

Comparison of Handgrip Strength among Diabetes Mellitus with and without Cervical Radiculopathy

FAYZA MUSHTAQ¹, MIRZA M FAROOQ¹, KHUSBOO GULZAR¹, FAROOQ ISLAM¹, SHAHRAYAR ASGHER¹, FATIMA KALSOOM¹

¹Doctor of Physical Therapy, University Institute of Physical Therapy, University of Lahore Gujarat Campus

Correspondence to: Fayza Mushtaq, Email: fayzamushtaq786@gmail.com, Cell: 0307-6121257

ABSTRACT

Background: Patients with Diabetes Mellitus type 2 have reported to be more disabled in self-care tasks and other daily living activities because of many hand complications. There is reduction in grip strength in diabetic population. The purpose of this study was to compare hand grip strength among diabetes mellitus with and without cervical radiculopathy. A dynamometer can be used to swiftly and precisely measure the link between diabetic patient's hand grip strength and their blood sugar levels.

Objective(s): The study's objective was to evaluate the comparison of hand grip strength among diabetes mellitus with and without cervical radiculopathy.

Methodology: A Cross-sectional study was carried among 385 diabetic patients with and without cervical radiculopathy from age 35-75. Data collected from two hospitals of Gujrat City. The study was completed June 2022 to October 2022 within 4 months by non-probability convenient sampling. Both genders were included. Instruments used in this study were handheld dynamometer. We were start to measure handgrip strength in both dominant and non-dominant hand of diabetic patients with and without cervical radiculopathy. Result was analyzed by SPSS version 24; mean and standard deviation were calculated for quantitative variables whereas frequency and percentages were used for qualitative variables.

Results: The results had been obtained from 385 diabetic patients (50.6%) were females and (49.4%) were males. In our study the data was collected on the bases of age, gender, socioeconomic status, area and dominance of hand. 61(32.28%) diabetic patients with cervical radiculopathy hand grip strength are more effected as compared to those without cervical radiculopathy that were 15(7.94%) and there ($P < 0.001$) which indicates it is statistically significant.

Practical Implication: The study suggests that fewer patients were diagnosed with cervical radiculopathy in diabetic patients and more patients were without cervical radiculopathy.

Conclusion(s): This study concluded that the hand grip strength of patients with cervical radiculopathy prone to diabetes was affected highly as compared to those of which were not diagnosed with cervical radiculopathy but with diabetes. Although our study suggests that less patients were diagnosed with cervical radiculopathy in diabetic patients and more patients were without cervical radiculopathy, our study also proves that diabetic patients are also likely to develop neuropathies in later ages.

Keywords: Hand grip strength, Handheld Dynamometer, Cervical Radiculopathy, Diabetes Mellitus

INTRODUCTION

Musculoskeletal pain is most common in our society that including neck, shoulder, and back pain. Cervical pain is the second most common pathology in our society. The pattern of symptoms and location vary from person to person depending upon the level of nerve root affected.¹ Cervical radiculopathy is one of the most common causes of neck pain and disability.²

Cervical radiculopathy refers to a group of signs and symptoms related to compression or irritation of the cervical spinal nerve root. Patients most commonly present sensory changes (such as sensory loss or gain), motor abnormalities (such as reduced strength and reflexes), and unilateral neck-arm pain.³

C6 and C7 radiculopathy affects muscles that are injured with medial epicondylitis: pronator teres, flexor carpi radialis, palmaris longus, flexor digitorum superficialis, and flexor carpi ulnaris.⁴ When compared to unaffected side, patients with unilateral cervical radiculopathy had significantly worse grip strength, hand function.⁵

Diabetes mellitus is a chronic metabolic condition characterized by persistent hyperglycemia, with resultant morbidity and mortality. Muscle weakness has been associated with type-II diabetes, even among subjects with high body mass indices. There is decremental effect of DM-II on skeletal muscles.⁶

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. There is reduction in grip strength in diabetic population.⁷ There is growing recognition that complications associated with Type 2 Diabetes Mellitus (T2DM) may translate into functional impairment in older people.⁸

Based on the kinetic chain principles that the upper limb is a system of linked segments working together to perform daily activities, the produced muscle atrophy contributes to a generalized muscle weakness in the affected limb and consequently reduce the strength of gripping activities.⁹

The skeletal muscle is one of the major target organs of insulin actions and is reported to be responsible for over 80% of the postprandial uptake of glucose from the circulation; thus, decreased skeletal muscle mass and strength may exacerbate insulin resistance.¹⁰

Compared with non-diabetic patients, those with diabetes mellitus (DM) have a higher incidence of arteriosclerotic diseases such as coronary disease and stroke.¹¹

Due to loss of muscle strength, reduced handgrip strength is observed along with the development of physical disability in diabetes. In diabetic individuals, the hand is an organ system that is primarily damaged, which is accompanied by impaired function and discomfort for the patients.¹²

Diagnostic imaging (magnetic resonance imaging) most commonly used. Manually diagnosing the CR includes specific tests as the Spurling test, the Upper-Limb Tension Test (ULLT), and the distraction test.¹³

Even with varying assessors or dynamometer brands, hand grip strength can be accurately measured when standard procedures and calibrated equipment are applied.²⁰ The hands-on experience with a Hand-Held electronic dynamometer proved to be helpful for the patients as well as the researcher.¹³⁻¹⁵

Using this tool to evaluate knee flexor and extensor muscles in healthy individuals showed a good reproducibility and it is clinically acceptable when compared with gold standard of strength measurement.¹⁶

Handgrip strength significantly decreased with aging, showing a positive and strong association with functional and health parameters.³⁰ Cardiorespiratory fitness is positively associated with muscle strength measured by handgrip test in women.²³

HGS decrease has been observed as a consequence of numerous pathologies such as cervical radiculopathy or carpal tunnel syndrome (CTS). It can also be used to predict disability in the elderly. This deterioration of hand function in the elderly is attributed to age related degenerative structural changes and is

often accompanied with pathological conditions such as osteoporosis or rheumatoid arthritis.²⁰

Extrinsic and intrinsic hand muscles work together to contract, which causes the hand joints to flex, resulting in a stronger grip. Its strength may be impacted by the position of the body and upper limbs.¹⁴

Numerous researches have determined how the location of the neck affects the effects of upper extremity power. It was discovered that the grip strength of the elderly's dominant hands generally decreased with ageing and was considerably different across men and women.²⁹

The need to send patients to imaging tests will diminish if a straightforward diagnostic test for cervical spine disease and radiculopathy, like the Spurling test, has high sensitivity and specificity. This will reduce the negative effects of radiation exposure and increase in medical expenses.²⁵

According to the dynamometer or measurement procedure selected, different techniques are employed to describe grip strength.¹⁸ As a quick test that may be used in clinical settings, grip strength is a noninvasive indicator of skeletal muscle strength and function.²⁷

In the view of above, this study aimed is to compare the handgrip strength among diabetes mellitus with and without cervical radiculopathy.

This study aimed to find comparison of hand grip strength among diabetes mellitus with and without cervical radiculopathy. One of the important components in evaluating hand function is grip strength.

METHODS

This Cross-sectional study was conducted according to the rules and regulations set by the ethical committee of University of Lahore, Gujrat campus by selecting 385 diabetic patients, the study was completed June 2022 to October 2022 from Doctor's hospital, Aziz Bhatti shaheed teaching hospital from their Department of Physical Therapy in District Gujrat by following clearly described inclusion and exclusion criteria.³³⁻³⁴ Sample size has been calculated by the given formula:

$$n = Z^2 \cdot a / 2P(1-P)$$

d2

Z = standard normal variant at 95% confidence interval = 1.96, P = expected proportion in population, d = marginal error effect size = 0.05, n = 385. Data were collected from those who meet the inclusion and exclusion criteria.

The study included people between 35 and 75 years of age with the disease onset of more than 3 years of diabetic patients, with and without cervical radiculopathy patients. Patients reported with neuropraxia, reported cognitive impairment, surgical intervention of hand/forearm (Carpal tunnel Surgery, skin Grafting), diagnosed deQuervain's tenosynovitis, corticosteroid injection, shoulder pathology (Tendinitis, Bursitis), Gestational diabetes were excluded from this study.

Instruments used in this study were handheld dynamometer. Firstly, consent form was signed from the patients. After getting permission we were start taking demographic data. The individual was informed about the whole study procedure and the purpose of the study also explained. We were start to measure handgrip strength by using handheld dynamometer in both dominant and non-dominant hand of diabetic patients with and without cervical radiculopathy. The patient was lying back in a chair with his or her feet flat on the ground, their backs supported, and their elbows bent at a 90-degree angle at their sides. The patient was instructed to gently grasp the dynamometer's readout dial before being instructed to hold the handle for two to three seconds while squeezing as hard as they could before relaxing. The patient's second and third trials were then performed, with a 15-second rest period being provided to prevent fatigue. The highest score of the three trials was then recorded.

Statistics: Data were entered and analyzed through a statistical software, Statistical Package for Social Science (SPSS) version

24, IBM Corp. Released 2016. To calculate the normality of date Shapiro Wilk test was applied. For descriptive analysis, mean and standard deviation was calculated for quantitative variables whereas frequency and percentages were used for qualitative variables. Paired Sample T- test and independent t-test was applied. All results were calculated 95% confidence interval and p-value ≤ 0.05 was considered as a significant value.

RESULTS

During research period 385 diabetic patients were surveyed among which there were cervical radiculopathy patients under the study from Aziz Bhatti Shaheed Hospital and Doctor's Hospital from their Department of Physical Therapy; district Gujrat to compare the hand grip strength among diabetes mellitus with and without cervical radiculopathy. Out of 385 patients (50.6%) were females and (49.4%) were males. Mean age was Mean \pm Std Deviation 1.49 \pm .501. Age of the participants was 35-75 among which (8.8%) were of 50 years of age, (5.7%) were of 55 years of age, (1.3%) were of 72 years of age, (4.4%) were of 56 years of age, (3.6%) were of 40 years of age, (3.9%) were of 45 years of age, (3.1%) were of 65 year of age, (3.4%) were of 60 years of age. Patients were divided into three categories in terms of socioeconomic status out of 385 patients 55 were from upper class, 208 were from middle class, 122 were from lower class. Patients were also categorized in terms of areas i.e., urban and rural, 128 patients were from urban area and 257 were from rural area. The patients that were evaluated on the basis of dominant hand were associated with the gender as well, 157 right hand dominant were females and 160 right hand dominant were males on the otherwise 38 females were left hand dominant and 30 males were left hand dominant. The diabetic patients without cervical radiculopathy were 197 and those with cervical radiculopathy prone to diabetes were 188. The right-hand grip strength of patients with cervical radiculopathy were categorized into three categories, 61 patients were in poor hand grip category, 27 patients were in average and 2 patients were in excellent hand grip strength category. Those patients that were not prone to cervical radiculopathy but were diabetic were 15 in poor category, 63 were in average and 21 were in excellent hand grip strength category. The left-hand grip strength of patients with cervical radiculopathy were 56 in poor hand grip strength category, 40 were in average and 2 were in excellent hand grip strength category. Patients without cervical radiculopathy were 51 in poor hand grip strength category, 33 were in average and 14 were in excellent hand grip strength category. There was 61 (32.28%) diabetic patients with cervical radiculopathy hand grip strength are more effected as compared to those without cervical radiculopathy that were 15 (7.94%) and there ($P < 0.001$) which indicates it is statistically significant.

RESULTS

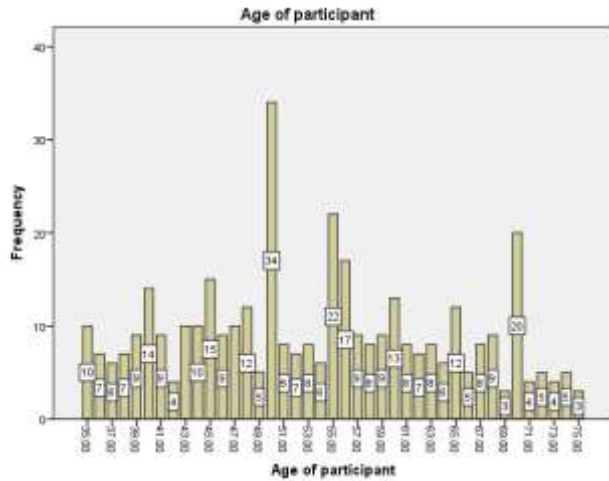
Table 1: Age Group of Participants (Years) with respect to percentage

Gender Distribution of Participants		
Gender	n	%
Female	195	50.6
Male	190	49.4
Total	385	100

Table 1 Shows those Out of 385 patients 195 (50.6%) were females and 190 (49.4%) were males.

Among 385 participants 10 were 35 age, 7 were of 36 age, 6 were of 37 age, 7 were of 38 age, 9 were of 39 age, 14 were of 40 age, 9 were of 41 age, 4 were of 42 age, 10 were of 43 age, 10 were of 44 age, 15 were of 45 age, 9 were of 46 age, 10 were of 47 age, 12 were of 48 age, 5 were of 49 age, 34 were of 50 age, 8 were of 51 age, 7 were of 52 age, 8 were of 53 age, 6 were of 54 age, 22 were of 55 age, 17 were of 56 age, 9 were of 57 age, 8 were of 58 age, 9 were of 59 age, 13 were of 60 age, 8 were of 61 age, 7 were of 62 age, 8 were of 63 age, 6 were of 64 age, 12 were of 65 age, 5 were of 66 age, 8 were of 67 age, 9 were of 68 age, 3 were of 69 age, 20

were of 70 age,4 were of 71 age,5 were of 72 age,4 were of 73 age,5 were of 74 age,3 were of 75 age.



In 2015, a study conducted a study to find Effect of longstanding Diabetes Mellitus II on handgrip strength: An observational study and they concluded that Grip strength was much lower in diabetic patients than in non-diabetic individuals. Furthermore, substantial differences were found between the diabetes group and the non-diabetic group in terms of the grip strength of the dominant and non-dominant hands.³²

In 2016, study was conducted on handgrip strength in patients with type 2 diabetes mellitus and concluded that the average age and body mass index (BMI) of research participants were 54.74 and 2.61 years, respectively. Diabetes group's mean HGS of the dominant hand was 20.763.55 kg, whereas the control group's was 32.907.60 kg. Comparing diabetics to controls, HGS of the dominant hand was considerably lower.³² In our study, we compared the hand grip strength among diabetes mellitus with and without cervical radiculopathy and we found that patients with cervical radiculopathy had weak hand grip strength as compared to those who were without cervical radiculopathy.

CONCLUSION

This study concluded that the hand grip strength of patients with cervical radiculopathy prone to diabetes was affected highly as compared to those of which were not diagnosed with cervical radiculopathy but with diabetes. Although our study suggests that less patients were diagnosed with cervical radiculopathy in diabetic patients and more patients were without cervical radiculopathy.

Acknowledgements: In the name of Allah, The most gracious and the most merciful. First and foremost, I am thankful to Almighty Allah for giving me the strength, knowledge, ability and opportunity to undertake this study and complete it satisfactorily. The research project would make possible because of appreciation and support of many individual. I would like to pay my regards and heartedly thankful to my supervisor Dr. Farooq Mirza. I am thankful to Dr. Shehryar Asghar for his support and guidance throughout in the research. I present my gratitude to respected HOD, Dr. Farooq and all teachers of our department who motivated us and encourage us to work hard. Last but not least I am thankful to my parents and my sibling for their unconditional supports. Because of Allah almighty and prayers of my parents this all would be possible.

REFERENCES

- Aroob A, Zahoor IA, Ghaffar M, Ghaffar N, Rana AA, Shabbir S. Comparison Of the Effectiveness of Maitland Manipulation of Thoracic Spine Versus Grade I And II Maitland Mobilization of Cervical Spine on Pain Intensity and Functional Status in Patients of Cervical Radiculopathy: Cervical Spine on Pain Intensity and Functional Status in Patients of Cervical Radiculopathy. *Pakistan BioMedical Journal*. 2022;134-8.
- Sun B, Xu C, Qi M, Shen X, Zhang K, Yuan W, et al. Predictive effect of intervertebral foramen width on pain relief after ACDF for the treatment of cervical radiculopathy. *Global Spine Journal*. 2023;13(1):133-9.
- Marco B, Evans D, Symonds N, Peolsson A, Coppieters MW, Jull G, et al. Determining the level of cervical radiculopathy: Agreement between visual inspection of pain drawings and magnetic resonance imaging. *Pain Practice*. 2023;23(1):32-40.
- Lee AT, Lee-Robinson AL. The prevalence of medial epicondylitis among patients with c6 and c7 radiculopathy. *Sports Health*. 2010;2(4):334-6.
- Faisal C, Mathew N, Mathias L, Ajith S. Grip strength and hand function changes in unilateral cervical radiculopathy. *International Journal of Current Research and Review*. 2012;4(21):82.
- Shambhuvani MC, Diwan SJ, Vyas NJ. Effect of longstanding Diabetes Mellitus II on handgrip strength: An observational study. 2015.
- Gill PKS, Sandhu R, Dhillon SK, Arora AK. Handgrip strength in patients with type 2 diabetes mellitus. *Pakistan Journal of Physiology*. 2016;12(2):19-21.
- Sandhu PK, Sandhu R, Arora AK. Hand grip strength in type 2 diabetics and non-diabetics. *Pakistan Journal of Physiology*. 2015;11(3):32-4.
- Gärtner FR, Marinus J, van den Hout WB, Vleggeert-Lankamp C, Stiggelbout AM. The Cervical Radiculopathy Impact Scale: development and evaluation of a new functional outcome measure for cervical radicular syndrome. *Disability and Rehabilitation*. 2020;42(13):1894-905.
- Hayashi T, Wada N, Kubota T, Koizumi C, Sakurai Y, Aihara M, et al. Associations of sleep quality with the skeletal muscle strength in patients with type 2 diabetes with poor glycaemic control. *Journal of Diabetes Investigation*. 2023.
- Morikawa Y, Kawakami R, Horii M, Yamamoto Y, Yabuta M, Saito Y. Handgrip strength is an independent predictor of cardiovascular outcomes in diabetes mellitus. *International Heart Journal*. 2021;62(1):50-6.
- Sandhu R, Koley S. A Study of Handgrip Strength in Patients with Type-2 Diabetes Mellitus and Its Association with Some Anthropometric Variables.
- Shen F, Kim H-J, Jeon SW, Chang B-S, Lee C-K, Yeom JS. Influence of handgrip strength and paraspinal muscles' volume on clinical outcomes in the patients with each sagittal imbalance and lumbar spinal stenosis. *Global Spine Journal*. 2021;21925682211001871.
- Cannon DE, Dillingham TR, Miao H, Andary MT, Pezzin LE. Musculoskeletal disorders in referrals for suspected cervical radiculopathy. *Archives of physical medicine and rehabilitation*. 2007;88(10):1256-9.
- Mansfield M, Smith T, Spahr N, Thacker M. Cervical spine radiculopathy epidemiology: a systematic review. *Musculoskeletal Care*. 2020;18(4):555-67.
- Picconi F, Ryan C, Russo B, Ciotti S, Pepe A, Menduni M, et al. The evaluation of tactile dysfunction in the hand in type 1 diabetes: a novel method based on haptics. *Acta Diabetologica*. 2022;59(8):1073-82.
- Shrestha B, Gurung P. Hand grip strength in Type II diabetic patients visiting out patient department of a tertiary care centre of Nepal. *Journal of Chitwan Medical College*. 2023;13(1):68-70.
- Fritz NE, McCarthy CJ, Adamo DE. Handgrip strength as a means of monitoring progression of cognitive decline—a scoping review. *Ageing research reviews*. 2017;35:112-23.
- Bidja M, Mishra N, Mishra A. A STUDY ON CORRELATION BETWEEN NECK PAIN AND HAND GRIP STRENGTH AND ITS EFFECT ON QoL AMONG FEMALE BEAUTICIANS. *International Journal of Research and Analytical Reviews*. 2018;5(3):417-20.
- Amin DI, Hawari MZ, Hassan HE, Elhafez HM. Effect of sex and neck positions on hand grip strength in healthy normal adults: a cross-sectional, observational study. *Bulletin of Faculty of Physical Therapy*. 2016;21(1):42-7.
- Mathiowetz V. Comparison of Rolyan and Jamar dynamometers for measuring grip strength. *Occupational therapy international*. 2002;9(3):201-9.
- Wollesen B, Gräf J, Schumacher N, Meyer G, Wanstrath M, Feldhaus C, et al. Influences of neck and/or wrist pain on hand grip strength of industrial quality proofing workers. *Safety and Health at Work*. 2020;11(4):458-65.
- Massy-Westropp NM, Gill TK, Taylor AW, Bohannon RW, Hill CL. Hand Grip Strength: age and gender stratified normative data in a population-based study. *BMC research notes*. 2011;4(1):1-5.
- Karaganova I, Mindova S. Application of Hand-Held Dynamometer for Monitoring Functional Recovery in Patients with Cervical Radiculopathy. *Journal of IMAB—Annual Proceeding Scientific Papers*. 2022;28(2):4345-9.
- Fortes JPA, Hotta GH, Aguiar DP, Oliveira VBSD, OLIVEIRA FCD, BRITO M, et al. Reliability of the isometric dynamometer in control, paraplegic, and amputee individuals. *Acta Ortopédica Brasileira*. 2023;31.
- Patino-Villada FA, Estrada-Restrepo A, Aristizábal J. Handgrip strength in older adults from Antioquia-Colombia and comparison of cutoff points for dynapenia. *Scientific Reports*. 2023;13(1):1718.
- Hamasaki H, Yanai H. Handgrip strength is inversely associated with augmentation index in patients with type 2 diabetes. *Scientific Reports*. 2023;13(1):1125.
- Shahidi B, Johnson CL, Curran-Everett D, Maluf KS. Reliability and group differences in quantitative cervicothoracic measures among individuals with and without chronic neck pain. *BMC musculoskeletal disorders*. 2012;13(1):1-11.
- SHADY N, NEGM HM, ZITOUN ZMY, ABDELHAKIEM NM. Multimodal intervention of high-intensity laser with neurodynamic mobilization in cervical radiculopathy. *Pjmh*; 2021.
- Kang K-C, Jang TS, Jung CH. Cervical Radiculopathy: Focus on Factors for Better Surgical Outcomes and Operative Techniques. *Asian Spine Journal*. 2022;16(6):995-1012.
- Oktayoglu P, Acar A, Gunduz I, Caglayan M, Akbostanci MC. Assessment of hand functions in patients with idiopathic cervical dystonia. *Human Movement Science*. 2020;70:102581.
- Kim M, Shinkai S. Prevalence of muscle weakness based on different diagnostic criteria in community-dwelling older adults: A comparison of grip strength dynamometers. *Geriatrics & gerontology international*. 2017;17(11):2089-95.
- Farid G, Warraich NF, Iftikhar S. Digital information security management policy in academic libraries: A systematic review (2010–2022). *Journal of Information Science*. 2023;01655515231160026.
- Khalid A, Malik GF, Mahmood K. Sustainable development challenges in libraries: A systematic literature review (2000–2020). *The Journal of academic librarianship*. 2021 May 1;47(3):102347.