

Remedial exercise training program (aerobic and brisk walk training) for type II diabetes (T2DM)

Vinod Kuamr¹, Vinu W^{1*}

¹ Department of Physical Education and Sports, Pondicherry University, Puducherry.

* Correspondence: Vinu W; wilsonvinu@gmail.com

ABSTRACT

Diabetes type 2 Mellitus (T2DM) is a severe world crisis. The Indian population, mostly above forty years' age group they sick with Diabetes. Most doctors prescribe walking as an endurance activity to improve diabetic patients. Therefore, the aim of this study was to investigate the effect of aerobic exercise, including spot jogging, stepping, jumping exercises and simple dance movements, together with brisk walking on the improvement of type II diabetes. Ten subjects with type II diabetes mellitus (T2DM) were selected as participants for this study. Totally 12 weeks of training was executed for this diabetes group, the training intensity was followed beginning with two minutes of continuous exercises with one-minute rest interval, and it has been progressively increased. The timing and intensity continue to forty minutes with five minutes' rest intervals to reach to find the improvement in Type II diabetes. Statistical Package for Social Sciences version 21.0 was used to analyze the data. Aerobic exercises and brisk walking significantly reduced the body weight, blood sugar level and showed significant changes in the systolic and diastolic blood pressure of type II diabetes.

KEYWORDS

Type II Diabetes; Brisk Walk; Aerobic Exercises

1. INTRODUCTION

Today mankind lives in a computerized world. All work is quickly done by machine with a single button. So, the physical work of a human being slowly vanishes, leading to obesity. Assuming have diabetes, exercise offers astounding advantages. In addition to the fact that it brings down the feelings of stress and anxiety, it might likewise bring down the glucose level and may try and diminish the insulin prerequisites (Gasnick, 2022).

Diabetes influences roughly 382 million of people around the world, and is anticipated to increment to 439 million of people by 2030. Approximately 85 to 95% of diabetes affects by type 2 diabetes mellitus (T2DM) (Pan et al., 2018). Cardio workout, is very advantageous for keeping up with the solid working on the whole body. Practicing cardiovascular activity can diminish high blood pressure, decline the hazard of diabetes, heart illnesses, and stroke (Gasnick, 2022). Practicing aerobic activities is a vital part of the way of life treatment for counteraction and treatment of type 2 diabetes (T2D). These suggestions have a positive relationship between physical work and prevention of T2D, treatment, and infection related dreariness and mortality (Salwa et al., 2023). Doing exercises as their regular practicing gets the advantages to the diabetes, the glycated hemoglobin (HbA1c) it outright decreases of 0.67% with organized well planned module of exercises (Williams 2020). The cardio or aerobic physical activity is viewed as a foundation in the administration of type 2 diabetes mellitus (T2DM). It further develops glucose control and escape from the dangerous conditions of cardiovascular factors (Moggetti et al., 2020).

Type 2 diabetes mellitus (T2DM) has a pathophysiology that is largely determined by insulin resistance (Kumar et al., 2019). Diabetes doing alternate days' regular exercise controls body weight loss, improves cardiovascular fitness and vascular function, controls low-grade inflammation, and significantly improves the lipid profile and glycemic control (Kirwan et al., 2017). Nowadays, a man over 40 years is affected by diabetes (T2DM). The patient with Type II diabetes had to train 25 minutes per day for three days per week in moderate to vigorous aerobic exercises that significantly improve blood sugar levels as per the American Diabetes Association (ADA) recommendation. However, any physical activity which is undergoing the diabetic patients with less energy expenditure who are doing a low volume of exercises with several walking steps and progressively improve the volume of exercises significantly enhances the level of diabetic, as compared with the non-diabetic adults (Fagour et al., 2013).

Adults with type 2 diabetes examined the walkability and steps per day walking would measure the improvement on the diabetic level (Hajna et al., 2016). The aerobic activity could improve the mortality risks of type 2 diabetes and reduce cardiovascular diseases (Sluik et al., 2012). Resistance exercise program significantly improves the blood pressure, insulin resistance, and glycemic control of type 2 diabetes (Gordon, 2009). The low to moderate intensity of walking and jogging improves the T2D diabetes (Little et al., 2011). Type 2 diabetes (T2D) has more therapeutic value after the aerobic and resistance exercise (Gaesser, 2007). 12 months of brisk walking programme clinical benefit to the type 2 diabetes (Praet et al., 2008). Every general practitioner

should repeatedly encourage patient to take every suitable opportunity to engage in physical activity, with the aim of improving insulin resistance (Klare, 2007).

As the investigator has many discussions with the physicians regarding why and what the reason, this diabetes affected the adults at the earliest age. They replied strongly that diabetes may cause because of inactive people who are not involved physical activities and they may fall into obesity. To avoid getting this Diabetes, they need medication under the physician's advice. But people don't know why it has spread rapidly past twenty years and it is due to the lack of physical activity. Is it the physical activity increase, or will it decrease obesity? If obesity is set away, there is no chance of getting any disease or Diabetes.

If the person gets the diabetes, the doctor recommended to go for a walk, but they are not given any set of programme to execute to reduce the diabetes level. The investigator has considered this point and try to make a good package of exercise to reduce the diabetic level of the patients. This study insists on the workout of simple aerobic activities along with the brisk walk to betterment for type II diabetes. There is no cure for it at this time. However, the disease can be controlled. This result would help us understand how to control the Diabetes and the importance of doing so. Therefore, the aim of this study is to investigate the effect of aerobic exercise, including spot jogging, stepping, jumping exercises and simple dance movements, together with brisk walking on the improvement of type II diabetes.

2. METHODS

2.1. Participants

Aerobic exercise refers to the repeated and continuous exercise of large muscle groups, including on-the-spot stationary stepping, jogging, jumping, and dancing. Ten subjects with type II diabetes mellitus (T2DM) were selected as participants for this study. The subjects were chosen from Pondicherry University male teaching and non-teaching staff only residency inside the campus, Puducherry. Their age ranged between 44 years to 52 years. All were undertaking medications. Before the training period, all the participants were tested only the fasting blood sugar level it was ranged between 108-148mg/dL. In this study, we did not consider the test after a meal because the doctor said that it may depend on the food ingested, so the doctor only considered the fasting blood glucose level. All subjects had been patients for two to three years. The ethical approval was cleared by the Pondicherry University Ethics Committee.

2.2. Training Schedule

All the patients were tested in the laboratory tests in the Pondicherry University Health Centre by the lab technicians. The variables chosen for this study were body weight, blood sugar level, and blood pressure. The selected subjects underwent simple aerobic and continuous brisk walking programs. The training programs were conducted six days a week for 12 weeks. The program includes warming up, training schedule, and warming down. The type II diabetes patients underwent an aerobic exercise program on alternate Mondays, Wednesdays, and Fridays, and the brisk walk program was conducted on Tuesdays, Thursdays, and Saturdays (Table 1 and 2).

Table 1. Training schedule of aerobic exercise program

Week	Monday	Wednesday	Friday
1 to 12 weeks	Aerobic Training	Resistance training	Pilates Exercises
Warm-up	10 minutes (Proper stretching with warming up exercises)		
Training duration	30- 40 minutes		
Training Exercises	Aerobic dance, Stepping exercises, Treadmill training	Cycling exercise, Own body weight exercises, Gym workouts (light weight apparatus)	The Hundredth, Crisscross, Spine stretch, Roll up, Donkey kick, Alternate Leg raise, Planks, Shoulder Bridge, Saw, Single Leg stretch, Cat stretch
Intensity for walk/jog	The intensities are progressively increased for aerobic exercises based on their pulse rate; It begins with 1-3 weeks 10%, 4-6 weeks 15%, 7-8 weeks 20%, 9-10 weeks 25%, and 11-12 weeks 30%.		
Rest Interval	2 to 3-minute of the interval at the end of the each aerobic exercise.		
Warm-down	10 minutes warming down stretching exercises		

Table 2. Training schedule of brisk walk training

Week	Tuesday	Thursday	Saturday
1 to 12 weeks	Brisk walk-on the track	Brisk walk-on uneven surface	Brisk walk-up and down slop surface
Warm-up	10 minutes (Proper stretching with warming up exercises)		
Training duration / Intensity	1-week - 20 minutes, 2-3 weeks - 25 minutes, 4-6 weeks - 30 minutes, 7-9 weeks - 35 minutes, 10-12 weeks - 40 minutes		
Rest Interval	5-6 minutes of the interval at the end of the each aerobic exercises		
Warm-down	10 minutes warming down stretching exercises		

2.3. Data Analysis

Statistical Package for Social Sciences version 21.0 was used to analyze the data. The data were collected on the variables of body weight (weighing machine), blood sugar (fasting blood test) and blood pressure (sphygmomanometer). Pretest data were collected two days before the training program, and posttest data were collected 24 hours after the last training session at the end of 12 weeks. As in the experimental group, the single-group experimental design was taken for this study. The significance of the difference among the means of training group was found out by pretest and posttest. The data were analyzed through the independent t-ratio method. In all cases, 0.05 level of confidence was fixed to test the hypothesis.

3. RESULTS

The pre- and post-test results of analysis of body weight, blood sugar level (T2DM), and blood pressure are presented in Table 3.

Table 3. Pre- and post-test results of analysis of body weight, blood sugar level (T2DM), and blood pressure

Variables	Pretest Mean	Post-test Mean	Mean Difference + S.D	t-ratio	p
Body Weight (kg)	71.39±4.32	67.70±4.02	3.69±1.91	6.095*	.000
Blood Sugar Level (T2DM) (mg/dL)	135.04±6.39	112.01±8.43	23.03±6.51	11.186*	.000
Systolic Blood Pressure (mmHg)	134.50±8.86	119.40±2.75	15.10±7.69	6.205*	.000
Diastolic Blood Pressure (mmHg)	79.20±5.39	75.00±4.08	4.20±2.029	5.775*	.000

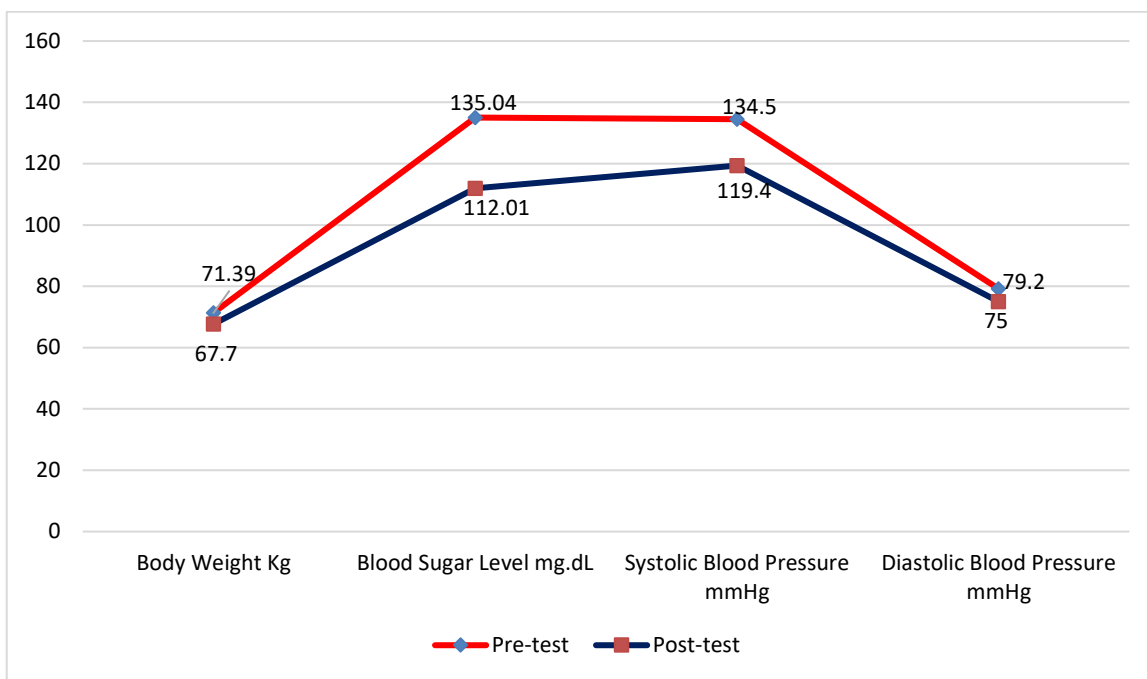


Figure 1. Body weight, blood sugar level, systolic and diastolic blood pressure of type II diabetes after aerobic exercises and brisk walk training

The results above showed that type II diabetes significantly changed all variables after aerobic exercises and brisk walking training. The results showed that body weight was significantly reduced by 3.49%, that is, 3.69 kg mean differentiated with t-ratio 6.095, and the blood sugar level was significantly reduced by 19.10% is 23.03 mm/dL mean differentiated with t-ratio 11.186. The results of blood pressure showed significant changes of 13.40% in systolic blood pressure, 15.10 mmHg mean determined by t-ratio 6.205, and diastolic blood pressure changes 3.97% 4.20 mmHg mean differentiates with t-ratio 5.775.

4. DISCUSSION

The results of the study showed that type II (T2DM) diabetes significantly changed after aerobic exercises and brisk walking training. Pan (2018) stated that type 2 diabetes can be prevented by physical activity (PA), aerobic exercise was more powerful in improving HbA1c and blood glucose level could be controlled (Colberg et al., 2010) the brisk walking programme significantly decreases blood glycaemia (Lakhdar et al., 2020), aerobic exercises and walking improve glucose control for T2DM people (Moggetti et al., 2021). Interval-walking training improves glycemic control of type 2 diabetes (Rigshospitalet, 2014). The preventative values of exercise for T2D are

developed, the therapeutic impact of exercise on diabetes metabolic and cardiovascular outcomes, the barriers to exercise including hypoglycemia (Salwa et al., 2023). Aerobic activity can lower the need of insulin (Gasnick et al., 2022), 85% of adult Australians participate in insufficient levels of physical activity to meet current physical activity guidelines and obtain the major benefits of participation, including the prevention of type 2 diabetes (T2D) (Williams et al., 2020), walking is a useful therapeutic tool for people with T2DM, regular exercise is considered a cornerstone in the management of type 2 diabetes mellitus (T2DM) (Moggetti et al., 2020). The evidence highlights the effectiveness of a structured exercise intervention program for insulin resistance in T2DM (Sampath Kumar A, 2018), All forms of exercise training produce small benefits in the main measure of glucose control: A1C (Snowling & Hopkins, 2006).

The results of this research showed that body weight was significantly reduced after twelve weeks of aerobic and brisk walking training. Similarly, Melam et al. (2016) said that brisk walking and aerobics are the best methods for controlling and reducing body weight and body mass composition. Weight loss happened to the aerobic group; weight loss: 5.02 kg lower (Pan et al., 2018).

The results of this study stated that aerobic and brisk walking training group had significant changes in the systolic and diastolic blood pressures of type II diabetes. Similar studies stated that the blood pressure of Indians could be reduced the aerobic training (Punia et al., 2016), aerobic exercise is to decrease blood pressure (Dimeo et al., 2012), the adults with hypertension had reduces of systolic and diastolic blood pressure after aerobic training (de Barcelos et al., 2022). Lakhdar et al. (2020), gradual decrease in blood pressure levels has been disclosed after seven-month (28 weeks) of follow-up of the brisk walking programme. After 12 weeks of brisk walking, Systolic blood pressure during resting, low and high-intensity (He et al., 2018), the exercise was significantly reduced. Moderate-intensity aerobic exercise for at least 30 min on at least 3 days of the week or resistance exercise on 2-3 days of the week, after an exercise session, blood pressure decreases (Alpsoy, 2020), 8 to 12 weeks of aerobic exercise significantly decreased systolic and diastolic daytime ambulatory blood pressure by 6 ± 12 and 3 ± 7 mm Hg, respectively ($p=0.03$ each) (Dimeo et al., 2012).

5. CONCLUSIONS

Aerobic exercises and brisk walk training of alternate days for six days in a week had significantly reduced the body weight. The 12 weeks of moderate-intensity aerobic exercises with alternate brisk walk training decrease the blood sugar level (T2DM) of diabetes type II Mellitus.

Also, the training group had significant changes in the blood pressure (B.P.) level in the systolic and diastolic blood pressures of type II diabetes.

6. RECOMMENDATIONS

Based on the results of our study, we recommend as following:

- To practice regular aerobic exercise combined with brisk walking because it can control the diabetic level.
- The systolic and diastolic blood pressure could be normal by involving the hypertensive diabetic patients after this aerobic and brisk walk training in which there is no risk of cardiac problems in the future. This training may be a preventive aspect of diabetes.

7. REFERENCES

- Alpsoy, S. (2020), Exercise and Hypertension. *Advanced Experimental Medical Biology*, 1228, 153-167. https://doi.org/10.1007/978-981-15-1792-1_10
- Colberg, S. R., Sigal, R. J., Fernhall, B., Regensteiner, J. G., Blissmer, B. J., Rubin, R. R., Chasan-Taber, L., Albright, A. L., Braun, B., American College of Sports Medicine, & American Diabetes Association. (2010). Exercise and type 2 diabetes: The American College of Sports Medicine and the American Diabetes Association: joint position statement. *Diabetes Care*, 33(12), e147–e167. <https://doi.org/10.2337/dc10-9990>
- De Barcelos, G. T., Heberle, I., Coneglian, J. C., Vieira, B. A., Delevatti, R. S., & Gerage, A. M. (2022). Effects of Aerobic Training Progression on Blood Pressure in Individuals with Hypertension: A Systematic Review with Meta-Analysis and Meta-Regression. *Frontiers in Sports and Active Living*, 4, 719063. <https://doi.org/10.3389/fspor.2022.719063>
- Dimeo, F., Pagonas, N., Seibert, F., Arndt, R., Zidek, W., & Westhoff, T. H. (2012). Aerobic exercise reduces blood pressure in resistant hypertension. *Hypertension*, 60(3), 653–658. <https://doi.org/10.1161/HYPERTENSIONAHA.112.197780>
- Dimeo, F., Pagonas, N., Seibert, F., Arndt, R., Zidek, W., & Westhoff, T. H. (2012). Aerobic exercise reduces blood pressure in resistant hypertension. *Hypertension*, 60(3), 653–658. <https://doi.org/10.1161/HYPERTENSIONAHA.112.197780>

- Fagour, C., Gonzalez, C., Pezzino, S., Florenty, S., Rosette-Narece, M., Gin, H., & Rigalleau, V. (2013). Low physical activity in patients with type 2 diabetes: the role of obesity. *Diabetes & Metabolism*, 39(1), 85–87. <https://doi.org/10.1016/j.diabet.2012.09.003>
- Gaesser, G. A. (2007). Exercise for prevention and treatment of cardiovascular disease, type 2 diabetes, and metabolic syndrome. *Current Diabetes Reports*, 7(1), 14–19. <https://doi.org/10.1007/s11892-007-0004-8>
- Gasnick, K. (2022). *What Is Aerobic Exercise? Verywell health, obesity, prevention*. Best Exercises for People with Diabetes, *Diabetes & Endocrinology*.
- Gordon, B. A., Benson, A. C., Bird, S. R., & Fraser, S. F. (2009). Resistance training improves metabolic health in type 2 diabetes: a systematic review. *Diabetes Research and Clinical Practice*, 83(2), 157–175. <https://doi.org/10.1016/j.diabres.2008.11.024>
- Hajna, S., Ross, N. A., Joseph, L., Harper, S., & Dasgupta, K. (2016). Neighbourhood Walkability and Daily Steps in Adults with Type 2 Diabetes. *PloS One*, 11(3), e0151544. <https://doi.org/10.1371/journal.pone.0151544>
- He, L. I., Wei, W. R., & Can, Z. (2018). Effects of 12-week brisk walking training on exercise blood pressure in elderly patients with essential hypertension: a pilot study. *Clinical and Experimental Hypertension*, 40(7), 673–679. <https://doi.org/10.1080/10641963.2018.1425416>
- Kirwan, J. P., Sacks, J., & Nieuwoudt, S. (2017). The essential role of exercise in the management of type 2 diabetes. *Cleveland Clinic Journal of Medicine*, 84(1), S15–S21. <https://doi.org/10.3949/ccjm.84.s1.03>
- Klare, W. G. (2007). More physical activity in patients with diabetes. *European publication*, 10(149), 36-9.
- Kumar, S. A., Maiya, A. G., Shastry, B. A., Vaishali, K., Ravishankar, N., Hazari, A., Gundmi, S., & Jadhav, R. (2019). Exercise and insulin resistance in type 2 diabetes mellitus: A systematic review and meta-analysis. *Annals of Physical and Rehabilitation Medicine*, 62(2), 98–103. <https://doi.org/10.1016/j.rehab.2018.11.001>
- Lakhdar, D., Mustapha, D., Khaled, M. B. (2020), Effectiveness of Brisk Walking Exercise on Glycaemic Control and Cardio-Vascular Risk Factors in Patients with Type 2 Diabetes. *Journal of Drug Delivery and Therapeutics*, 10(4), 53-62.

- Little, J. P., Gillen, J. B., Percival, M. E., Safdar, A., Tarnopolsky, M. A., Punthakee, Z., Jung, M. E., & Gibala, M. J. (2011). Low-volume high-intensity interval training reduces hyperglycemia and increases muscle mitochondrial capacity in patients with type 2 diabetes. *Journal of Applied Physiology*, *111*(6), 1554–1560. <https://doi.org/10.1152/jappphysiol.00921.2011>
- Melam, G. R., Alhusaini, A. A., Buragadda, S., Kaur, T., & Khan, I. A. (2016). Impact of brisk walking and aerobics in overweight women. *Journal of Physical Therapy Science*, *28*(1), 293–297. <https://doi.org/10.1589/jpts.28.293>
- Moggetti P, S. Balducci, L. Guidetti, P. Mazzuca, E. Rossi, F. Schena, (2021), Walking for subjects with type 2 diabetes: a systematic review. *Sport Sciences for Health*, *17*, 1–20.
- Moggetti P., Balducci, L., Guidetti, P., Mazzuca, E., Rossi, F., & Schena, G. (2020), Walking for subjects with type 2 diabetes: A systematic review and joint AMD/SID/SISMES evidence-based practical guideline. *European Publication*, (11), 1882-1898.
- Pan, B., Ge, L., Xun, Y. Q., Chen, Y. J., Gao, C. Y., Han, X., Zuo, L. Q., Shan, H. Q., Yang, K. H., Ding, G. W., & Tian, J. H. (2018). Exercise training modalities in patients with type 2 diabetes mellitus: a systematic review and network meta-analysis. *The International Journal of Behavioral Nutrition and Physical Activity*, *15*(1), 72. <https://doi.org/10.1186/s12966-018-0703-3>
- Praet, S. F., van Rooij, E. S., Wijtvliet, A., Boonman-de Winter, L. J., Enneking, T., Kuipers, H., Stehouwer, C. D., & van Loon, L. J. (2008). Brisk walking compared with an individualised medical fitness programme for patients with type 2 diabetes: a randomised controlled trial. *Diabetologia*, *51*(5), 736–746. <https://doi.org/10.1007/s00125-008-0950-y>
- Punia, S., Kulandaivelan, S., Singh, V., & Punia, V. (2016). Effect of Aerobic Exercise Training on Blood Pressure in Indians: Systematic Review. *International Journal of Chronic Diseases*, *2016*, 1370148. <https://doi.org/10.1155/2016/1370148>
- Rigshospital, A. (2014), Exercise Training and Type 2 Diabetes. The National Library of Medicine.
- Salwa, J., Zahalka, M. D, Layla, A., Abushamat, M. D., Rebecca, L, Scalzo, P. D, & Jane, E. B., Reusch, M. D. (2023). The Role of Exercise in Diabetes, National Library of Medicine, Endotext.

Sluik, D., Buijsse, B., Muckelbauer, R., Kaaks, R., Teucher, B., Johnsen, N. F., Tjønneland, A., Overvad, K., Ostergaard, J. N., Amiano, P., Ardanaz, E., Bendinelli, B., Pala, V., Tumino, R., Ricceri, F., Mattiello, A., Spijkerman, A. M., Monninkhof, E. M., May, A. M., Franks, P. W., ... Nöthlings, U. (2012). Physical Activity and Mortality in Individuals with Diabetes Mellitus: A Prospective Study and Meta-analysis. *Archives of Internal Medicine*, 172(17), 1285–1295. <https://doi.org/10.1001/archinternmed.2012.3130>

Snowling, N. J., & Hopkins, W. G. (2006). Effects of different modes of exercise training on glucose control and risk factors for complications in type 2 diabetic patients: a meta-analysis. *Diabetes Care*, 29(11), 2518–2527. <https://doi.org/10.2337/dc06-1317>

Williams, A., Radford, J., O'Brien, J., & Davison, K. (2020). Type 2 diabetes and the medicine of exercise: The role of general practice in ensuring exercise is part of every patient's plan. *Australian Journal of General Practice*, 49(4), 189–193. <https://doi.org/10.31128/AJGP-09-19-5091>

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

FUNDING

This research received no external funding.

COPYRIGHT

© Copyright 2024: Publication Service of the University of Murcia, Murcia, Spain.