ORIGINAL ARTICLE

HANDGRIP STRENGTH IN PATIENTS WITH TYPE 2 DIABETES MELLITUS

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Background: Diabetes mellitus type 2 is the most common endocrine disorder all over the world and is characterised by abnormal metabolic conditions and many long term illnesses. Muscle weakness has been linked with type-2 diabetes, even amongst subjects with high body mass indices. There is decremental effect of diabetes mellitus type 2 on skeletal muscles. This study was undertaken to measure the handgrip strength in type-2 diabetic patients as a measure of sarcopenia, and compare it with age- and sex-matched apparently healthy non-diabetic subjects. **Method:** This comparative cross-sectional study was carried out in the Outpatient Department of Civil Hospital, Amritsar. The study included 50 clinically diagnosed diabetic male patients of more than 50 years age having type-2 diabetes mellitus for at least 10 years; and 50 age- and sex-matched apparently healthy non-diabetic controls. Hand Grip Strength (HGS) of all subjects was measured using Jamar Handheld Dynamometer. The independent *t*-test was used to analyse the difference in HGS between the diabetic and the non-diabetic subjects. **Results:** The mean age of study subjects was 54.74±2.61 years, and their mean Body Mass Index (BMI) was 26.83±2.49 Kg/m^2. Mean HGS of dominant hand of diabetic and control group was 20.76±3.55 Kg and 32.90±7.60 Kg respectively. HGS of dominant hand amongst diabetic group was significantly lower as compared to controls (t=10.23, p<0.001). **Conclusion:** Handgrip strength was lower in diabetic patients compared to controls.

Keywords: Type 2 Diabetes Mellitus, T2DM, Hand Grip Strength, Sarcopenia, Jamar Handheld Dynamometer, Body Mass Index (BMI)

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INTRODUCTION

Diabetes mellitus is a chronic metabolic condition characterised by persistent hyperglycaemia with resultant morbidity and mortality.[1] According to International Diabetes Federation (IDF), prevalence of Diabetes Mellitus type 2 exceeds 250 million worldwide.[2] Hand grip strength (HGS) is the maximal power of forceful voluntary flexion of all fingers under normal bio kinetic conditions.[3] There is significant reduction in grip strength in diabetic population.[4,5]

Musculoskeletal syndrome associated with diabetes mellitus may be very debilitating, most commonly recognised maladies associated are stenosing tenosynovitis, Dupuytren's contracture, carpal tunnel syndrome and limited joint mobility.[6] Panapas associated the duration of diabetes with even poorer muscle quality and increased incidence of musculoskeletal conditions. Type 2 Diabetes mellitus also results in chronic complications involving eyes, kidneys, nervous system and blood vessels.[8]

Patients with Diabetes Mellitus type 2 have reported to be more disabled in self-care tasks and other daily living activities than non-diabetic subjects because of many hand complications. However, there are a limited number of researches related to such problems.[9] Carpel tunnel syndrome has been reported to be the most common pathology with an incidence of 45%. Its specific relationship to diabetes is thought to be median nerve entrapment caused by the diabetes-induced connective tissue changes.[10]

Detection of such changes can be a forewarning signs for more diabetic complications. There are very few studies on this premise. We tested the hypothesis that hand grip strength is less in patients with Diabetes Mellitus type 2.

SUBJECTS AND METHODS

The study was approved by the research and ethical committee of the Institute. This cross-sectional study was carried out in the outpatient clinics of the Civil Hospital, Amritsar. The target population consisted of type 2 diabetic males in the age group 50–60 years, with diabetes duration >10 years. Fifty diabetic subjects and 50 age- and sex-matched apparently healthy volunteers were included in the study. Ninety percent of the participants were right handed. All diabetic subjects were either on only hypoglycaemic agents, or on hypoglycaemic agents and a diabetes diet formula. Nature and rationale of the study was

explained to the subjects followed by written informed consent in vernacular language.

The included subjects had no glucose intolerance, no history of pain and musculoskeletal problems in the shoulder, arm or hand, no documented history of trauma or brachial plexus injury, peripheral nerve injury, or cervical radiculopathy in the previous 6 months. None of the participants was involved in occupation that requires manual handling that can influence the handgrip.

Participant with history of cervical spondylosis, carpal tunnel syndrome, peripheral nerve injury and cervical radiculopathy during the previous 6 months were excluded from the study.

Demographic information in the form of questionnaire was taken from each subject. Weight and height were recorded to calculate BMI. Age was calculated in years to nearest half year. Height to nearest centimetre was recorded in subjects standing barefoot on the floor against the wall with their heels slightly separated and their buttocks in contact with the wall. Their weights were measured in kilograms on a portable weighing machine without wearing shoes. BMI was calculated using formula:

$$\text{BMI (Kg/m}^2\text{)} = \text{Wt (Kg)}/\text{Ht}^2\text{ (m)}$$

Hand Grip Strength was measured on Dominant Hand using Jamar Handheld Dynamometer. The subject was seated in a straight back chair with their feet flat on floor. The shoulder was adducted and neutrally rotated, elbow flexed at 90 degrees, forearm in neutral position with the wrist between 0–30 degrees extension and between 0–15 degrees ulnar deviation. The period of the effort did not exceed 5 seconds. A period of 30 seconds rest was given between three trials for the dominant hand to be tested and average of the three trials was calculated.

Means and standard deviations were used to describe the participants' demographic data. Statistical measures of the mean scores and standard deviation were calculated for the baseline measurement for each participant. Paired *t*-test was used for comparing data of the subjects.

RESULTS

Table-1 shows descriptive statistics of hand grip strength in dominant hand with selected anthropometric variables in diabetic and control males. Diabetic males had lower mean values hand grip strength (20.76 Kg) than their control counterparts (32.90 Kg), and higher mean values of weight (79.74 Kg) and BMI (26.83 Kg/m^2) than their control counterparts with weight (71.10 Kg) and BMI (23.59 Kg/m^2) respectively. These differences were found to be statistically highly significant (p<0.001).

Table-1: Anthropometric variables and HGS in dominant hand in diabetic and control males (Mean±SD)

Parameters	Diabetic males (n=50)	Control males (n=50)	*t*	*p*
Age (Years)	54.74±2.61	55.28±2.83	0.991	NS
Height (Cm)	172.92±5.78	173.46±5.74	0.478	NS
Weight (Kg)	79.74±7.86	71.10±9.47	0.962	<0.001
BMI (Kg/m^2)	26.83±2.49	23.59±2.74	6.188	<0.001
HGS (Kg)	20.76±3.55	32.90±7.6	10.23	<0.001

p<0.001=highly significant

DISCUSSION

It was found in the present study that hand grip strength in individuals with long standing diabetic mellitus type 2 is considerably lower than age and sex matched controls. Fittzgibbons *et al*[6] also observed similar results depicting reduced hand grip strength in diabetic population. Park *et al*[11] concluded that muscle quality was associated with duration of diabetes mellitus type-2. Our results are consistent with other studies reporting that Diabetes Mellitus type-2 is associated with poorer upper limb muscle strength and quality.[12,13] The results of this study are in close agreement with another study[2] stating that the Diabetes Mellitus type-2 seems to result in decrease in hand grip strength. Finding of present study is also supported by Anderson *et al*[14] who found 7–17% lower muscle strength in ankle and knee in diabetic group compared to control.

Significant reduction in muscle strength in diabetics compared to age matched healthy individuals is explained by two mechanisms: increased insulin tissue resistance and hyperglycaemia, 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.[15] Another cause of muscle weakness could be underlying subclinical neurological process which involves motor neurons in long standing Diabetes Mellitus type-2.[16]

However, some researchers[17] have observed that there is a significant reduction in the muscle strength of the ankle dorsal and plantar flexors while insignificant reduction in the muscle strength of wrist flexors and extensors, contrary to what we observed.

CONCLUSION

The hand muscles strength represented in grip strength is significantly affected by long standing type 2 diabetes mellitus. Such individuals have been found to have an augmented risk of developing functional disabilities due to hand muscle weakness which can lower productivity. Assessment of hand grip strength in diabetics can help in detection of disability and rehabilitation.

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