# INFLUENCE OF EXERCISE PROGRAM CONTENT ON ELDERLY PERSONS WITH DIABETES MELITUS TIP 2

*UTICAJ PROGRAMSKIH SADRŽAJA VJEŽBANJA NA OSOBE TREĆE ŽIVOTNE DOBI OBOLELE OD DIABETES MELITUSA TIP 2*

**Raid Mekić[1,2], Merisa Mekić[4], Zana Dolićanin[1], Adem Mavrić[2], Ilma Čaprić[1,2], Emir Biševac[1] & Armin Zećirović[3]**

[1]*State University of Novi Pazar, Study Program Sports and Physical Education, Serbia*
[2]*Faculty of Sports and Physical Education, University of Niš, Serbia*
[3]*Faculty of Sports and Physical Education, University of East Sarajevo,Bosnia & Herzegovina*
[4]*Medical Faculty University of Ljubljana, Slovenia*

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**Correspodance:**
Mekić Raid
Teaching Associate at Novi Pazar State University,
Student of doctoral academic studies at the Faculty of Sports and Physical Education,
University of Niš, Serbia
Zmaj Jovina 17, Novi Pazar 36 300, Serbia
+38163 8827756
E-mail: rmekic@np.ac.rs

**SUMMARY**

*The research included seven original scientific papers. All of them addressed the main problem and could give an adequate answer. The aim of this study was to determine the impact of exercise content on people with type 2 diabetes mellitus (DM) and the importance of this activity on the health of people with this problem. The selection of works from 2002 to 2019 was taken as a method. We conclude that the physical activity of people with DM is partially limited due to the specificity of the disease. Special attention should be paid to side effects, especially hypoglycemia. Exercise frequency should be at least three days a week for aerobic activities and two days a week for resistance activities. The risk of hypoglycemia is increased, glycemic control in this population is more difficult to achieve. The goals of DM management in the elderly should be set differently for each patient.*

**Key words:** *diabetes mellitus, physical activity, elderly, type 2 mellitus, exercise program, glycemic control.*

## INTRODUCTION

Diabetes mellitus is a syndrome characterized by chronically elevated blood glucose level (above 6.1 mmol / l) and disorders of carbohydrate, fat and protein metabolism associated with absolute or relative deficiency of insulin secretion and / or insulin action. (Stefanović, et al., 1980; Đukanović, et al., 2010). Diabetes mellitus type 2 (DM) is a major cause of serious health problems in the elderly. In addition to well-known microvascular (retinopathy, nephropathy, neuropathy) and macrovascular (coronary heart disease, cerebrovascular disease, peripheral vascular disease) complications, older people with diabetes may also suffer from devastating conditions such as depression, cognitive impairment, muscle weakness, fractures, and physical weakness (American Diabetes Association, 2012; Sinclair et al., 2012). Chronic hypoglycemia in DM is associated with damage, dysfunction of various organs, especially eyes, kidneys, nerves, heart and blood vessels (Sučić & Škrabalo, 1990). Older people with DM have altered body composition, decreased skeletal muscle strength, and poor muscle quality in general (Park et al., 2006). Good control of DM depends on constant monitoring of blood glucose, proper medication, diet and especially physical activity (Schuster & Duvuuri, 2002). Proper physical participation and exercise can prevent or delay the onset of DM in a high-risk population (Schneider & Elouzi, 2000). The potential risk of developing insulin-independent diabetes, with moderate or intense exercise, which is performed regularly, reduces the possibility by 30-50% compared to inactive individuals (Manson & Spelsberg, 1994). Physical activity is a powerful therapeutic tool in various patients with diabetes or risk for its development. However, before recommending physical activity, the team of doctors who treat DM must carefully weigh the benefits and possible risks of exercise that may occur in given patients (Baretić., 2017). Despite a number of beneficial effects, in a number of people with DM, exercise can be a burden because their glucoregulatory mechanisms are not at an adequate level (Lindstrom et al., 2006). In older people with DM, the risk of disability related to mobility and daily tasks is increased by twice as much as those who do not suffer from this disease (Gregg, Engelau & Narayan, 2002). Exercise has positive effects on many processes in people with diabetes, the most important of which are: increase in insulin sensitivity, increase in VO2 max, reduction of body weight, which improves blood glucose control, prevention of cardiovascular diseases etc.


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## METHODS

Research data for the purposes of this paper were collected through electronic databases PubMed, Scholar Google, DOAJ. The search of works was done in the period from 2002 to 2019. The following keywords were used in the database research: diabetes mellitus, physical activity, elderly, mellitus type 2, exercise program, glycemic control. The found research titles, abstracts and full texts were then read and analyzed. In order for the research to be accepted for the final analysis, it had to meet two criteria: the first criterion refers to the issue of DM in the elderly (40 - 67 years of age), the second criterion is the analysis of works in the selected period. The research that met the set criteria was then analyzed and presented on the basis of the following parameters: reference (first letter of the name of the author, year and year of research publication, sample of respondents (age, total number and subgroups of respondents), applied exercise program, program duration and research results.

## RESEARCH RESULTS

Based on the key words, 263 works were identified. The number of studies that were immediately excluded on the basis of titles, duplicate papers, as well as papers that were excluded on the basis of the period when they were published (older than 2002) is 228, while 35 papers were included in further analysis. Further analysis of 35 papers excluded 28 papers based on several criteria: abstract, because it was a systematic review research, as well as the absence of a control group in the research. The remaining seven papers met the set criteria, namely: being published in the period from 2002 to 2019, and participants who all had DM.

**Table 1.** *Procedure for collection, analysis and elimination of found works*

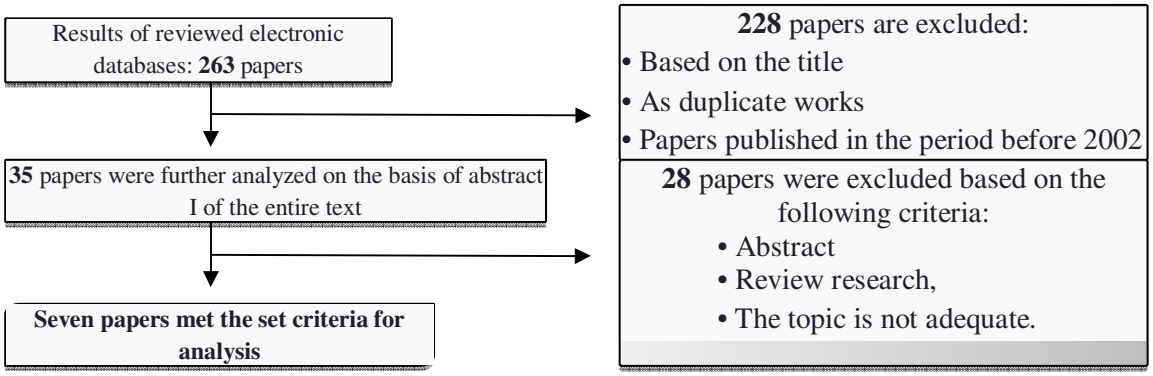


**Table 1** shows the entire protocol on the basis of which the works that met the set criteria were selected.


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*Table 2*. Overview of works

| Reference | Populacija | Grupacija | Tretman | Protokol | Rezultati |
|---|---|---|---|---|---|
| **Castaneda et al. (2002)** | Population M. and F. 66 +/- 8 suffering form DM | n=40 (Ž) n=22 (M) random division on EG and KG | EG- training PO high intensity; CG- UA control GK, MS, ST. | TT - 16 weeks, 3x weekly | Improvements in all tested variables. High-intensity PO training improves the control of MS-associated GC in DM individuals. |
| **Loimaala et al. (2003)** | Population M. 53.3 +/- 5.1 suffering from DM | n=50 (M) random division onEG and KG | Effect asse TT na BRS, HRV, $VO_{2max.}$ | TT - 12 month, 2x weekly | Improvements in BRS and sensitivity to DM, increase in blood pressure, muscle strength and glucose control. Improving the prognosis from a person with DM |
| **Brooks et al. (2006)** | Population M. 55 +/- 6 suffering from DM | n=62 (M) random division on EG and KG | EG - (health care +TT); CG - (UA) TS n, HM, IK, protein, FFA. | TT - 16 weeks, 3x weekly | TS improves the quality of muscles and the whole body and KI. The use of this program in the ongoing monitoring of persons with DM remains to be considered. |
| **Bello et al. (2011)** | Population M. 46,22 ± 9,79 suffering from DM | n=18 (M) random division on EG and KG based on TG. | EG –individually prescribed AV CG – (UA) GK, GH, LVG, LNG, WHOQ | TT – 8 weeks, 3x weekly, 30 min. | TT AV showed significant improvement. Not in all variables, but in most. Quality of life improved. |
| **Moura et al. (2014)** | Population M. 51,1 ± 8,2 sufferingfrom DM | n=8 (M), only EG. | EG – consumption $VO_{2max}$ na 50 – 60%. Body composition, GK, FZ, KGK. | TT – 8 weeks, 3x weekly, 30 – 60 min. | After TT increase VO2max. Progress in GC control. This TT is effective and can replace additional medications. |
| **Yavari et al. (2015)** | Population M. 40-65 suffering from DM | random division onEG and KG EG=35; KG=30 respondents | EG – aerobic training; CG – standard activities GH, GK | EG - 16 weeks, 3x weekly, 90 min. | In EG GH significantly reduced. Changes in body weight, significant reduction in pressure. GC control can be achieved with such TT. |
| **Mikolčević, J. (2019)** | Population M-F. suffering from DM | n= 100 | The survey method was used. Data about age, education, marital status, place of residence and the type of therapy used by the respondents werecollected. | The questionnaire examines the physical, mental or social consequences of limited health. | By analyzing the results obtained by the research, we come to the conclusion that type 2 diabetes has a greater impact on the physical than on the emotional health of patients. Patients feel less restricted in performing physical activities. |

**M**.-male; **F**- female; **DM**-diabetes mellitus type 2; **EG**-experimental group; **CG**-control group; **PR**-progressive resistance; **UA**-usual activities; **GK**-glycemia; **MS**-metabolic syndrome; **BC**-body composition; **TT** treatment; **BRS**- baroreflex sensitivity; **HRV**-heart rate variability; **VO2max**-maximum oxygen consumption; Skilled exercise capacity; **TS** strength training; **HM**-muscle hypertrophy; **IK** insulin control; FFA-free fatty acids; **SB**-secret ballot; **AE**-aerobic exercise; **GH** - glycosylated hemoglobin; High-density **LVG**-lipoprotein; Low density **LNG** lipoprotein; **WHOQ**-questionnaire by the health organization on quality of life; **FZ**-fructosamine; **CBG**-capillary blood glucose.


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## DISCUSSION

Table 2 contains an overview of papers dealing with the exercise program in elderly people with DM. The table shows the results of applying a particular exercise program, as well as the methods used in working with these individuals. The analysis of the table shows that various exercise programs generally give positive results in the rehabilitation of people with DM.

The first paper of the table contains research data conducted on a sample of 66 respondents, 40 female respondents and 22 male respondents. The subjects were 66 +/- 8 years old. The sample was randomly divided into experimental and control groups. The experimental group was subjected to a high-intensity progressive resistance program, while the control group had normal activities. The experimental program lasted sixteen weeks with a frequency of three training sessions per week. The results on the control measurement in the experimental group showed statistically significant improvements in all tested variables. This type of treatment improves the glycemic control associated with the metabolic syndrome in people with diabetes mellitus (DM).

The second part of the table contains data from a research conducted on a sample of 50 male respondents. The subjects were 53.3 +/- 5.1 years old. The sample was randomly divided into experimental and control groups. The experimental group was subjected to a program that monitored baroreflex sensitivity (a measure of the body's ability to change heart rhythm depending on changes in blood pressure, diabetes), frequency variability and maximum oxygen intake. The experimental program lasted 12 months with a frequency of two trainings per week. The results indicate an improvement in baroreflex sensitivity, an increase in exercise capacity, muscle strength and glucose control. This type of treatment improves the prognosis in people with DM.

The third part of the table contains data from a research conducted on a sample of 62 male respondents. The sample was randomly divided into experimental and control groups. The subjects were 55 +/- 6 years old. The experimental group underwent a strength training program and nutrition care. The control group had normal activities. The experimental program lasted sixteen weeks with a frequency of three trainings per week. Strength training improves the quality of muscles and the whole body and acts on insulin control. The use of this program in the ongoing monitoring of persons with DM remains to be considered.

The fourth paper of the table contains data from a research conducted on a sample of 18 male respondents. Ages 46.22 ± 9.79 years. The sample was randomly divided into experimental


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and control groups. The experimental group underwent an aerobic exercise program, while the control group had normal activities. The parameters of lipoproteins, glycemia as well as the questionnaire by the Health Organization for quality of life were measured. Aerobic training has contributed to the quality of life and improvement of most variables, not all.

The fifth paper of the table contains data from a research conducted on a sample of 8 male respondents. Ages 51.1 ± 8.2 years. The study had only an experimental group and an aerobic program with monitoring of maximal oxygen consumption, body composition, and capillary glucose. The results show a significant impact of the eight-week program with a frequency of 3 workouts per week on all parameters with the conclusion that drug intake under this treatment can be significantly reduced.

The sixth paper of the table contains data from a survey conducted on a sample of 65 respondents. The respondents were aged 40-65 years. The sample was divided into an experimental group with 35 subjects and a control group with 30 subjects. The experimental treatment had the application of aerobic training with monitoring of glycosylated hemoglobin (GH) and glycemia. The program lasted 16 weeks with a training frequency of 3 times a week for 90 min. After the experimental program, GH was significantly reduced, there were changes in body weight and arterial blood pressure. With this type of treatment, it is possible to control glycemia within 16 weeks.

The seventh paper of the table contains data that was conducted at the Department of Internal Medicine OB "Dr. Josip Benčević" in Slavonski Brod. The study included 100 patients with type 2 diabetes. Data were collected through a questionnaire survey. The method of personal interrogation was used. Data were collected on age, level of education, marital status, place of residence and the type of therapy that respondents receive. The questionnaire examines the physical, mental or social consequences of limited health. Results: Analyzing the results of the research, we conclude that type 2 diabetes has a greater impact on the physical than on the emotional health of patients. Patients feel less restricted in performing physical activities. Respondents who assess their health more positively, have a better level of physical functioning, less physical or emotional problems interfere with social activities and perform the desired number of activities. The quality of life of people with type 2 diabetes is of great importance.

The quality of life of the patient will also depend on the way in which the patient will maintain a good general condition.


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## CONCLUSION

Elderly people must be encouraged to exercise. The aging process leads to degeneration of muscles, ligaments, bones and joints, and inactivity and DM can exacerbate this problem. For this reason, we must take care of the selection of patients with this disease and the control of diabetes and taking care of it. Regular exercise and physical activity also have special benefits for people with DM, such as the body's sensitivity to insulin, helping to regulate blood glucose levels, weight and blood pressure. Physical activity is one of the best complementary factors in the regulation of type 2 diabetes, for both men and women. Preparing people with DM for safe and useful exercise is just as important as the exercise itself. Exercise frequency should be at least three days a week for aerobic activities and two days a week for resistance activities. The risk of hypoglycemia is increased, glycemic control in this population is more difficult to achieve. The goals of DM management in the elderly should be set differently for each patient. Type 2 diabetes affects the quality of life, but a positive and responsible attitude towards the disease can provide patients with a better quality of life.

## REFERENCES


1. American Diabetes Association (2012). Standards of medical care in diabetes. *Diabetes Care*, *35*(1), 11–63.
2. Brooks, N., Layne, J., E., Gordon, P., L., Roubenoff, R., Nelson, M., E., & Castaneda, S., C. (2006). Strength training improves muscle quality and insulin sensitivity in Hispanic older adults with type 2 diabetes. *International Journal of Medical Sciences*, *14*(1), 19-27. doi: 10.7150/ijms.4.19; PMid: 17211497**;** PMCid: 1752232.
3. Baretić M. (2017). Fizička aktivnost i šećerna bolest. *Acta medica croatica,* 71, 57-62.
4. Bello, A., I., Owusu, B., E., Adegoke, B., O., & Adjei, D., N. (2011). Effects of aerobic exercise on selected physiological parameters and quality of life in patients with type 2 diabetes mellitus. *International Journal of General Medicine*, 4, 723-727. doi: 10.2147/IJGM.S16717; PMid: 22114516; PMCid: PMC3219758
5. Castaneda, C., Layne, J.E., Munoz, O.L., Gordon, P.L., Walsmith, J., Foldvari, M., Roubenoff, R., Tucker, K.L., & Nelson, M.E. (2002). A randomized controlled trial of resistance exercise training to improve glycemic control in older adults with type 2 diabetes. *Diabetes Care*, *25*(12), 2335-2341. doi: 10.2337/diacare.25.12.2335 PMid:12453982
6. Đukanović, N., Ražnatović, A., & Jovanović, I. (2010). Diabetes mellitus i fizička aktivnost. Crnogorska sportska akademija. *Sport Mont*, *21*(22), 230-234.
7. Gregg, E., W., Engelgau, M., M., & Narayan, V. (2002.) Complications of diabetes in elderly people. *Biomedical Journal*, *325*(7370), 916–917. doi: 10.1136/bmj.325.7370.916;

PMid: 12399324; PMCid: PMC1124430
8. Lindstrom, J., Ilanne, P.P., & Peltonen, M. (2006). Sustained reduction in the incidence of type 2 diabetes by lifestyle intervention: follow-up of the Finnish Diabetes Prevention Study. *Lancet*. *368*(9548), 1673-1679. doi: 10.1016/S0140-6736(06)69701-8;
PMid: 17098085
9. Loimaala, A., Huikuri, H., V., Koobi, T., Rinne, M., Nenonen, A., & Vuori, I. (2003). Exercise training improves baroreflex sensitivity in type 2 diabetes. *Diabetes*, *52*(7), 1837-1842.
doi: 10.2337/diabetes.52.7.1837; PMid: 12829654
10. Manson, J., E., & Spelsberg, A. (1994) Primary prevention of non-insulin-dependent diabetes mellitus. *American Journal of Preventive Medicine*, 10, 172-184.
https://doi.org/10.1016/S0749-3797(18)30615-9
PMid: 7917445.
11. Mikolčević, J. (2019). Kvaliteta života osoba oboljelih od šećerne bolesti tip 2. *Hrvatski časopis za javno zdravstvo*, 33-40.
12. Moura, B., P., Amorim, P., R., S., Silva, B.P.P., Franceschini, S., C., C., Reis, J., S. & Mar, J., C., B. (2014). Effect of a short-term exercise program on glycemic control measured by fructosamine test in type 2 diabetes patients. *Diabetology & Metabolic Syndrome*, *6*(16).
https://doi.org/10.1186/1758-5996-6-16
PMid:24512719; PMCid:PMC3925446
13. Park, S.W., Goodpaster, B.H., Strotmeyer, E.S., Rekeneire, N., Harris, T.B., Schwartz, A.V., Tylavsky, F.A., & Newman, A.B. (2006). Decreased muscle strength and quality in older adults with type 2 diabetes: the Health, Aging, and Body Composition Study. *Diabetes*, *55*(6), 1813-1818.
doi: 10.2337/db05-1183;
PMid: 16731847
14. Sinclair, A., Morley, J.E., Rodriguez, M.L., Paolisso, G., Bayer, T., Zeyfang, A., Bourdel, M.I., Vischer, U., Woo, J., Chapman, I., Dunning, T., Meneilly, G., Rodriguez, S.J., Gutierrez, R.L.M., Cukierman, Y.T., Gadsby, R., Schernthaner, G., & Lorig, K. (2012) Diabetes mellitus in older people: position statement on behalf of the International Association of Gerontology and Geriatrics (IAGG), the European Diabetes Working Party for Older People (EDWPOP), and the International Task Force of Experts in Diabetes. *Journal of the American Medical Directors Association*, *13*(6), 497–502.
https://doi.org/10.1016/j.jamda.2012.04.012
PMid:22748719
15. Stefanović, S. i saradnici (1980). *Specijalna klinička fiziologija*, III izdanje. Beograd-Zagreb: „Medicinska knjiga“.
16. Sučić, M., & Škrabalo, Z. (1990) Sedentary lifestyle, nutrition, and diabetes mellitus: preventiona spects. U: Fabris, F., Pernigotti, I., Ferrario, E., eds. Sedentary life and nutrition. *Raven Press*, 145-156.
17. Schuster, D.P. & Duvuuri, V. (2002). Diabetes mellitus. *Clinics in Podiatric Medicine And Surgery*, *19*(1), 79-107.
doi:10.1007/s10900-011-9393-3
PMid:21442339
18. Schneider, S.H. & Elouzi, E.B. (2000). The role of exercise in type II diabetes mellitus. *Preventive Cardiology*, *3*(2), 77-82.
doi: 10.1111/j.1520-037X.2000.80365.x
PMid:11834922
19. Yavari, A., Hajiyev, A., M. & Naghizadeh, F. (2015). The effect of aerobic exercise on glycosylated hemoglobin values in type 2 diabetes patients. *The Journal of Sports Medicine and Physical Fitness*, *50*(4), 501-505.
PMid: 21178937

# INFLUENCE OF EXERCISE PROGRAM CONTENT ON ELDERLY PERSONS WITH DIABETES MELITUS TIP 2


## SAŽETAK

*Istraživanje je obuhvatilo sedam originalnih naučnih radova. Svi radovi su zadovoljili problematiku i mogli su da daju odgovor na postavljeni problem. Cilj rada je bio da se utvrdi uticaj programskih sadržaja vežbanja na osobe koje boluju od diabetes melitusa tipa 2 (**DM**) i značaj navedene aktivnosti na zdravlje osoba sa ovim problemom. Kao metod uzeta je selekcija radova od 2002. do 2019. godine. Zaključujemo da je fizička aktivnost osoba sa **DM** delimično ograničena zbog specifičnosti bolesti. Posebna pažnja treba da bude usmerena na neželjene efekte, posebno hipoglikemiju. Učestalost vežbanja treba biti najmanje tri dana u nedelji za aerobne aktivnosti i dva dana nedeljno za aktivnosti sa otporom. Rizik od hipoglikemije je povećan, kontrola glikemije kod ove populacije je teže ostvariva. Ciljeve upravljanja **DM** kod starijih osoba treba postaviti drugačije prema svakom pacijentu.*



**Ključne reči:** *diabetes melitus, fizička aktivnost, starije osobe, melitus tip 2, program vežbi, glikemijska kontrola.*

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Korespodencija:
**Mekić Raid**
Saradnik u nastavi na Državnom univerzitetu u Novom Pazaru,
Student doktorskih akademskih studija na Fakultetu za sport i fizičko vaspitanje,
Univerziteta u Nišu
Zmaj Jovina 17, Novi Pazar 36 300, Srbija
Telefon: +381- 63 8827756
E-mail: rmekic@np.ac.rs





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