



Original Research Article

# Effect of longstanding Diabetes Mellitus II on handgrip strength: An observational study

Monica Chandreshbhai Shambhuvani<sup>1\*</sup>, Shraddha Jasmin Diwan<sup>2</sup>, Neeta Jayprakash Vyas<sup>3</sup>

<sup>1</sup>PG Student, <sup>2</sup>Lecturer, <sup>3</sup>Principal

S.B.B. College of Physiotherapy, V.S. Hospital, Ahmedabad, Gujarat, India

\*Corresponding author email: [moni.shambhuvani@gmail.com](mailto:moni.shambhuvani@gmail.com)

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## Abstract

**Introduction:** Diabetes mellitus is a chronic metabolic condition characterized by persistent hyperglycemia, with resultant morbidity and mortality. Muscle weakness has been associated with type-II diabetes, even among subjects with high body mass indices. There is decremental effect of DM-II on skeletal muscles.

**Objective:** The study was aimed to find the effect of longstanding DM-II on hand grip strength.

**Material and methods:** 25 subjects with DM-II diagnosed since more than 6 years aged between 35-75 years ( $60.96 \pm 7.6$ ) (Group A), with mean diabetic duration of  $13.25 \pm 8.5$  years and independent in their ADL were compared with 25 healthy non diabetic subjects ( $55.00 \pm 9.93$ ) (Group B) for their hand grip strength of dominant hand using hand held dynamometer. Subjects with any upper limb amputation or with cervical spondylosis, cervical pott's disease, 1 degree metastatic tumor or fracture or dislocation of cervical vertebra, Thoracic outlet syndrome, Peripheral nerve injury, cervical neurofibromatosis and cervical radiculopathy in previous 6 months before commencement of study were excluded. Wilcoxon Signed Rank Test was used for within group analysis and Mann-Whitney 'U' Test was used for between group analyses.

**Results:** For group A,  $W = -3.009$ ,  $p = 0.003$  and for Group B,  $W = -3.909$ ,  $p = 0.0001$ . The U value for between group analysis is  $U = 87.00$ ,  $p = 0.001$ .

**Conclusion:** Grip strength was significantly reduced in diabetic individuals as compared to non-diabetic individuals. There is also significant difference in dominant and non-dominant hand grip strength in diabetic group and non diabetic group.



## Key words

Diabetes Mellitus II, Hand grip strength, Dynamometer.

## Introduction

Diabetes Mellitus II (DM II) is a chronic metabolic condition characterized by persistent hyperglycemia with resultant morbidity and mortality (Cohen 2007). Type II diabetes mellitus accounts for about 95% cases of diagnosed cases of diabetes in adults.

According to International Diabetes Federation (IDF), prevalence of DM II exceeds 250 million worldwide [1]. Muscle weakness has been associated with type II DM even among the subjects with high body mass indices [2]. It is considered as one of the most common risk factor for functional disability specially after long duration of illness [3]. It may be associated with peripheral neuropathy, coronary, cerebral or tangential vascular disease, retinopathy, nephropathy, diabetic foot syndrome and depression which are indicator of functional disability.

Patients with DM II have been reported to be more disabled in self care tasks and other daily living activities than non-diabetic subjects because of many hand complications [4]. Longer the duration of illness the greater will be reduction of hand grip strength, agility and disability [5, 6, 7].

Low muscle strength but not muscle mass is associated with poor physical function in older men and women [8, 9]. Muscle strength measured in midlife or old age is highly predictive of functional disability up to 25 years later [10, 11].

From above mention studies it can be hypothesized that long standing DM-II would impair the handgrip strength. So the need of

present study was to check the same thing in our population. In the present study we have evaluated the effect of long standing DM II on handgrip strength in males and females who have diabetes more than 6 years.

## Material and methods

Subject suffering from DM-II were screened from diabetic OPD of V.S. general hospital and community. Using purposive sampling 25 subjects with DM-II diagnosed since more than 6 years aged between 35-75 years ( $60.96 \pm 7.6$  years) with mean diabetic duration of  $13.25 \pm 8.5$  years and independent in their ADL were selected and compared with 25 healthy age matched non diabetic subjects ( $55.00 \pm 9.93$ ) for their hand grip strength of dominant hand using hand held dynamometer. Subjects with any upper limb amputation or with cervical spondylosis, cervical Pott's disease, 1 degree metastatic tumor or fracture or dislocation of cervical vertebra, Thoracic Outlet syndrome, Carpel Tunnel Syndrome, Peripheral Nerve Injury, cervical neurofibromatosis and cervical radiculopathy in previous 6 month before commencement of study were excluded. None of participant was involved in occupation that requires manual handling that can affect handgrip.

Research was approved by Institutional Ethics committee, Nature and purpose of the study was explained to the subjects followed by written informed consent in vernacular language. Demographic data was recorded in the beginning of the study. Handgrip strength was measured using Hand JAMAR Hydraulic hand held dynamometer (White Plains, NY 10602 USA) (ICC value 0.87-0.97) [12].



Arm position for handgrip test standardized by The American Society of Hand Therapists was utilized. Each subject was positioned in a straight back chair (about 46 cm in height, without an arm rest) with both feet flat on the floor. The arm position was demonstrated to the subjects. Each subject was asked to place their hand on their thigh one by one and assume a position of adducted and neutrally rotated shoulder, the elbow in approximately 90 degree flexion, with the forearm and wrist in neutral position, and the fingers flexed for the needed maximum contraction. They were instructed to breathe in through the nose and exhale through a pursed lip after a maximum grip effort was made. A demonstration of maximum handgrip strength was given to each subject before they were asked to do it themselves. Trial was also given to them before the actual reading was taken. Each subject was instructed to squeeze the handle of the dynamometer, which was placed vertically in their hands, as hard as possible. The period of the effort did not exceed 5 seconds. A period of 30 seconds rest was given between two trials. Best of two was taken in consideration. Both hands' strength was taken one after another [1].

### Statistical analysis

Wilcoxon Signed Rank Test was used for within group analysis. Mann-Whitney 'U' Test was used for between group analyses with level of significance at 5%.

### Results

25 subject independent in their ADL aged between 35-75 years ( mean age  $60.96 \pm 7.6$  yrs) of either gender (Group A), with mean diabetic duration of  $13.25 \pm 8.5$  years were compared for handgrip strength of their dominant hand with 25 healthy age matched non diabetic subjects with mean age of  $55.00 \pm 9.93$  years (Group B).

Mean age and SD for diabetic and non-diabetic group was as per **Table - 1**. It also showed mean value and SD for dominant and non-dominant hand trials. Subjects who were left hand dominance, their left hand value were taken in consideration for dominant hand trials.

Wilcoxon Signed Rank Test was applied to compare the right and left handgrip strength within groups showed a significant difference ( $p=0.003$ ) as per **Table - 2**. For between group analysis Mann-Whitney 'U' test was applied which shows significant difference between diabetic and non-diabetic patients ( $p=0.001$ ) as per **Table - 3**.

### Discussion

In the present study, it was found that grip strength was reduced in diabetic individuals as compared to non-diabetic individuals. There was also significant difference in dominant and non-dominant handgrip strength. Present study clearly demonstrated that upper limb muscle quality was consistently lower in adults with a long duration (>6 years) of type 2 diabetes, regardless of gender. This finding possibly explains the increased risk of upper limb functional limitations in older individuals with long-standing type II diabetes.

Significant reduction in muscle strength in diabetics as compared to age matched healthy individuals is explained by two mechanisms. Muscle weakness has been associated with DM II can be attributed to increased insulin tissue resistance and hyperglycemia, which cause a reduction in the number of mitochondria in the muscle cells, a decrease in glycogen synthesis and an increase in the amount of circulating systemic inflammatory cytokines, all of which have a decremental effect on the skeletal muscles [13]. Additionally, the physiological cross section of the muscles is significantly lower in individuals with diabetes, with being worse

with longer duration of illness and poorer control [14]. The metabolic disturbances associated with DM II also cause damage to the connective tissues of the hand leading to limitation in joint range of motion, Dupuytren's contracture, and flexor tenosynovitis in approximately 50% of individuals with DMII [5, 7, 14]. The another cause of muscle weakness can be an underlying subclinical neurological process which involves motor neurons may be a cause in long standing DM II [15].

Finding of present study is supported by Andresen, et al. in 2004 who found 7-17% lower muscle strength at ankle and knee in diabetic group as compared to control group. In present study it was found that handgrip strength was affected in both males and females who had type II DM. This finding was also supported by Eczema and colleagues in 2012 who found that DM II seems to result in decrease in muscle strength in both males and females.

Limitation of present study was small sample size. Also, in both group genders were not matched. Further study can be carried out with larger number of subjects. Pinch Grip strength can also be measured in subjects with DM II. DM II affects the skeletal muscles so study can be carried out on other skeletal muscles.

### Conclusion

The study concludes that Grip strength was significantly reduced in diabetic individuals as compared to non-diabetic individuals. There was also significant difference in dominant & non-dominant hand grip strength in diabetic group and non diabetic group.

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**Table - 1:** Mean age, dominant hand strength and Diabetic duration.

	Age (Mean ± SD)(years)	Dominant Hand Trial (Mean ± SD) (kilograms)	Mean Diabetic Duration (Mean ± SD) (years)
Diabetic Group	60.96 ± 7.65	18.28 ± 5.12	13.25 ± 8.5
Non-diabetic Group	55 ± 9.93	25.83 ± 5.23	

**Table - 2:** Within group analysis Wilcoxon Signed Rank Test.

	W value	p value
Diabetic Group	-3.009	0.003
Non-diabetic Group	-3.909	0.0001

**Table – 3:** Between group analysis Mann-Whitney ‘U’ Test.

U value	p value
87.00	0.001