



Correlation of Average Hand Grip Strength with BMI of Diabetic and Non-Diabetic Study Participants

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Abstract

Background: Assessing grip strength could serve as an early screening method for identifying individuals in populations who may be at a greater risk of physical disability due to diminished muscle strength. **Objective:** This study aimed to assess the correlation of average hand grip strength with the BMI of diabetic and non-diabetic study participants. **Methodology:** This cross-sectional comparative study was conducted at the Department of Physical Medicine and Rehabilitation at Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh from April 2020 to March 2021. The populations of this study consisted of type 2 diabetes mellitus in the age group 36 to 65 years, diabetes duration more than 5 years, and nondiabetic individuals. A total of 160 patients were selected as study subjects by purposive sampling technique. The statistical analysis was conducted using SPSS (Statistical Package for the Social Science) version 25 statistical software. **Results:** No significant age or BMI differences were found between the groups. Diabetic individuals exhibited significantly lower hand grip strength compared to non-diabetics. Additionally, within both groups, right-hand grip strength surpassed the left. Weak, statistically non-significant negative correlations were observed between BMI and hand grip strength in both diabetic and non-diabetic groups. **Conclusion:** In conclusion, there is a significant reduction of handgrip strength in type 2 diabetes mellitus patients compared to non-diabetic individuals attending a tertiary-level hospital, in Bangladesh. [*Journal of National Institute of Neurosciences Bangladesh, July 2025;11(2):181-185*]

Keywords: Hand grip strength; BMI; Diabetic patients; non-diabetic patients

Introduction

Diabetes mellitus (DM) is a clinical syndrome characterized by an increase in plasma blood glucose (hyperglycemia)¹. Type 2 diabetes mellitus (T2DM), type 1 diabetes mellitus (T1DM), and gestational diabetes mellitus (GDM) are by far the most frequent forms, but other specific types exist that are much less common². Type 1 diabetes develops as a result of autoimmunity against the insulin-producing β cells, resulting in complete or near total insulin deficiency. Type 2 diabetes is a heterogeneous group of disorders characterized by variable degrees of insulin resistance, impaired insulin secretion, and increased hepatic glucose production.

Specific genetic and metabolic abnormalities in insulin function or secretion lead to the shared characteristic of hyperglycemia in type 2 diabetes mellitus (DM). These findings carry significant therapeutic implications, especially with the availability of pharmacological agents that can target precise metabolic dysfunctions. Glucose intolerance developing during the second or third trimester of pregnancy is classified as gestational diabetes mellitus³.

The total number of individuals with diabetes among South Asians is estimated to reach 46 million in India, 14 million in Pakistan, and 11.1 million in Bangladesh by 2030⁴. Hira et al.⁵ demonstrated a notably high

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prevalence of diabetes mellitus within the rural Bangladeshi adult population, standing at 9.5%. The prevalence of DM in males is less than in females (4.25% and 5.25 respectively). That study also found that about one in ten Bangladeshi adults have diabetes (9.5%). The complications of diabetes mellitus have traditionally been divided into macrovascular complications (for example, cardiovascular disease (CVD)) and microvascular complications (for example, complications affecting the kidney, the retina, and the nervous system). Complications of T2DM are very common, with half of patients with T2DM presenting with microvascular complications⁶. Various skeletal and muscular system problems arise in Diabetes Mellitus (DM). Soft tissue fibroproliferative disorders encompass a spectrum of conditions such as limited joint mobility syndrome, frozen shoulder, Dupuytren's contracture (DC), carpal tunnel syndrome, and flexor tenosynovitis (trigger finger), among others.

The hand of a human is a remarkable instrument, capable of performing countless actions owing to its function as prehension and precision. The functional viewpoint of the hand is the effector organ of the upper limb which supports it mechanically and allows it to adopt the optimal position for any given action⁷. Hand grip strength reflects the maximum strength derived from a combined contraction of extrinsic and intrinsic hand muscles which leads to the flexion of hand joints⁸. Assessing grip strength could serve as an early screening tool to pinpoint individuals in populations who may face an elevated risk of physical disability due to diminished muscle strength⁹ and also can provide objective quantifiable information regarding hand function [10]. The aim of the objective was to assess the correlation of average hand grip strength with BMI of diabetic and non-diabetic study participants.

Methodology

Study Settings and Population: This cross-sectional comparative study was conducted at the Department of Physical Medicine and Rehabilitation, Bangabandhu Sheikh Mujib Medical University, Dhaka, April 2020 to March 2021. The populations of this study consisted of type 2 diabetes mellitus in the age group 36 to 65 years, diabetes duration more than 5 years, and non-diabetic individuals. A total of 160 patients were selected as study subjects as per inclusion and exclusion criteria. A purposive sampling technique was adopted in this study.

Selection Criteria: The study focused on comparing the correlation between average hand grip strength and BMI in diabetic and nondiabetic individuals through a

retrospective approach. For diabetic study participants, inclusion criteria comprised individuals of either gender, aged between 36 and 65 years, diagnosed with type 2 diabetes mellitus as per the American Diabetic Association criteria, with a diabetes duration exceeding 5 years, and right-hand dominance. Conversely, non-diabetic study participants meeting the inclusion criteria were individuals aged 36 to 65 years, without diabetes, and also right-hand dominant. Exclusion criteria were established to ensure the homogeneity of the study population. Diabetic participants were excluded if they had type 1 diabetes mellitus, diabetes duration less than 5 years, any musculoskeletal or neurological disorder, inflammatory joint disease, connective tissue disease, or recent trauma within 6 months preceding the study.

Study Procedure: Additionally, individuals engaged in occupations or sports potentially enhancing hand grip strength were excluded. Similarly, non-diabetic participants were excluded if they had any musculoskeletal or neurological disorder, inflammatory joint disease, connective tissue disease, or recent trauma within the previous 6 months. Those engaged in manual labor or sports activities potentially conferring better hand grip strength were also excluded. Data were taken from the outpatient Department of Physical Medicine and Rehabilitation of BSMMU. A weight measuring scale and a metal measuring tape were used to measure the weights and heights of people. Anthropometric equipment and handgrip dynamometer were calibrated before each assessment. Hand grip strength was measured on the right (dominant) and left (non-dominant) hand using a Baseline Lite Hydraulic Hand Dynamometer. Three measurements of each hand grip were obtained in kilogram (Kg) at 30 s intervals and an average of the three trials was calculated. All data were collected using a pre-formed questionnaire.

Statistical Analysis: The statistical analysis was conducted using SPSS (Statistical Package for the Social Science) version 25 statistical software. The findings of the study were presented by frequency and percentage in tables. Means and standard deviations for continuous variables and frequency distributions for categorical variables were used to describe the characteristics of the total sample. Associations of categorical data were assessed using the Chi-square test while associations of continuous data were assessed using Student 's t-test and non-parametric data were assessed by using the Mann Whitney U test. The Pearson Correlation coefficient was calculated to assess the correlation between continuous variables. In the

case of skewed data, the Spearman correlation coefficient was calculated. Statistical significance was assessed at the 0.05 level for all analyses.

Ethical Clearance: Ethical clearance was taken from the Institutional Review Board (IRB) of BSMMU. Informed written consent was obtained from the participants. Privacy, anonymity, and confidentiality of data information were maintained strictly.

Results

Among the diabetic study participants, 33 (41.3%) were from the 46 to 55 years age group and another 33 (41.3%) were from the 56 to 65 years age group while among the non-diabetic study participants, 35 (43.8%) were from 46 to 55 years age group and 26 (32.5%) were from 56 to 65 years age group. No significant statistical difference was found between the groups regarding age as $p=0.455$ (obtained by Chi-square test). The mean age of the participants in the diabetic and non-diabetic groups was 53.22 ± 8.08 and 51.51 ± 7.41 years respectively (Table 1).

Table 1: Comparison of Study Participants by Age Group (N=160)

Age Group	Diabetic	Non-diabetic	P value
36 to 45 Years	14 (17.5%)	19 (23.8%)	0.460
46 to 55 Years	33 (41.3%)	35 (43.8%)	
56 to 65 Years	33 (41.3%)	26 (32.5%)	
Total	80 (100.0%)	80 (100.0%)	-
Mean $\pm$ SD	53.22 ± 8.08	51.51 ± 7.41	

Among the diabetic study participants, 49 (61.3%) were overweight while among the non-diabetic study participants, 44 (55.0%) were overweight. No significant statistical difference was found between the groups regarding BMI as $p=0.460$ (obtained by Chi-square test). The mean BMI of the participants in the diabetic and non-diabetic groups were 26.12 ± 2.34 and 25.87 ± 2.34 respectively.

Table 2: Comparison of study participants by Body Mass Index (BMI) in Kg/m² (N=160)

BMI	Diabetic f	Non-diabetic f	P value
Normal (18.5-24.9 kg/m ²)	23 (28.7%)	30 (37.5%)	0.460
Overweight (25.0-29.9 kg/m ²)	49 (61.3%)	44 (55.0%)	
Obese (≥ 30.0 kg/m ²)	8 (10.0%)	6 (7.5%)	
Total	80 (100.0%)	80 (100.0%)	-
Mean $\pm$ SD	26.12 ± 2.34	25.87 ± 2.34	

The mean hand grip strength in the right hand of diabetic study participants (21.38 ± 4.23) was significantly lower than non-diabetic study participants (30.53 ± 8.73) as $p < 0.001$ (obtained from independent sample t-test). Again, the mean hand grip strength in the left hand of diabetic study participants (20.52 ± 4.27) was significantly lower than nondiabetic study participants (29.32 ± 8.59) as $p < 0.001$ (obtained from independent sample t-test). The average mean hand grip strength of diabetic study participants (20.95 ± 4.25) was significantly lower than non-diabetic study participants (29.92 ± 8.65) as $p < 0.001$ (obtained from independent sample t-test). [Table 3]

Table 3: Comparison of study participants by hand grip strength in Kg (N=160)

Hand grip strength (Kg)	Diabetic f	Non-diabetic f	P value
Right	21.38 ± 4.23	30.53 ± 8.73	<0.001
Left	20.52 ± 4.27	29.32 ± 8.59	<0.001
Average	20.95 ± 4.25	29.92 ± 8.65	<0.001

A comparison of study participants by right-hand grip strength (Kg) with left-hand grip strength (Kg) in diabetic and non-diabetic presented in Table 4.11. The mean hand grip strength (Kg) in the right hand of diabetic (21.38 ± 4.23) was significantly higher than diabetic left hand (20.52 ± 4.27) as $p < 0.001$ (obtained from independent sample t-test), the mean hand grip strength (Kg) in non-diabetic right hand (31.29 ± 8.73) was significantly higher than non-diabetic left hand (29.32 ± 8.59) as $p < 0.001$ (obtained from independent sample t-test) (Table 4).

Table 4: Comparison of study participants by right-hand grip strength (Kg) with left-hand grip strength (Kg) in diabetic and non-diabetic (N=160)

Hand grip strength (Kg)	Right f	Left f	P value
Diabetic	21.38 ± 4.23	20.52 ± 4.27	<0.001
Non-diabetic	31.29 ± 8.73	29.32 ± 8.59	<0.001

Table 5: Correlation of average hand grip strength with BMI of diabetic and non-diabetic study participants (N=160)

BMI	R	P value
Diabetic	-0.210	0.062
Non-diabetic	-0.187	0.108

There was a weak negative correlation ($r = -0.210$) between BMI and average hand grip strength of diabetic patients which was statistically non-significant

($p=0.062$, obtained by Pearson 's correlation coefficient test). Again, there was a negligible negative correlation ($r=-0.187$) between BMI and average hand grip strength of non-diabetic study participants which was also statistically non-significant ($p=0.108$, obtained by Pearson 's correlation coefficient test). (Table 5).

Discussion

The results of the present study showed that the mean age of the participants in the diabetic and non-diabetic group were 53.22 ± 8.08 and 51.51 ± 7.41 years respectively and no significant statistical difference was found between the groups regarding age. Other studies also found that the mean age of the study participants was around 51 years to 55 years which is almost similar to the present study¹¹⁻¹⁴.

Majority of the study participants in both groups were overweight and there was no significant statistical difference was found between the groups regarding BMI and weak negative correlation was observed between BMI and average hand grip strength of diabetic ($r=-0.210$) and nondiabetic ($r=-0.187$) patients which was statistically non-significant. Massy-Westropp et al¹⁵ noted that BMI was negatively correlated with HGS in age groups of the 4th, 5th, and 6th decades which also correlate with the present study. Das, et al¹⁶ also reported a negative correlation between BMI and Hand grip strength which was not statistically significant as similar to the present study. Cetinus, et al¹⁷ found that no correlation was observed between handgrip strength and BMI. Sandhu, R. and Koyey, S.¹⁸ found a significant positive correlation of dominant and non-dominant handgrip strength with BMI.

The average mean hand grip strength of diabetic study participants (20.95 ± 4.25) was lower than non-diabetic study participants (29.92 ± 8.65) which was statistically significant ($p<0.001$). Savas, et al.¹⁹ found the mean hand grip strength of diabetic study participants (27.48 ± 9.26) was significantly lower than non-diabetic study participants (31.72 ± 9.86) ($p=0.02$). Shah & Sheth,¹³ also found the mean hand grip strength of diabetic patients (18.86 ± 5.55) was significantly lower than non-diabetic individuals (31.73 ± 6.76) ($p<0.001$). The study of Sandhu, et al.¹² reported that the mean hand grip strength of the diabetic group (20.76 ± 3.55) was significantly lower than non-diabetic study participants (32.90 ± 7.6) ($p<0.001$) and average hand grip strength of the current study was as similar as Sandhu, et al.¹² and Shah & Sheth.¹³ Other studies also reported that the hand grip strength of diabetic study participants was significantly lower than the non-diabetic group.

Significant reduction in muscle strength in diabetics compared to non-diabetic individuals is explained by two mechanisms: 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 decremented effect on the skeletal muscles²⁰. In the current study, all of the participants were right-hand dominant and the study showed that the mean hand grip strength in the diabetic right hand (21.38 ± 4.23) and non-diabetic right hand (31.29 ± 8.73) was significantly higher than diabetic left hand (20.52 ± 4.27) and non-diabetic left hand (29.32 ± 8.59) respectively. Other studies also found dominant hand grip strength was significantly higher than non-dominant hand grip in both diabetic and non-diabetic groups^{17,18,21}.

Limitations of The Study

Some limitations were perceived while planning and conducting the study. The study place and population were selected purposively which might result in selection bias. As the study was conducted in only one institution, the results might not represent the entire population. Level of physical activity and body composition was not considered which could have influenced the handgrip strength in this study.

Conclusion

Diabetes mellitus is the most common endocrine disorder. The musculoskeletal system is a silent target organ for diabetic complications. This study concludes that there is a significant reduction of handgrip strength in type 2 diabetes mellitus patients compared to non-diabetic individuals attending a tertiary-level hospital, in Bangladesh.

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Data Availability

The datasets generated and analyzed during this study are not publicly available due to patient confidentiality and institutional data protection policies. However, anonymized data may be made available from the corresponding author upon reasonable request, subject to approval by the institutional ethics committee.

Ethics Approval and Consent to Participate

Ethical approval for the study was obtained from the Institutional Review Board. As this was a prospective study the written informed consent was obtained from all study participants. All methods were performed in accordance with the relevant guidelines and regulations. The ethical approval was obtained from July 2024 to December 2024.

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