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International Journal of Current Research in Life Sciences
Vol. 07, No. 06, pp.2187-2190, June, 2018

ISSN: 2319-9490

RESEARCH ARTICLE

EFFECT OF UPPER LIMB RESISTED EXERCISE VS. ABDOMINAL EXERCISE ON FASTING BLOOD SUGAR IN COMMUNITY DWELLING INDIVIDUAL WITH TYPE 2 DIABETES MELLITUS

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Received 17th April, 2018; Accepted 13th May, 2018; Published 12th June, 2018

ABSTRACT

Introduction: The burden of type 2 diabetes mellitus varies remarkably throughout the region of the world and is a serious public health problem in both developed and developing countries. Despite the advancement in knowledge and the increasingly effective therapeutic strategies for type 2 diabetes mellitus management, sustainable control rates at the population level are still elusive.
Objective: To compare effect of upper limb resisted exercises versus abdominal exercises on fasting blood sugar in community dwelling individuals with type 2 diabetes mellitus.
Methodology: 84 participants (M- 46, F- 34) were enrolled in study. Group 1 participants have performed upper limb resisted exercises and Group 2 performed abdominal exercises for 4 weeks. Post test data was collected from 80 participants (M- 46, F-34) in this Group 1has (M-22, F-18) and Group has (M-24, F-16).
Results: There is highly significant different between Group 1 and Group 2 (t=4.03). This shows upper limb resisted exercises is responsible for the reducing fasting blood sugar more compared to abdominal exercises.
Conclusion: Upper limb resisted exercises should be part of the management of type 2 diabetes mellitus.

Key words: Upper limb resisted exercises, Abdominal exercises and type 2 diabetes mellitus

Citation: Dhruvkumar Dave and Dr. Ali Irani, 2018. "Effect of upper limb resisted exercise vs. abdominal exercise on fasting blood sugar in community dwelling individual with type 2 diabetes mellitus" *International Journal of Current Research in Life Sciences*, 7, (06), 2187-2190.

INTRODUCTION

Type 2 Diabetes mellitus (T2DM) is a group of metabolic disorders characterized by hyperglycemia. The epidemic of T2DM is ever increasing in developed and developing countries in spite of the enormous facilities available to control its growth (Satpute *et al.,* 2009). The prevalence of diabetes among adults was estimated to be around 285 million (6.4%) in 2010, and expected to reach 439 million (7.7%) by 2030. India leads the world with 50.8 million diabetics, followed by china with 43.2 million (Raja *et al.,* 2014). Most of patients with this form of diabetes are obese, and obesity itself causes some degree of insulin resistance. This form frequently goes undiagnosed for many years because the hyperglycemia develops gradually and at earlier stage is often not so severe enough for the patients to notice any of the classic symptoms of diabetes. Diabetes is a widespread disorder and the management of diabetes required a multidisciplinary approach in which exercise is a key element (Subramaniyam *et al.,* 2012).

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Endurance exercise programs have been traditionally recommended for older patients with T2DM and have associated with weight loss, improved glucose tolerance, and cardiovascular fitness (Ligtenberg *et al.,* 1997). Recent position statements from both the American Diabetes Association (Albright *et al.,* 2000) and the American College of Sports medicine (Colado *et al.,* 2010) also recommend the use of resisted training as a part of well- rounded exercise program for older individuals. Elastic resisted training may be more easily available and affordable exercise for older adult populations (Colado *et al.,* 2010). These elastic devices (bands and tubes) are practical and of low cost (Zion *et al.,* 2003). Training with elastic resistance has been increasingly used because it allows functional movement patterns, more versatile and accessible for individual of different ages and is more readily available in a variety of clinical conditions. One of its most versatile characteristic is the portability that allows training programs in outdoors situations (Egana *et al.,* 2012). As age advances, lower limb exercises increase penetration to the skin and it converts in to the foot ulcer (Harrison *et al.,* 2012). It Produce also difficulty in the brisk walking (Walker *et al.,* 2010). Older people tend to have decline in insulin sensitivity because of their decreased physical activity and increased central obesity (Standards of Medical care in

Diabetes, 2015). The diagnostic criteria for T2DM based on the FBS are interpreted as Table 1 (ACSM a guidelines 9th edition, 2010). Contradicting and inconsistent findings were reported in the literature regarding the lower limb exercises for T2DM. It also increases risk of fall, foot problem and balance problem in persons with T2DM. So, the objective of the study was to compare the effect of upper limb resisted exercise vs. abdominal exercise on fasting blood sugar (FBS) in community dwelling individuals with T2DM.

Table – 1. Diagnostic criteria for diabetes based on fasting blood sugar

FBS Values (mg/dl)	Interpretation
<100	Normal
100 – 125	Increased Risk of Diabetes
≥ 126	Diabetes

MATERIALS AND METHODS

The study was approved by the Intuitional Review Board. Participants were recruited from the Anand, Gujarat, India. All the participants of Type 2 Diabetes Mellitus are screened and those who have met the inclusion criteria are invited for study. All screened individuals are initially participated in an orientation session to receive information on the aims, inclusion and exclusion criteria, procedures and risks of the study. A written informed consent was then obtained from all the participants.

Study Design: Pre – post Quasi Experimental Study
Study Setting: Community setting
Study sampling method: Nonrandom convenient sampling method
Sample size: n = 80 patients of Type II Diabetes Mellitus
Group: 1: 40 = Upper Limb Resisted Exercise Group
Group: 2: 40 = Abdominal Exercise Group

Outcome Measures

a. Fasting Blood Sugar by Glucometer

Inclusion Criteria

- Age: 40-60 years
- Type 2 DM: Suffering for more than 1year.
- Fasting blood sugar – 125- 200mg/dl
- Taking Medications:
  - Metformin – Daily dose 0.5- 2.5g, 1-2 does/ day
  - Pioglitazone – Daily dose 15 – 45mg, 1 does/day

Exclusion Criteria

- If any known cardiovascular disease like atherosclerosis, heart attack, cardiomyopathy
- Upper limb musculoskeletal problem
- SBP > 130 mm of hg at rest
- DBP > 90 mm of hg at rest
- Exercise participation in last 3 months
- If low back pain lasting for more than 90 days.

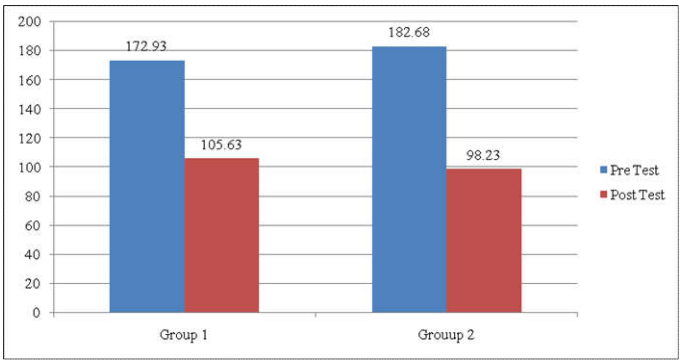
Procedure: According to the above mentioned criteria, 80 participants (44 Male, 36 Female) were enrolled and finished the study procedure.
Study Protocol: Before doing exercise fasting blood sugar was measured for each participant. After pre-test measurement, the training program was carried out 3 times per week over a period of 4 weeks. The exercise intervention was structured and supervised by physiotherapist. All pharmacological management of each participant was not changed. They are constantly on their prescribed drugs. At the end of 1st week up to 4th week Fasting blood sugar was measured.

Exercise Regimen for Group 1: Warm up (5min) - self stretching for triceps, long flexors, middle trapezius and pectoralis major. (3 rep×1set×20-30 sec hold). Exercise with theraband for shoulder flexors, extensors, abductors, adductors, elbow flexors, extensors. The detailed protocol for group 1 was given in Table 2. Cool down (5 min) – Free exercise for upper limb

Exercise Regimen for Group 2: Abdominal Crunch, Abdominal side Crunch, Bridging, Knee to chest, Trunk rotation in supine, Trunk rotation in sitting The detailed protocol for group 1 was given in Table 3.

RESULTS

Data analysis was done using Microsoft Excel 2007. Demographics were compiled for mean, standard deviation and frequency distribution. Paired & Unpaired t test were applied for comparing the FBS results within as well as between groups with level of significance p = 0.05. Demographics are elaborated in Table 4. Unpaired t test result was in Table 5. Progressive resisted exercise in Group 1 had produced significant difference in FBS compared to abdominal exercise in Group 2. Paired t test result for group 1 was in Table 6. Progressive resisted exercise in Group 1 had produced significant different in FBS. Paired t test result for group 2 was in Table 7. Abdominal exercises in Group 2 had produced significant difference in FBS.



Graph – 1 Pre & post comparison of FBS in group 1 vs. Group 2

Table 2. Protocol for group 1

		Week 1	Week 2	Week 3	Week 4
Frequency		3days/week			
Intensity	Set	2	3	4	5
	Repetition	8	12	16	20
Time		25 to 45 min			
Type		Resisted exercise			

Table 3. Protocol for Group 2

		Week 1	Week 2	Week 3	Week 4
Frequency		3days/week			
Intensity	Set	2	3	4	5
	Repetition	8	12	16	20
Time		20 to 40 min			
Type		Resisted exercise			

Table 4. Demographics

	Age
Group 1 (Mean ± SD)	48.67±6.34 years
Group 2 (Mean ± SD)	48.6±6.58 years
	Gender
Group 1	Male – 22, Female – 18
Group 2	Male – 24, Female – 16
	Occupation
Group 1	Housewife-15
	Job- 11
	Business- 8
	Retired- 6
Group 2	Housewife -16
	Job-8
	Bussiness-11
	Retired-5
	Drug dosage
Group 1	Metformin: 1 ± 0.58 gram
	Pioglitazone: 25.45 ± 4.71 mg
Group 2	Metformin: 1.15 ± 0.64 gram
	Pioglitazone: 26.5 ± 4.11 mg
	Duration of onset of T2DM
Group 1	4.42±1.79 years
Group 2	4.33±1.86 years

Table 5. Unpaired t-test of group 1 vs. group 2

Degree of freedom	78
t Statistical value	4.03**
P(T<=t) one-tail	0.0001
t Critical one-tail	1.66

**p<0.05

Table 6. Paired t-test of group 1

Degree of freedom	39
t Statistical value	46.4**
P(T<=t) one-tail	0.000001
t Critical one-tail	1.68

**p<0.05

Table 7. Paired t-test of group 2

Degree of freedom	39
t Statistical value	44.27**
P(T<=t) one-tail	0.00001
t Critical one-tail	1.68

**p<0.05

DISCUSSION

The finding our study was that there was significant difference between pre and post-test measurement among Group 1, while Group 2 also shows some degree of change in pre and post measurement. However, Fasting Blood Sugar control rate tended to be higher in the Group 1 than the Group 2 after 4-weeks of intervention. Further, the two groups demonstrated significant reduction in fasting blood sugar of the 4week of interventions, although, being more widespread in the Group 1. Same result found in David B et al study in2005 showed that glucose clearance is higher in arm than leg muscle, regardless of insulin resistance, which may indicate better preserved insulin sensitivity in arm than leg muscle in T2DM. Membrane permeability to glucose increases with muscular contraction, possible attributable to increase in number of glucose transporters associated with plasma membrane. Thus, acute bouts of exercise decrease insulin resistance and increases insulin sensitivity thus reducing cell's requirement for insulin. This decrease in insulin resistance and increase in insulin sensitivity may primarily be response of each individual to a bout of exercise rather than the result of long term changes associated with training (Colberg *et al.,* 2010). Abdominal contraction and relaxation during exercise which has a direct influence on pancreatic secretion by rejuvenation of the pancreatic cells. Second, muscle contraction and relaxation improves blood supply to the muscles, which enhances the insulin receptor expression and increases the glucose uptake by muscles and thus reducing blood Glucose (Subramaniyam *et al.,* 2012). The dietary patterns of the participants and pharmacological therapy effects have not been measured in the study. We recommend having similar study with larger population with increase study duration for each group for long term effects should be taken in future.

Conclusion

There is significant difference of upper limb resisted exercises on fasting blood sugar.

Clinical implication: This study implies that upper limb resisted exercise would be useful to treat diabetes patients those who have problems with lower limbs for doing exercises.

Acknowledgement: We would like to thank all our participants without whom this study would not have been possible and materialized. We would like to thank acknowledge Dr. Balaganapathy, and Ms. Hejal Patel for their support in data collections.

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