ORIGINAL ARTICLE

HAND GRIP STRENGTH IN TYPE 2 DIABETICS AND NON-DIABETICS

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Background: The incidence and prevalence of diabetes is increasing in developing countries, many complications have been reported, and hand getting affected is one of them. There is decremental effect of type 2 diabetes mellitus (T2DM) on skeletal muscles. The aim of the present study was to assess the hand grip strength and compare it with age and sex matched apparently healthy non-diabetic subjects. **Methods:** This was a comparative cross-sectional study carried out in the Outpatient Department of Civil Hospital, Amritsar, India. The study included 100 clinically diagnosed diabetics (50 males, 50 females) of more than 50 years of age having T2DM for at least ten years and 100 age and sex matched apparently healthy non-diabetic controls. Hand Grip Strength (HGS) of all subjects in dominant hand was measured using Jamar Handheld Dynamometer. The independent *t*-test was used to analyse the difference in HGS between diabetic and the non-diabetic subjects. **Results:** There were significant differences in mean HGS between both male and female diabetics and non-diabetics ($p<0.001$). There was significant difference in HGS of male and female subjects (diabetics and controls, $p<0.001$). **Conclusion:** Long-standing T2DM seems to result in a decrease in HGS. This physical limitation may contribute to low productivity in people with T2DM.

Keywords: Type 2 Diabetes Mellitus, T2DM, Handgrip strength, Muscle wasting, Myopathy
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INTRODUCTION

According to World Health Organization, diabetes globally affects approximately 347 million people and diabetes deaths will double between 2005 and 2030.[1] There is growing recognition that complications associated with Type 2 Diabetes Mellitus (T2DM) may translate into functional impairment in older people.[2] Handgrip 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] This may reflect a link between the metabolic and mechanical functions of the muscle.

There are wide variety of diabetic complications involving bones, joints, and peri-articular soft tissues. The upper extremity complication known as 'diabetic hand' include not only more specific diabetes related conditions such as limited joint mobility but also conditions related to the non-diabetic hand such as trigger finger, Dupuytren's disease etc.[6,7] The development of musculoskeletal disorders is dependent on age and on the duration of diabetes mellitus.[8] Nevertheless, there are a limited number of researches related to such problems.[9]

Little is known of the relationship between long duration T2DM and handgrip strength in the state of Punjab. This study was designed to compare the handgrip strength (HGS) of individuals with long standing T2DM with the HGS of apparently healthy age and sex matched counterparts.

MATERIAL 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 of this study consisted of type 2 diabetics in age group 50–60 years, with diabetes duration >10 years. One hundred subjects (50 males and 50 females) and 100 age and sex matched apparently healthy volunteers (fifty males and fifty females) were recruited for the study. Ninety percent participants were right handed. Participant with history of cervical spondylosis, carpal tunnel syndrome, peripheral nerve injury, or cervical radiculopathy during the previous 6 months were excluded from the study. All diabetic subjects were either on hypoglycaemic agents alone, or hypoglycaemic agents and a diabetes diet formula.

The 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, cervical radiculopathy in the previous 6 months. None of the participants were involved in occupation that requires manual handling that can influence the handgrip.

Nature and rationale of the study was explained to the subjects, and written informed approval in vernacular language was obtained. Demographic information in the form of questionnaire was taken from each subject. Weight and height were recorded to calculate BMI. Age calculated in years to the nearest of

0.5 years. To measure height in centimetres subjects stood 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 Kg with a subject standing on a portable weighing machine without wearing shoes. BMI was calculated using formula:

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

Hand Grip strength of Dominant Hand was recorded using the Jamar Handheld Dynamometer. The subjects were seated in an armless chair with shoulders adducted and neutrally rotated, elbow flexed at 90 degrees, forearm in neutral position with the wrist between 0–30 degrees of dorsiflexion. A demonstration of maximum handgrip strength was given to each subject before they were asked to do it themselves. The participants were instructed to squeeze the handle as hard as possible.[10] 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 the average of the three trials was taken.

RESULTS

Table-1 shows statistics of grip strength in dominant hand with selected anthropometric variables in diabetic and control males. Diabetic males had lower mean values for handgrip strength (20.76±3.55 Kg) than their control counterparts (32.90±7.60 Kg) and higher mean values in weight (79.74±7.86 Kg) and BMI (26.83±2.49 Kg/m^2) than their control counterparts with weight 71.10±9.47 Kg) and BMI (23.59±2.74 Kg/m^2) respectively. These differences were found to be statistically highly significant (p<0.001), weight (t=9.60), BMI (t=6.18), handgrip strength (t=10.23).

Table-2 shows descriptive statistics of grip strength in dominant hand with anthropometric variables in diabetic and control females. Diabetic females had lower mean values of handgrip strength (18.36±3.50 Kg) than their control counterparts (25.16±3.45 Kg) and this difference was statistically highly significant (p<0.001, t=9.79). Difference in other parameters was non-significant.

Table-3 shows statistics of grip strength in dominant hand with selected anthropometric variables in diabetic males and females. Diabetic females have lower mean values in height (156.72±5.91 Cm), weight (65.70±9.59 Kg), BMI (26.68±3.69 Kg/m^2), handgrip strength (18.36±3.50 Kg) compared to diabetic males with height 172.92±5.78 Cm), weight 79.74±7.86 Kg), BMI (26.83±2.49 Kg/m^2), handgrip strength (20.76±3.55 Kg). The differences were statistically highly significant (p<0.001) for height (t=13.85), weight (t=8.00), handgrip strength (t=3.40) while differences in BMI were non-significant.

Table-4 shows statistics of grip strength in dominant hand with selected anthropometric variables in control males and females. Females had lower mean values in height (159.62±6.01 Cm), weight (67.22±10.05 Kg), and handgrip strength (25.16±3.45 Kg) compare to control males with height 173.46±5.74 Cm, weight 71.10±9.47 Kg, handgrip strength 32.90±7.60 Kg, while BMI of females (26.43±4.15 Kg/m^2) was higher than males (23.59±2.74 Kg/m^2). Statistically significant differences (p<0.001) were noted in height (t=11.77) BMI (t=4.03) and handgrip strength (t=6.55).

Table-1: Hand grip strength in dominant hand in diabetic and control males (n=50 each)

Parameters	Diabetics	Controls	*t*	*p*
Age (Year)	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*
Hand Grip Strength (Kg)	20.76±3.55	32.90±7.60	10.23	<0.001*

*highly significant

Table-2: Hand grip strength in dominant hand in diabetic and control females (n=50 each)

Parameters	Diabetics	Controls	*t*	*p*
Age (Year)	54.90±2.85	54.62±2.55	0.52	NS
Height (Cm)	156.72±5.91	159.62±6.01	2.43	<0.017*
Weight (Kg)	65.70±9.59	67.22±10.05	0.77	NS
BMI (Kg/m^2)	26.68±3.69	26.43±4.15	0.32	NS
Hand Grip Strength (Kg)	18.36±3.50	25.16±3.45	9.79	<0.001*

*highly significant

Table-3: Hand grip strength in dominant hand in diabetic males and diabetic females (n=50 each)

Parameters	Diabetic males	Diabetic females	*t*	*p*
Age (Year)	54.74±2.61	54.90±2.85	0.29	NS
Height (Cm)	172.92±5.78	156.72±5.91	13.85	0.001*
Weight (Kg)	79.74±7.86	65.70±9.59	8.00	0.001*
BMI (Kg/m^2)	26.83±2.49	26.68±3.69	0.24	NS
Hand Grip Strength (Kg)	20.76±3.55	18.36±3.50	3.40	0.001*

*highly significant

Table-4: Hand Grip Strength in dominant hand with selected anthropometric variables in control males and control females (n=50 each)

Parameters	Control males	Control females	*t*	*p*
Age (Year)	55.28±2.83	54.62±2.55	1.2	NS
Height (Cm)	173.46±5.74	159.62±6.01	11.77	0.001*
Weight (Kg)	71.10±9.47	67.22±10.05	1.24	NS
BMI (Kg/m^2)	23.59±2.74	26.43±4.15	4.03	0.001*
Hand Grip Strength (Kg)	32.90±7.60	25.16±3.45	6.55	0.001*

*highly significant

DISCUSSION

Diabetes mellitus is usually associated with mild hand muscle weakness with peripheral sensory neuropathy.[11] The results of the current study revealed that there is a significant decrease of the handgrip strength in the diabetic patients compared with apparently healthy age and sex matched subjects. The grip strength test was commonly done to evaluate the performances of hand muscles by measuring the maximal grip force that could be executed in one muscular contraction.[12]

Similar conclusions were derived by Savas *et al* who noted significantly lower handgrip strength in diabetics than the non-diabetic controls ($p<0.05$).[13] Results of this study are also in close agreement with authors who stated that type 2 Diabetes Mellitus seems to result in a decrease in handgrip strength in both male and female subjects. This physical limitation may contribute to low productivity in people with type 2 Diabetes Mellitus.[14,15] Some researchers have independently reported decreased handgrip strength in individuals with type 2 diabetes mellitus.[16,17] Insulin resistance may have been responsible for the muscle weakness[18] and, therefore, the decreased grip strength but loss of strength could also be due to age.[19]

Handgrip strength of men were higher than women and this difference in handgrip strength values between diabetic men and women as well as control men and women could be attributed to physiological differences between them.[20,21]

However, Andersen *et al*[22] opposed this view insisting that grip strength is not compromised in long-standing diabetes type 2. These differences in the reports may be due to the lack of baseline record of grip strength in all studies, thereby making it impossible for the change in grip strength after the onset of diabetes to be determined.

CONCLUSION

Long standing type 2 diabetes mellitus is associated with poorer upper limb muscle strength and quality which may contribute to functional and physical limitation. Timely assessment of handgrip strength in diabetics can help in detection of disability and proper rehabilitation.

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