

KNOWLEDGE REGARDING DIABETES AMONG STUDENTS OF THE FINAL YEAR OF MEDICINE IN POLAND

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ABSTRACT

Introduction: There is a rising number of people with diabetes worldwide. It was the first non-infectious disease to be acknowledged by the World Health Organization as an epidemic. This is the first study to assess basic diabetes-related knowledge among students of the final year of medicine in Poland.

Materials and methods: Medical students from: Medical University of Silesia (Schools of Medicine in Katowice(34%) and Medicine with the Division of Dentistry in Zabrze(32%)), Medical University of Warsaw(12%) and Medical University of Lodz(22%) completed an anonymous questionnaire (519 responses (63.8% women); response rate 68.7%). The survey covered five questions concerning the respondent and 25 concerning basic diabetological knowledge covered by the curriculum (based on current recommendations by Diabetes Poland).

Results: The mean total score was 20.92 ± 3.9 (highest: 25). 96% of respondents participated in diabetology classes. Only 5.39% were willing to specialize in diabetology. 31% described themselves as poorly/not at all prepared to take care of patients with diabetes. 3% were not aware that Type 1 diabetes is presently incurable and 16% - that these patients require insulin even when fasting. 5% would use insulin to treat hypoglycemia. In contrast to factors such as gender, diabetes in the student's family or their willingness to specialize in diabetology, only the self-assessed level of preparedness to take care of patients with diabetes and participation in diabetological classes seemed to have influenced the knowledge of the students significantly.

Conclusions: Medical students should be prepared to deal with diabetes as an epidemiologically important issue. There is a constant need for improving the knowledge of Polish students regarding diabetes.

Keywords: diabetes, knowledge, medical students, education, health care delivery, prevention of diabetes.

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Introduction

Diabetes mellitus (DM) is one of the largest global health emergencies of the 21st century. It is the only non-infectious disease that is recognised by the World Health Organization (WHO) as an epidemic. Every year this condition, which can result in lifestyle-changing and life-threatening complications, affects a rising number of patients. In addition to 422 million adults who are currently estimated to have DM, there are about 318 million people

with impaired glucose tolerance⁽¹⁾. DM is a major cause of blindness, kidney failure, heart attacks, stroke and lower limb amputation and is expected to be the 7th leading cause of death in 2030⁽²⁾. In 2016 WHO published the Global Report on diabetes, which calls for action to reduce exposure to the known risk factors for Type 2 DM and to improve access to and the quality of care for people with all forms of DM⁽²⁾.

The statistics mentioned above indicate that all physicians are very likely to be exposed to situations

when they meet patients with DM and/or its complications - regardless of their speciality. Therefore, they should be prepared and equipped with adequate knowledge to deal with these clinical settings. Nonetheless, the conducted studies concerning DM knowledge among physicians or medical doctors are limited. Due to the high prevalence of DM, it is recommended that they should have at least basic knowledge. It is also a well-known fact that the scientific field of diabetology develops rapidly, so the knowledge needs to be up to date. For the patients' safety and their adequate treatment, in the course of medical studies students should be equipped with both the practical and theoretical basis of diabetology. Additionally, the awareness of physicians and healthcare professionals translates into public awareness. According to researches there are two most essential aspects allowing to predict Type 2 DM development. Those are: positive family history, which cannot be changed and physical activity level, which can be used to decrease the risk of the disease (3-5). Doctors should be a source of reliable knowledge regarding health and diseases and motivate their patients to lead a healthy lifestyle. A high level of society's awareness concerning DM allows better prevention, earlier DM diagnosis and a lower rate of complications.

Materials and methods

Aim

We developed a study, which aimed to assess DM-related knowledge among future physicians - final year medical students. It is important to underline that this is the first study assessing knowledge regarding DM among students of the final year of medical studies in Poland.

Participants

Nowadays, students in Poland have the possibility to study medicine at twenty universities. The study group consisted of final year medical students from four Schools of Medicine of three different influential public Polish universities with good diabetological centres as shown in Table 1. Within the University of Silesia, there are two separate Schools of Medicine (Katowice and Zabrze).

Based on the curriculum of the studies, these students have completed almost all courses in the Faculty of Medicine and should be prepared to deal with basic, DM-related questions. Their knowledge at the end of the studies should be sufficient to take

care of patients with DM as the main or concomitant disease. In a few months, they will graduate and become doctors, with a great probability they may be responsible for the treatment of DM at least on a first contact level for example in the emergency room or as a general practitioner.

Development of the questionnaire

A questionnaire based on the 2016 Guidelines published by Diabetes Poland was developed⁽⁶⁾. It consisted of five questions regarding the respondent and twenty-five concerning DM. The first part included information about: gender, DM in the respondent's family, diabetology classes during the study curriculum, the respondent's plans to specialise in diabetology and her/his attitude towards treating patients with DM. The second part, regarding DM, covered True or False questions (first ten) as well as multiple choice (ABC) questions (subsequent 15). Only one answer was correct, but in all, there was a possibility to choose "I don't know". The highest total score that could be obtained was 25 points - one for each correct answer (incorrect or "I do not know" responses counted as 0 points). The full questionnaire is shown in Additional file 1.

BASIC QUESTIONS:

- Gender:
 - Female Male
2. Do you or does anyone in your family suffer from diabetes?
 - YES NO
3. Have you attended diabetology classes during medical studies?
 - YES NO
4. Do you want to specialize in diabetology in the future?
 - YES NO
5. How confident do you feel in medically managing patients with diabetes?

| | | | |
|-------------------------|--|------------------------------------|--------------------------|
| I am not confident 1 | I am afraid of taking care of diabetic patients 2 | To some extent I am confident 3 | I am very confident 4 |
| | | | |

Question 1:
Diabetes type 1 can be cured.
 YES NO I DON'T KNOW

Question 2:
Patients with type 1 diabetes always need insulin even if they are not eating.
 YES NO I DON'T KNOW

Question 3:
Patients with diabetes should not exercise regularly.
 YES NO I DON'T KNOW

Question 4:
Monogenic types of diabetes are only 1-2% of diabetes. In (COUNTRY) it is possible to diagnose diabetes earlier by genetic tests as well as optimize patient's and family treatment.
 YES NO I DON'T KNOW

Question 5:
Diabetic patients treated with multiple insulin injections should control their blood sugar level at least four times per day.
 YES NO I DON'T KNOW

Question 6:
In case of acute infectious disease the insulin requirement of patients with diabetes does not change.
 YES NO I DON'T KNOW

Question 7:
Sweats, palpitations, tremor and hunger are signs of high blood sugar level.
 YES NO I DON'T KNOW

Question 8:
DLP-4 inhibitors and SGLT-2 inhibitors are main groups of drugs used to treat diabetes type 1.
 YES NO I DON'T KNOW

Question 9:
Pregnancy is one of contraindications among women with diabetes.
 YES NO I DON'T KNOW

Question 10:
Insulin is used to treat hypoglycemia.
 YES NO I DON'T KNOW

Question 11: How long in the past does Hemoglobin A1c represent the average blood glucose level for?
 A. one month B. six months C. three months D. I don't know

Question 12: What effect does unsweetened fruit juice have on blood sugar level?
 A. raises it B. lowers it C. has no effect D. I don't know

Question 13: Diabetic Ketoacidosis can develop in which type of diabetes:
 A. type 1 B. type 2 C. type 1 and 2 D. I don't know

Question 14: High blood sugar may be caused by:
 A. intense exercise B. acute infection C. high dose insulin D. I don't know

Question 15: Below which level that we define hypoglycemia among patients with diabetes:
 A. <40 mg/dl B. <50 mg/dl C. <70 mg/dl D. I don't know

Question 16: Insulin pumps :
 A. must be implemented surgically
 B. can administer only basal insulin and the rest must be administered by injections
 C. administer only rapid acting insulin analog
 D. I don't know

Question 17: Constant glucose monitoring (CGM) devices:
 A. enable to stop insulin delivery
 B. record blood sugar level in interstitial fluid , can be used with insulin pump or separately; in different types of diabetes
 C. enable to stop counting carbohydrates and sticking to diabetic diet
 D. I don't know

Question 18: Personal insulin pumps:
 A. have infusion sets which cannot be changed
 B. can be combined with CGM systems. In some models insulin delivery can be stopped if blood sugar level is dropping to low.
 C. basal insulin as well as insulin boluses cannot be modified by a patient
 D. I don't know.

Question 19: Among children with type 1 diabetes:
 A. we do not use insulin pumps
 B. daily insulin demand can be variable
 C. we do not use diabetic diet and carbohydrate counting
 D. I don't know.

Question 20: Impaired fasting glycaemia is the state"
 A. when fasting glycaemia is between 100 and 125 mg/dl and is an indication for OGTT
 B. when fasting glycaemia is between 100 and 125 mg/dl and is not indication for OGTT
 C. when fasting glycaemia is more than 140 mg/dl
 D. I don't know

Question 21: Pregnant woman with type 2 diabetes should be treated with:
 A. oral antidiabetic drugs B. should not be treated C. insulin D. I don't know

Question 22: Treatment of diabetic ketoacidosis involves:
 A. balancing electrolytes level B. use of glucagon C. use of insulin D. I don't know

Question 23: Diabetic complications typically do not develop in:
 A. eyes B. kidneys C. lungs D. I don't know

Question 24: Short acting insulin is used in diabetes type 2 :
 A. to cover the basal insulin requirement B. we do not use short acting insulin in treatment of diabetes type 2 C. before meals D. I don't know

Question 25: Oral antidiabetic drugs:
 A. are used only in monotherapy
 B. are used to treat diabetes type 1
 C. can be combined with other antidiabetic drugs and insulin
 D. I don't know

Additional file 1: DM students knowledge questionnaire. docx The questionnaire used in the study.

Conducting the survey

The surveys were handed out before the test exam in paediatrics and were returned by the students when leaving after the exam finished. Participation was voluntary and anonymous. Students were not able to consult on questions or refer to other materials when answering them. Out of the total 756 questionnaires that were distributed, 519 were returned (general response rate: 68.7%).

Among participants 188 (36.2%) were men, 331 (63.8%) - women. 499 (96.2%) attended diabetology classes during medical studies. Nearly one in four of respondents (145 (27.9%)) admitted to having a close relative with DM and/or having DM him/herself. Detailed data concerning numbers of distributed and returned questionnaires, gender and School of Medicine distribution as well as respective response rates are shown in Table 1. The study was reported to and approved by the Ethical Committee of the Medical University of Silesia.

| | Questionnaires | | % of returned surveys | Response rate per School of Medicine | Gender | |
|--|----------------|----------|-----------------------|--------------------------------------|------------|-------------|
| | Given | Returned | | | Men | Women |
| Katowice - Medical University of Silesia | 308 | 175 | 33.7% | 56.82% | 53 (30.3%) | 122 (69.7%) |
| Zabrze - Medical University of Silesia | 197 | 166 | 32.0% | 84.26% | 60 (36.1%) | 106 (63.9%) |
| Medical University of Lodz | 132 | 116 | 22.4% | 87.88% | 48 (41.4%) | 68 (58.6%) |
| Medical University of Warsaw | 119 | 62 | 11.9% | 52.10% | 27 (43.6%) | 35 (56.5%) |

Table 1: Numbers of questionnaires, gender and Medical School distribution, and respective responsive rates.

Statistical analysis

Statistical analysis was carried out using the R software (www.bioconductor.org). The maximum likelihood statistical significance G-test with Williams correction for continuity was used in a comparison study of ranked and discrete variables. Non-parametric Kruskal-Wallis ANOVA, supported by Mann-Whitney test with Bonferroni correction for multiple comparisons was applied to verify hypotheses on test result equality among medical schools. McNemars' test was performed to search for an association between responses to different questions. Yule's Q and Phi correlation coefficients were estimated to measure the association level. The significance level was set at 0.05.

Results

A general summary of results

The mean total score was 20.92 ± 3.9 (highest: 25). The lowest number of correct answers was given to question 15, which concerned the blood glucose level at which hypoglycemia can be diagnosed (question 15; 56.07% correct answers). The best-answered question was that regarding physical activity among patients with DM (question 3; 97.30% correct answers). Apart from the above medical students achieved best scores in questions concerning the pathogenesis of Type 1 DM, hypoglycemia treatment, DM complications and oral antidiabetic drugs (in all more than 90% correct answers). The lowest proportion of proper responses was found for questions addressing the following problems:

diabetic ketoacidosis, monogenic DM, hypoglycaemia level and symptoms (approximately 50-70% of correct answers). Detailed data regarding rates of correct answers and topics/problems addressed by specific questions are given in Table 2.

| Question number and problem addressed | Total of correct answers [%] | Total of incorrect answers [%] | Total of "I don't know" answers [%] |
|--|------------------------------|--------------------------------|-------------------------------------|
| 1. Type 1 DM – cure | 97.11 | 2.70 | 0.19 |
| 2. Type 1 DM - the absolute need for insulin | 83.82 | 14.26 | 1.92 |
| 3. DM – physical activity allowed | 97.30 | 2.31 | 0.39 |
| 4. Monogenic DM | 73.99 | 6.55 | 19.46 |
| 5. Diabetes control | 87.28 | 7.51 | 5.21 |
| 6. DM and acute infection | 84.39 | 11.37 | 4.24 |
| 7. Hypoglycemia symptoms | 73.60 | 24.66 | 1.74 |
| 8. Type 2 DM – drugs for the treatment | 89.02 | 6.17 | 4.81 |
| 9. DM and pregnancy | 93.06 | 3.66 | 3.28 |
| 10. Hypoglycemia treatment (insulin) | 95.57 | 1.54 | 2.89 |
| 11. HbA1c | 85.93 | 12.14 | 1.93 |
| 12. Diet | 90.37 | 5.97 | 3.66 |
| 13. DKA | 62.81 | 33.34 | 3.85 |
| 14. Hyperglycemia causes | 76.11 | 12.71 | 11.18 |
| 15. Hypoglycemia level | 56.07 | 39.69 | 4.24 |
| 16. Insulin pumps | 71.87 | 21.0 | 7.13 |
| 17. CGM | 77.26 | 11.76 | 10.98 |
| 18. Insulin pumps | 85.55 | 8.86 | 5.59 |
| 19. Type 1 DM in children | 84.78 | 5.2 | 10.02 |
| 20. Impaired fasting glycaemia | 88.63 | 7.52 | 3.85 |
| 21. Type 2 DM and pregnancy | 89.40 | 7.71 | 2.89 |
| 22. DKA treatment | 81.31 | 9.63 | 9.06 |
| 23. DM Complications | 92.68 | 3.85 | 3.47 |
| 24. Type 2 DM insulin treatment | 83.62 | 10.6 | 5.78 |
| 25. Oral antidiabetic drugs | 90.56 | 4.82 | 4.62 |

Table 2: Problems addressed and respective percentage of correct, incorrect and "I do not know" answers.

DM - diabetes, Type 1 DM - type 1 diabetes, Type 2 DM - type 2 diabetes, CGM - continuous glucose monitoring, DKA - diabetes ketoacidosis

"I don't know" was less frequently chosen in most questions than an incorrect answer (Table 1). Only in seven questions (9, 14, 17, 19, 22, 23, 25), the number of false answers was similar or lower than that of "I don't know" answers. Interestingly, in question 4, which concerned monogenic DM, almost every fifth (19.46%) student stated that she/he does not have the proper knowledge to answer this issue. Analysis of correlations revealed some significant associations. Students were likely to answer in the same way (correctly or incorrectly) two questions referring to the same problem, such as Type 1 DM, DM and pregnancy, hypoglycemia or hyperglycemia (for all $p < 0.05$). Moreover, the answer to the question regarding monogenic DM was related to the respondents' knowledge concerning insulin pumps, continuous glucose monitoring and both, hypo- and hyperglycemia (for all $p < 0.05$).

Comparison of results of students from different Schools of Medicine

The maximal and minimal total scores of students from different Schools of Medicine are shown in Figure 1. There was a significant difference between the mean score achieved by students from the four different centres (Kruskal-Wallis ANOVA $p < 0.001$) - Figure 1. The highest score was obtained by respondents from the Medical University of Lodz (24 points) (Katowice vs Lodz and Zabrze vs Lodz $p < 0.001$, Warsaw vs Lodz $p < 0.01$), second highest - from the Medical University of Warsaw (Katowice vs Warsaw and Zabrze vs Warsaw $p < 0.001$). Students from both Schools of The Medical University of Silesia (Zabrze and Katowice) achieved the lowest number of points, and their mean results did not differ significantly.

Regarding single questions, there were significant differences ($p < 0.05$) between the Schools of Medicine in given answers in fifteen questions (2, 4-7, 11, 13-19, 22, 24). Responses given to problems addressed in questions 1, 3, 8-10, 12, 20, 21, 23, 25 did not vary between centers.

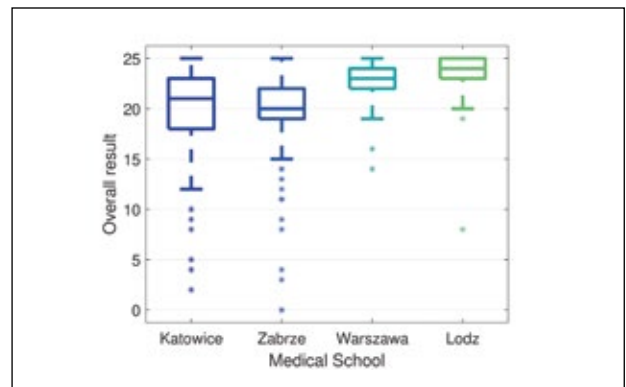


Figure 1: Results obtained by students from different Schools of Medicine - whole questionnaire (Kruskal-Wallis ANOVA $p < 0.001$).

Attitude towards taking care of patients with diabetes

Only 5.39% of students declared that they are interested in specialising in diabetology in the future. When asked to indicate, how ready they feel to take care of patients with DM, more than half of the respondents (64%) felt confident with taking care of this group of patients. Only 6% claimed to be well prepared. Noteworthy as many as 31% of students described themselves as poor or not at all prepared to attend patients with DM (Table 3). The attitude towards taking care of patients with DM showed to some extent an association with the score obtained in the questionnaire - Table 3.

| Declared degree of preparation to deal with patients with diabetes | Percentage of students | The total score on the questionnaire | | |
|--|------------------------|--------------------------------------|---------|--------|
| | | Minimum | Maximum | Median |
| None | 3.9% | 20 | 24 | 22.5 |
| Weak | 26.8% | 19 | 23 | 21*† |
| Standard | 63.5% | 20 | 24 | 22* |
| Good | 5.8% | 21 | 24 | 23† |

Table 3: Results obtained depending on the declared degree of preparedness to take care of patients with diabetes. *Kruskal-Wallis ANOVA* $p=0.01$; *weak vs standard $p=0.005$; †weak vs good $p=0.02$, all other $p=ns$

Factors influencing student's knowledge

There were no differences in median total score achieved in the questionnaire between women and men. The number of correct answers was also independent of having family members with DM. Also, students who declared that they are willing to specialise in diabetology did not achieve better scores. Only attending diabetology classes during the studies significantly improved students' DM-related knowledge. Those who participated in diabetology classes achieved better scores than those who did not (Me=22, Q1=20, Q3=24 vs Me=17, Q1=10.5, Q3=19.5; $p<0.001$).

Discussion

DM is a problem worldwide. According to WHO, the prevalence of DM has risen from 108 to 422 million people between 1980 and 2014⁽²⁾. It is the main reason why this study is important.

It should be emphasised that this is the first study in Poland which assesses DM-related knowledge among final year medical students. Although similar studies, concerning knowledge regarding DM, were conducted in other countries, in most cases they have not considered final year medical students⁽⁷⁻¹⁰⁾. In some of the studies assessing the knowledge of students the data were compared to residents, physicians and nurses⁽⁸⁻¹⁰⁾. Another group of studies dealt only with certain aspects of DM - for example, insulin treatment⁽⁹⁾. There are also results from research conducted in Africa, but it is difficult to compare them to our population due to different health care and education systems^(11,12). The only one similar study was carried out in Germany and published in the year 2000⁽¹³⁾.

The results revealed significant differences in the knowledge of students from the four investigated Schools of Medicine. The divergence between the median scores was significant but not large - they

varied between 20 (80%) and 24 (96%). The curriculum of medical studies covers the same topics regardless of the university. However, the number of hours devoted to diabetology (seminars, lectures and exercises) was not analysed. In all of the participating sites - three different influential public Polish universities - there are good diabetological centres. Correspondence of the order of scores of the participating Schools of Medicine to the 2017 ranking list of Medical Universities could be argued⁽¹⁴⁾.

Overall, the students had on average approximately 84% correct answers. Nevertheless, this study concerned only basic knowledge of DM and results closer to the upper limit would rather be expected. No advanced issues were involved and all questions referred to the topics, which should be mentioned during medical studies. Among the topics addressed in the survey, some issues are very concerning.

First of all, in the final year of medical studies, some of the students who are not aware that Type 1 DM is an incurable disease. It is worrisome as potentially stopping insulin treatment or lack of insulin for patients with Type 1 DM is life-threatening. Furthermore, students encountered considerable problems while answering questions concerning chronic and acute complications of DM. About 50% of students are unable to indicate the glucose level at which hypoglycemia should be diagnosed in a person with DM. It is important as hypoglycemia is related to increased mortality among patients with DM⁽¹⁵⁾.

It should also be emphasised that students have problems with basic knowledge regarding the diagnosis and treatment of DKA (diabetic ketoacidosis). Still many patients, especially at DM onset (particularly in Type 1 DM - >30%), are admitted to hospital with DKA^(16,17). This problem is underlined not only in Poland⁽¹⁸⁻²⁰⁾ but also in many other countries⁽²¹⁻²⁴⁾. Proper care for such a patient may improve and accelerate recovery from DKA as well as decrease negative outcomes. Additionally, awareness and knowledge of basic facts lead to earlier diagnosis (especially of Type 1 DM) which prevents DKA development, what is one of the main goals of improving general DM care^(19, 20, 25, 26). Medical students at the end of their studies should be able to recognise early symptoms of DM and be able to prevent the patient from a life-threatening condition.

Moreover, the physicians' and other healthcare professionals' awareness and knowledge concerning DM can affect positively, for example through health-education, the knowledge of patients as well as the awareness and understanding of the society^(27, 28).

The latter is very important in decreasing the frequency and consequences of acute DM complications. Therefore, it seems that more attention should be paid to teaching DM during medical studies.

There is a need to introduce students to the most up to date knowledge as well as the newest technologies that are available. Physicians, especially those who have just finished their training, should be aware that patients nowadays can be treated in many different ways.

As far as monogenic DM is concerned, students from Lodz achieved the best scores. The Medical University of Lodz is an influential diabetological centre in Poland. It also has a major genetic laboratory specialising in monogenic DM and has carried out a national screening program for this type of the disease. The mentioned facts may explain a high number of correct answers from their students.

In general, it seems that students had more difficulties in correctly answering questions concerning more practical knowledge than those that can be considered as theoretical. It would indicate that more emphasis should be put on classes where students can learn diabetology in clinical practice.

Importantly, one-third of students described themselves as mediocre or not prepared to take care of patients with DM. It is striking as it is very unlikely that they will not contact a patient with DM during their career. Probably many of them will see patients with DM or its complications often, maybe even daily. The difference in scores obtained regarding the declared attitude towards taking care of patients with DM was significant. More interesting is that only attending diabetology classes had a strong impact on students' knowledge. It emphasises how essential such classes are in the curriculum of medical studies.

Reference to the results of studies conducted in other countries is challenging. As mentioned earlier research comes from various regions of the world. More importantly, a direct comparison of obtained scores is impossible because of the different questionnaires used and different scopes of knowledge tested. The study conducted in Germany revealed similar results to ours that previous additional classes in diabetology were associated with greater DM knowledge⁽¹³⁾. It also confirmed that students have problems mainly with clinical aspects of diabetology, whereas knowledge concerning pathophysiology and pharmacology was relatively good⁽¹³⁾. Other authors also identified the need for increasing knowledge among the studied groups of medical

students, physicians or healthcare professionals^(7-10, 13, 20). Some specific knowledge deficits among health professionals may lead to incorrect or delayed management of some subsets of patients⁽²⁹⁾.

This study's limitations should be mentioned. These concern mostly typical aspects of survey-based research. Firstly, not all of the students have completed the questionnaire, although the overall response rate was quite high (68.7%) when compared to rates reported by other authors, especially regarding mail- or web-based surveys⁽³⁰⁻³²⁾. It is difficult to perceive the reasons for non-responding. Possibly the large study group limited the impact their results would have on the average score. The second drawback is that not all Polish universities are represented in this study. Four influential universities with good diabetological centres have participated, so presumably, the level of DM-related knowledge among other students in Poland should be considered to be similar.

In summary, the 6% of students who were eager to choose this speciality will not be enough to meet one needs of diabetic patients. It has been estimated that globally as many as 210 million people (half of all aged 20-79 years with DM) are unaware of their disease. Students in the future can choose different medical specialization, but they will meet patients with diagnosed or undiagnosed DM everywhere and should be prepared to deal with this epidemiologically important issue. The results obtained in the questionnaire indicate a constant need for improving the knowledge of polish students regarding DM.

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