Original Research Article

Comparison of handgrip strength between type II diabetic patients and non-diabetic individuals

Ashok Kumar Dash[1], Sanghamitra Panda[2*], Nikhat Yasmeen[3], Abdul Raoof Omer Siddiqui[4], Aiesha Durrebar Younus Khan[3], Ratna Kumari N[3]

[1]Senior Consultant, Yoshoda Hospitals, Secunderabad, Telangana, INDIA.
[2]Professor, [4]Associate Professor, [3]Assistant Professor, Department of Physiology, Shadan Institute of Medical Sciences, Peerancheruvu, Hyderabad- 500008, Telangana, INDIA.
Email: dr.sm.panda@gmail.com

Abstract

Background: Diabetes mellitus has attained the status of a global epidemic. It is one of the fastest growing chronic metabolic disorders. Skeletal muscle mass is significantly lower in individuals with diabetes, being worse with longer duration of illness and poor glycaemic control leading to muscle weakness. The aim of the study is to measure the handgrip strength (HGS) in type 2 diabetic patients and compare it with healthy, age and sex matched control subjects. Glycated haemoglobin (HbA1c) was correlated with HGS of diabetic patients using Pearson correlation coefficient test. **Materials and Methods:** This cross sectional study included 53 clinically diagnosed diabetic patients (21 males and 32 females) and 50 non-diabetic control subjects (29 females and 21 males) in the age group of 40 to 75 years. Mean duration of the disease in the study group, was more than 10 years. A Hand Spring Dynamometer was used to measure Hand grip strength (HGS) of the participants. **Results:** Mean HbA1c of study group (7.83 ± 1.26) was significantly higher than the control group 5.19 ±0.49 ($p < 0.001$). Remarkable low handgrip strength was observed in the diabetic group (Right hand: 23.28 ± 6.04, Left hand: 21.37 ± 5.65) in comparison to the control group (Right hand: 34.88 ± 5.37, Left hand: 33.68 ± 5.28) which were found to be statistically highly significant ($p < 0.001$). A weak negative correlation ($R = -0.4308$, $R^2 = 0.1856$) was found between mean HGS and HbA1c in diabetic patients with a p-value of 0.0013 which is statistically significant. **Conclusion:** A considerable reduction in the HGS and high HbA1c in long standing type 2 diabetes mellitus may affect muscle strength. This can worsen the efficiency of muscle action thereby enhances the risk of developing functional disabilities.

Key Words: Type 2 Diabetes, Hand grip strength, HbA1c, Dynamometer.

[*]**Address for Correspondence:**
Dr. Sanghamitra Panda, Omkara Nilayam, House No: 5-128/4, Shanti nagar colony, Hydershakote, Hyderabad, 500091, INDIA.
Email: dr.sm.panda@gmail.com
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INTRODUCTION

Diabetes mellitus is a set of metabolic diseases with elevated blood sugar level. Defects in insulin secretion, insulin action or both are observed in DM. It is a major cause of morbidity and mortality in India and worldwide[1]. As per the data published by International Diabetes Federation (IDF) currently 425 million people in the world are diabetic and India has the second largest number of diabetics[2]. The chronic hyperglycemia of diabetes is associated with long-term damage, dysfunction, and involvement of various tissues and organs, giving rise to complications like retinopathy, neuropathy, nephropathy, coronary and cerebral artery disease[3] Insulin is an anabolic hormone; defects in insulin signaling in DM can lead to reduced muscle synthesis and sarcopenia. Skeletal muscle mass is significantly lower in individuals with diabetes, being worse with longer duration of illness and poor glycaemic control[4,5]. Connective tissue damage due to chronic metabolic derangements in type 2 diabetes mellitus leads to

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limitation in hand movements, in a large number of diabetic individuals[6]. Therefore this study was carried out to compare the handgrip strength (HGS) of type 2 diabetic patients with that of age and sex matched healthy control subjects.

MATERIAL AND METHODS

The subjects of this cross sectional study comprised of 53 clinically diagnosed type 2 diabetic patients, among them 21 were male and 32 were female. All the cases were in the age group 40 to 75 years. They were selected from the outpatient department of Internal Medicine. 50 healthy non-diabetic volunteers served as the control group. Among them 21 were male and 29 were female. All the study group subjects recruited were established cases of diabetes mellitus for at least 5 years or more. They were either on Oral hypoglycemic agents (OHA) or on OHA with a diabetic diet formula. An oral glucose tolerance test was undertaken to evaluate the present glycaemic status of all the patients. Duration of diabetes was obtained by taking the information about the reported age at the time of diagnosis. Screening test was done for all the control group subjects to rule out diabetes before they were inducted into the study. Fasting Plasma Glucose was measured by an automated blood glucose analyzer. All the participants were briefed about the basis of the study and a written consent was taken before the initiation of the study. A short history regarding occupation, duration of illness and type of anti-diabetic medication used was obtained. Patients with less than 5 years duration of diabetes were excluded from the study. Subjects with a history of brachial plexus or peripheral nerve injury, carpal tunnel syndrome and any disorder involving cervical vertebrae and spinal cord, in the previous six months were also excluded. None of the participant was involved in any kind of sports or manual labour that may help them to have better handgrip. Demographic data like age, sex, height and weight were obtained for all the participants. Height was measured in centimeters for all the subjects standing barefoot on a stadiometer. Weight was measured in kilograms by using a portable digital weighing scale without wearing shoes to the nearest 1 Kilogram (Kg). BMI was calculated from height and weight parameters for all the participants. Hand grip strength (HGS) of all the subjects was measured by a spring type hand grip Dynamometer. All the participants were right handed and were able to perform routine daily basic activities. Subjects were asked to sit on a chair maintaining erect posture with right hand positioned on their right thigh. Maximum hand muscle contraction was achieved by maintaining the right arm in adducted position and elbow flexed at ninety degree with forearm and wrist in neutral position and the fingers flexed. Arm position and the technique to record maximum handgrip strength were demonstrated to all the participants before the test. They were asked to press the knob of the dynamometer with maximum force possible with in a period of 5 seconds. Subjects had to repeat the same procedure after a gap of 30 seconds. Resetting of Dynamometer to the starting point (zero) was ensured before each reading. A time piece was used for noting the contraction period and the rest time. All the data collected were analyzed using Graph-pad software. The mean, standard deviation (SD), standard error of mean (SEM) and confidence interval (CI) were calculated. The unpaired t- test ($p = < 0.05$) was used to evaluate the statistical significance between the two groups. Correlation of HGS with their glycated haemoglobin (HbA1c) was also evaluated using Pearson correlation coefficient test.

RESULTS

Table 1 depicts the statistical analysis of anthropometric variables, HbA1c and HGS of Diabetic and non-diabetic subjects. Demographic data like mean age, height and body weight did not show any significant difference between the study and control group. Mean BMI of both the groups were in the overweight range, BMI was marginally high in the study group than the control. Mean duration of diabetes in the study group was 11.30 ± 5.48 years. Mean HbA1c of diabetic subjects were 7.83± 1.26 % which showed that the glucose level were high for them in the recent weeks. The mean HGS value of right and left hand of the diabetic patient were 23.28± 6.06 and 21.67± 5.65 Kg whereas control group mean HGS values were 34.88±5.37 and 33.68± 5.28 respectively. Mean HGS of study group individuals were significantly lower (p value < 0.0001) in comparison to control groups in both the hands.

Table 1: Statistical analysis of anthropometric variables, HbA1c and HGS of Diabetic and non-diabetic subjects

Parameters	Diabetics (n= 53)	Non-diabetics (n= 50)	95% CI	P- Value
	Mean ± SD	Mean ± SD		
Age(years)	58.64 ± 8.77	58.24 ± 8.81	3.03 to 3.83	0.817 (NS)
Height (Cm)	160.05 ±8.19	160.78 ± 7.93	- 3.88 to 2.42	0.647 (NS)
Weight (Kg)	69.62 ± 10.31	68. 9 ± 7.99	-2.90 to 4.34	0.694(NS)
BMI (Kg/M^2)	27.06 ± 2.25	26.59 ± 1.68	0.89 to 1.18	0.239 (NS)
Duration of DM(years)	11.30 ± 5.48	--	--	--
HbA1c (%)	7.83 ± 1.26	5.19 ± 0.49	2.26 to 3.02	0.001 (HS)
HGS (Kg) (Right Hand)	23.28 ± 6.04	34. 88 ± 5.37	- 13.83 to -9.35	0.001 (HS)
HGS (Kg) (Left Hand)	21.37 ± 5.65	33. 68 ± 5.28	-14.64 to -10.35	0.001 (HS)

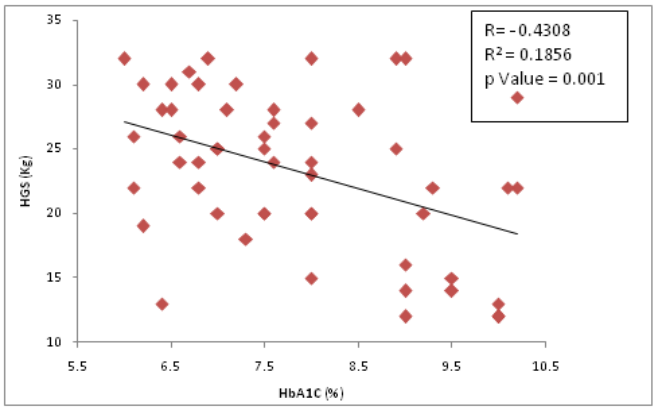

Figure 1

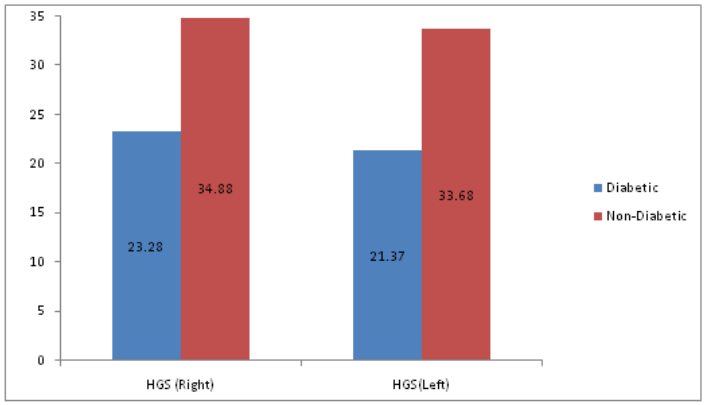

Figure 2

Figure 1: Correlation of HbA1c with hand grip strength in diabetic patients;
Figure 2: Comparison of Mean HGS in right and left hand between Diabetic and Non diabetics

Fig 1 shows the correlation between the mean HGS and glycated haemoglobin. A weak negative correlation (R= -0.4308, R^2 = 0.1856) was found between mean HGS and glycated haemoglobin in diabetic patients with a p-value of 0.0013 which is statistically significant.

Fig 2 depicts the Comparison of Mean HGS in right and left hand between Diabetic and Non diabetics. A significant low HGS is observed in diabetic patient in both hands, (dominant as well as non-dominant) when compared to controls which are evident from this study.

DISCUSSION

In the present study, the handgrip strength (HGS) of diabetic patients is considerably less in comparison to their non diabetic counterparts which are found to be statistically highly significant ($p<0.05$). Similar results of reduced hand grip strength in diabetic patients were also observed by Eczema *et al*[7]. Skeletal muscle mass reduction, reduced strength and quality of the upper limb muscle in type 2 DM was also reveled in the study by Seok Won Park *et al*[8]. Increased resistance of the tissue to insulin, decrease glycogen synthesis and consistent hyperglycemia leads to mitochondrial depletion in the muscle cells which may be the cause for decrease muscle strength in diabetics[9,10]. Apart from this the increased circulating inflammatory cytokines seen in DM may also contribute to skeletal muscle weakness[11,12]. Significant decrease in muscle mass and sarcopenia is more apparent in long standing diabetes mellitus which worsens the hand grip strength.[13] Findings of this present study are in consistence with the study by T. Hermen *et al* who found that type 2 diabetes patients irrespective of the involvement of peripheral nerves shows decreased muscle strength in the lower extremity. Involvement of both sensory and motor nerves in long standing cases of DM can also be the reason of subclinical polyneuropathy manifested as sensory and motor nerve dysfunction leading to muscle weakness[14,15] In this study it was observed that there is a weak inverse correlation (R= -0.4308) between the hand grip strength and their glycated haemoglobin levels. Miho Nishatani *et al* also revealed similar results depicting weak but significant inverse relationship between HbA1c and muscle strength[16]. However Dhanwal *et al* found no significant correlation

between the HGS and HbA1C of diabetic patients.[17] Few limitations of this study were the size of the sample, a more accurate and dependable result to substantiate the association of Diabetes mellitus and HGS can be obtained by a bigger sample size. In addition to hand grip strength other investigative parameters like bone mineral density, serum calcium and vitamin D level to assess the osteoporotic changes need to be considered which could have a reason for decreased handgrip strength. Nerve conduction studies can also be taken into consideration to assess the nerve involvement in the disease.

CONCLUSION

A considerable decrease in HGS was evident in long standing DM. High glycated haemoglobin in poorly controlled DM may influence the muscle strength and quality. This may affect the efficiency of the hand muscles adversely that leads to functional limitations and reduced efficiency. Regular HGS measurement in diabetic patient is paramount to identify emergence of any disability, so that timely corrective measures can be taken to prevent or limit the damage to the muscle. Rehabilitation measures like resistive training exercise can be instituted to decelerate the rate of deterioration. Most of the times diabetic patients develop complications due to lack of apt knowledge about the disease and the role of glycemic control. Therefore awareness and counselling sessions should be conducted for these patients, this will definitely have an immense impact to prevent or at least reduce the complication of diabetes.

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