Body weight training versus series 7 diabetes dance: their influence on glucose levels in patients with type 2 diabetes mellitus

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Abstract: Managing blood glucose levels is critical for preventing complications associated with type 2 diabetes mellitus (T2DM). Physical activity has been shown to be an effective strategy for glucose control, with various forms of exercise yielding different results. This research aims to explore the effects of body weight training and series 7 diabetes dance on reducing blood glucose levels in patients with T2DM, and to compare the efficacy of these two interventions in achieving glucose control. The type of research was a quasi-experiment with a two groups pre-test post-test design. The series 7 diabetes dance group performed the exercise 4 times a week (duration: 170 minutes 8 seconds/week), while the body weight training group performed exercise 3 times a week (8 movements, number of repetitions close to failure, circuit system, 3 sets per training session). Both groups were doing an exercise program for three months. The research sample was for about 16 patients of type 2 diabetes mellitus (8 people per group, devided randomly), taken by using non probability sampling technique, purposive sampling type (effect size 1.6, significant level (α) 0.05 and Power 0.8). The data analysis used the paired sample t test and the independent t test with a significance level of $\alpha = 0.05$. The results showed that 1) there is no significant effect of series 7 diabetes dance towards the decreasing the level of blood sugar of the patients with type 2 diabetes mellitus), 2) there is a significant effect of body weight training towards the decreasing level of blood glucose of the patients with type 2 diabetes mellitus, 3) dody weight training is more effective in decreasing the level of blood glucose of patients with type 2 diabetes mellitus compared to series 7 diabetes dance. Future research must be carried out as a true experiment with a larger number of samples and with the HbA1c research instrument.

Keywords: body weight, series 7 diabetes dance, patients, type 2 diabetes mellitus

INTRODUCTION

The number of people suffering from type 2 diabetes mellitus has increased dramatically over the last three decades due to population growth, urbanization, increasing prevalence of obesity, and decreasing physical activity (Wild et al., 2004). An estimated 425 million adults were living with diabetes in 2017, which is expected to increase to 629 million by 2045 (Karuranga et al., 2017). The main components that cause type 2 diabetes mellitus are abdominal obesity, overweight, and lack of physical activity (Stumvoll et al., 2008). Therefore, apart from a balanced diet, physical activity is also an important step in achieving optimal glucose control and preventing or preventing complications related to type 2 diabetes mellitus (Shrivastava et al., 2013).

Physical activities that can be done by type 2 diabetes mellitus patients to reduce blood sugar levels include diabetes dance and resistance training. Diabetes dance is an aerobic activity for diabetes mellitus sufferers with a series of movements chosen deliberately following the rhythm of music so as to create rhythmic conditions, continuity and a certain duration to achieve certain goals (Fitriani & Fadilla, 2020). Diabetes dances have been implemented since 1997 in diabetes clubs in Indonesia. Currently, diabetes dance consists of series 1 to the newest series 7. Then resistance training is various types of exercise that cause statistical and dynamic muscle contractions that are resisted by forces

originating from outside either manually or mechanically (Kisner & Colby, 2012). Forms of resistance training can be with free weights, machines, resistance bands, or your own body weight (Kanaley et al., 2022).

Series 7 diabetes dance and bodyweight exercises can be done anywhere as long as the place is sufficient to perform the specified or desired movements. Series 7 diabetes dance has been widely distributed on the YouTube website so that patients with type 7 diabetes mellitus can easily do the dance by streaming or downloading series 7 diabetes dance videos for free without having to hire an instructor. Likewise, bodyweight exercises can be done anywhere as long as the patients know or bring the body weight exercise program. The body weight exercise program can be brought in the form of notes, or document files or photos stored on a mobile phone or in printed form. Series 7 diabetes dance and body weight training also do not require a lot of money. To do series 7 diabetes dance, type 2 diabetes patients only need a mobile phone or other gadget that can access the YouTube website or that can download or save videos and play videos. Currently, mobile phones and gadgets with such specifications are widely owned by all levels of society, including type 2 diabetes mellitus patients. To do bodyweight exercises, type 2 diabetes mellitus patients only need a clean surface to do the exercise activities. Series 7 diabetes dance and body weight training can both be done anywhere at a low cost. Then the busyness of type 2 diabetes mellitus patients, which of course determines the duration of free time that type 2 diabetes mellitus patients have to do physical activities, encourages researchers to find out the influence and compare the effectiveness of series 7 diabetes dance and body weight training in reducing blood glucose levels in patients with type 2 diabetes mellitus.

Diabetes dance is influential and effective in reducing blood glucose levels in diabetes mellitus patients (Afridon & Komalasari, 2018; Oktavianisya & Aliftitah, 2022). Resistance training also had an effect on reducing blood glucose levels in diabetes mellitus patients (Adifa, 2019; Pratiwi, 2018). However, there has been no research that explicitly examines the effect of series 7 diabetes dances and body weight training on blood glucose levels in patients with type 2 diabetes mellitus. This study aimed to determine the effects of body weight training and series 7 diabetes dance on reducing blood glucose levels in patients with T2DM, and to compare the efficacy of these two interventions in achieving glucose control.

METHODS

This research is a quasi-experiment research with a two-group pre-test post-test design. Group A performed series 7 diabetes dance twice per session (total duration 46 minutes 32 seconds consisting of warm-up, core training and circulation) and group B performed body weight training with a total of 8 movements (push ups, sit ups, superman back ups, tricpes dips, hamstring bridges, Russian twists, alternating lunges, pike push ups) with a circuit training system. The number of repetitions in each movement was as many reps as possible until close to failure (training to close to failure) in 3 sets. Series 7 diabetes dance were carried out four times a week, while body weight trainings were carried out three times a week. Both groups carried out a physical training program for three months.

The calculation of the number of samples determined was based on calculations by setting the test group: t-test, setting the sample group: independent group, number of tails: two, effect size 1.6, significance level (α) 0.05 and power 0.8, so the number of samples is 16 people. The sample size was divided into two groups, namely 8 people in the series 7 diabetes dance group and 8 people in the body weight training group. The samples in this research were taken using a non-probability sampling technique, purposive sampling type. A test of fasting blood glucose levels used as an indicator of the success or failure of a physical activity program in lowering blood glucose levels in patients with type 2 diabetes mellitus.

The normality test was carried out first before analyzing the data. The normality test in this study used the Shapiro-Wilk test.

Tabel 1. Normality Test Result

	P.	α value	conclusion
Pretest of Series 7 Diabetes Dance	0,469		Normal
Posttest of Series 7 Diabetes Dance	0,068	0,005	Normal
Pretest of Body Weight Training	0,555		Normal
Posttest of Body Weight Training	0,305		Normal

Table 1 shows that all the data (pre-test and post-test data for the series 7 diabetes dance group and the body weight training group) were normally distributed. The paired sample t-test was used to determine the effect before and after treatment of series 7 diabetes dance and body weight training, then the independent T-Test was carried out to compare the two treatments and to find out which one had more influence between series 7 diabetes dance and body weight training in lowering blood glucose levels.

RESULTS AND DISCUSSION

Physical activity both series 7 diabebtes dance and body weight training will cause blood glucose to be absorbed by the human body as energy during and after physical activity. The amount of blood glucose used by the human body during and after physical activity is influenced by the frequency, intensity, time and type of physical activity. The greater the frequency, the higher the intensity of the exercise, and the longer the physical activity time, the more energy will be expended and this also means that more blood glucose will be used. Anaerobic physical activity requires longer recovery than aerobic physical activity, so anaerobic activity burns more blood glucose during recovery.

Series 7 Diabetes Dance on Reducing Blood Glucose Levels in Type 2 Diabetes Mellitus Patients

The first hypothesis test is to determine the effect of series 7 diabetes dance in reducing blood glucose levels in type 2 diabetes mellitus patients using a paired sample t-test: pretest and posttest blood glucose levels in the series 7 diabetes dance group (see Table 2).

Tabel 2. Paired Statistics for Diabetes dance Group Series 7

		Mean	N	σ	σM
Paired Samples Statistics					
Pair 1	Pre-Test of Series 7 Diabetes Dance Group	183.25	8	61.376	21.700
	Post Test of Series 7 Diabetes Dance Group	185.75	8	63.100	22.309

Table 2 shows that there was no effect of series 7 diabetes dance on blood glucose levels. The average posttest value was higher than the average pretest value or ($\mu A1$ 183.25 < $\mu A2$ 185.75) with a difference of -2.5.

Tabel 3. Paired Sample T-Test Results for Diabetes dance Group Series 7

		Paired Differences			
Paired Samples Test					
		95% Confidence Interval of the Difference			
		Upper	t	df	Sig. (2-tailed)
Pair 1	Pre-test – Post Test of Series 7 Diabetes Dance Group	53.293	-.106	7	0.919

Table 3 shows the significance value, the sig. (2-tailed) value is 0.919. This value was greater than $\alpha 0.05$, therefore it means there was no significant difference. Thus, it could be concluded that there was no significant effect of series 7 diabetes dance on reducing blood glucose levels in patients with type 2 diabetes mellitus.

Basicly during aerobic exercise like series 7 diabtes dance the muscles contract and then experience relaxation. Glucose will be used or burned for energy. Glucose is transferred from the blood to the muscles during and after aerobic activity. On the other hand, aerobic activity makes insulin more sensitive. Insulin will work better to open the entrance for glucose into muscle cells. Thus, there will be a lot of glucose in the blood and it will be easily transferred to the muscles and internal glucose levels

will fall. Previous studies reported that diabetes dance is effective in reducing blood glucose levels in patients with type 2 diabetes mellitus (Afridon & Komalasari, 2018; Oktavianisya & Aliftitah, 2022; Rahayuningrum & Yenni, 2018). Kurdanti & Khasana (2018) recommends that diabetes patients simply do diabetes exercises 3 times a week with a duration of 30 minutes in each session.

In this study, series 7 diabetes dance was carried out twice in each session, taking approximately 42 minutes 32 seconds. Done with a training frequency of 4 times a week. This means the duration of training per week is 170 minutes 8 seconds. The frequency and duration of exercise is in accordance with the aerobic activities recommended by Kanaley et al., (2022). However, physical activities such as series 7 diabetes dance are difficult to regulate the intensity, because the intensity of the exercise adjusts and/or is influenced by the tempo/beat of the music being listened to. Kanaley et al., (2022) recommend to doing aerobic activity with moderate intensity (40%-59% of VO2R or HRR, RPE 11-12) or high intensity (60%-89% of VO2R or HRR, RPE 14-17). Researchers suspect that the intensity of the series 7 diabetes dances was not heavy enough and did not fall into the moderate or heavy category for the research participants. Therefore, the research participants in the diabetes dance group series 7 had no effect on reducing blood glucose levels.

However, table 2 shows that the average difference between the pretest (μ 183.25) and posttest (μ 185.75) for the series 7 diabetes dance group is -2.5. This means that the series 7 diabetes dance with the duration and frequency per week in this research can maintain blood glucose values in patients with type 2 diabetes mellitus. The series 7 diabetes dance can be done by type 2 diabetes mellitus patients whose blood glucose levels are already normal to stay normal.

Body Weight Training in Reducing Blood Glucose Levels in Type 2 Diabetes Mellitus Patients

The second hypothesis test was to determine the effect of body weight training in reducing blood glucose levels in type 2 diabetes mellitus patients using a paired sample t-test. The results can be seen in Table 4.

Tabel 4. Paired Sample Statistics for Body Weight Training Group

Paired Samples Statistics		Mean	N	σ	σM
Pair 1	Pre-test of Body Weight Training Group	269.88	8	93.644	33.108
	Post Test of Body Weight Training Group	191.88	8	78.246	27.664

Based on the Table 4, there was an effect of body weight training on blood glucose levels. The posttest average value was lower than the pretest average value or (μA1 269.88 > μA2 192.88) with a difference of 77.

Tabel 5. Paired Sample T-Test Results for Body Weight Training Group

Paired Samples Test		Paired Differences	t	df	Sig. (2-tailed)
		95% Confidence Interval of the Difference			
		Upper			
Pair 1	Pre-test – Post Test of Body Weight Training Group	156.721	2.343	7	0.042

Table 5 shows that the sig. (2-tailed) value is 0.042 (smaller than α0.05), means there was a significant difference. It can be concluded that there was a significant effect of body weight training on reducing blood glucose levels in patients with type 2 diabetes mellitus.

In this study, body weight training was carried out three times a week with eight movements per session, carried out using a circuit system with 3 sets. The frequency, number of movements and number of sets was in accordance with those recommended by Kanaley et al., (2022). However, body weight training is difficult to determine the intensity of the exercise, because body weight is fixed and difficult to raise or lower. Kanaley et al., (2022) recommend that resistance training be carried out at moderate intensity (50%-69% of 1RM) or high (70%-85% of 1RM) with 10-15 repetitions for each movement. In this study, the training load was only based on the body weight of the study participants. Therefore, to maximize the amount of energy expenditure or burning of blood glucose and to maximize muscle hypertrophy, the researchers set the number of repetitions as much as possible until they were close to failure.

The results of the study showed that the body weight training group had the effect of reducing blood glucose levels after undergoing resistance training intervention with body weight for three months. This is in accordance with the theoretical studies that resistance training (including body weight training) can burn blood glucose during and after exercise, increase insulin sensitivity (Flack et al., 2010; Gordon et al., 2009; Kohrt et al., 1993), and also increase muscle mass (Phillips & Winett, 2010). Increasing muscle mass will increase glucose absorption in the blood. Muscles function as a reservoir for glycogen which comes from blood glucose. The higher the muscle mass, the more glycogen the muscles will hold and decrease blood glucose levels.

Body Weight Exercises vs Series 7 Diabetes dances at Lowering Blood Glucose Levels in Type 2 Diabetes Mellitus Patients

In this study, the question of which is more effective at lowering blood glucose levels in patients with type 2 diabetes mellitus—body weight training or series 7 diabetic dance?—was addressed using the independent t-test. The independent t test carried out was data on the difference between the pretest and post-test scores of the diabetes dance group series 7 and the data on the difference between the pretest and post-test scores of the body weight training group. This was done considering that the average value of the pretest for the series 7 diabetes dance group (μ 183.25) and the pre-test for the body weight training group (μ 269.88) was very different. The results of the independent t test are displayed in Table 6.

Tabel 6. Statistics of the Series 7 Diabetes Dance Group and Body Weight Training Group

Group Statistics					
	Homogenity	N	Mean	σ	σM
Effectivity	Series 7 diabetes dance	8	-2.5000	66.73615	23.59479
	Body Weight	8	71.0000	98.04226	34.66318

Based on table 5, it is known that the average value of the difference in reducing blood glucose levels in patients with type 2 diabetes mellitus in the series 7 diabetes dance group was -2.5, while for the body weight training group was 71. Based on these results, it could be concluded that there was an average difference. The decrease in blood glucose levels in patients with type 2 diabetes mellitus in the series 7 diabetes dance group and the body weight training group, with the decrease of glucose levels in body weight training group in was greater than in the series 7 diabetes dance group. To find out whether there is a significant difference or not, it can be seen and interpreted from the independent sample test result (see Table 7). Table 7 shows that the sig value of Levene's test for equality of variance is 0.375. This value is greater than 0.05. It could be interpreted that the data variance between the series 7 diabetes dance group and the body weight training group is homogeneous or the same. The interpretation of the independent sample test result (see Table 8) was guided by the values contained in the "equal variances assumed" table.

Tabel 7. Homogeneity Test Results for Diabetes dance Group Series 7 and Body weight training Group

		Levene's Test for Equality of Variances		t-test for Equality of Means	
		F	Sig.	t	df
Effectivity	Equal variances assumed	.839	.375	-1.753	14
	Equal variances not assumed			-1.753	12.340

Based on the Table 8 in the "equal variances assumed" section, the sig (2-tailed) value is 0.001. This value is smaller than 0.05 means that there was a significant difference between the average reduction in blood glucose levels in the series 7 diabetes dance group and body weight training.

Tabel 8. T-Test For Equality of Means Series 7 Diabetes Dance and Body Weight Training Group

Independent Samples Test

		t-test for Equality of Means			95% Confidence Interval of the Difference
		Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower
Effectivity	Equal variances assumed	0.001	-73.50000	41.93149	-163.43411
	Equal variances not assumed	.104	-73.50000	41.93149	-164.58227

The results showed that body weight training is better in reducing blood glucose levels in patients with type 2 diabetes mellitus compared to series 7 diabetes dance, with a significant difference. The intensity of body weight training in this study was carried out using a circuit system with a number of repetitions close failure and most likely the intensity is heavier than series 7 diabetes dance. This causes more blood glucose to be burned. The study states that high and low intensity corresponds to increases and decreases in insulin sensitivity (Flack et al., 2010). Bodyweight training is also a more effective exercise than series 7 diabtes dance to do, because only the frequency of body weight training 3 times a week has better results in reducing blood glucose levels than the series 7 diabetes dance with a training frequency of 4 times a week. This finding is in line with Ranasinghe et al., (2021) which revealed that resistance exercise is more effective than aerobic exercise in reducing blood glucose levels in patients with type 2 diabetes mellitus.Body weight training is the right choice for type 2 diabetes mellitus patients so they can do weight training at home with a low cost.

Patients with type 2 diabetes mellitus can control their blood glucose levels with physical activity/exercise, either aerobic or resistance. During physical activity/exercise (either aerobic or resistance), glucose will be used or burned for energy. Glucose will be transferred from the blood to the muscles during and after physical activity, thus, blood glucose will decrease. On the other hand, physical activity increases insulin receptors and insulin becomes more sensitive. Insulin will work better to open the entrance for glucose into cells. Specifically for resistance training, resistance training can increase muscle mass. Muscles play a role in accommodating glycogen from the blood so that blood glucose levels can be absorbed. The higher/larger the muscle mass, the more glycogen is absorbed so that blood glucose levels can be reduced.

Actually, both aerobic and resistance exercise can reduce blood sugar levels in patients with type 2 diabetes mellitus. This can be manipulated by adjusting the frequency, intensity, and duration of the exercise. In this study, aerobic exercise in the form of series 7 diabetes dance in terms of frequency and duration has been included in the recommended exercise dose by Kanaley et al., (2022) but the results of the study showed no decrease in blood sugar levels after three months of exercise. Researchers suspect

that the intensity of this series 7 diabetes dance does not meet the standards of Kanaley et al., (2022). So, in the future, there needs to be manipulation of the intensity of this series 7 diabetes dance.

Resistance training in this study was done with less frequency than aerobic exercise but the results showed a significant decrease in blood sugar levels from the participants in the body weight training group. It is suspected that the dose of body weight training undertaken by the participants was sufficient to burn blood glucose, increase insulin sensitivity, and increase muscle hypertrophy so that the blood sugar levels of patients can be reduced significantly. Thus, researchers recommend body weight training more than series 7 diabetes dance in reducing blood sugar levels in patients with type 2 diabetes mellitus. Body weight training can also be done anywhere and is inexpensive.

This research has limitations in its implementation. This research often carried out at each research participant's home, apart from that, many research participants do not have cell phones, so it is difficult for researchers to control the exercise program carried out by each research participant. In fact, supervised training can optimize training results compared to training that is less and not supervised. Supervised resistance training can increase the load and magnitude of training resulting in greater maximal strength gains (Gentil & Bottaro, 2010; Mazzetti et al., 2000), greater muscle adaptation, better body composition (Vieira et al., 2020) and increased training compliance (Coleman et al., 2023). Compliance that occurs due to supervision in aerobic exercise also makes it possible to maximize the results of aerobic exercise.

The number of samples in this study is relatively small. The larger the sample, the more likely it is to reflect the population and the better the research results (Alwi, 2012). For experimental and comparative research, a sample of 15-30 respondents is required for each group to be compared (Gall et al., 2007). However, if the sample must be divided into two categories such as men and women, then a minimum sample size of 30 is required for each category (Agung, 2006). In fact, if this experimental research was strictly controlled (true experiment), then the number of samples in this research would be sufficient. Holland & Wainer (1993) say that strictly controlled experimental research with each group consisting of between 8 and 10 subjects is considered capable of obtaining accurate results, although statistical tests always show significance if the sample size is large enough.

Nutritional factors which of course influence blood glucose levels were not controlled by researchers. It could be that those who do not experience a decrease in glucose levels or whose decrease in glucose levels are low are caused by poor nutrition (frequently consuming foods and drinks with a high glycemic index). Salmerón et al., (1997) confirmed that a diet with a high glycemic index and low fiber cereals was hypothesized to be an independent risk factor for type 2 diabetes mellitus. Diets rich in whole milk, red meat and butter increase the risk of type 2 diabetes mellitus (Montonen et al., 2005). Dietary fiber (More consumption of fruit and vegetables) helps avoid the development of type 2 diabetes mellitus by reducing insulin demand after meals (Montonen et al., 2005). Other researchers also found that eating a less animal-based diet and a more plant-based diet can reduce the risk of insulin resistance, prediabetes and Type 2 diabetes mellitus (Chen et al., 2018). A vegetarian diet and switching to a vegetarian diet can protect against type 2 diabetes mellitus (Chiu et al., 2018). Healthy diets are consistently associated with a 20% reduced risk of type 2 diabetes mellitus (Esposito et al., 2014).

Due to limited costs, the research instrument used was the fasting blood glucose test. It is recommended that this research use the HbA1c test. HbA1c is more effective than the fasting glucose level test in predicting the presence of type 2 diabetes mellitus (Sitasuwan & Lertwattanarak, 2020). although the value of fasting blood glucose affects the value of HbA1C, because the higher blood glucose is more Hb molecules that bind to sugar (Amelia & Luhulima, 2020; Matsushita et al., 2020). But, fasting blood glucose test has the disadvantage that it can be affected by temporary changes in blood sugar. The HbA1c test can show average blood glucose levels over 2–3 months. This duration corresponds to the life cycle of red blood cells, which is 3 months. Therefore, this examination is more accurate in describing blood sugar levels over a long period of time. However, the price of the HbA1c test is expensive for researchers and cannot be done.

CONCLUSION

The conclusions of this research are multifaceted and provide comprehensive insights into the management of type 2 diabetes mellitus through physical activity. Firstly, the study indicates that series 7 diabetes dance does not have a significant effect on reducing blood glucose levels in patients with type 2 diabetes mellitus. In contrast, body weight training, also known as resistance or strength training, has been shown to have a significant effect on reducing blood glucose levels in these patients. Furthermore, the research suggests that body weight training is more effective in reducing blood glucose levels compared to series 7 diabetes dance. This is supported by various studies that highlight the benefits of resistance training in improving insulin sensitivity, increasing muscle mass, and enhancing glucose uptake by muscle cells, which collectively contribute to better glycemic control.

Future research on the effect of series 7 diabetes dance and body weight training on blood glucose levels in patients with type 2 diabetes mellitus should be conducted as true experiments with a larger number of samples. Utilizing the HbA1c research instrument, which measures average blood glucose levels over a period, will provide more accurate and reliable data. This approach will help to further elucidate the mechanisms by which different types of physical activity influence glycemic control and ultimately inform more effective management strategies for individuals with type 2 diabetes mellitus. Moreover, combining resistance training with other forms of exercise, such as aerobic activities, may yield even greater benefits in terms of glucose regulation and overall health.

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