Immediate Effect of Stretching Versus Strengthening Excercises on Blood Glucose Level in Chronic Diabetes Mellitus

Shweta M Mehta[1], Smita Patil[2]

[1]Intern Physiotherapy, [2]Assistant Professor, Department of Musculoskeletal Sciences of Physiotherapy, Krishna College of Physiotherapy, Krishna Institute of Medical Sciences Deemed To Be University, Karad

Abstract

Background : Diabetes mellitus affects the muscles as muscle play notable role in the regulation of blood sugar level. The lack of glucose can lead to muscle cells atrophying and therefore loss of muscle mass. Stretching can increase cellular glucose uptake. Strengthening may improve strength , enlarged muscle mass and to improve insulin sensitivity and glycaemic control. Their paucity of literature on immediate effect of stretching versus strengthening exercises on blood glucose level in diabetes mellitus .

Objective: To find out immediate effect of stretching on blood glucose level in diabetes mellitus individuals. To find out immediate effect of strengthening exercises on blood glucose level in diabetes mellitus individuals. To compare the immediate effectiveness of stretching and strengthening exercises on blood glucose level in diabetes mellitus individuals.

Methodology: the study was conducted in Krishna hospital, in physiotherapy department. 44 subjects were selected with simple random sampling method. Chronic type 2 diabetes mellitus individuals were divided in to two groups. Group A (stretching) and group B (strengthening exercises)was given. The pre- and post –treatment postprandial Blood glucose values was measured by glucometer.

Result: In conducted study, postprandial BGL showed statistically significant difference between pre and post treatment values in both group A and B.

Conclusion: from the above conducted study it concludes that both stretching and strengthening exercises are effective in decreasing postprandial blood glucose level in type 2 diabetes mellitus, as there is no significant difference between both the groups . Strengthening exercises increased more flexibility in females than passive stretching and males were benefited with both stretching and strengthening exercises.

Key words*: type 2 diabetes mellitus, stretching, strengthening exercises, postprandial blood glucose level (BGL).*

Introduction

Type 2 Diabetes mellitus (DM) is a long-term metabolic disorder that is characterized by high blood sugar, insulin resistance, and relative lack of insulin[(1)]. There are two types of diabetes mellitus; Type 1 diabetes mellitus : insulin dependent and Type 2 diabetes mellitus : none-insulin dependent[(1)]. In India, there are about 50.8 million adults with DM[(2)].In Maharashtra there are 9.3% of people with type 2 DM, 51% in females and 49% in males[(2)].

The onset of this chronic condition and associated comorbidities, a life-long reduction of quality of life and premature mortality due to micro- and macro vascular complications occurs[(3)]. Diabetes mellitus (DM) causes disturbance of carbohydrates, fat and protein metabolism resulting in defect in insulin secretion [(5)].In DM muscle atrophy is caused by an imbalance in contractile protein synthesis, degradation and overall poor glucose control. As it reduce muscle quality and affects muscle functional capacity to perform physical activities which ultimately can increase secondary complications such as mortality, long term DM damages , inability to function

and failure of organs such as kidneys, eyes, heart and blood vessels[5,6].

As there is lack of physical activity causing sedentary lifestyle. Hence, body mass index (BMI) increases which leads to obesity. The evidence shown that hemoglobin A1c (HbA1c) is the gold standard for monitoring glycemic control, may to find for diabetes hence, there is changes in HbA1c .In type 2 diabetes mellitus ,the maximal oxygen uptake Vo_2max values are lower than comparatively normal individuals. This causes alteration in oxygen delivery.[7]

The type 2 DM is also known as adult onset diabetes which include insulin deficiency and having combination of three main metabolic problems – reduced beta cell function with decreased insulin production, insulin resistance in peripheral tissues, increased hepatic glucose production.[5]

To achieve good glycemic control in type 2 DM individuals ,an adequate exercise therapy is needed.in aerobic exercise muscles get activated to extract energy in the form of adenosine triphosphate (ATP) it includes jogging ,walking etc.[6] stretching can increase glucose level uptake when sustained tension develops in muscles trough external forces.[4] As strengthening exercises can increase muscle strength and enlarge muscle mass and to improve insulin sensitivity and glycemic control.[5]

Material and Methodology

Patients presenting with the history of chronic type 2 diabetes mellitus were diagnosed by physician of KIMS hospital, karad who reported to physiotherapy department of KIMS hospital volunteered to participate in the study were selected as subjects. An approval for the study was obtained from the protocol committee and ethical committee of KIMSDU. Each of the subjects was screened as per inclusion and exclusion criteria and they were briefed about the study and intervention. Informed consent was taken from the subjects. The subjects in group A and group B, stretching and strengthening exercises groups respectively assessed for postprandial BGL by glucometer and exercise regimen was carried out 2 hours after meal according to their allocated groups. Pre and post-exercise blood glucose were measured and documented.

A total no. of 44 subjects were divided into 2 groups (18 females, 26 males) with simple random sampling method. In group A (9 females ,13 males) and in group B (9 females, 13 males).Age group selected for exercise was 40 to 65 years[5].

The exercise regimen consisted for 10 mins warm up phase, 40 mins intervention phase, 10 mins cool down phase. The intervention for both the groups were carried out for 60 minutes duration. The intervention done on two muscles of upper limbs (biceps brachii, triceps brachii) and two muscles of lower limbs (quadriceps, hamstrings) in both the groups. Both the groups initially treated with free exercises for 10 minutes before and after the intervention phase. Circular rotation of both hands, Anti-circular rotation of both hands, Jogging, Walking. Ingroup A (stretching exercise),Patients were given passive stretching for 40 minutes. Each muscles was held in the stretched position for 30 sec and was repeated for 3 times followed by 10 sec relaxation between 3 sets and different stretches were separated by minimum 1 minute. Biceps stretch, Triceps stretch, Quadriceps stretch, Hamstring stretch bilaterly and in group B (strengthening exercises); Strengthening exercises was performed with theraband for 40 minutes. The patients were asked to performed 3 sets of the exercise with 10 repetition each set with 30 sec relaxation period between the sets for each muscle. The muscles selected for the exercise were similar to the stretching group[4,5,11].

Findings

Table no. 1.1 Comparison of pre and post postprandial BGL values within group.

Groups	Pre-treatment	Post- treatment	p	T	Significance
	Mean + SD	Mean + SD			
A	126.9 +10.37	123.4 +10.37	0.0014	3.680	Very significant
B	131.4 + 12.92	128.2 + 13.15	< 0.0001	12.931	Extremely significant

INTERPRETATION :The pre-interventional postprandial BGL values were 126.9 + 10.37 in group A and 131.4 + 12.92 in group B respectively, whereas the post interventional BGL values were 123.4 + 10.37 in group A and 128.2 + 13.15 in group B respectively. Intra group changes in the postprandial BGL values showed statistically very significant reduction in A group and extremely significant reduction in BGL values in group B. This was done by using paired 't' test .

Table no.1.2 comparison of pre-pre and post-post postprandial BGL values in between groups.

Groups	**Pre-treatment**	**Post-treatment**
	Mean ± SD	**Mean ± SD**
A	126.9 ± 10.37	123.4 ± 10.37
B	131.4 ± 12.92	128.2 ± 13.12
P	0.2191	0.1899
t	12.24	1.332
Significance	Not significant	Not significant

INTERPRETATION :The pre-interventional postprandial BGL values were 126.9 + 10.37 in group A and 131.4 + 12.92 in group B respectively, whereas the post- interventional BGL values were 123.4 + 10.37 in group A and 128.2 + 13.12 in group B. Inter groups changes in the postprandial BGL values showed statistically not significant difference between both the groups. This was done by using unpaired 't' test.

Table no.1.3. Gender-wise comparison of pre and post postprandial BGL values within group A

Group A	**Pre-treatment**	**Post- treatment**	**P**	**T**	**Significance**
	Mean + SD	**Mean + SD**			
Male	127.85 + 9.82	124.1 + 10.17	<0.0001	7.117	Extremely significant
Female	125.75 + 11.62	122.4 + 11.19	0.1890	1.436	Not significant

INTERPRETATION : The pre-interventional postprandial BGL values were 127.85 + 9.82 in males and 125.75 + 11.62 in females respectively, whereas the post interventional BGL values were 124.1 + 10.17 in males and 122.4 + 11.19 in females respectively. Intra group changes in the postprandial BGL values showed statistically extremely significant reduction in male and not significant reduction in BGL values in females . This was done by using paired 't' test .

Table no.1.4 Gender-wise comparison of pre and post postprandial BGL values within group B

Group B	**Pre – treatment**	**Post- treatment**	**P**	**T**	**Significance**
	Mean + SD	**Mean + SD**			
Male	131.34 + 13.61	128.27 + 13.95	< 0.0001	8.035	Extremely significance
Female	131.34 + 12.66	128.14 + 12.73	<0.0001	14.116	Extremely significance

INTERPRETATION :The pre-interventional postprandial BGL values were 131.34 + 13.61 in males and 131.4 + 12.66 in females respectively, whereas the post interventional BGL values were 128.27 + 13.95 in males and 128.14 + 12.73 in females respectively. Intra group changes in the postprandial BGL values showed statistically extremely significant reduction in both males and females . This was done by using paired 't' test .

Discussion

Diabetes mostly contributed by type 2 diabetes mellitus which constitutes 80% to 95% among the total diabetic population. Type 2 diabetes mellitus is formerly called adult onset diabetes.

In DM muscles get atrophy due to insulin resistance and pancreas loses its ability to secret enough insulin. As it reduce muscle quality and affects muscle functional to perform physical activities which ultimately leads to secondary complications such as mortality , long term DM damages , inability to function and failure of organs such as kidneys ,eyes , heart and blood vessels. Individuals with type 2 DM having lack of physical activity causing sedentary lifestyle.

This research was undertaken with the aim to study and compare the immediate effect stretching and strengthening exercises on blood glucose level in chronic diabetes mellitus .

44 patients (18 females, 26 males) of type 2 DM, age group 40 – 65 years approaching to OPD of Krishna college of physiotherapy participated in the study. They were divided into two groups. Each group had 22 patients. A thorough diagnose was done in medicine OPD before application of treatment strategies.

Group A was treated with passive stretching. 9 females and 13 males participated in the group. and group B was treated with strengthening exercises with theraband. 9 females and 13 males were included in this study. Two muscles of upper limb (biceps , triceps) and lower limb (quadriceps , hamstring) were taken for treatment for both the groups. Pre-treatment outcome measure for postprandial blood glucose level was done with glucometer. The specific protocol was given to the patients according to the groups. The time taken for the both groups was 60 minutes and at the end of the treatment, blood glucose level was measured by glucometer. Statistical analysis was done using paired 't' test within group and unpaired 't' test was applied to compare the results between the two groups.

In the study pre-interventional postprandial BGL values were 126.9 + 10.37 in group A and 131.4 + 12.92 in group B respectively, whereas the post interventional BGL values were 123.4 + 10.37 in group A and 128.2 + 13.15 in group B respectively. Group A ($p = 0.0014$, $t= 3.680$), group B ($p <0.0001$,$t= 12.931$). Intra group changes in the postprandial BGL values showed statistically very significant and reduction in postprandial BGL values in A group and extremely significant difference and decreased in BGL values in group B. Inter group analysis for postprandial BGL showed statistically not significant difference between group A versus group B ($p=0.2191$,$t= 1.332$) .

In the study gender-wise comparison within group A the pre-interventional postprandial BGL values were 127.85 + 9.82 in males and 125.75 + 11.62 in females respectively, whereas the post interventional BGL values were 124.1 + 10.17 in males and 122.4 + 11.19 in females respectively. Males ($p <0.0001$, $t = 7.117$) ,in females ($p = 0.1890$, $t = 1.436$). Intra group changes in the postprandial BGL values showed statistically extremely significant difference and reduction in males and not significant difference in postprandial BGL values in females .

In the study gender-wise comparison in group B pre-interventional postprandial BGL values were 131.34 + 13.61 in males and 131.4 + 12.66 in females respectively, whereas the post interventional BGL values were 128.27 + 13.95 in males and 128.14 + 12.73 in females respectively. Males ($p<0.0001$, $t= 8.035$) , females ($p<0.0001$, $t = 14.116$) . Intra group changes in the postprandial BGL values showed statistically extremely significant difference and reduction in both males and females .

In above study , 60 mins of treatment were divided into 3 phase (warm up phase, treatment phase, cool down phase.) for both the groups.

Free exercises to warm up the body and activate the muscles for further treatment for both the groups. Even after treatment (cool down phase),free exercises which helped in muscle relaxation .[8,10]

In group A ,Passive stretching improved flexibility , elongated a shortened muscle- tendon unit and peri-articular connective tissues. It helped to remove

contracture formation and other soft tissues that had adaptively shortened. It was found to be extremely significant in males compared to that of females.The other group i.e Strengthening , produced muscle tension and increased in the maximum force – producing capacity of muscle and increased in muscle fiber size and flexibility . Insufficient muscular strength caused major functional losses of even the most activities of daily living[5,6,8,9,10].

Therefore strengthening increased more flexibility in females than passive stretching and males were benefited with both stretching and strengthening exercises. statistically it was found that the results were not significant difference between group A and group B.

Conclusion

Thus, from the above conducted study it concludes that both stretching and strengthening exercises are effective in decreasing postprandial blood glucose level in type 2 diabetes mellitus, as there is no significant difference between both the groups . Strengthening exercises increases flexibility in females than passive stretching and males were benefited with both stretching and strengthening exercises.

Conflicts of Interest: There is no conflict of interest in this study.

Source of Funding: Self -funded

Ethical Clearance: This study undergone ethical clearance through the university level ethical committee. Protocol number 087/2019-2020.

References

1. Ramanchandran A, Snehalatha C. Diabetes mellitus; epidemiology and basic consideration of diabetes. In: API Textbook of Medicine.10th ed., Vol. 1. New Dehli: Jaypee brother's Medical Publishers;2015. p.467 -4.
2. Harris MI, Hadden WC, Knowler WC, Bennett PH. Prevalence of diabetes and impaired glucose tolerance and plasma glucose levels in U.S. population aged20-74 yr. Diabetes 1987 ; 36:523-34.
3. Sanghani NB, Parchwani DN, Palandurkar KM, Shah AM, Dhanani JV. Impact of lifestyle modification on glycemic control in patients with type 2 diabetes mellitus. Indian **j** Endocrinol Metab 2013; 17: 1030-9.
4. Seong Hoon PARK, MSc, PT:Effect of passive static stretching on blood glucose level in patients with type 2 diabetes mellitus .journal of phys. Ther. Sci. 2015;27: 1463-1465.
5. Peeyoosha gurudut , Abey P. Rajan : Immediate effect of passive static stretching versus resistance exercises on postprandial blood sugar levels in type 2 diabetes mellitus : a randomized clinical trial. Journal of exercise rehabilitation 2017 ;13(5):581-587
6. Ben D Perry , Marissa K Caldow ,Tara C Brennan-Speranza ,et al:Muscle atrophy in patients with type 2 diabete mellitus: roles of inflammatory pathways, physical activity and exercise.Exerc Immunol Rev.2016 ; 22:94-109.
7. Farzad Najafipour ,Majid Mobasseri , Abbas Yavari,et al; Effect of regular exercise training on changes in HbA1c , BMI , and $V0_{2max}$ among patients with type 2 diabetes mellitus; an 8 year trial. BMJ Open Diabetes Research and Care.2017;1-7.
8. Cybelle Nery, Silvia eRgina Arruda De Moraes, Karyne Albino Novaes;et al; Effectiveness of resistance exercise campare to aerobic exercise without insulin therapy in patients with type 2 diabetes mellitus : a meta-analysis**.** Brazilian journal of physical therapy;2017;400-415.
9. Carolyn kisner , Lynn Allen Colby. Therapeutic Exercises Foundation and Technique. 6th edition. New Delhi: Jaypee Brothers Medical Publisher (p) Ltd;2012.
10. Oyos ML, Barkley S. Diabetes medications : guidelines for exercise safety, ACSM'S certified news 2012;22:6-10.
11. Navid Taheria…Mojitaba Heshmatipur;The effect of passive stretching on the blood glucose levels of patients with type 2 diabetes.Journal of bodywork and movement therapies. Vol23, issue 2, april 2019, pg 394-398.
12. Cheng S, Kujala UM. Exercise in type 2 diabetes : the mechanisms of resistance and endurance training. J. sport health sci 2012;65-66.
13. Colberg SR, Sigal RJ, Fernhall B, et al;Americam college of sports medicine; American diabetes association. Exercise and type 2 diabetes: joint position statement executive summary. Diabetes care 2010;33:2692-2696.

14. Manders RJ , Van Dijik , van loon LJ: low intensity exercise reduces the prevalence of hyperglycemia in type 2 diabetes.Med sci sports exerc,2010, 42:219-225.
15. Boule NG, Haddad E, Kenny GP, et al: Effect of exercise on glycemic control and body mass in type 2 diabetes mellitus; a meta-analysis of controlled clinical trial . JAMA, 2001, 286; 1218-1227.
16. Nelson AG, Kokkonen, Arnall DA. Twenty minutes of passive stretching lowers glucose levels in an at risk population: an experimental study. J. physiotherapy 2011;57:173-178.