime, iar 10% au desenat numai torsul. Părinţii au întâmpinat rar dificultăţi sociale. Raportul privind consilierea nutriţională a evidenţiat o dificultate majoră în implementarea acestei direcţii de intervenţie.

Concluzii. Strategia de intervenţie interdisciplinară aplicată a fost eficientă în ceea ce priveşte atingerea obiectivelor de ordin medical, specifice diabetului şi, indirect, a determinat creşterea calităţii vieţii subiecţilor.

Cuvinte cheie: diabet zaharat, copii, exerciţiu fizic.

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Introduction

Worldwide specialists draw attention to the alarming incidence of diabetes during childhood, as this autoimmune disorder occurs more often between 0 and 4 years old (Green & Patterson, 2001). Statistics show that in Europe, over 140,000 people suffer from type 1 diabetes mellitus (T1DM). Under the age of 25, there are as many or even more, according to estimates, because no updated record exists in this respect. Regarding children diagnosed with T1DM in Romania, it is known that there are almost 3,000 medically recorded cases (Moraru et al., 2008) and up to 2,000 unrecorded cases.

Facing the challenge of T1DM at early ages requires complex treatment for good diabetes management and changes in the lifestyle of the whole family. Besides the specific therapy involving insulin dependence, diet and physical activity, children with diabetes must cope with social issues linked to their possibilities of taking part in different activities alongside their peers (Sherrill, 2004). The topic of T1DM is even more complex, since medical references emphasize the comorbidities that an individual with chronic disease may develop throughout life. Among the diabetes complications, Nathan (1993) mentions the following: peripheral and autonomic neuropathy, silent ischemia, cardiac arrhythmia and sudden death. Hypoglycemia unawareness during the night, also known as the "dead-in-bed syndrome", is the cause of sudden unexplained deaths of young people with T1DM (Secrest et al., 2011).

Evidence claims that regular physical activity improves health and well-being in T1DM individuals, leading them to achieve the targeted lipid profile, body composition, fitness and glycemia goals (Quirk et al., 2014). Authors such as Bachmann et al. (2016) recommend physical activities for T1DM children after they are trained on how to fight and manage blood glucose fluctuations.

Although physical activity is recognized to have essential advantages for T1DM patients, most children tend to have a less active lifestyle. Hypoglycemia that may occur both during and after physical exercise is closely linked to physical activity. Thus, the fear of an uncontrolled decrease in the blood glucose levels influences the involvement of T1DM children in sports activities (Riddell et al., 2017) and may lead to a sedentary lifestyle. Repeated hypoglycemic episodes generate anxiety, depression, low self-esteem, limitations in daily activities and social issues due to school absenteeism (Alvarez-Guisasola et al., 2010). These aspects are reflected in the overall well-being of T1DM children and their quality of life. Moreover, each family member will be emotionally affected and disturbed by the health state of their relative.

Objectives

The aim of the study was to explore an interdisciplinary strategy based on motor, psychological, social and nutritional interventions, addressed to children with type 1 diabetes mellitus, besides the specific medical care, in order to achieve a good diabetes management without major oscillations of glycemia values and indirectly to improve the overall well-being.

Hypothesis

The study hypothesis was that applying an interdisciplinary intervention to children with type 1 diabetes mellitus would allow avoiding hypoglycemia episodes due to physical exercise and would lead to educate young patients for embracing an active way of living, in order to increase their quality of life.

Material and methods

Research protocol

This study was designed as a pilot research that could be developed and applied for European funds within the Erasmus + Sport program and H2020 projects. The entire strategy was planned with the diabetes medical care and was structured into four components: motor, psychological, social and nutritional.

The research complied with the World Medical Association Declaration of Helsinki (1). The legal guardians of the children gave their written consent for the participation of the subjects in the project activities, the processing of personal data and the publication of results. The research protocol was supervised by a medical specialist in pediatric diabetes care (VM subj). The Ethics Committee of UNEFS Bucharest approved this study involving human subjects (893/21.03.2016).

a) Period and place of the research

The research took place at the National University of Physical Education and Sports from Bucharest, in collaboration with DiabNutriMed Clinic of Diabetes, during 2014 - 2016.

b) Subjects and groups

The strategy involved 11 children with T1DM, aged between 5 and 12 years (8 boys and 3 girls), from the DiabNutriMed Clinic of Diabetes in Bucharest. Their medical history showed that they had unbalanced diabetes and repeated severe fluctuations in blood glucose levels when they were included in the study. Also, their treatment was focused only on insulin therapy and blood glucose control, neglecting physical activity, psychological challenges, healthy diet and social interactions.

Their families, adults aged 35 to 45 years, were also engaged in the research. Eleven parents (3 fathers and 8 mothers) participated in our study, 3 of the mothers working as social personal assistants for their children.

c) Tests applied

For the *motor intervention*, the designed experiment included leisure activities, with physical activity once per week (Urzeală, 2014). The applied program was based on moderate-intensity aerobic exercise performed for 1 hour to 1 hour and a half, varying according to blood glucose levels. The physical activity sessions included dynamic games, dance, gymnastics and body expression, all of them tailored to the metabolic reactions of children. For safety reasons, fresh fruit juice, carbohydrate products with fast and slow absorption, still water and dextrose tablets were made available to children. Pre-, intra- and post-effort blood glucose levels were measured and registered for each subject. Depending on those values, snacks were provided to avoid hypoglycemia. Two assessments, initial and final, were conducted at the beginning and at the

end of the motor intervention, consisting of the Matorin test and the Eurofit Test Battery. A major difficulty was encountered in organizing the physical exercise program, because of the children's timetable and extracurricular activities, the parents' professional duties and the distance to cover to get to UNEFS in rush hours. These issues led to only one physical activity per week, on Saturdays, but each subject was given individual recommendations about what to perform at home, at least twice a week.

For the *psychological intervention*, our goal was to identify the emotional challenges that children with diabetes had to face. For this purpose, the Man test (Draw yourself!) was applied (Verza, 2004). Children received a piece of paper and were asked to draw themselves. With the support of a psychologist from UNEFS, we described the emotional aspects revealed by analyzing each body limb drawn (Urzeală & Bejan, 2016).

For the *social intervention*, we conducted a social survey based on two questionnaires: one addressed to the parents of T1DM children, and the other addressed to the classmates of a subject with type 1 diabetes mellitus (AND subj) that was part of our group. In this study, the analysis of the items was presented only partially, as considered relevant for the global pictures of the interdisciplinary strategy. The questionnaire for parents was designed by us and included 19 items grouped on three main directions: the child's functional independence, his/her social integration and the support from healthcare services. The respondents were asked to express their opinions relating to different social contexts (Urzeala & Teodorescu, 2015). For the social integration issues of T1DM children, our intervention considered only one of the subjects, namely a boy (AND subj) facing the need to be understood by his classmates. In this respect, 18 healthy children (aged 6-7 years) matched for age and the school grade, participated in the research. The classmates of the T1DM child filled out a questionnaire with 12 items concerning: the involvement of their peer in physical education lessons; team building and choosing the practice partner; the pupils' opinions about the different lifestyle of their peer. Items 6 to 9 allowed creating Moreno matrices, which emphasized the axiological relationships expressed during the physical education lessons.

For the *nutritional intervention*, 10 nutritional counseling sessions for parents were conducted by a nutritionist from the "Anamaria Iulian" Individual Medical Practice in Bucharest, while the T1DM children were performing physical activities. These activities aimed to raise parental awareness of the energy value of different foods, so that they could choose the healthiest products. In this regard, our references are based on the report drawn up by the nutritionist.

Medical care was provided by the children's diabetes physician (MV subj) from DiabNutriMed Clinic of Diabetes in Bucharest. The specialist watched the subjects 24 hours a day and monitored their blood glucose levels using modern telemedicine devices (Continuous Glucose Monitoring System, insulin pumps, Night Scout platform), preparing reports for each patient. In this study, we present the case of a girl (AT subj) using an Omnipod wireless insulin pump.

d) Statistical processing

Data analysis was performed using Microsoft Office Excel 2007. For motor assessment, the mean, standard deviation and paired t-test were calculated. For the questionnaires, a percentage analysis and Moreno social matrices (Neculau, 2007) were performed, also calculating the group cohesion index (Dragnea, 2006).

Results

The participating subjects (Table I), aged between 5 and 12 years (mean: 8.9 years), were normal weight children, without body composition problems. Their average Body Mass Index (BMI) was 17.80, indicating good control of their body weight, according to age.

The patients had no other health issues or diabetes complications, with only one exception, a gluten allergic patient (NC subj). They were not registered with medical exemptions from the physical education lessons, being encouraged by their physician to participate in sports activities. Children's involvement in physical exercise was facilitated by the use of Dexcom Platinum G4 Continuous Glucose Monitoring System (CGMS) (7 subjects). Only 3 children used insulin pumps - 1 wireless (AT subj) and 2 wire pumps. The physical activity program organized within our project was the only extracurricular physical activity for the subjects, except for 3 boys: 2 practicing basketball and 1 performing swimming, as leisure.

Significant improvements were noticed in 4 of the applied *motor assessments*, namely in 2 Eurofit tests (Flamingo and tapping), and in the Matorin test (Table II).

Table I

Children with T1DM participating in the research

No.	Subjects' initials	Age (years)	Gender	Weight (kg)	Height (cm)	BMI	CGMS user	Insulin pump	Physical activity
1	AB	8	M	35	140	17.9	yes	yes	basketball
2	AM	12	F	55	167	19.7	no	no	none
3	AND	6	M	22	119	15.5	yes	no	swimming
4	ARC	11	M	43	149	19.4	yes	no	none
5	AT	9	F	38	160	14.8	yes	yes	none
6	VE	5	M	20	116	14.9	no	no	none
7	MM	9	M	30	138	15.8	yes	no	none
8	NC	5	F	21	119	14.8	yes	no	none
9	ŞtS	9	M	37	138	19.4	yes	yes	basketball
10	AR	12	M	51	153	21.8	no	no	none
11	MP	12	M	54	157	21.9	no	no	none

Table II
Statistics for the motor assessments

Motor assessment	Mean		T-statistic	P
	Initial	Final		
Flamingo	13.45 ± 9.05	10.90 ± 8.12	4.81	<0.001
Tapping	19.27 ± 5.04	17.63 ± 6.59	1.82	<0.05
Right turn jump	300.9 ± 59.74	335.90 ± 3.085	3.085	<0.01
Left turn jump	257.27 ± 88.55	290.90 ± 60.73	3.29	<0.01

We focused on the *emotional challenges* revealed by the Man test. Ninety percent of children with diabetes drew the entire silhouette and 10% drew only the torso. In 46% of cases, the eyes were missing or were small, and 73% of subjects drew themselves without ears. Also, 45% of children drew the face with no nose, and 55% drew only a pointed out nose. There were 10 drawings with wavy, mop or neat hair, while the hair was missing in one drawing. Fig. 1 illustrates a drawing made by one of the participants who showed anxiety and fear of expressing his emotions.

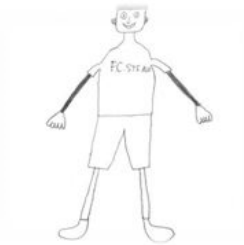

Fig. 1 – Example of drawing made by one of the participants

The *social survey* revealed that the parents of T1DM children had rarely faced social problems related to isolation or marginalisation: 29% - to a small extent, and 71% - not at all (Fig. 2).

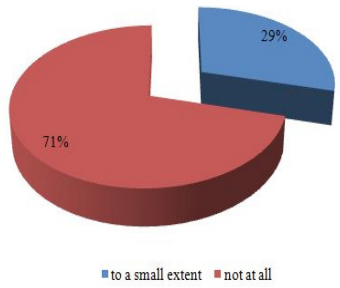

Fig. 2 – Attitudes of social rejection felt by the parents

The social survey also showed that the classmates of the T1DM child had a tendency to isolate him during the physical education classes, and only two options for shared motor tasks were recorded (Fig. 3).

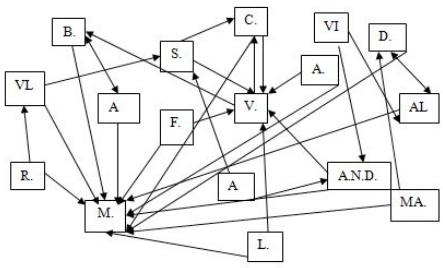

Fig. 3 – Moreno matrices for the child with T1DM in physical exercise.

For this child, the survey evidenced a social status index of 0.37 and a group cohesion index of 0.02.

The report on *nutritional counseling activities* highlighted a major difficulty in carrying out this approach, because parents fighting against their children's disease were convinced that they were acting properly when choosing the diet, and therefore they were reluctant to other recommendations. Strong persistence was noted in giving their children only the usual food, although they understood that certain products were less healthy. Thus, an inner conflict arises between the pain generated by the child's lifestyle and the restrictions imposed in the choice of food.

The *diabetes medical report* emphasized that including physical activity in the treatment of T1DM children helps achieve the glycemia goals and reduce the amount of insulin. In this respect, we exemplify the monitoring of diabetes for one subject (AT subj), by using the DexCom Platinium CGMS, Omnipod wireless insulin pump and Night Scout platform in two different days, with and without physical activity. We noted that the need for insulin dropped by 0.7 units on the day the child performed physical activity.

Discussions

The quality of life of the investigated children was difficult to measure due to their age and limited functional independence related to the caregiving provided by their parents. Thus, the research objective was assessed through the balanced diabetes obtained during our intervention, which was revealed by the medical follow-up. As a result of our interdisciplinary strategy, better control of blood glucose fluctuations was achieved for all participants, which improved their quality of life by allowing them to practice sports without any risk, attend all school activities (without absenteeism caused by hypoglycemia) and raise parents' awareness of the emotional challenges and social issues faced by their children. Furthermore, insulin therapy was improved for one subject, which led to good diabetes management and consequently to better quality of life.

Motor intervention

It was noticed that children became more active and increased their participation in physical activities. During the program, their great emotional involvement, strong wish to play and win, minor worry for blood glucose levels and fewer reported symptoms of blood glucose fluctuations were also observed. Regarding our recommendation to perform physical training sessions at home, parents recognized they had not complied with the individual programs prescribed for their children. The subjects generally performed 3 physical activity sessions per week, with an average duration of 60 minutes each (2 physical education classes in school and 1 physical activity within our intervention). Even so, the American Diabetes Association standards regarding the amount of physical activity that T1DM children must include in their daily treatment program were not reached. An average 60 minutes/day of moderate to vigorous intensity aerobic activity is prescribed, with muscle strengthening and bone strengthening activities included at least 3 days/week (***, 2017).

For children with T1DM, the BMI is not an impediment to get involved in physical activity and, since their weight

is normal, they do not perceive the sedentary lifestyle they have as a threat for their body composition and risk of obesity. As studies highlight that intensive insulin therapy leads to BMI issues for adults with T1DM (***, 2001), we consider it important to educate children to adopt an active lifestyle for their future normal development.

The age distribution from 5 to 12 years influenced the choice of the instruction contents and the relevance of motor assessments. Being a socially harmonious group of children before our intervention, their parents refused to have them divided into two categories of ages to perform various training sessions. Moreover, children preferred to play all together, regardless of their age, the older ones always helping the younger kids in performing the same motor tasks. Physical activity was customized for each repetition in accordance with their age, motor skills and blood glucose fluctuations. The CGMS proved to be an efficient tool in conducting physical activities with the investigated subjects and avoiding hypoglycemic episodes.

Psychological intervention - Emotional issues related to anxiety, communication difficulties and the worry about not disappointing their parents and peers were identified. Lawrence et al. (2012) emphasized similar results in their studies, explaining that T1DM subjects might face distress, depression, anxiety and eating disorders.

Social intervention - Families participating in our survey had a social comfort created over time by carefully choosing the social group they wanted to join, as a protective measure for the child and themselves.

Even if we conducted team building activities with the classmates of the child exposed to social isolation, this subject moved to another school the following year. The cohesion index was influenced by the fact that the initial group matching his school age had been formed a short time ago (6 months).

Nutritional intervention - In case of hypoglycemia, children preferred to consume the sweets they were used to, but not always the healthier ones, even if they had other choices. This intervention failed, parents being reluctant to accept the proposed nutritional counseling activities. As diet is an important factor for the growth process of each child, we consider that this intervention has still remained unexplored. Bento et al. (2015) also supported in their studies the need for food and nutrition education strategies in order to enable adult people to recognize and adopt a healthy diet for their children and themselves.

Diabetes medical care - Children did not record severe hypoglycemia during our interdisciplinary intervention and achieved good diabetes management, which was revealed by the regular blood analysis specific to this metabolic disease. The need for insulin is lower when the T1DM child gets involved in physical activity, which was demonstrated for one of the studied subjects. This outcome is consistent with the American Diabetes Association Standards of Care (***, 2017), which have emphasized insulin resistance as one of the physical activity benefits for T1DM children. Because of the high cost, the young patients with T1DM included in our research cannot easily benefit from wireless insulin pumps and CGMS as standards of care able to ensure proper insulin therapy.

Limitations of the study

The quality of life of the investigated subjects was not directly assessed, due to their young age and limited functional independence. This can be viewed as a study limitation.

Children showed low availability for extracurricular activities, which restricted the statistical analysis on the differences between boys and girls, preschool and primary school subjects. The large range of participants' age limited the analysis of any existing psychosocial differences.

The use of non-standardized tests is another limitation of this pilot study, the findings not being presented in a totally objective approach.

Conclusions

1. The applied interdisciplinary strategy was effective in improving the quality of life of T1DM children and, even if this aspect was not directly assessed, it was reflected in the diabetes management that was achieved.

2. The motor, psychological, social and nutritional interventions addressed to T1DM children fulfilled the specific medical diabetes care and positively interacted, which led to an increase in the well-being of these young patients.

3. The physical activity program was also effective in combating the participants' sedentary lifestyle, but it can be improved in further studies by adjusting the subjects' compliance and including other kinds of sports (e.g. playful outdoor activities or aquatics).

4. Further nutritional intervention must be pursued, as the strategy applied in this study did not receive the expected echoes from the participating parents. Their poor involvement in healthy diet counseling must be countered by further educational approaches meant to change the eating behaviors of the whole family.

5. The complex therapy of T1DM children should address not only insulin dependence, diet and physical activity, but also the psychosocial challenges that the young patients and their families must face and manage throughout life.

Conflicts of interests

The authors had no interests in the outcomes of this study that might be considered a personal advantage or a compromising fact for the integrity of this research.

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