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THE IMPORTANCE OF EDUCATION ON THE QUALITY OF LIFE IN PATIENTS WITH TYPE TWO DIABETES

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Abstract. *Diabetes mellitus is a complex metabolic disease that leads to impaired organ morphology and function, reducing patients' quality of life and life expectancy and causing early disability. The challenges posed by diabetes itself have been studied with a particular focus on type II diabetes. Genetic predisposition, inadequate or insufficient insulin secretion, insulin resistance and increased body weight are the most important factors in the insulin-independent type of diabetes. This study* ***aims*** *to investigate to examine the impact of education on the quality of glycoregulation in patients with type 2 diabetes mellitus.* ***Methodology of the Study.*** *The study included patients with type II diabetes mellitus of both sexes who applied the principles of education to improve glycregulation. The analysis of the methods used to implement the training included information on the frequency and type of training provided. The study was conducted at the Diabetes Outreach Clinic of the General Hospital of Ćuprija.* ***Results and Discussion.*** *In this study, great attention was paid to the educational program itself, its presentation and the motivation of the patients themselves for the new knowledge and integration into their lifestyle habits. During the intensive implementation of the training, the respondents were constantly motivated to actively participate in the program, which led to good results and showed the way. By applying the educational principles in the self-control program, satisfactory glycoregulation and thus control of the disease was achieved. It has been shown that in addition to proper education of patients with diabetes, medical staff should also be continuously trained, because without thorough training of educators, patient education cannot be successful. By applying the principles of education and self-control, we have enabled patients with type II diabetes to integrate the disease into their personality, change their behavior, and accept all the limitations that such a life entails. The treatment itself requires a multidisciplinary approach in which the principles of self-control and education are adapted to the individual.* ***Conclusion.*** *The data obtained in this way could contribute to the appropriate planning and implementation of educational programs aimed at achieving the best possible quality of life for people with type II diabetes. There is no single model, but the basis of this model is based on lifestyle modification that includes dietary correction with dosed physical activity, appropriate treatment, and regular health checks to prevent chronic complications and the development of early disability. The frequency and type of education provided has a significant impact on achieving optimal quality of glycoregulation and correcting metabolic and cardiovascular disorders.*

Keywords: *type 2 diabetes mellitus, education, multidisciplinary approach, life habits, quality of life*

1. INTRODUCTION

Diabetes mellitus (DM) is a complex metabolic disorder fundamentally characterised by a permanent disturbance of glycoregulation and altered sensitivity of peripheral tissues to insulin, primarily muscle and adipose tissue. Diabetes can cause morphological damage and dysfunction of individual organs, which over time lead to a decrease in the patient's quality and length of life and the onset of early disability [1, 2]. The challenges posed by diabetes have been studied extensively, with particular emphasis on type II diabetes [3]. Type II diabetes mellitus is an aetiopathogenetically heterogeneous disease. Diabetes is not only an individual health problem but also has significant social and medical implications, affecting an average of 2–5% of the total population [4, 5].

Currently, both globally and in our country, programmes for early detection and appropriate treatment of diabetes are being implemented to prevent acute complications and to halt or slow the progression of chronic complications. For example, a study conducted in Russia from 2002 to 2007 indicated that the prevalence of diabetes mellitus increased by 16.3%, while the incidence of type II diabetes mellitus rose by 45% [6, 7, 8].

Genetic predisposition, defective or insufficient insulin secretion, insulin resistance, and weight gain are the most important factors in non-insulin-dependent diabetes [9, 10].

It is believed that the genetic basis plays a significant role in the development of non-insulin-dependent diabetes; however, no definitive genetic markers have been identified to date [11, 12]. It is believed that the genetic basis plays an important role in the development of non-insulin-dependent diabetes. Still, no definitive genetic markers have been identified to help determine individuals at high risk. The inheritance

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of this type of diabetes is assumed to be polygenic. High insulin levels with hyperglycaemia indicate insulin resistance [13, 14, 15].

One of the first papers on insulin resistance was published in 1879 by Launcereux and Lapiette, who described "thin and obese diabetic patients". The first direct statement of the concept of insulin sensitivity or resistance was made by H. Himsworth in 1936 in The Lancet, describing "insulin-sensitive" and "insulin-insensitive" diabetes. This approach was quickly abandoned, and after 40 years, Himsworth's hypothesis was accepted by the National Diabetes Data Group [1]. Since glucose transport is one of the first limiting factors in glucose metabolism and is downregulated in T2DM, the GLUT4 gene was considered a candidate for elucidating the molecular mechanisms involved in peripheral insulin resistance. However, no correlation was found between insulin resistance and reduced GLUT4 expression in T2DM, as reduced GLUT4 expression is also present in some healthy individuals. Impaired GLUT4 transport to the muscle cell membrane surface upon insulin stimulation was observed. [16, 17, 18, 19, 20]

Changes in the neuroendocrine system, particularly in specific regions of the hypothalamus, can lead to imbalances in insulin secretion, insulin resistance, and obesity [13, 11].

Since individual genetic traits cannot be changed, it is necessary to intensify research aimed at identifying a specific genetic marker that would allow the detection of individuals at high risk of developing diabetes. Until this is achieved, prevention of type II diabetes should focus on identifying individuals who exhibit glucose intolerance, central obesity, and a family history of diabetes [13 9, 12]. It is generally recognised that, although identifying individuals at high risk of developing diabetes is important for preventive efforts, this will have only a limited impact on the national diabetes rate. Measures that reduce this risk across the entire population are also needed.

Further research should re-evaluate environmental factors and their effects before the onset of diabetes, investigate the biochemical pathway of hyperglycaemia, and seek specific means to correct the disturbed biochemical processes [21, 22]. Research should enable targeted intervention in predisposed individuals to prevent the development of non-insulin-dependent diabetes [1]. It is known that the results of therapy, diet, and daily activities are reflected in fluctuations of glucose levels in the blood and urine, which are the first indicators of the level of diabetes regulation.

The adoption of a healthy lifestyle (appropriate nutrition, properly regulated physical activity, maintaining an ideal body weight, quitting smoking, and reducing alcohol consumption) is a goal that every society should pursue, as it can significantly reduce the incidence of type II diabetes and other chronic diseases. [13,23].

Modern methods for early detection of the disease, effective organisation of the health service, and increasing patient awareness about the disease itself contribute to the earliest possible diagnosis of diabetes. Through appropriate treatment, this can prevent the development of acute and chronic complications, thereby improving quality of life [24]. Patients should never remain or become passive observers. Learning about a chronic disease requires patients to establish a balance of all adaptation mechanisms that help them psychologically overcome the disease and integrate it into their own identity. The challenges imposed by diabetes, particularly type II diabetes, have been studied in detail. Despite the acquisition of new knowledge, progress in diabetes control depends not only on increasing patient information or changing patient behaviour, but also on proven methods for improving the health system to achieve the best possible outcomes.

This research aims to examine the impact of education on the quality of glycoregulation in patients with type 2 diabetes mellitus.

This study also aims to determine the level of education among patients with type 2 diabetes mellitus and to analyse the methods of education provided. In line with these objectives, the main working hypothesis was defined as follows:

Ha: The implementation of the education programme will have a significant impact on improving the quality of glycoregulation, regardless of the type of hypoglycaemic and antidiabetic therapy applied.

In addition to the main research hypothesis, an auxiliary research hypothesis was defined:

Ha: The frequency and type of education provided will have a significant impact on achieving optimal quality of glycoregulation and improving metabolic and cardiovascular disorders.

2. Research methodology

The study included patients of both sexes with type 2 diabetes mellitus who applied educational principles to improve glycoregulation. The analysis of educational methods included collecting information on the frequency and type of education provided. All patients were assessed during visit 1 according to the type of education programme. During the two-month follow-up, the application of educational knowledge and self-monitoring was observed to analyse the importance of these methods in achieving optimal glycoregulation control.

Patient education was assessed according to the type of education provided, which included: individual contact with a doctor; a planned conversation that incorporates elements of a personal discussion but is structured and focused on specific aspects relevant to the treatment and management of type 2 diabetes mellitus; participation in a small group through organised lectures and workshops; and individual conversation followed by subsequent inclusion in lectures and seminars via small group work.

The examination was conducted at the Diabetes Counseling Centre of Ćuprija General Hospital. The results were analysed using appropriate statistical tests (ANOVA), depending on group size, characteristic type, and distribution. Statistical analysis was performed both within and between the defined groups.

3. Results and discussion

The influence of gender and average age of patients on the selection and implementation of specific types of education is presented in Table 1.

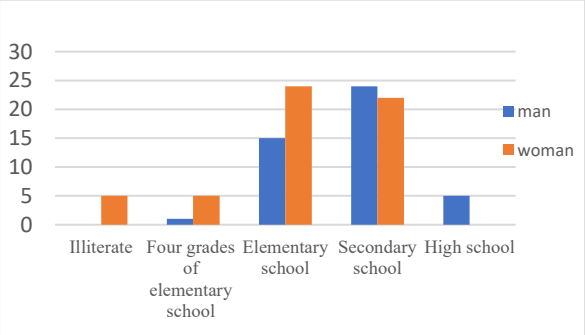
Table 1. Age and gender distribution of patients in relation to the type of education applied

	Individual interview	Planned interview	Small group work	Individual interview + small group work
Women	15/46.9	20/61.8	11/68.8	9/47.4
Men	17/53.1	13/38.2	5/31.3	10/52.6
Age	57.6±9.2	61.2±6.7	57.3±9.3	61.05±7.7

Data are presented as numbers/percentages and as mean values ± standard deviations.
NS for all parameters.

The analysis using the Chi-square test did not show any significant difference in gender distribution between groups with different types of education, indicating that gender did not influence the type of education applied. The analysis of variance did not show any significant difference in the average age of patients between groups with different types of education (ANOVA, F = 1.66, p = NS) (Table 1).

The level of education of the patients examined is shown in Figure 1. Women predominate in subgroups with a lower level of education, while men predominate in subgroups with a higher level of education (Figure 1).



*p < 0.05 compared to higher education and secondary education

Figure 1. Education of the examined patients

The analysis using Fisher's exact probability test shows a significant predominance of women in the group of illiterate and primary school patients compared to the group with secondary and higher education.

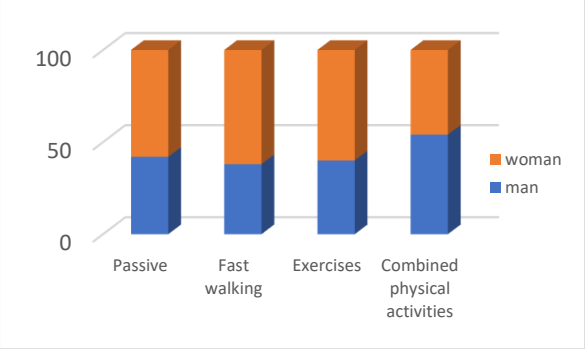


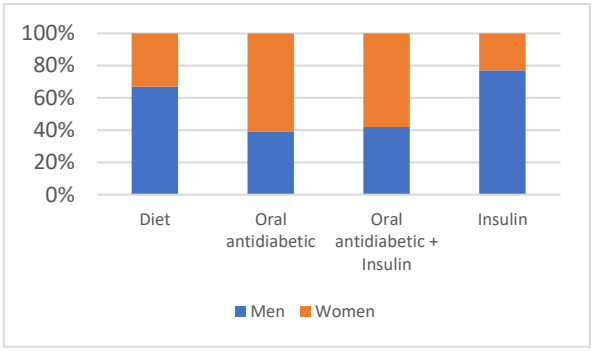
Figure 2. Type of physical activity performed by the examined patients in relation to gender

The implementation of the physical activity programme in the studied patients with type II diabetes mellitus, in relation to gender, is shown in Figure 2.

The implementation of the physical activity programme in the studied patients with type II diabetes mellitus, in relation to gender, is shown in Figure 2.

The type of physical activity applied did not differ significantly between genders in the studied patients with type II diabetes mellitus (Figure 2).

Figure 3 shows the type of type 2 DM therapy in relation to gender.



*Chi²=5.01, p<0.05 compared to insulin; **Fisher p<0.05 compared to insulin.

Figure 3. Type of DM type 2 therapy in relation to the gender of the patient

The lipid status in the studied patients was assessed based on triglyceride and total cholesterol values. The results are shown in Table 2.

Table 2. Values of lipid parameters in the examined patients

	Triglycerides (mmol/l)	Cholesterol (mmol/l)
Women	2.5±1.9	6.1±2.2
Men	2.5±1.7	6.2±1.4
Total	2.6±1.8	6.1±1.9

Data are presented as mean value ± standard deviation; Triglycerides – triglycerides (mmol/l), Cholesterol – total cholesterol (mmol/l); NS for all parameters

The analysis performed using the Student's t-test did not show any significant difference in lipid indicator values between the sexes (Table 2).

Figure 4 shows that almost half of the patients examined (45.5%) monitor their glycaemia once a month in the laboratory of the relevant health institution, while a third of patients do so twice a month.

Self-monitoring of body weight was determined by the number of body weight measurements taken at home and in outpatient settings.

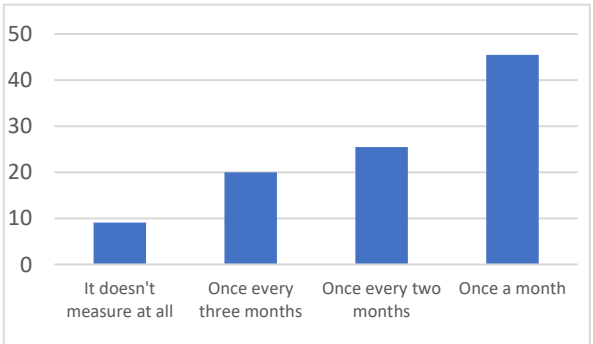


Figure 4. Frequency of body weight measurement in home and outpatient settings

The largest proportion of patients with type II diabetes mellitus monitor their body weight once a month (45.5%), while almost 10% do not monitor their body weight at all (Figure 4).

The quality of glycoregulation, assessed by glycosylated haemoglobin A1c values and morning and postprandial glycaemia values in relation to the frequency of self-monitoring, is shown in Table 3.

Table 3. Quality of glycoregulation and frequency of self-measurement of glycaemia

	Fasting blood glucose (mmol/l)	Postprandial blood glucose (mmol/l)	HbA_1c (%)
1	8.0±1.5	12.5±1.8*	8.5±1.2
2	8.6±2.9	13.04±3.8	9.4±2.6
3	7.7±2.0	12.5±2.5*	8.9±1.3
4	8.96±2.5	13.8±3.3	9.6±1.6
5	9.8±2.6	14.1±2.8	10.0±3.1
Total	8.4±2.3	13.07±3.03	9.06±2.3

Data are presented as mean value ± standard deviation; NS for all parameters.
1 – once a week; 2 – twice a week; 3 – three times a week; 4 – four times a week; 5 – five times a week.

The quality of glycoregulation, as assessed by morning and postprandial glycaemia values and glycosylated haemoglobin values, does not show significant variation in relation to the frequency of self-monitoring of glycaemia. It has been shown that patients who use a self-monitoring device daily have slightly worse results, but this is probably a consequence of poorer glycaemic regulation and a current greater need for its use (Table 3).

The frequency of laboratory monitoring of glycaemia and its significance for lipid and cardiovascular indicators is shown in Table 4.

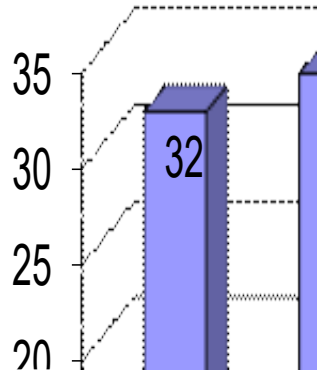
Table 4. Lipid and cardiovascular indicators for different frequencies of laboratory determination.

	Triglycerides (mmol/l)	Cholesterol (mmol/l)	Systolic pressure (mm Hg)	Diastolic pressure (mm Hg)
1	2.21±2.2	5.243±2.6	133.5±19	85.00±9
2	2.66±1.7	5.900±1.6	137.6±21	84.40±10
3	2.24±1.3	6.360±2.07	130.6±22	80.63±10
4	2.20±1.2	5.083±1.6	140.0±20	81.67±9
Total	2.59±1.8	6.17±1.9	135.6±20	82.7±10

1 – once in 2 months; 2 – once a month; 3 – twice a month; 4 – three times a month.
Data are presented as mean value ± standard deviation.
NS for all parameters.

The analysis (ANOVA test) did not confirm the existence of a significant difference in the values of lipid and cardiovascular indicators between subgroups with different frequencies of glycaemic control under laboratory conditions (Table 4).

The prevalence of individual types of education programmes among patients with type 2 diabetes mellitus is shown in Figure 5.



O1 – individual conversation; O2 – planned conversation; O3 – work in a small group; O4 – individual conversation + small group work

Figure 5. Types of educational programmes implemented

The most common types of education provided to patients with type 2 diabetes mellitus were individual and planned interviews, while small group work and a combination of individual interviews and small group work were recorded in a significantly smaller percentage (Figure 5).

To gain preliminary insight into diabetes education, the International Diabetes Federation (IDF) surveyed in 2008. The survey results provided insight into the role of diabetes education [25].

The results showed that diabetes education was integrated into national diabetes programmes in two-thirds of the countries with such a programme. The results also indicated that education was continuously implemented, but had shortcomings related to the lack of information sources, particularly regarding the number of educators, and that people with diabetes did not have the time or support from their employers to participate in education. This survey also identified obstacles that should be addressed by further research [26, 27]. The development of education programmes worldwide will also help to resolve these problems.

One hundred respondents participated in the survey. The study included 100 respondents: 45% male and 55% female, with an average age of 59.4 years. There was a higher proportion of women with a lower educational profile.

The diet and physical activity of the respondents, as the basis of therapy for patients with type II diabetes mellitus, indicated the need to guide their lifestyle habits towards healthier choices and to educate them accordingly, enabling them to achieve this independently.

The largest number of respondents were on oral antidiabetic therapy, with a predominance among women.

All respondents participated in an education programme from the beginning of the study, where they acquired new knowledge about their disease and the necessary measures to improve their quality of life.

The education programme was implemented in several stages, with different visits to the respondents. Based on the results, the greatest interest was shown in education through individual conversations and small group work, while other types were less represented. Regarding gender, age, and education level, the research results showed these factors were not decisive for participation in the education programme.

The quality of the implemented educational programme was evident in the more frequent engagement in higher levels of physical activity among respondents who participated in education through small group work and individual conversation combined with small group work. The impact of education was also observed in the values of morning and postprandial glycemia, as well as in lipid status values after the educational programme began.

Throughout the study, all effects of self-control and education for patients with type II diabetes included in the research were monitored during visit 1 and visit 2, with a one-month interval between visits. During this period, patients received additional motivation to adhere to educational advice.

Monitoring the effects of the educational programme showed a decrease in morning and postprandial glycemia values among respondents who received education through small group work and individual conversation combined with small group work. A reduction in HbA1c values was also demonstrated by respondents who participated actively in small group education and individual discussion combined with small group work. The impact of education on HbA1c values was monitored over 17 years in a large study called the HOORN Study [28, 29]. This study included 1,952 participants in 1989 and 1,718 participants in a new version conducted in 2006.

The results of this study showed an increase in HbA1c values in both sexes at the very beginning of the study, indicating inadequate self-management of the disease and the need for an urgent response. The findings also showed that HbA1c values decreased, but not significantly, which remains a cause for concern. The impact of education on nutrition was evident in the improvement of food consumption habits compared to the start of the study. Subjects who adjusted their eating habits demonstrated better glycoregulation parameter values. These results are consistent with those of the DEPLAN study conducted in Athens [30]. In that study, education was shown to correlate with weight loss, with an average reduction of 4.7±1.0 kg (1.1% of initial body weight). Consequently, the percentage of patients with any glucose abnormalities decreased after the education (68% at baseline, 53.6% one year after the start of the education).

The impact of education on the quality of life of patients with type II diabetes is a research focus in many countries, aiming to prevent the disease itself. In Great Britain, the DESMOND structured educational programme was developed for patients with type II diabetes mellitus [31]. The programme included a one-year study in which data on lifestyle, nutrition, physical activity, and habits were collected [32]. The educational component involved applying knowledge about the correct approach to diabetes management. Comparing the results from this study with those from the implementation of the DESMOND educational programme, it can be concluded that the level of patient education is fundamental for adequate disease control. This study also demonstrated significantly better regulation of glycaemic parameters following education, indicating that this is an area requiring further attention.

In this study, considerable attention was given to the education programme itself, its delivery, and the motivation of patients to acquire new knowledge and integrate it into their daily habits. During the intensive implementation of education, participants were consistently encouraged to actively engage in the programme, which produced positive results and indicated the appropriate course of action. By applying educational principles within the self-control programme, satisfactory glycaemic regulation was achieved, and consequently, effective disease management.

It has been demonstrated that, in addition to providing adequate education for patients with diabetes, medical staff must also receive ongoing training, as successful patient education is not possible without well-educated educators.

By applying the principles of education and self-control, we enabled patients with type II diabetes to integrate the disease into their self-identity, modify their behaviour, and accept the limitations associated with this condition. The treatment itself requires a multidisciplinary approach, in which the principles of self-control and education are tailored to the individual [33, 34, 35].

4. Conclusion

The data obtained in this way could contribute to the effective planning and implementation of education programmes, to achieve the best possible quality of life for people with type II diabetes. There is no single model, however, the foundation is based on lifestyle changes, including dietary correction with prescribed physical activity, appropriate treatment, and regular health checks, all aimed at preventing chronic complications and the development of early disability. The frequency and type of education provided have a significant impact on achieving optimal glycaemic control and correcting metabolic and cardiovascular disorders.

References

1. R. A. DeFronzo et al., “Type 2 diabetes mellitus,” *Nat. Rev. Dis. Primers*, vol. 1, 15019, Aug. 2015. DOI: 10.1038/nrdp.2015.19
   PMid: 27189025
2. *Global report on diabetes*, WHO, Geneva, Switzerland, 2016.
   Retrieved from: https://www.who.int/publications/i/item/9789241565257
   Retrieved on: Apr. 2, 2026
3. Y. Zheng, S. H. Ley, F. B. Hu, “Global aetiology and epidemiology of type 2 diabetes mellitus and its complications,” *Nat. Rev. Endocrinol.*, vol. 14, no. 2, pp. 88 – 98, Feb. 2018.
   DOI: 10.1038/nrendo.2017.151
   PMid: 29219149
4. N. A. ElSayed et al., “Introduction and Methodology: Standards of Medical Care in Diabetes—2023,” *Diabetes Care*, vol. 46, suppl. 1, pp. S1 – S4, Jan. 2023.

DOI: 10.2337/dc23-Sint
PMid: 36507647
PMCid: PMC9810461
5. F. B. Hu, "Globalization of diabetes: The role of diet, lifestyle, and genes," *Diabetes Care*, vol. 34, no. 6, pp. 1249 – 1257, Jun. 2011.
DOI: 10.2337/dc11-0442
PMid: 21617109
PMCid: PMC3114340
6. I. I. Dedov et al., "Prevalence of type 2 diabetes mellitus (T2DM) in the adult Russian population (NATION study)," *Diabetes Res. Clin. Pract.*, vol. 115, pp. 90 – 95, May 2016.
DOI: 10.1016/j.diabres.2016.02.010
PMid: 27107818
7. M. Uusitupa et al., "Prevention of Type 2 Diabetes by Lifestyle Changes: A Systematic Review and Meta-Analysis," *Nutrients*, vol. 11, no. 11, 2611, Nov. 2019.
DOI: 10.3390/nu11112611
PMid: 31683759
PMCid: PMC6893436
8. M. V. Z. Huang et al., "Medication management support in diabetes: a systematic assessment of diabetes self-management apps," *BMC Med.*, vol. 17, no. 1, 127, Jul. 2019.
DOI: 10.1186/s12916-019-1362-1
PMid: 31311573
PMCid: PMC6636047
9. D. Katanić, S. Pavlović, "Genetski faktori i rizik od razvoja dijabetesa melitusa tipa 2," *Med. Glas. (Zenica)*, tom 26, br. 1, str. 45 – 54, 2021.
(D. Katanic, S. Pavlovic, "Genetic factors and the risk of developing diabetes mellitus type 2," *Med. Glas. (Zenica)*, vol. 26, no. 1, pp. 45 – 54, 2021.)
Retrieved from:
http://www.medglasnik.ba/article/
Retrieved on: Apr. 2, 2026
10. *IDF Diabetes Atlas*, 10th ed., IDF, Brussels, Belgium, 2021.
Retrieved from:
https://diabetesatlas.org/atlas/tenth-edition/
Retrieved on: Apr. 2, 2026
11. M. I. McCarthy, "Genomics, type 2 diabetes, and obesity," *N. Engl. J. Med.*, vol. 363, no. 24, pp. 2339 – 2350, Dec. 2010.
DOI: 10.1056/NEJMra0906948
PMid: 21142536
12. R. B. Prasad, L. Groop, "Genetics of type 2 diabetes—pitfalls and possibilities," *Genes*, vol. 6, no. 1, pp. 87 – 123, Mar. 2015.
DOI: 10.3390/genes6010087
PMid: 25774817
PMCid: PMC4377835
13. M. M. Jovanović, "Etiopatogeneza insulin-nezavisnog dijabetesa," u *Šećerna bolest*, M. M. Jovanović, B. S. Matiljević, Urednici, Kragujevac, Srbija: Prizma, 1998, str. 81 – 106.
(M. M. Jovanović, "Etiopatogenesis of insulin-independent diabetes," in *Diabetes*, M. M. Jovanović, B. S. Matiljević, Eds., Kragujevac, Serbia: Prizma, 1998, pp. 81 – 106.)
14. H. P. Himsworth, "Diabetes mellitus: its differentiation into insulin-sensitive and insulin-insensitive types," *Lancet*, vol. 227, no. 5864, pp. 127 – 130, Jan. 1936.
DOI: 10.1016/S0140-6736(01)36134-2
15. S. E. Kahn, R. L. Hull, K. M. Utzschneider, "Mechanisms linking obesity to insulin resistance and type 2 diabetes," *Nature*, vol. 444, no. 7121, pp. 840 – 846, Dec. 2006.
DOI: 10.1038/nature05482
PMid: 17167471
16. J. R. Zierath, A. Krook, H. Wallberg-Henriksson, "Insulin action in skeletal muscle from patients with NIDDM," *Mol. Cell. Biochem.*, vol. 182, no. 1 – 2, pp. 153 – 160, Apr. 1998.
DOI: 10.1023/A:1006861628496
PMid: 9609124
17. D. E. James, M. Strube, M. Mueckler, "Molecular cloning and characterization of an insulin-regulatable glucose transporter," *Nature*, vol. 338, no. 6210, pp. 83 – 87, Mar. 1989.
DOI: 10.1038/338083a0
PMid: 2645527
18. A. Chadt, H. Al-Hasani, "Glucose transporters in adipose tissue, liver, and skeletal muscle in metabolic health and disease," *Pflugers Arch.*, vol. 472, no. 9, pp. 1273 – 1298, Sep. 2020.
DOI: 10.1007/s00424-020-02417-x
PMid: 32591906
PMCid: PMC7462924
19. E. D. Abel et al., "Adipose-selective targeting of the GLUT4 gene impairs insulin action in muscle and liver," *Nature*, vol. 409, no. 6821, pp. 729 – 733, Feb. 2001.
DOI: 10.1038/35055575
PMid: 11217863
20. B. Thorens, M. Mueckler, "Glucose transporters in the 21st Century," *Am. J. Physiol. Endocrinol. Metab.*, vol. 298, no. 2, pp. E141 – E145, Feb. 2010.
DOI: 10.1152/ajpendo.00712.2009
PMid: 20009031
PMCid: PMC2822486
21. M. Brownlee, "Biochemistry and molecular cell biology of diabetic complications," *Nature*, vol. 414, no. 6865, pp. 813 – 820, Dec. 2001.
DOI: 10.1038/414813a
PMid: 11742414
22. P. Zimmet, K. G. M. M. Alberti, J. Shaw, "Global and societal implications of the diabetes epidemic," *Nature*, vol. 414, no. 6865, pp. 782 – 787, Dec. 2001.
DOI: 10.1038/414782a
PMid: 11742409
23. A. R. Saltiel, J. M. Olefsky, "Inflammatory mechanisms linking obesity and metabolic disease," *J. Clin. Invest.*, vol. 127, no. 1, pp. 1 – 4, Jan. 2017.
DOI: 10.1172/JCI92035
PMid: 28045402
PMCid: PMC5199709
24. M. M. Jovanović, *Aktivan život s dijabetesom*, Kragujevac, Srbija: Prizma, 2009, str. 7 – 15.
(M. M. Jovanovic, Active life with diabetes, Kragujevac, Serbia: Prizma, 2009, pp. 7 – 15.)
25. *Diabetes Education Survey Report 2008*, IDF, Brussels, Belgium, 2008.
Retrieved from: https://idf.org/
Retrieved on: Apr. 2, 2026
26. S. L. Norris, M. M. Engelgau, K. M. V. Narayan, "Effectiveness of self-management training in type 2 diabetes: A systematic review of randomized controlled trials," *Diabetes Care*, vol. 24, no. 3, pp. 561 – 587, Mar. 2001.
DOI: 10.2337/diacare.24.3.561
PMid: 11289485
27. A. Sampath Kumar et al., "Exercise and insulin resistance in type 2 diabetes mellitus: A systematic review and meta-analysis," *Ann. Phys. Rehabil. Med.*, vol. 62, no. 2, pp. 98 – 103, Mar. 2019.
DOI: 10.1016/j.rehab.2018.11.001
PMid: 30553010
28. C. Ruijgrok et al., "Reducing postprandial glucose in dietary intervention studies and the magnitude of the effect on diabetes-related risk factors: a systematic review and meta-analysis," *Eur. J. Nutr.*, vol. 60, no. 1, pp. 259 – 273, Feb. 2021.
DOI: 10.1007/s00394-020-02240-1
PMid: 32277270
PMCid: PMC7867534
29. Z. Gvozdanović et al., "Diet education as a success factor of glycemia regulation in diabetes patients: a prospective study," *Int. J. Environ. Res. Public Health*, vol. 16, no. 20, 4003, Oct. 2019.
DOI: 10.3390/ijerph16204003
PMid: 31635047
PMCid: PMC6843948

30. A. Vavitis, I. A. Anastasiou, D. Kounatidis, E. Rebelos, N. Tentolouris, "Adherence to the Mediterranean diet is a strong predictor of glycemic and lipidemic control in adults with type 2 diabetes: an observational study from a tertiary hospital in Greece," *Nutrients*, vol. 18, no. 2, 285, Jan. 2026.
DOI: 10.3390/nu18020285
PMid: 41599898
PMCid: PMC12845472
31. M. J. Davies et al., "Effectiveness of the diabetes education and self-management for ongoing and newly diagnosed (DESMOND) programme for people with newly diagnosed type 2 diabetes: cluster randomised controlled trial," *BMJ*, vol. 336, no. 7642, pp. 491 – 495, Feb. 2008.
DOI: 10.1136/bmj.39474.922025.BE
PMid: 18276664
PMCid: PMC2258400
32. T. C. Skinner et al., "Diabetes education and self-management for ongoing and newly diagnosed (DESMOND): process modelling of pilot study," *Patient Educ. Couns*., vol. 64, no. 1 – 3, pp. 369 – 377, Dec. 2006.
DOI: 10.1016/j.pec.2006.04.007
PMid: 17011154
33. L. Haas et al., "National standards for diabetes self-management education and support," *Diabetes Care*, vol. 35, no. 11, pp. 2393 – 2401, Nov. 2012.
DOI: 10.2337/dc12-1707
PMid: 22995096
PMCid: PMC3476915
34. M. M. Funnell, R. M. Anderson, "Empowerment and self-management of diabetes," *Clin. Diabetes*, vol. 22, no. 3, pp. 123 – 127, Jul. 2004.
DOI: 10.2337/diaclin.22.3.123
35. S. R. Shrivastava, P. S. Shrivastava, J. Ramasamy, "Role of self-care in management of diabetes mellitus," *J. Diabetes Metab. Disord*., vol. 12, no. 1, 14, Feb. 2013.
DOI: 10.1186/2251-6581-12-14
PMid: 23497559
PMCid: PMC3599009