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Assessing the knowledge of the consequences of uncontrolled diabetes in pregnancy and its effects on fetal development, among female adolescents with type 1 diabetes

Ocena wiedzy nastolatek z cukrzycą typu 1 na temat wpływu złej kontroli metabolicznej cukrzycy na przebieg ciąży i rozwój płodu

[1]Anna Wołoszyn-Durkiewicz, [1]Magdalena Żalińska, [1]Agnieszka Brandt, [1]Małgorzata Myśliwiec, [2]Maja Ściesińska, [3]Joanna Kuhn

[1]Klinika Pediatrii, Diabetologii i Endokrynologii, Uniwersyteckie Centrum Kliniczne w Gdańsku [2]NZOZ Wanda Kabata Medycyna Rodzinna [3]VII Szpital Marynarki Wojennej z Przychodnią, Samodzielny Publiczny Zakład Opieki Zdrowotnej im. kontradmirała profesora Wiesława Łasińskiego w Gdańsku

Abstract

Introduction. Two forms of diabetes can be distinguished during pregnancy: gestational diabetes and pregestational diabetes, which exists prior to pregnancy. In young women, the most common form of pregestational diabetes is type 1 diabetes (T1D). Regarding the decreasing age of sexual initiation and health risks for the mother and child related to hyperglycemia, it is essential that adolescents with T1D possess proper knowledge of pregnancy planning and diabetes management in case of pregnancy. Preconception counseling in adolescent patients with T1D remains a challenge for the whole therapeutic team. **Aim of the study.** Assessing the awareness of consequences of uncontrolled diabetes on the course of pregnancy and fetal development among patients with T1D. **Material and methods.** The study was carried out in the group of 70 patients with T1D, aaged 15-18 years. The survey was consisted of 25 questions regarding health status, lifestyle, the knowledge of self-management of diabetes and the impact of diabetes on pregnancy and fetal development. Respondents were asked to indicate the sources of information from which they had gianed knowledge about the aforesaid issues. The data obtained were statistically analyzed. **Results.** 20% (n=14) of respondents declared sexual activity. In the group of sexually active patients, in 50% (n=7) last HbA1c level, reported by subjects, was between 7.5-9%, and in 21.4% (n=3) >9%. The patients were aware of the consequences of uncontrolled diabetes on fetal development, however their knowledge was unsatisfactory. Surveyed adolescents indicated metabolic disorders (61.4 %, n=43), central nervous system malformations (55.7%, n=39) and heart defects (47.1%, n=33) as the most frequent complications. The respondents gathered knowledge mainly from a diabetologist (40%, n=28) and the Internet (40%, n=28). The majority of patients stated that preconception care should be provided by a diabetologist (88.6%, n=62) or a gynecologist (70%, n=49). **Conclusion.** In spite of continuous diabetes care, adolescents with T1D do not possess sufficient knowledge regarding the consequences of hyperglycemia during pregnancy. This study has emphasized the need for including reproductive health issues in diabetes education addressed to adolescent patients.

Key words

type 1 diabetes, adolescents, pregnancy, fetal development

Streszczenie

Wstęp. W trakcie ciąży możemy wyróżnić cukrzycę ciążową i przedciążową, rozpoznaną przed zajściem w ciążę. U młodych kobiet najczęstszą postacią cukrzycy przedciążowej jest cukrzyca typu 1 (T1D). Z uwagi na stale obniżający się wiek inicjacji seksualnej oraz zagrożenia zdrowotne dla matki i dziecka, mogące wynikać z hiperglikemii, ważne jest, aby nastolatki z cukrzycą typu 1 posiadały odpowiednią wiedzę dotyczącą planowania ciąży i postępowania w jej przebiegu. Opieka prekoncepcyjna u nastoletnich pacjentek z cukrzycą typu 1 stanowi wyzwanie dla całego zespołu terapeutycznego sprawującego opiekę nad tą grupą pacjentek. **Cel badania.** Określenie świadomości wpływu niewyrównania metabolicznego cukrzycy na przebieg ciąży i rozwój płodu u nastolatek z cukrzycą typu 1. **Materiał i metody.** Anonimowe badanie ankietowe zostało przeprowadzone w grupie 70 pacjentek z T1D w wieku 15–18 lat. Ankieta składała się z 25 pytań sprawdzających wiedzę w zakresie samokontroli cukrzycy, wpływu cukrzycy na przebieg ciąży

lek. Anna Wołoszyn-Durkiewicz
Klinika Pediatrii, Diabetologii i Endokrynologii,
Uniwersyteckie Centrum Kliniczne w Gdańsku
ul. Dębinki 7, 80-952 Gdańsk, tel. 58 349 28 90
e-mail: aniawoloszyn@onet.pl

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i rozwój płodu oraz pytań dotyczących stanu zdrowia i stylu życia, a także źródeł pozyskiwanej wiedzy. Odpowiedzi poddano analizie statystycznej. **Wyniki.** 20% (n=14) ankietowanych deklarowało aktywność seksualną. W grupie aktywnych seksualnie nastolatek u 50% (n=7) deklarowany poziom HbA1c wynosił 7,5–9%, a u 21,4% (n=3) >9%. Badane pacjentki były świadome negatywnego wpływu źle kontrolowanej cukrzycy na płód, jednakże ich wiedza była niepełna. Jako najczęstsze powikłania wskazywały zaburzenia metaboliczne (61,4%, n=43) oraz wady mózgu (55,7%, n=39) i serca (47,1%, n=33). Wiedzę czerpały głównie od diabetologa (40%, n=28) i z internetu (40%, n=28). Większość pacjentek uważa, że informacji o ciąży powinni udzielać diabetolog (88,6%, n=62) oraz ginekolog (70%, n=49). **Wnioski.** Pomimo stałej opieki diabetologicznej poziom wiedzy nastolatek z cukrzycą typu 1 na temat powikłań hiperglikemii w ciąży jest niewystarczający. Przeprowadzone badanie wykazało konieczność poszerzenia edukacji diabetologicznej w okresie adolescensji o tematykę koncepcyjną.

Słowa kluczowe
cukrzyca typu 1, nastolatki, ciąża, rozwój płodu

Introduction

The incidence rate of diabetes is still increasing over the recent years. The most frequent type of diabetes diagnosed during childhood and adolescence is type 1 diabetes (T1D), which is characterized by the absolute deficiency of insulin secretion due to autoimmune destruction of β cells of the pancreas. According to IDF report (International Diabetes Federation), in 2015 there were over 542.000 children affected by diabetes worldwide [1].

Regarding the decreasing age of sexual initiation and health risks for the mother and child, related to hyperglycemia, it is essential that adolescents with T1D possess proper knowledge of pregnancy planning and diabetes management in case of pregnancy. According to literature data, the mean age of sexual initiation in women ranges between 15 and 18 years [2]. Preconception counseling in adolescent patients with T1D remains a challenge for the whole therapeutic team.

Two types of diabetes can be distinguished during pregnancy, gestational diabetes, a hyperglycemic state firstly recognized during pregnancy and pregestational diabetes, which exists prior to pregnancy [3,4].

Pregestational diabetes, most frequently T1D, constitutes around 10–20% of cases of diabetes in pregnancy. In pregestational diabetes, good metabolic control of disease before conception, or at least at the moment of conception, and during first 8–10 weeks of pregnancy (organogenesis period), has a pivotal role [5]. Uncontrolled diabetes increases the risk of numerous complications for the mother and child.

Poorly managed diabetes is associated with higher incidence rate of perinatal mortality of mothers and infants. Numerous clinical studies have shown that there is a relation between blood glucose concentration during organogenesis and the risk of spontaneous miscarriages as well as the development of congenital anomalies in fetuses [6]. Maternal hyperglycemia predisposes to intrauterine hypertrophy, which in turn, leads to the higher risk of preterm labour, birth injuries and perinatal hypoxia. On the other hand, fetal hypotrophy may be observed in pregnant women who suffer from vascular complications of diabetes. This condition is associated with higher risk of intrauterine deaths. Moreover, uncontrolled diabetes in pregnancy may cause a wide range of neonatal complications such as: respiratory distress syndrome, hypoglycemia, hypocalcemia, hyperbilirubinemia, polycythemia, as well as central nervous system, heart and renal malformations [3]. Furthermore, it increases the mortality rate in the first year of life of infants [7]. Finally, long-term complications such as type 2 diabetes, obesity or worse psychosomatic and intellectual development, may be present in children of diabetic mothers [3–5,8].

Therefore, it is imperative that conception occurs when good metabolic control is achieved. According to Polish Diabetes Association recommendations, target level of glycated hemoglobin (HbA1c) in patients with T1D is <6.5%, whereas optimal levels of fasting glycaemia should be ranged between 80–110 mg/dl (4.4–6.1 mmol/l) and <140 mg/dl (7.8 mmol/l) two hours after meal ingestion. Patients with pregestational diabetes, who plan pregnancy, are recommended to achieve HbA1c level <6.5% beforehand. However, in II and III trimester of pregnancy, the therapeutic goal of HbA1c is more restrictive (<6%), unless the intensification of insulin treatment increases the rate of hypoglycemia [9]. Diabetic patients, who plan pregnancy, should receive professional care at diabetes and obstetric centers. In Poland, just a few percent of women affected with diabetes become pregnant in such circumstances. In reality, the majority of women are provided with professional care in 6–10 weeks of pregnancy. The degree of metabolic control varies among patients. Pregnancy planning should be considered in young diabetic females in order to enable fetal development while organ complications of diabetes are not serious [5]. According to ADA guidelines (American Diabetes Association) preconception care should be provided to all women with diabetes of child-bearing potential and counseling should start at puberty [10].

Aim of the study

The aim of the study was to assess the awareness of the consequences of uncontrolled diabetes on the course of pregnancy and fetal development, among patients with T1D. The researchers were interested in the percentage of sexually active patients and the age of sexual initiation for the purpose of evaluating the potential need for intensification of education regarding pregnancy planning, complications of poorly

controlled glycemia, and the treatment of diabetes during pregnancy, in adolescents with T1D. In addition, the authors wanted to estimate the level of self-control and diabetes management in the surveyed adolescents.

Material and methods

A survey was conducted at the Clinic of Pediatrics, Diabetology and Endocrinology of University Clinical Centre in Gdańsk for 15 months. The study was carried out in the group of 70 patients with T1D, aged 15–18 years. The survey was anonymous, the participation was voluntary. Ethical approval was obtained from the local ethics committee. Criteria for participation included: T1D lasting at least one year, written consent from the patients and their parents or guardians. The survey consisted of of 25 single- and multiple-choice questions.

The researchers received data concerning patients' treatment, their adherence to medical and dietary recommendations (questions concerning diet, physical activity and keeping diabetes logbook) as well as last glycated hemoglobin level. Thereby, the metabolic control of diabetes in interviewed patients was assessed. The survey included a number of questions concerning the impact of diabetes on pregnancy and on maternal and fetal health. Adolescents were questioned for the source of information from which they had gained knowledge about the aforesaid issues. They were asked to indicate the preferable way of educational training. The data obtained were statistically analyzed with the use of Excel software.

Results

Average age of interviewed adolescents was 16.14±1.15 years, whereas average age at the time of diagnosis of diabetes was 9.25±3.58. The patient with the longest history of diabetes had been suffering from this disease for 16 years. The average duration of diabetes was 7±3.68 years.

In the first part of survey the researchers focused on the patients' lifestyle and their adherence to self-monitoring of blood glucose recommendations. 44.3% of respondents (n=31) were treated with the personal insulin pump, whereas 55.7% (n=39) were treated with multiple daily dose injections. The majority of patients regularly monitored their blood glucose levels – 42.9% over 6 times a day (n=30), 40% (n=28) 3–6 times a day. Among the surveyed adolescents – 28.6% (n=20) did not keep diabetes logbook. All of the patients claimed to know dietary recommendations in diabetes. However, 15.7% (n=11) admitted that they did not manage to respect healthy diet rules. Only 10% (n=7) of patients stated that they disliked physical effort. Among others, 64.3% (n=45) attended sporting activities after school and 15.6% (n=7) of them practiced sport professionally. 91.4% (n=64) of patients menstruated, in this group 56.3% (n=36) reported having regular menstrual cycles. The average age at menarche was 12.8 ±1.6 years.

20% (n=14) of respondents declared sexual activity (Fig. 1). The age of sexually active subjects ranged from 16 to 18 years. The majority of them – 78.6% (n=11) indicated condoms as the preferred method of contraception. In the group of the surveyed adolescents no one used oral contraceptives. One of the subjects, aged 17 years old, reported using a transdermal patch and one 16 years old patient indicated an intrauterine spiral as the chosen method of contraception. One of the patients did not use any form of contraceptives.

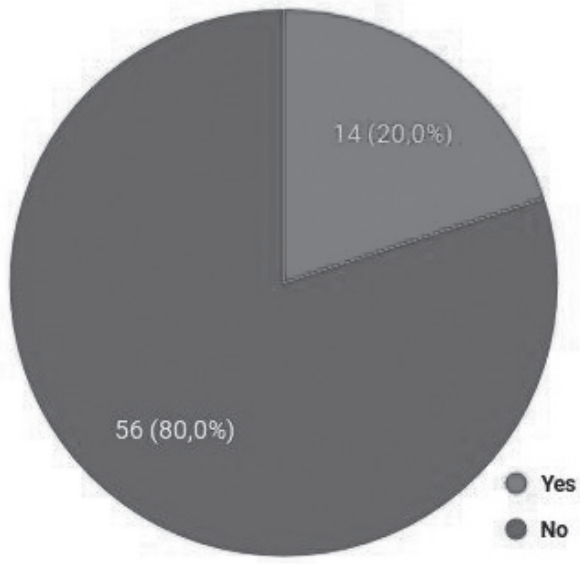

Fig. 1. Sexual activity among the surveyed adolescents
Ryc. 1. *Aktywność seksualna wśród ankietowanych nastolatek*

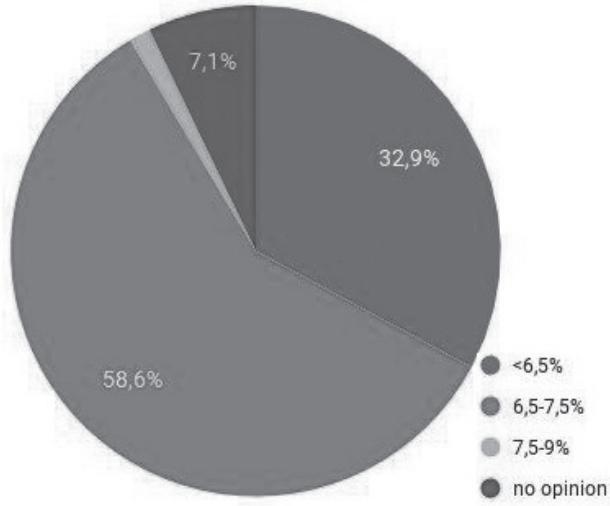

Fig. 2. Target HbA1c level in T1D according to patients
Ryc. 2. *Docelowy poziom HbA1c w cukrzycy typu 1 według pacjentek*

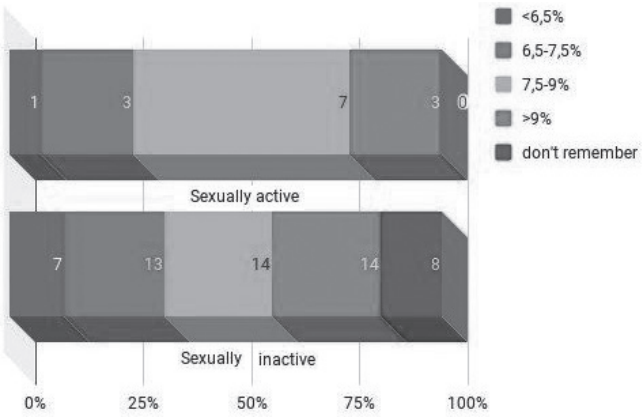

Fig. 3. HbA1c level declared by the surveyed patients. Numbers in the figure correspond to numbers of patients who declared particular HbA1c level
Ryc. 3. *Poziom HbA1c deklarowany przez ankietowane nastolatki. Numery podane na wykresie odpowiadają liczbie pacjentek, które deklarowały dany poziom HbA1c*

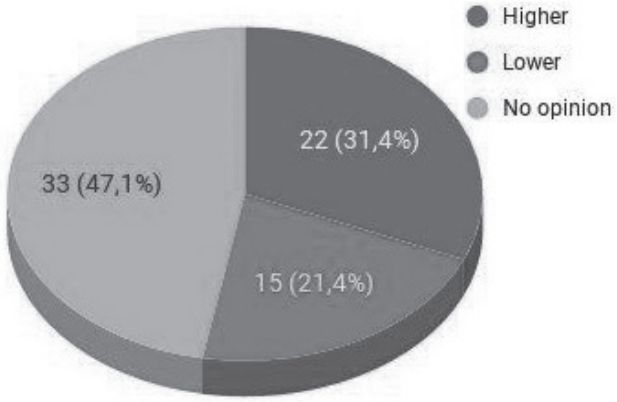

Fig. 5. Target HbA1c level during pregnancy in comparison to HbA1c level before conception according to patients
Ryc. 5. *Docelowy poziom HbA1c w ciąży w porównaniu do poziomu sprzed ciąży według pacjentek*

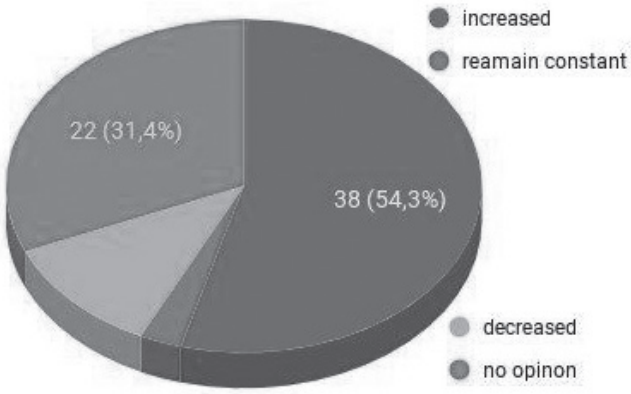

Fig. 4. Insulin requirements during II and III trimester of pregnancy compared with insulin requirements before conception according to the surveyed patients
Ryc. 4. *Zmiana zapotrzebowania na insulinę w II i III trymestrze ciąży według ankietowanych pacjentek*

Barely 32.9% (n=23) of the surveyed adolescents were aware of the target HbA1c level in T1D (Fig. 2). Declared HbA1c level was within normal range (HbA1c<6,5%) only in 11.4% (n=8) of patients, whereas in 24.3% (n=17) HbA1c level was above 9%. In addition, 11.4% (n=8) were not able to indicate their last HbA1c level. In the group of sexually active patients, in 50% (n=7) the last HbA1c level, declared by subjects, was between 7.5-9%, and in 21.4% (n=3) HbA1c level was >9% (Fig. 3).

The second part of the survey was focused on assessing knowledge of the consequences of poorly controlled diabetes in the course of pregnancy and its effects on fetal development. Among the surveyed adolescents 54.3% (n=38) were aware of the increase in insulin requirements during II and III trimester of pregnancy (Fig. 4). According to 31.4% (n=22) of patients, HbA1c level in the course of pregnancy should be lower than before conception (Fig. 5).

The patients were aware of the consequences of poorly controlled diabetes on fetal development, however their knowledge was unsatisfactory. The surveyed adolescents indicated metabolic disorders (1.4%, n=43), central nervous system malformations (55.7%, n=39) and heart defects (47,1%, n=33) as the most frequent complications (Fig. 6). The respondents gathered knowledge mainly from a diabetologist (40%, n=28) and from the Internet (40%, n=28). On the other hand, 18.6% (n=13) of patients did not receive counseling from any source of information and they did not try to find information by themselves. The majority of patients stated that preconception care should be provided by a diabetologist (88.6%, n=62) or a gynecologist (70%, n=49) (Fig. 7). 27.1% of adolescents (n=19) assessed their knowledge as insufficient. Only 25.7% (n=18) evaluated their knowledge as good or very good. Other respondents were convinced that their knowledge was sufficient or they had no opinion.

At the end of the survey, the number of correct answers concerning consequences of uncontrolled diabetes in pregnancy was summed up. The knowledge was assessed as adequate if at least 60% of answers were correct. Barely 21.4% (n=15) of the surveyed adolescents had satisfactory knowledge, in this group 40% (n=6) of patients were sexually active. Researchers did not observe a significant correlation between the level of knowledge presented by the surveyed adolescents and the duration of the disease (correlation coefficient r=0.1) or the age of the patients (correlation coefficient r=0.3). Moreover, no significant correlation was

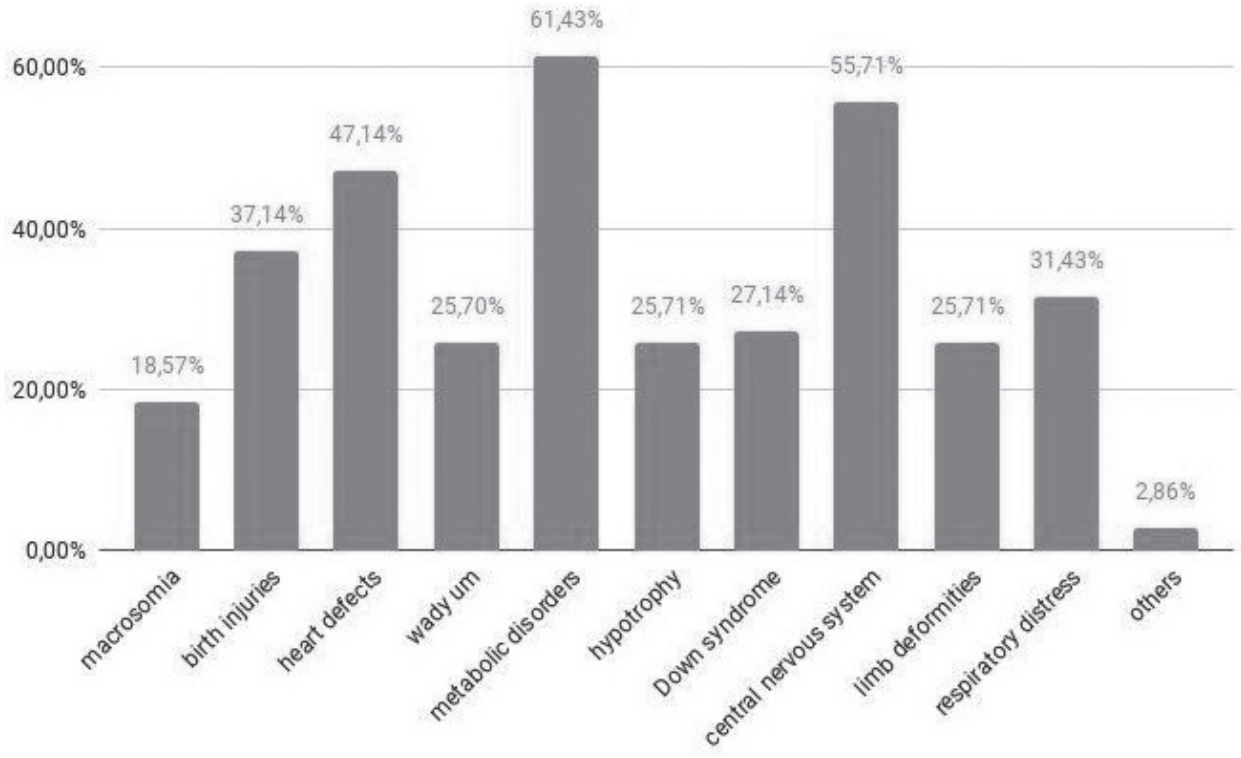

Fig. 6. Possible consequences of poorly controlled diabetes during pregnancy on fetal development, indicated by adolescents
Ryc. 6. *Wskazane przez ankietowane nastolatki możliwe konsekwencje niewyrównanej metabolicznie cukrzycy w ciąży związane z rozwojem płodu*

shown between the level of knowledge and HbA1c level declared by patients (correlation coefficient r=0.2).

Discussion

The survey demonstrated that the questioned adolescents did not possess sufficient knowledge of the consequences of poorly controlled diabetes on the course of pregnancy and its effects on fetal development. All of the patients were treated in accordance with current guidelines for diabetes care. The majority of participants adhered to medical recommendations, tried to maintain a healthy diet and performed exercises regularly, however the metabolic control of diabetes was not satisfactory. In addition, a large part of patients was not acquainted with the target HbA1c level. Over 25% admitted that their knowledge of pregnancy planning and diabetes management during pregnancy was not sufficient. It may be caused by insufficient preconception care in patients with T1D in pediatric diabetes centres. Despite regular visits to the Diabetes Centre, over a half of the surveyed adolescents did not receive preconception counseling from a specialist. Issues concerning reproduction are frequently omitted during routine visits in diabetes centres. It may be caused by parental presence during visits and the difficulty in raising an embarrassing topic by adolescents and doctors [11].

Moreover, when patients reach 18 years of age, they must transfer from pediatric to adult diabetes center. The transition should be well planned, otherwise there is a danger of the deterioration of metabolic control and earlier development of chronic complications. According to literature, the transition process lasts for more than 6 months even in 31% of patients [12]. Due to the fact that the patient may not be provided with preconception care early enough, the risk of complications during pregnancy is elevated.

In other countries, diabetes societies have repeatedly highlighted the issue of inadequate knowledge concerning reproduction, among diabetic adolescents. The need for the expansion of preconception education was emphasized many times. Numerous studies assessing knowledge in patients with T1D from Malta, France or the United States have shown that they were not aware of the importance of the problem. Women were not conscious of possible consequences of poorly managed diabetes on fetal development [13–15]. In the presented study, patients gathered information concerning preconception care from diabetologists and gynecologists. The same results were obtained from other studies [4,15].

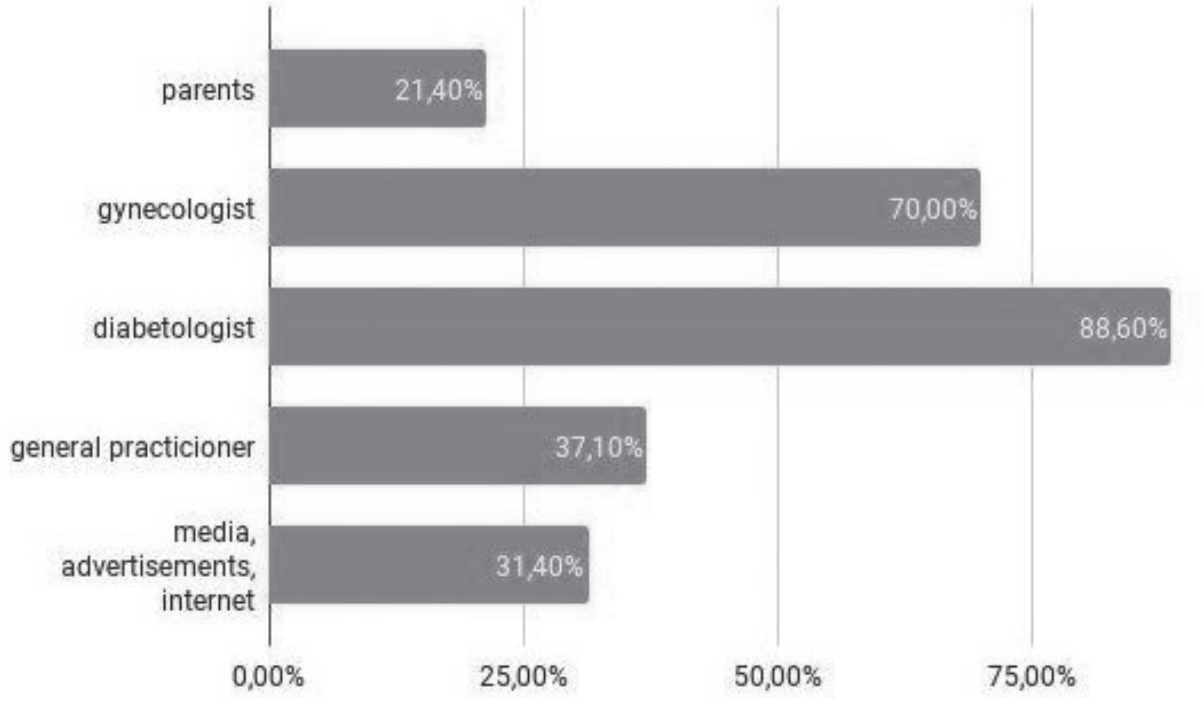

Fig. 7. Source of information, concerning reproductive health issues, preferred by adolescents
Ryc. 7. *Źródła informacji dotyczące tematyki okołokoncepcyjnej preferowane przez nastolatki*

One of the studies has demonstrated that certain adolescents were not even aware of the existence of preconception care [15]. The study assessing accessibility to preconception care among Australian with T1D has shown that there is a significant lack of reliable sources of information in this regard. Women, who received preconception care, were highly satisfied with it. However, some of them reported certain barriers to successful interactions with educators, including an authoritarian attitude of professionals, inconsistent advice instead of partnership and health care providers with a poor knowledge base [16]. Relationship between women and educators should be based on a partnership approach that encourages mutual trust and respect [17]. More attention should be paid to the fact that patients' perception of diabetes during pregnancy and their expectations regarding preconception care may significantly differ [18]. Healthcare providers should be especially attentive while working with adolescents. Young women may feel uncomfortable and embarrassed. [15,19]. Good rapport and honesty are the key to raise a discussion, which could influence future reproductive behavior of patients. Adolescents should be encouraged to choose a person on the team with whom they feel the most comfortable [15]. It is pivotal to clarify who is responsible for the delivery of preconception care to women with pregestational diabetes [17]. In one of the studies, assessing pregnant women's knowledge upon diabetes, the role of family doctors in education was emphasized. Their involvement in preconception care is insufficient, thus a special attention should be paid to improve their qualifications in this regard [4]. Apart from doctors, diabetes nurse educator could deliver preconception care as well. First, though, proper training of healthcare providers is required [20].

A study carried out by Diabetes Pregnancy Group has demonstrated that patients with the onset of diabetes before the age of 15 possessed better knowledge than other surveyed women. Therefore, education in pediatric centres has a pivotal role [14]. In the United States a program specifically tailored for adolescents, READY-Girls (Reproductive-health Education and Awareness of Diabetes in Youth for Girls), was carried out. The program was addressed to diabetic patients at the age 13–19.9 years. Participants received educational material (CD-ROM, book) and preconception care provided by a nurse. READY-Girls did not require high financial investment. Moreover, the program was beneficial and had long-term sustaining effects [10,21,22]. A similar study was carried out in the United Kingdom. It has demonstrated the effectiveness of a DVD in increasing knowledge and enhancing attitudes of women with diabetes to preconception care [23].

In addition, exceptional attention should be paid to the fact that the consequences of uncontrolled pregestational diabetes constitute a substantial burden to the public health care system [24]. It could be easily prevented by providing preconception counseling to patients. Numerous studies have shown that

preconception care reduces the risk of preterm deliveries, major birth defects and perinatal mortality. Moreover, it has been proven that preconception counseling enables to lower HbA1c level by 2.43% in the first trimester [6,24].

Adolescent pregnancy and sexuality issues remain a taboo subject. The need for sex education in Poland is ignored. Meanwhile, the average age of sexual initiation in Poland has decreased in recent decades [2]. The study conducted in the United States has revealed that half of the sexually active adolescents, affected with diabetes, had sex without birth control at a time they were trying to avoid pregnancy. The most frequently used forms of contraception were nonprescription methods [19]. In the study of Polish adolescents from Warsaw, researchers have demonstrated that 20% of young women did not use any family planning method. Condoms were the most commonly reported type of contraceptives. Hormonal oral contraception and emergency contraception were preferred mainly by older adolescents [25]. Comparable results were obtained in this study.

In Poland diabetes education program does not focus on reproductive issues in adolescence. The implementation of preconception counseling program specifically tailored for young women with diabetes is worth considering. Beforehand, the revision of legal regulations is required. Polish medical and legal circles lack unequivocal stand on how to take care of juvenile patients who are sexually active. For instance, this problem relates to prescribing contraceptives to minors. Use of contraception by adolescents could help to reduce the number of unplanned pregnancies as well as its emotional, economic and, above all, health consequences for the mother and child [2].

Conclusions

In conclusion, in spite of continuous diabetes care, adolescents with T1D do not possess sufficient knowledge regarding the consequences of hyperglycemia during pregnancy. Data obtained from this study highlights the need for improving preconception care of adolescent patients with T1D. Substantial health and cost burden associated with poorly controlled diabetes in pregnancy could be prevented by the implementation of education programs tailored for juvenile diabetic patients. This study has emphasized the need for including reproductive health issues in diabetes education addressed to adolescent patients.

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