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Comparison of Lower Limb Strength and Endurance Between Diabetics and Non-Diabetics

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ABSTRACT

Background: The Process of aging is associated with numerous changes in all bodily systems that ultimately manifest in a decline in peak physiological function. The Prevalence of Type 2 DM increased with age.
Purpose: The purpose of this study was to asses Lower Limb Strength and Endurance in patients with Diabetics in comparison with Age and Gender matched Healthy control subjects.
Methodology: Observational analytical study was conducted by Convenience sampling on ≥60years old people of either gender diagnosed with Diabetes and Non diabetics were included. Participants were divided into two groups- Diabetics (Group-A) and Non-Diabetics (Group-B).In each group the individuals were divided into young-old and old-old subgroups. Each individual performed 30 sec Chair stand test to measure Lower limb strength and 2 min step test to measure Endurance. Each subject was given appropriate rest period between the tests.
Result: Mean Age of Diabetics and Non- Diabetics is 66.72 ± 6.8 years. Non parametric Mann Whitney U test was applied to find the significance of Strength and Endurance of Young-old and Old-old group of Diabetics and Non-Diabetics. There was a significant difference in Endurance of Young old and Old old group in Diabetics and Non-Diabetics ($p<0.05$). There was no significant difference between Strength of lower limb of Young old and Old old group in Diabetics and Non-Diabetics ($p>0.05$). There was significant negative correlation of Post Diabetic Duration with Strength ($r= -0.295$) and Endurance ($r= -0.270$).
Conclusion: Long term Diabetes creates changes in endurance of elderly individuals but the overall strength does not change in a tested sample.

Keywords: diabetics, endurance, lower limb strength

INTRODUCTION

The aging is related to numerous changes in our body system which declines functional ability. The functional ability in advanced age can be evaluated by the 4 components of fitness (cardiorespiratory endurance, muscular strength and endurance, flexibility and body composition). [1]

Diabetes mellitus has long been recognized as a cause of accelerated aging. [2]In 1958 fewer than 2 million in the United States were diabetic, whereas today the number approaches 16 million. There has been a similar increase in diabetes throughout the world, with alarming recent increases in diabetes in developing nations as well as in the developed world.[3]

Diabetes mellitus is a disease of older persons, more than half of all diabetics in the United States are over 60 years of age. The prevalence of diabetes mellitus peaks in persons between 65 to 74 years of

age.[4]Twenty percent of men and more than 15% of women 65 to 74 years of age have diabetes. There is a decrease in prevalence rates in persons 75 years and older. It is important to recognize that in 25% to 41% of persons who have diabetes the diagnosis has not been made. [5]

Ageing causes physical and biological changes in both the structure and the function of muscles. Muscle mass/intensity deteriorates physically as a result of ageing which leads to a significant reduction of muscle power and function. [6] Studies shows that diabetes causes muscle strength degradation in ankle joints through affecting the blood circulation in lower limbs; Other effects include increase in dryness in the dorsiflexion ankle joints and reduction in proprioceptive receptors of these limbs. Reduction in proprioceptive receptors of ankle affects consistency in walking and consequently raises the risk of falling down while walking.[7] Insulin resistance, metabolic inflexibility, muscular and neuromuscular impairments develop the decrease of muscle strength and quality especially in the lower limb.[8]

Decreased muscular endurance has been reported in patients with neurogenic muscle weakness and was explained as an accelerated reduction in membrane excitability[9] Therefore, in addition to muscle weakness, impaired muscular endurance in diabetic patients could give rise to functional shortcomings during daily activities.[10]

Practically, because the exercise has important role in the control and treatment of diabetes, the identification of muscle strength and endurance properties can be helpful to design the better exercise protocol.[11] Functional strength and endurance testing is quicker, more clinical to perform. This will arise a need to asses Lower limb Strength and Endurance between Diabetics and Non-diabetics.

MATERIALS & METHODS

Observational analytical study was conducted by Convenience sampling from various communities of Ahmedabad in July 2021. The estimated sample size was 116 subjects. Total duration of study was 1 month. Subjects with known case of Diabetes of either gender, aging between 60-85 years and age & gender matched non diabetics were included in the study.

The patients with any neurological conditions like stroke, Parkinson's disease, Alzheimer's disease, any Malignancy, Who has undergone recent surgery, Wheelchair bound patients, any psychological conditions and Osteoarthritic patients with pain having NPRS > 8 were excluded. n= 116 subjects aged of 60 to 85 (mean, 66.72 ± 6.8), M:F = 52/64 were selected as per selection criteria.

Participants were divided into two groups- Diabetics (Group-A) and Non-Diabetics (Group-B) (A/ B= 58/58). In each group the individuals were further divided into young-old and old-old subgroups (Y_Old / O_Old = 48/10). Each individual performed 30 sec Chair stand test to measure Lower limb strength[12](ICC=0.92)[13] and 2 min step test[14] ($r = 0.93$, $P < 0.001$)[15] to measure Endurance. Each subject was given appropriate rest period between the tests.

Statistical analysis

Data was analyzed using SPSS version 20 and Microsoft Excel 2007. Statistical Analysis was done keeping the power $p<0.05$ using Non Parametric Mann Whitney U test.

RESULT

The present study was done to compare Lower Limb Strength and Endurance between Diabetics and Non-Diabetics having 60-85 years of age. In each group the individuals were further divided into young-old and old-old subgroups.

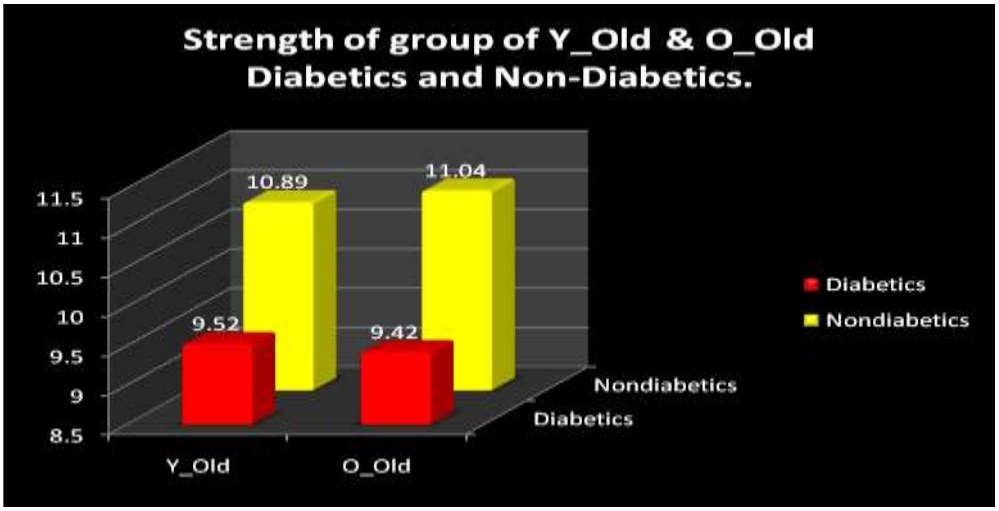
The distribution of data was evaluated using Kolmogorov Smirnov test. Since the data was not normally distributed for all outcome measures, non-parametric test (Mann Whitney U test) was applied for analysis.

Table 1: Demographical Details

	Variable	Diabetics MEAN± SD	Non-Diabetics MEAN± SD
1	Mean Age of Diabetics & Non-Diabetics	66.72 ± 6.8	66.72 ± 6.8
2	Gender (Male/female)	26/32	26/32
3	Y_Old / O_Old	48/10	48/10
4	Post Diabetic Duration (Months)	89 ± 79	

Table 2: MEAN ± SD and p-value of strength of diabetics and non-diabetics of group young-old and old-old.

Group	Diabetics Strength (MEAN±SD)	Non-diabetics Strength (MEAN±SD)	P-value Interpretation
Y_Old	9.52 ± 3.59	10.89 ± 4.0	0.078 Not Significant
O_Old	9.42 ± 3.65	11.04 ± 3.94	0.236 Not Significant

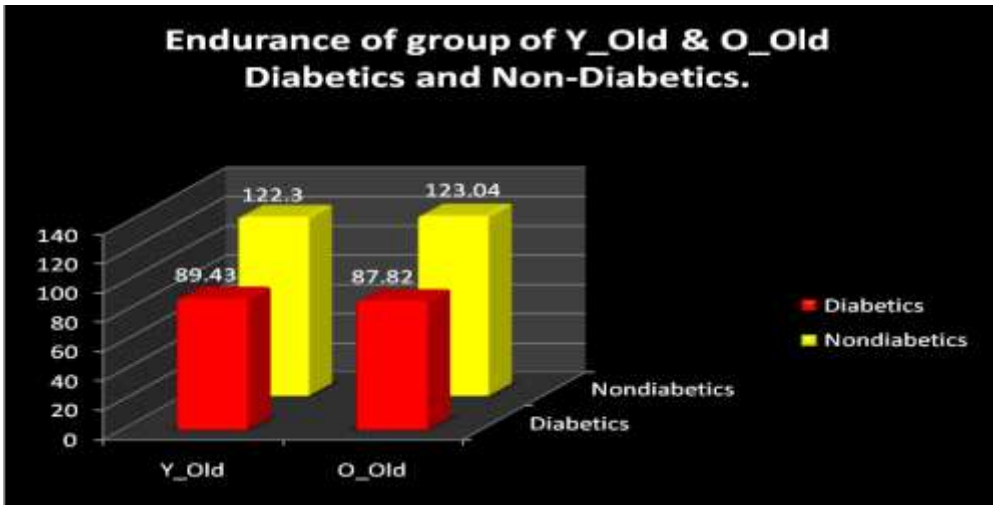


Graph 1: Strength of Diabetics and Non-Diabetics.

Comparison of Strength of Group Young-Old and Old-Old was done using Mann Whitney U test shows not significant difference with p>0.05.

Table 3: MEAN ± SD and P-VALUE of endurance of group young-old and old-old.

Group	Diabetics Endurance (MEAN±SD)	Non-diabetics Endurance (MEAN±SD)	P-value Interpretation
Y_Old	89.43±49.29	122.3±47.66	0.002 Significant
O_Old	87.82±49.23	123.04±47.44	0.015 Significant



Graph 2: Endurance of group of Y Old & O Old Diabetics and Non-Diabetics.

Comparison of Endurance of Group Young-Old and Old-Old was done using Mann Whitney U test shows significant difference with $p<0.05$.

Table 4: Correlation Between Post Diabetic Duration & Strength and Post Diabetic Duration & Endurance

	VARIABLES	r VALUE	INTERPRETATION	STATISTICAL SIGNIFICANT
1	Post Diabetic Duration and Strength	-0.295	NEGATIVE CORRELATION	Significant (p= 0.025)
2	Post Diabetic Duration and Endurance	-0.270	NEGATIVE CORRELATION	Significant (p=0.040)

Spearman rank test showed significant Negative correlation of Post Diabetic Duration with Strength (r= -0.295) (p=0.025) and Endurance (r= -0.270) (p=0.040).

DISCUSSION

The present study was done to compare the Lower Limb Strength and Endurance between Diabetics and Non-Diabetics. The mean age of both group was 66.72 Years and mean Post Diabetic duration was 89 months. 116 subjects participated in the study conducted to evaluate the difference of Lower Limb strength and Endurance between Diabetics and Non-Diabetics.

Subjects were evaluated for Lower extremity Strength by 30 sec Chair stand test and Endurance by 2 min Step test.

Diabetes is associated with poorer physical function and this relationship is mediated by peripheral nerve function. While it is known that diabetes results in accelerated loss of muscle function and muscle protein synthesis, and peripheral nerve dysfunction can result in decreased muscle mass and strength.[16]

In present study, there was no significant difference found between lower limb strength of Young- old Diabetics and Non-Diabetics (p=0.078) from 9.52 ± 3.59 to 10.89 ± 4.0 respectively and also for Old-old group in Diabetics and Non-Diabetics (p= 0.236) from 9.42 ± 3.65 to 11.04 ± 3.94 respectively (Table no: 2, Graph no: 1), which observed on completion of 30 sec chair stand test. These results are attributed to the fact that transferring from a sitting to a standing position requires surprisingly large moments, particularly at the hip and the knee. Diabetic patients had reduction of strength of ankle muscles more than knee muscles. So, sit to stand activity which includes predominant role of knee muscles more than ankle muscles, is not affected.

In agreement to present study, M Rahimi et al,[17]2019 reported that, with regard to the lower extremity muscle force, the difference between the two groups was not significant (p>0.05) from 22.13 ± 10 to 23.39 ± 10 respectively.

Diabetes can also directly damage the structure and affect the function of the myocardium and lungs. The development of pulmonary complication could be explained by the biochemical alteration of connective tissue constituents, particularly collagen and elastin, as well as micro-angiopathy of pulmonary vessels due to a nonenzymatic glycosylation of proteins induced by chronic hyperglycemia.[18] Long-term hyperglycemia may lead to myocardial hypertrophy and fibrosis, ventricular stiffness, and myocardial dysfunction. Diabetes is also an independent risk factor for lung volume and lung dispersion.[19]

In present study, there was significant difference found between Endurance of Young- old Diabetics and Non-Diabetics (p=0.002) from 89.43 ± 49.29 to122.3 ± 47.66 respectively and also for Old-old group in Diabetics and Non-Diabetics (p= 0.015) from 87.82 ± 49.23 to 123.04 ± 47.44 respectively (Table no: 3, Graph no: 2), which observed on completion of 2 min step test. These results are attributed to the fact that with increase in visceral fat and blood glucose level in Diabetics, which damages to blood vessels and ultimately cardiopulmonary endurance decreases gradually.

In agreement to present study, Sultan A. Meo et al,[20] 2006 reported that inspiratory and expiratory phases of respiration, diabetic patients showed a significant reduction in the mean values of direct

maximum voluntary ventilation (MVV) test ($p<0.001$) relative to their matched controls.

Present study findings are also supported by L Fuso et al,[21] 2012 reported that, Maximal inspiratory pressure (MIP) were significantly reduced in diabetics comparison with those of control subjects ($p<0.0001$) from 74.04 ± 27.83 to 98.02 ± 33.21 respectively. Same for maximum voluntary ventilation (MVV) were significantly reduced in diabetics comparison with those of control subjects ($p<0.0001$) from 78.45 ± 25.99 to 122.45 ± 44.24 respectively.

In present study, there was significant negative correlation of Post diabetic duration with strength ($r= 0.295$) ($P=0.025$) and Endurance ($r= 0.270$) ($p= 0.040$).

In agreement to present study, RR Kalyani et al,[22] 2014 reported that accelerated loss of muscle mass and strength is recorded in individuals with diabetes, is greater with longer diabetes duration or higher HbA1c, and is attenuated by use of insulin sensitisers. B Hatef et al,[23] 2014 concluded that patients with long-term diabetes more than 10 years had more decline in the muscle strength than sex, BMI, ABI and PAI-matched Health control and T2DM < 10 Y groups.

In agreement to present study, Sultan A. Meo et al,[24] 2007 concluded significant negative correlation between duration of disease and endurance, as measured by FEV1 ($r = 0.258$, $p = 0.04$), FVC ($r = 0.282$, $p = 0.28$), and the middle half of the FVC (FEF25–75%) ($r = 0.321$, $p = 0.014$).

CONCLUSION

Long term Diabetes creates changes in endurance of elderly individuals but the overall strength does not change in a tested sample.

Clinical Implication: Measures to improve Endurance with Physiotherapy, enhances Quality of Life in subjects with Diabetics.

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Conflict of Interest: None

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Ethical Approval: Approved

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