

Functional Impairments of Hands in Persons with Type 2 Diabetes Mellitus - A Narrative Review

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ABSTRACT

Background: The prevalence of Diabetes Mellitus (DM) is increasing across the world, being more prevalent in low and middle socio – economic countries like India. Literature on diabetic hand complications and functional impairments are scarce.

Need of the study: Hand dysfunction may affect Activities of Daily Living (ADL) and can affect self-care activities. This narrative review explored hand functional impairments among diabetic population.

Method: Thorough literature search was conducted on PubMed, Google Scholar and Cochrane reviews. Full text articles were included for review. Search was restricted to English language. Studies conducted after 2005 were included. The key words used were diabetes mellitus, hand dysfunction, hand function, hand dexterity and hand strength.

Results: Two hundred and one articles were found related to the search and eleven were included for this review based on inclusion criteria. Cross sectional and observational case control studies were reviewed. Significant decline in hand grip and pinch strength, gross and fine hand dexterity, joint mobility and hand functional outcomes were reported in the reviewed articles.

Discussion: The decline in hand muscle strength, dexterity, mobility and functional outcomes could be the result of structural changes in connective tissues, proliferation of collagen in the skin, subcutaneous tissues, tendons, muscles and peri-articular tissues.

Conclusion: Screening of hands among persons with diabetes is highly recommended. Implementation of therapeutic exercises may prevent the functional impairments in diabetic hand,

Key words: Diabetic hand, hand function, hand grip strength, hand dexterity, hand screening

Key Messages: Decline in hand muscle strength, dexterity and function are reported in uncontrolled hyperglycaemia. Early screening of functional impairments in diabetic hand can prevent the complications and improve the performance level of people with diabetes mellitus.

INTRODUCTION

According to the tenth edition of International Diabetes Federation, among adults within age group of 20-79 years, 537 million people across the globe are

estimated to have diabetes mellitus which is expected to inflate to 783 million by 2045¹. The increase in number of diabetes is estimated to be more among low and middle income countries as the population growth

is more. This metabolic disease can lead to complications in cardiovascular, renal, neural and musculoskeletal systems during the course of the disease. The mortality and morbidity rate are also considerable due to the complications of diabetes².

Type 2 diabetes mellitus which is prevalent than other types is considered to occur in older ages, but currently reported in younger ages too. Most of the type 2 diabetes cases remain undiagnosed due to poor awareness and lack of periodic screening especially in rural areas of lower and middle income countries^{2,3}. The glycosylation of proteins, decline in function of blood vessels and nerves, collagen accumulation in skin and periarticular structures leads to changes in connective tissues in diabetes. Musculoskeletal complications are reported in literature including structural and functional impairments in different parts of the body^{4,5}.

The complications of diabetic foot are researched extensively in the literature, whereas the diabetic hand complications are not explored to that extent. Hands are an integral part of the body for activities of daily living. The diabetic hand complications can impair the functional status of the person with diabetes and can affect the quality of life. Considering the long life expectancy and prevalence of diabetes, its need of the hour to explore the functional impairments in diabetic hand.

Objective: To explore the functional impairments of hands in diabetes mellitus

METHODOLOGY

Literature search was conducted from September to November 2022 by two reviewers. The search engines explored

were PubMed, Google scholar and Cochrane reviews. Full text cross sectional, observational and case-control researches which followed STROBE criteria were included for review. The key words used were type 2 diabetes mellitus, hand function, hand dexterity and hand strength. The inclusion criteria for the review were researches published in English language, published within the time frame of 2005 to 2022 and studies on hand function in terms of muscle strength, dexterity and function in type 2 diabetes mellitus.

RESULTS

The reviewers identified 1097 articles related to the subject which was screened for relevance and duplication. Two hundred and one articles were shortlisted and scrutinized with inclusion criteria and availability of full text. Eleven articles were found eligible and considered for the current review. Out of these eleven articles, five researches were conducted in India and remaining six were conducted in other countries. All eleven researches explored the changes in hand muscle strength, in which the grip strength was assessed with dynamometer and pinch strength was evaluated with pinch gauge. Three researches evaluated the changes in hand gross and fine dexterity with Minnesota Manual Dexterity test, nine hole peg board test or purdue pegboard test respectively. Hand function was evaluated with upper extremity function scale, Duruoz hand index, and the disabilities of arm, shoulder and hand questionnaire and Short form 36. One study explored hand joint mobility qualitatively by assessing presence of ‘prayer sign’ and ‘table-top sign’ (Table 1).

Authors & Year	Place	Outcome measures	Evaluation tool	Results
Neha M et al. 2019	Gujarat	Hand grip strength	JAMAR Dynamometer	Lower muscle strength in DM, Inverse correlation with duration of DM
Priyal Shah et al. 2019	Gujarat	Hand grip strength Key pinch	Dynamometer Pinch gauge Prayer & table top	Reduced grip & pinch strength, joint mobility & function in T2DM

		strength Joint mobility Hand function	signs UEFS	
Tasneem Ansari et al. 2018	Maharashtra	Hand grip strength Hand grip endurance	Handgrip Dynamometer	Decreased muscle strength & endurance in T2DM
S K Wani et al. 2018	Maharashtra	Hand grip strength Pinch strength Gross & fine dexterity	JAMAR Dynamometer Pinch gauge MMDT Nine hole peg test	Reduced grip & pinch strength, gross & fine hand dexterity in T2DM
Parminder Kaur et al, 2015	Punjab	Hand grip strength	JAMAR Dynamometer	Reduced grip strength in T2DM
Qi Zhang et al. 2021	China	Hand grip & pinch strength Tactile sensory threshold Dexterity	Handgrip Dynamometer Pinch meter SW Monofilaments Purdue pegboard test	Decline in muscle grip & pinch strength & dexterity in T2DM No difference in tactile sensory threshold
Pinar Akpınar et al. 2017	Turkey	Hand grip strength Functional hand disability	JAMAR Dynamometer Duruoz Hand Index	No significant difference in strength Hand function decline in T2DM
Mohamed E Khallaf et al. 2014	Egypt	Hand grip & pinch strength	JAMAR Dynamometer Pinch meter	Reduced grip & pinch strength in T2DM
Christine L Redmond et al. 2009	Australia	Hand grip strength Dexterity Function	EVAL Electro Dynamometer Rolyan 9 hole pegboard test DASH, SF 36	Decline in muscle grip & dexterity in T2DM Decline in DASH & physical component of SF 36
Seok Won Park et al. 2006	Korea	Hand grip strength Knee extension strength	Isometric Dynamometer Isokinetic Dynamometer	Decline in muscle strength
Ercan Cetinus et al. 2005	Turkey	Hand grip & pinch strength	JAMAR Dynamometer Pinch meter	Reduced grip & pinch strength in T2DM

Table 1: Summary of researches included in review

DISCUSSION

This review revealed decline in hand grip and pinch strength, gross and fine hand dexterity and hand function among people with diabetes mellitus. Hand grip strength is a measure of muscular strength or the maximum force or tension generated by one's forearm muscles. Poor glycaemic control for prolonged period is associated with deficient muscle quality which is muscle strength per unit muscle mass in kilograms^{6,7}. The presence and severity of neuropathy is found to be associated with decreased muscle strength in diabetes mellitus^{7,8,9}. In uncontrolled

hyperglycaemia, muscle protein break down, decreased use of energy, increased systemic inflammatory cytokines and skeletal muscle atrophy are reported which can lead to decreased muscle function^{7,10,11}. The decline in hand muscle strength can decrease the functional independence of the person affected by longstanding diabetes mellitus, thereby reducing productivity^{12,13}. According to Neha M et al, an increase in duration of diabetes is inversely related with decline in hand muscle grip strength¹⁴. The decline in hand muscle strength and psychomotor executive functions among prolonged uncontrolled hyperglycaemic

individuals may affect the fine movements and dexterity¹⁰. The sensory impairments affecting the distal parts of hands may affect the task performances affecting hand dexterity¹⁵. The glycosylation in the connective tissues leads to stiffness in the small joints of hand along with visual impairments related to diabetic retinopathy may impair the hand eye coordination activities required in performing dexterity activities¹¹.

Increased glycosylation and cross linking of collagen, increased proliferation of collagen to periarticular tissues and decreased degradation of collagen may have a detrimental effect on mobility of hand joints¹⁶. Limited joint mobility in diabetes can be due to increased inflammatory cytokines and micro-angiopathy which is confirmed through presence of prayer sign and table top sign⁸.

The decline in hand function can be influenced by various physical and psychological factors¹⁵. Decreased hand muscle strength, hand joint mobility may affect the activities of daily living among individuals with long standing diabetes mellitus¹⁷. Decreased performance may adversely affect the psychological status and quality of life among diabetic individuals¹⁸. Routine evaluation and preventive measures are required to ensure functional independence among people with diabetes mellitus.

The current review exposed controversial results on relation of duration of diabetes and functional impairments of hands. The physical activity levels and occupation of an individual may have influence on hand function which need to be explored more. The comorbidities like hypertension, obesity may have an influence on hand function. Moreover, the pathological changes in neural, retinal and renal systems in diabetes also may affect hand function. These confounding factors need to be considered while recruiting subjects in future studies.

CONCLUSION

This narrative review revealed decline in hand muscle strength, dexterity, mobility and function among people with diabetes mellitus. Currently, diabetic foot screening and evaluation are conducted routinely in clinical practice, whereas, screening for hand function is still a neglected area. Early detection and implementing physiotherapeutic measures for diabetic hands may prevent or reduce the functional impairments. There is an urgent need for awareness programs for health professionals and the public on functional impairments of diabetic hand to ensure early screening and interventions.

Future researches need to focus on hand dysfunction in diabetes considering all possible confounding factors. Newer physiotherapeutic techniques and exercises need to be developed to improve hand function among diabetic population.

Declaration by Authors

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REFERENCES

1. https://diabetesatlas.org/idfawp/resource-files/2021/07/IDF_Atlas_10th_Edition_2021.pdf
2. <https://www.who.int/publications/i/item/9789241565257>
3. Shubha Gundmi, Arun G Maiya et al., Hand dysfunction in type 2 diabetes mellitus: systematic review with meta-analysis, *Annals of Physical and Rehabilitation Medicine*, 2018; 61; 99-104
4. Rachel Peterson Kim et al, Musculoskeletal complications of Diabetes mellitus, *Clinical Diabetes*, 2001, 19 (3), 132-5
5. Pandey A et al, Prevalence of hand disorders in type 2 diabetes mellitus and its correlation with microvascular complications, *Annals of Medical and Health sciences research*, 2013, 3 (3), 349-54
6. Jean Yves Hogrel et al., Grip strength measured by high precision dynamometry in

- healthy subjects from 5 to 80 years, BMC Musculoskeletal Disorders 2015, 16:139, 1-11
7. Seok Won Park et al., Decreased muscle strength and quality in older adults with type 2 diabetes – The health, aging and body composition study, Diabetes; 2006; 55, 1813-19
 8. Andrzej Zyluk et al., Hand disorders associated with diabetes: A review, Acta Orthop. Belg.: 2015; 81: 191-96
 9. Ercan Cetinus et al., Hand grip strength in patients with type 2 diabetes mellitus, Diabetes research and clinical practice, 2005; 3346, 1-9
 10. Qi Zhang et al., Diabetic peripheral neuropathy affects pinch strength and hand dexterity in elderly patients, Hindawi Neural Plasticity, 2021, 1-8
 11. S K Wani, R P Mullerpatan, Hand function in people with Type 1 and Type 2 Diabetes, International journal of diabetes in developing countries, 2018
 12. Parminder Kaur Sandhu Gill et al., Hand grip strength in type 2 diabetics and non diabetics, Pak J Physiol, 2015; 11 (3)
 13. Mohamed E Khallaf et al., Effect of long standing diabetes mellitus type 2 on hand grip strength and pinch power of females in the city of Hail– KSA, IOSR-JNHS, 2014, 3 (1), 41-44
 14. Neha M et al., Comparison of hand grip strength in diabetics and non diabetics – An observational study, Medical journal of clinical trials & case studies, 2019, 3 (3)
 15. Christine L Redmond et al., Hand syndromes associated with diabetes: impairments and obesity predict disability, The journal of rheumatology, 2009, 36:12
 16. Priyal Shah et al., Comparison of hand grip, hand mobility and upper extremity impairments in type 2 diabetes v/s healthy matched individuals, NJIRM, Vol 10 (1)
 17. Tasneem Ansari et al., Study of hand grip strength and handgrip endurance in type 2 diabetes, National journal of physiology, pharmacy and pharmacology, 2018, 8 (7). 1001-4
 18. Pinar Akpınar et al., Hand functions in type 1 and type 2 diabetes mellitus, Srp Arh Celok Lek, 2017
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