ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 11, Issue, 04, pp.3173-3177, April, 2019

DOI: https://doi.org/10.24941/ijcr.35235.04.2019

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

PROJECT TITLE - A COMPARATIVE STUDY OF THE EFFECTS OF ZUMBA AEROBIC TECHNIQUE VERSUS WALKING ON BLOOD GLUCOSE LEVEL AND QUALITY OF LIFE IN SUBJECTS WITH TYPE 2 DIABETES MELLITUS

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ARTICLE INFO

Article History:
Received 19th January, 2019
Received in revised form
17th February, 2019
Accepted 15th March, 2019
Published online 30th April, 2019

Key Words:

Zumbaaerobic technique,
Walking,
Type 2 Diabetes Mellitus,
Ferrans and Powers Quality Of Life Index.

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ABSTRACT

Background: Type 2 Diabetes Mellitus is characterized by peripheral insulin resistance and inadequate insulin secretion by pancreatic β-cells. When there is a build-up of glucose in the blood it may lead to acute and serious, long-term complications. Walking has been shown to reduce blood glucose levels and improve the Quality of life in subjects having Type 2 Diabetes Mellitus. Effects of Zumba have been studied and shown improvement in Quality of life in several neuro-musculoskeletal disorders. However as per our knowledge no study has been done till date to compare the effects of Zumba aerobic technique and Walking on blood glucose level and Quality of life in subjects having type 2 Diabetes Mellitus.

Objectives

- To study and compare the effects of Zumba aerobic technique and Walkingon Fasting blood glucose levels and Quality of life in subjects with type 2 diabetes mellitus.
- To compare the effects of Zumba aerobic technique and Walking with age-matched controls on Fasting blood glucose levels and Quality of life in subjects with type 2 diabetes mellitus.

Methods: A convenience sample of 45 type 2 Diabetes Mellitus subjects participated in a prospective randomized control trial. Fasting blood glucose levels and Quality of life score was measured on day 1 and day 30 in group A which performed Zumba aerobic technique under supervision 3 times a week for 4 weeks. The scores were compared with group B which performed walking for 3 days a week for 4 weeks and group C which was the control group.

Results: A statistically significant reduction in Fasting blood glucose levels as well as significant improvement in the Quality of life score was observed after 4 weeks of training in both groups A (FBS,QOL p - < 0.0001) and B (FBS,QOL p - < 0.0001) whereas in Group C is was statistically non-significant (FBS p - 0.2115,QOL p - 0.1689). Also, a statistically significant change was seen in both FBS and QOL score on comparison between groups A, B and C. (FBS p - < 0.0001, QOL p - 0.0419)

Conclusion: Zumba aerobic technique and Walking are both effective in reducing the Fasting blood glucose levels and improving the Quality of life in subjects with Type 2 Diabetes Mellitus where Zumba shows better results as compared to Walking and age matched controls.

Citation: Vora Vrishti, Dangi Ashwini and Deo Medha. **2019.** "Project title - a comparative study of the effects of zumba aerobic technique versus walking on blood glucose level and quality of life in subjects with type 2 diabetes mellitus.", *International Journal of Current Research*, 11, (04), 3173-3177

INTRODUCTION

Diabetes mellitus (DM) is a group of metabolic diseases characterized by high blood sugar levels over a prolonged period that further produces symptoms like frequent urination, increased thirst and increased hunger (WHO Expert Committee on Diabetes Mellitus, 1980). Diabetes is characteristically of two types. Type 1 DM and Type 2 DM. Type 2 DM is characterized by a combination of peripheral insulin resistance and inadequate insulin secretion by pancreatic beta cells (Romesh Khardori, 2014).

When there is a build-up of glucose in the blood over a prolonged period of time instead of being absorbed by the cells, it may lead to acute complications such as Diabetic Ketoacidosis and serious, long -term complications such as Coronary Artery Disease, Neuropathy, and Nephropathy, if left untreated (Diabetes Complications, 2012). Management of Type 2 DM includes Medication or insulin therapy, regular exercise and healthy eating (Sigal, 2007). The American College of Sports Medicine defines Aerobic exercise as any exercise that is rhythmic, continually maintained and involves large muscle groups. According to the American Diabetes

Association, moderate intensity aerobic exercise plays a key role in managing Diabetes. A definitive study which was a randomized, controlled trial conducted on 251 Type 2DM patients reported improvements ranging from -0.38 to -0.97 percentage points in HbA1c from exercise training that ranged from ≈135 to 270 minutes of exercise per week for 6 months (Sigal *et al.,* 2007). QOL may be thought of as a multidimensional construct incorporating an individual's subjective perception of physical, emotional, and social wellbeing, including both a cognitive component and an emotional component. Quality-of-life issues are crucially important, because they may powerfully predict an individual's capacity to manage his disease and maintain long-term health and wellbeing. In diabetes, poor QOL leads to diminished self-care, which in turn leads to worsened glycemic control, increased risks for complications, and exacerbation of poor QOL in both the short run and the long run (Richard, 2000). Thus, QOL gets affected in subjects with DM. Walking was chosen as the mode of aerobic exercise in the study since it is widely accepted, easy to perform and one of the most commonly used forms of exercise.

In a study, 39 participating Type 2 Diabetics walked for half an hour every day for 8 weeks and it showed that post-walk glycemic levels were reduced by 2.2 mmol/l (SD 1.5) (Fritz *et al.,* 2001). Zumba was although first introduced in the United States in Miami in 1999, the Latin - inspired dance class originated in Columbia more than a decade earlier. Zumba grew from an improvised dance class in a Columbian aerobics studio in the 80s to a wide spread exercise phenomenon with more than 10 million regular participants as of October 2010 (Origins of Zumba, 2017). In a study it was shown that Zumba fitness program achieved statistically significant improvement in body mass, fat percentage and fat mass in 12 women aged 25-35 (Adriana Ljubojević1 *et al.,* 2014). Another study having 28 (14 type 2 diabetic and 14 non diabetic) over-weight / obese women showed improvement in intrinsic motivation to exercise and aerobic fitness; lost body weight and body fat percentage after completing a 16-week intervention attending Zumba dance classes 3 days/week, 60 minutes/class (Krishnan, 2015). Ample literature is available where walking has been shown to reduce blood glucose levels and improve the QOL in subjects having Type 2 DM. Also effects of Zumba have been extensively studied and shown improvement in QOL in several conditions like Parkinson's disease and musculoskeletal disorders. However as per our knowledge no study has been done till date to know the effects of Zumba aerobic technique on blood glucose level and QOL in subjects having type 2 DM. Hence, a need was felt to study the effects of Zumba aerobic technique versus Walking on blood glucose level and QOL in subjects with type 2 DM.

MATERIALS AND METHODS

A convenience sample of 45 type 2 Diabetes Mellitus subjects were included in this prospective, randomized control trial based on the inclusion and exclusion criteria.

Inclusion criteria

- Subjects diagnosed with type 2 DM for a time period of at least 5 years.
- Subjects who are currently on oral hypoglycaemic drugs.

Exclusion criteria

- Subjects with neurological symptoms or any other neuromuscular complications due to DM which will affect walking.
- Subjects with cardiopulmonary complications.
- Subjects on insulin therapy.
- Subjects previously performing Zumba or walking or any other form of exercise.
- Subjects unwilling to take part in the study.
- Institutional ethical consent was obtained before the start of the study. Explanation and demonstration regarding the study was given to all the subjects and a written informed consent was obtained from them. Selection of subjects based on inclusion and exclusion criteria as explained above was done.

Demographic details of all the subjects like age, gender, height, weight, BMI, duration of diabetes, medications were obtained. Instructions were given to all the subjects that during the entire study duration they are not supposed to change their diet or lifestyle and they are not supposed to perform any kind of other activity apart from their intervention. Pre intervention assessment of FBS and QOL using Ferrans and Powers QOL index was done. Assessment of blood glucose level was done by drawing blood under septic precautions and assessed by 'Johnson and Johnson One Touch' glucometer. Assessment of QOL using 'Ferrans and Powers QOL index' was done by one on one basis where questions were asked to all the subjects. Scores of all the domains were added up to get a total score for each subject. Subjects were then randomly allocated using a computer generated random number table in 3 groups as groups A, B and C. Group A received Zumba aerobic technique for 4 weeks under supervision of a licensed Zumba trainer. 3 sessions of Zumba training for 60 minutes each per week were held for consecutive 4 weeks. It included warm up for 8 to 10 minutes containing basic steps (march, step touch, side to side, etc.) with gradually accelerating tempo of music (120-135 bpm), conditioning phase of 8 to 10 Zumba fitness songs. The dance choreographies and movement intensity is created in accordance with tempo changing of music (tempo between 140-160 bpm). Each dance lasts 3-5 minutes, with pause of 15-30 seconds. Cool down was the final part containing easy dance movements on soft music with mental and physical relaxing purpose. Stretching was performed for muscle relaxation, to prevent muscle soreness and increase flexibility (tempo of music – 100 bpm).

Group B performed Walking for 4 weeks. 3 sessions of walking for 60 minutes each per week for consecutive 4 weeks were performed by the subjects. Group C which is the control group had the same diet and oral medications as that of group A and B but were not given any form of physical exercise. After completion of 4 weeks, post intervention assessment of FBS and QOL was done. At the end data analysis was done using the statistical tests.

RESULTS

In the present study, the effects of 4 weeks of Zumba aerobic technique and Walking on blood glucose levels and QOL were compared in subjects with Type 2 DM using Graph Pad Instat. The data was compared between the 3 groups, Group A (Zumba aerobic technique), B (Walking) and C (Control) prior to the intervention to assess the homogeneity of the samples.

Table 1. Comparison of parameters pre – intervention between Zumba aerobic exercise, Walking and Control groups

Variables	Group A	Group B	Group C	p value
Age group (years)	52.7 ± 3.6	53.4 ± 7.9	51.2 ± 5.03	0.5708
Gender	**MALES:6 FEMALES: 9**	**MALES:7 FEMALES: 8**	**MALES:7 FEMALES: 8**	
Onset of DM (years)	6.9 ± 1.4	6.7 ± 1.4	7 ± 1.5	0.8044
BMI (Kg/m^2)	27.9 ± 2.9	30.2 ± 3.2	28.3 ± 4.1	0.1667
FBS (mmol/L)	180.5 ± 15.1	191.3 ± 21.5	338.3 ± 13.1	0.2129
QOL score	336.6 ± 11.2	335.9 ± 13.03	338.3 ± 13.1	0.7945

Table 2. Comparison of Fasting Blood Glucose levels and Quality of Life in Group A, Group B and Group C pre and post intervention

Parameters	Group A			Group B			Group C		
	Pre	Post	p value	Pre	Post	p value	Pre	Post	p value
FBS level (mmol/L)	180.5 ± 15.1	138.3 ± 16.9	<0.0001 (extremely significant)	191.3 ± 21.5	165.7 ± 22.2	<0.0001 (extremely significant)	180.3 ± 20.3	179.9 ± 19.9	0.2115 (non - significant)
QOL score	336.6 ± 11.2	350.8 ± 12.9	<0.0001 (extremely significant)	335.9 ± 13.03	347.2 ± 13.6	<0.0001 (extremely significant)	338.3 ± 13.1	338.7 ± 12.3	0.1689 (non - significant)

Table 3. Comparison of Fasting Blood Glucose levels (FBS) and Quality of Life (QOL) between Groups A, B and C post intervention

	Group A	Group B	Group C	p value
FBS level (mmol/L)	138.3 ± 16.9	165.7 ± 22.2	179.9 ± 19.9	<0.0001
QOL score	350.8 ± 12.9	347.2 ± 13.6	338.7 ± 12.3	0.0419

Post intervention assessment was done within the groups and between the groups using Paired t test to analyze intra group parametric data, ANOVA test to analyze inter group parametric data, Wilcox on signed rank test to analyze intra group non-parametric data and Kruksal Wallis H test to analyze inter group non-parametric data. To determine the statistical significance, p value was set as $p < 0.05$. All the data is mentioned in the form of 'Mean ± Standard deviation'.
Inference: On comparison of the data pre – intervention, the p values yielded were statistically non – significant i.e. (p value > 0.05). This suggests that the data is homogeneous in distribution.

Comparison of fasting blood glucose levels (fbs) and quality of life (qol) pre and post intervention in group a (zumba aerobic technique), group b (walking) and group c (control)

Inference: The above table suggests that Zumba aerobic technique and Walking are effective in reducing Fasting Blood Glucose levels and improving Quality of Life in subjects with Type 2 DM whereas the Control group shows no significant effect in reducing Fasting Blood Glucose levels and improving Quality of Life in subjects with Type 2 DM.

Comparison of fasting blood glucose levels (fbs) and quality of life (qol) post intervention between groups a, b and c.

Inference: On comparison of Fasting Blood Glucose levels (FBS) in Groups A, B and C, post intervention, the p value obtained was highly significant with Group A showing the least mean value i.e. maximum improvement. Also, on comparison of Quality of Life (QOL) in Groups A, B and C, post intervention, the p value obtained was significant with Group A showing the maximum score i.e. maximum improvement.

DISCUSSION

Post Aerobic exercise, peripheral glucose uptake exceeds hepatic glucose production thus reducing blood glucose levels. Also, glucose is transported to skeletal muscles via a transporter enzyme GLUT-4. Exercise increases the translocation of GLUT-4 to skeletal muscle membrane and improves the glucose uptake and hence reduces blood glucose levels. Boule *et al.* (2001) undertook a systematic review on the effects of structured exercise interventions in clinical trials of 8 weeks duration on HbA1c and body mass in people with type 2 Diabetes and concluded that post-intervention HbA1c was significantly lower in exercise than control groups; $p< 0.001$. In Type 2 Diabetes with low insulin secretion, an increase in insulin secretion is seen as a result of physical training perhaps due to accompanying sensitization of the autonomic nervous system. Peripheral insulin concentrations are not altered; suggesting that the extra insulin produced is captured by the liver (Krotkiewski, 1985). There is growing evidence concerning the potent effect of psychosocial factors on physical health outcomes. People with diabetes often feel challenged by their disease and its day to day management demands. Thus, it can lead to stress. The psychosocial toll of living with diabetes can often affect self-care behaviour, long-term glycaemic control, Quality of Life and risk of developing long-term complications.

Valerie Myers, Megan McVay *et al.* (2013) performed a study on Exercise Training and Quality of Life in individuals with Type 2 DM and the results showed that exercise training interventions improved physical health QOL in individuals with type 2 DM regardless of training modality (aerobic, resistance, or combined) (Myers, 2013). A study comparing the effects of two forms of aerobic exercises i.e. Zumba and Walking is never done before. This is the first clinical trial comparing Zumba and Walking along with age matched Controls and in our study both, Zumba and Walking are effective in reducing the blood glucose levels and improving the quality of life in subjects with type 2 DM, but Zumba shows better results as compared to Walking. Zumba is practiced worldwide for its health benefits, including physical fitness as well as relaxation. It is a form of exercise which is not monotonous but is, in fact, enjoyed by the people. Thus, it maintains and improves an intrinsic motivation to exercise and reduces the number of drop outs. Adriana Ljubojević1, Vladimir Jakovljević1, and Milijana Popržen (2014) assessed

the effects of Zumba fitness program on body composition of womenand concluded that Zumba fitness program achieved statistically significant improvement in body mass, fat percentage and fat mass in 12 women aged 25-35 (Adriana Ljubojević1, 2014). Krishnan *et al.* (2015) assessed whether Zumba dance improves health in overweight/obese or type 2 diabetic women. This study had 28 (14 type 2 diabetic and 14 non diabetic) over-weight / obese women that showed improvement in intrinsic motivation to exercise and aerobic fitness; lost body weight and body fat percentage after completing a 16-week intervention attending Zumba dance classes 3 days/week, 60 minutes/class (Krishnan, 2015). Walking is widely accepted, easy to perform and one of the most commonly used forms of exercise. Also, many studies have been done to find out that walking is effective in reducing the blood glucose levels in diabetics. Fritz T, Rosenqvist U (2001) performed a study to determine the immediate effect of walking on blood glucose levels in patients with type 2 diabetes. 39 participants aged 63 (SD 8.5) with type 2 DM were made to walk for half an hour every day for 8 consecutive weeks. Results showed that post-walk glycemic levels were reduced by 2.2 mmol/L (SD 1.5). They concluded that walking can be safely employed in groups or individually as an introduction to low-intensity exercise and as a demonstration of its blood glucose lowering effect in type 2 DM.[7]Dr. R. Sirisha (2015) performed a study to see the effect of Walking on Fasting Blood Sugar in Type 2 Diabetes. A total of 25 male and female adult subjects with regular treatment for Type 2 diabetes more than one year were selected to measure Fasting Blood Sugar levels before and after walking for 30 minutes. There was a significant change in Fasting Blood Sugar after walking for 30 minutes with p-value <0.001. Walking for half an hour fits well as it plays a central role in preventing long term complications in the management of type 2 Diabetic patients (Sirisha, 2015). Walking is one of the most common forms of exercise that is easy, widely accepted and does not require any training, monitoring or equipment. Patients have the freedom of performing it at their convenience and it is not limited by the patient's fitness level. At the same time, it is self-paced and monotonous. Whereas Zumba aerobic technique is an exercise form that has multi-dimensional and better effects but it requires special training, a fixed protocol and constant monitoring. Being a form of group exercise Zumba improves motivation, maintains pace, takes away the monotony and reduces the number of drop outs.

There are few study limitations like, the above study has a small sample size. A larger sample size may help in studying greater variations in the study population and hence will show us the variations in the results, if any. Fasting Blood Glucose has been used as an outcome measure for the above study. This out-come measure can be influenced by various other factors, for e.g. Diet and lifestyle. Hb1Ac or Glycosylated Haemoglobin is a form of haemoglobin that is measured primarily to identify the average plasma glucose concentration over prolonged periods of time. As the average amount of plasma glucose increases, the fraction of glycosylated haemoglobin increases in a predictable way. This serves as a marker for average blood glucose levels over the previous 3 months as this is the half-life of red blood cells. Hence, Hb1Ac could be considered as a more reliable outcome measure. The Hb1Ac has several advantages to the Fasting Blood Glucose test, including greater convenience since fasting not required, possibly greater pre-analytical stability, and less day-to-day perturbations during stress and illness.

But, since our study was for four weeks only Fasting Blood Glucose level was chosen as the outcome measure. Hb1Ac can be chosen for studies of longer durations. No follow up was done on the subjects who were a part of the study. A follow up will help us gauge the patient adherence to the intervention along with giving us an idea of how long the effect of the intervention lasts.

Conclusion

Zumba aerobic technique and Walking are both effective in reducing the Fasting Blood Glucose levels and improving the Quality of Life in subjects with Type 2 DM. Zumba shows better results as compared to Walking and age matched controls in reducing the Fasting Blood Glucose levels and improving the Quality of Life in subjects with Type 2 DM. Zumba aerobic technique has better effects in reducing the fasting blood glucose levels and improving the quality of life in subjects with Type 2 DM. It is a form of group exercise and it improves the motivation, maintains pace, takes away the monotony and also reduces the number of drop outs. But at the same time it requires special training, a fixed protocol and constant monitoring. Therefore, it can be used as an adjunct in the exercise protocol for Type 2 diabetics. Whereas, though Walking is comparatively less effective, self-paced and monotonous, it is one of the most common forms of exercise. It is easy, widely accepted and does not require any training, monitoring and equipment. Therefore, patients have the freedom of performing it at their convenience and it is not limited by the patient's fitness level.

Conflict of Interest: None.

Funding Statement: Self - funded.

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