



# COMPARISON OF HAND GRIP STRENGTH IN INDIVIDUALS IN CONTROLLED AND UNCONTROLLED TYPE 2 DIABETES MELLITUS.

**Authors:** Malhar Vivek Gawande, Intern St. Andrews college of physiotherapy, Pune Dr. Deepshikha Trivedi (PT), Associate Professor, St. Andrew college of physiotherapy, Pune. Dr. Albin Jerome, Principal, St. Andrews college of physiotherapy, Pune

## Abstract

**Background:** Diabetes mellitus, particularly Type 2 Diabetes (T2D), is a growing global health emergency, contributing to significant morbidity and mortality worldwide. Despite advancements in understanding the disease's risk factors, including age, obesity, physical inactivity, and genetics, gaps remain in identifying reliable markers for assessing the risk of diabetes complications. Handgrip strength (HGS), a simple measure of muscle strength, has emerged as a potential indicator of overall health, with studies suggesting a correlation between HGS and various metabolic conditions, including T2D. This study aims to compare handgrip strength in individuals with controlled and uncontrolled T2D. Using handheld dynamometry, the muscle strength of participants from both groups will be objectively measured to assess any differences. Previous research has indicated that muscle strength may influence glucose metabolism and insulin sensitivity, but the relationship between HGS and T2D remains inconclusive. By exploring the potential link between handgrip strength and diabetes control, this study seeks to provide valuable insights into the role of muscle strength as a predictor of diabetes complications and as a tool for identifying individuals at higher risk for poor diabetes management. The findings could support the development of more targeted therapeutic and preventive approaches for individuals with T2D.

**Method:** The study was done on 100 individuals with type 2 diabetes mellitus. These samples are divided into two groups on basis of their HbA1c values into controlled (6.5-9%) and uncontrolled (Above 9%) Handgrip strength was checked by using handheld dynamometer for each individual. This research tries to find the comparison between controlled and uncontrolled group with help of independent T test.

**Result:** This study found a significant comparison between age and handgrip strength in individuals with T2DM, indicating that older patients tend to have weaker muscles. However, no significant Comparison was

found between HbA1c levels and handgrip strength, and no significant difference in muscle strength was observed between individuals with controlled and uncontrolled diabetes.

**Key words:** Diabetes, Handgrip, Hba1c, muscles, dynamometer.

**INTRODUCTION:** Diabetes is one of the largest global health emergencies of this century, ranking among the 10 leading causes of mortality together with cardiovascular disease (CVD), respiratory disease, and cancer. According to the World Health Organization (WHO), noncommunicable diseases (NCDs) accounted for 74% of deaths globally in 2019, of which, diabetes resulted in 1.6 million deaths, thus becoming the ninth leading cause of death globally. By the year 2035, nearly 592 million people are predicted to die of diabetes.<sup>[1]</sup>

Uncontrolled diabetes, medically known as uncontrolled hyperglycaemia, refers to a situation where blood glucose (sugar) levels remain persistently elevated beyond the target range despite treatment efforts. This condition can result from various factors such as inadequate medication, improper diet, lack of physical activity, or other underlying health issues. The conditions of diabetic ketoacidosis and NKH are life-threatening complications of poorly controlled diabetes mellitus.<sup>[1,2]</sup>

Hand grip strength refers to the measurement of the force exerted by the hand muscles when squeezing a dynamometer. It quantifies the maximum force generated by the muscles of the hand and forearm during a maximal voluntary contraction. Hand grip strength is typically measured in kilograms or pounds and serves as an indicator of upper body and overall musculoskeletal strength. This measurement is often utilized in clinical settings to assess functional capacity, monitor changes in muscle strength, and evaluate potential impairments or conditions affecting muscle health. Elevated handgrip strength (HGS) signifies the capacity to engage in routine muscle strengthening exercises and physical activities that enhance or sustain cardiorespiratory fitness (CRF).<sup>[3,4]</sup>

**Need of study:** Research into hand grip strength among individuals managing controlled and uncontrolled type 2 diabetes is pivotal due to its diverse implications. This investigation aims to evaluate how diabetes control influences the health of muscles and bones, providing valuable insights into the capabilities and limitations of these patients.

Furthermore, variations in grip strength could potentially act as indicators for diagnosing or foreseeing complications related to diabetes, assisting in managing the condition. The outcomes of this study hold promise in shaping personalized rehabilitation plans, enhancing the overall abilities and life quality of those with diabetes.

Additionally, it can assist healthcare practitioners in formulating comprehensive care strategies, making substantial contributions to the scientific understanding of managing diabetes and improving rehabilitation techniques.

**MATERIAL AND METHODS:** The study was carried out in Pune region. The participants were included according to inclusion and exclusion criteria. 100 samples were taken of diabetic individuals and consent was taken. This individual divided into two groups that is controlled with Hba1c values ranging from 6.5-9% and

uncontrolled above 9%. Handheld dynamometer is used to assess the handgrip strength of the diabetic individuals. Three readings were taken for each subject and the highest reading was considered in the study. To compare the handgrip strength independent T test was used and data was obtained.

**RESULTS:** This study found a significant comparison between age and handgrip strength in individuals with T2DM, indicating that older patients tend to have weaker muscles. However, no significant Comparison was found between HbA1c levels and handgrip strength, and no significant difference in muscle strength was observed between individuals with controlled and uncontrolled diabetes.

These findings suggest that glycaemic control alone may not be a strong predictor of muscle strength in T2DM, and that other factors, such age, duration of diabetes and physical activity play a more critical role.

**DISCUSSION:** A total 100 samples were taken in the study, which included both males and females of 25-55 age group. This samples are divided into two groups on basis of their HbA1c values into controlled and uncontrolled. Handgrip strength was checked by using handheld dynamometer for each individual. This research tries to find the comparison between controlled and uncontrolled group describes the distribution of subjects in different age groups. we have got the highest no. of samples from the 51-55 age group and least no. of samples from the youngest age group i.e 26-30.

Research done by Mathiowetz V, Kashman N, Volland G et al (1984) suggest that the prevalence of diabetes tends to increase with age, particularly in elderly populations, due to factors like decreased insulin sensitivity and higher rates of obesity. The prevalence of diabetes in the age group of 50 to 60 is notably high due to the cumulative impact of aging on insulin resistance and lifestyle factors. Also, this states that the age group of 20 to 30, the prevalence

of diabetes is relatively low, largely due to better insulin sensitivity, higher physical activity levels, and fewer associated metabolic conditions.<sup>[5]</sup>

The study conducted on Factors associated with grip strength decline in older adults highlights the significant impact of diabetes and aging on handgrip strength. It reveals that individuals with diabetes, particularly those over the age of 60, experience a more pronounced decline in grip strength compared to those without the condition. Diabetes exacerbates muscle loss due to chronic hyperglycaemia, inflammation, and associated complications like neuropathy, which contribute to reduced hand function and overall physical performance. This decline is a critical marker of frailty and reduced functional capacity in older adult.<sup>[6,7]</sup>

Gender distribution of subjects in our study which shows higher prevalence of male compared to female. Out of 100 samples 59 are males while 41 are females. In Gender-specific epidemiology of diabetes: a representative cross-sectional study done by Janet F Grant et al (2009) with the title that the prevalence of diabetes mellitus (DM) tends to be higher in males than in females. This difference is partly attributed to various biological, behavioral, and social factors. For instance, men often develop diabetes at a lower body mass index (BMI) than women, as men tend to accumulate more visceral fat, which is more closely associated with insulin resistance and the development of diabetes. In contrast, women generally need to reach higher BMI levels to experience the same level of insulin resistance. This can be considered as the reason for getting the higher no. of diabetic

males than females<sup>[8]</sup>

The Journal of Clinical Endocrinology & Metabolism describes that type 2 diabetes (T2D) prevalence is significantly higher in males compared to females. This study found that 14.6% of men were diagnosed with T2D, compared to 9.1% of women, highlighting nearly double the odds for men after adjusting for factors like physical activity and BMI. Global data also supports this trend, showing that male prevalence rates exceed those of females, particularly in high-income regions.<sup>[9]</sup>

The mean duration of diabetes in controlled and uncontrolled age groups that is 11.04 for controlled group and 8.4 for uncontrolled group. In another research Impact of diabetes duration on handgrip strength in middle-aged adults by A.G. Hu et al found that each additional year of diabetes duration was associated with a decrease in handgrip strength by 0.4kg.

The distribution of handgrip strength (mean) according to different age groups in controlled and uncontrolled group. It shows the handgrip strength is higher in younger age group that is 25-35 and lowest in elder age group that is 46-55. This shows as the age increases handgrip strength reduces.

In this study, we observed a statistically significant inverse correlation between age and handgrip strength ( $r = -0.433$ ,  $p < 0.001$ ). This finding is consistent with prior research that has demonstrated a natural decline in muscle mass and strength with advancing age, a condition known as sarcopenia. Age-related muscle atrophy, changes in muscle fiber composition, and loss of motor neurons contribute to reduced muscle function, which is exacerbated in individuals with chronic diseases like diabetes. Aging in the context of diabetes can accelerate sarcopenia due to the combined effects of insulin resistance, chronic inflammation, and oxidative stress, which further impair muscle quality and function.

The comparison of handgrip strength between controlled and uncontrolled group. Our results showed no statically significant difference in handgrip strength between the two groups ( $p = 0.32$ ). The mean handgrip strength for the controlled group was 26.72 kg, compared to 24.77 kg for the uncontrolled group. Although the controlled group exhibited slightly higher strength, the difference was not statistically significant.

In the study done by Alka pawlia et al on correlation of hand grip strength and duration of diabetes they found out the negative correlation between the duration and handgrip strength of the diabetic patients<sup>[10]</sup> Also graph 3 represents the mean duration of diabetes in controlled and uncontrolled age groups that is 11.04 for controlled group and 8.4 for uncontrolled group. This suggests that due to higher duration of diabetes can lead to get the lower values of handgrip strength as compared to uncontrolled group where the mean duration is lower.

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### REFERENCES

1. Pradeepa R, Mohan V. Epidemiology of type 2 diabetes in India. *Indian journal of ophthalmology*. 2021 Nov;69(11):2932
2. Kshirsagar MV, Ashturkar MD. Prevalence of lifestyle diseases in Maharashtra: A comparison between NFHS-5 and NFHS-4 surveys. *J Family Med Prim Care*. 2022 Jun;11(6):2474-2478.
3. Jabbour SA, Miller JL. Uncontrolled diabetes mellitus. *Clinics in laboratory medicine*. 2001 Mar 1;21(1):99-110.
4. van der Kooi AL, Snijder MB, Peters RJ, van Valkengoed IG. The Association of Handgrip Strength and Type 2 Diabetes Mellitus in Six Ethnic Groups: An Analysis of the HELIUS Study. *PLoS One*. 2015 Sep 14;10(9):e0137739.
5. van der Kooi AL, Snijder MB, Peters RJ, van Valkengoed IG. The Association of Handgrip Strength and Type 2 Diabetes Mellitus in Six Ethnic Groups: An Analysis of the HELIUS Study. *PLoS One*. 2015 Sep 14;10(9):e0137739.
6. Ola Sternäng, Chandra A. Reynolds, Deborah Finkel, Marie Ernsth-Bravell, Nancy L. Pedersen, Anna K. Dahl Aslan, Factors associated with grip strength decline in older adults, *Age and Ageing*, Volume 44, Issue 2, March 2015, Pages 269–274
7. Amandine Cournil, Bernard Jeune, Axel Skytthe, Jutta Gampe, Giuseppe Passarino, Jean-Marie Robine, Handgrip Strength: Indications of Paternal Inheritance in Three European Regions, *The Journals of Gerontology: Series A*, Volume 65A, Issue 10, October 2010, Pages 1101–1106
8. Grant JF, Hicks N, Taylor AW, Chittleborough CR, Phillips PJ; North West Adelaide Health Study Team. Gender-specific epidemiology of diabetes: a representative cross-sectional study. *Int J Equity Health*. 2009 Mar 11;8:6. doi: 10.1186/1475-2875-8-6. PMID: 19284598; PMCID: PMC2667425.
9. Anna Nordström, Jenny Hadrévi, Tommy Olsson, Paul W. Franks, Peter Nordström, Higher Prevalence of Type 2 Diabetes in Men Than in Women Is Associated With Differences in Visceral Fat Mass, *The Journal of Clinical Endocrinology & Metabolism*, Volume 101, Issue 10, 1 October 2016, Pages 3740–3746.
10. Pawalia A, Joshi S, Yadav VS. Correlation of grip strength with the duration of diabetes in diabetic



