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Review

A scoping review on targeted hand exercise interventions for hand function in diabetes mellitus

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Abstract

Diabetes Mellitus (DM) can lead to functional impairments in hands due to limited joint mobility and diabetic neuropathy. Hand exercises are essential to mitigate these impairments. Incorporation of hand exercise program is crucial in maintaining the functional skills and prevention of deterioration of hand function in persons with DM. This scoping review was conducted to identify all available standardized hand exercise programs which have been developed and used in DM.

A comprehensive literature search was conducted in PubMed, Scopus, Cochrane library and Google Scholar with key words diabetes mellitus, diabetic neuropathy, limited joint mobility, hand exercises and diabetic hand. Articles focusing on hand specific exercises and involving adults with DM were included, while non-English articles and those not related to hand function were excluded.

Eighteen articles were retrieved and after initial screening of title and abstract, seven articles were found relevant. Out of these seven relevant articles, five were selected for the scoping review based on the selection criteria. Out of five, three were randomized control trials and two were pretest-post test control design. The reported interventions were strengthening and stretching exercises along with functional exercises or proprioceptive exercises or task-oriented biofeedback or tendon gliding exercises.

There is a need for structured exercise program for hands which consider training in hand muscle strength, dexterity, joint mobility and functional activities.

Keywords: Diabetes mellitus, hand exercise, strengthening exercise, diabetic neuropathy, limited joint mobility.

INTRODUCTION

Diabetes Mellitus (DM), a chronic disorder initiated by insulin deficiency or resistance leads individuals to micro vascular and macrovascular complications.[1,2] These complications impair the mobility and quality of life among persons affected with DM.[3] Diabetes add high burden on health care system with 537 million people affected with DM across the world in 2021 as reported by International Diabetes Federation (IDF). As per the World Health Organization statistics, 95% of persons with DM have type 2 and there was three percentage increase in the mortality rate from DM in the duration 2000 – 2019.[3,4] According to the IDF, India was one of the top three countries with highest number of persons with DM in 2019 and the trend is expected to increase in 2030.[5] The literature reported increasing pandemic trend of DM in Kerala and high prevalence of complications like retinopathy among persons with DM in Kerala.[6,7]

DM is a leading cause of mortality and disability across the globe contributed by its complications and significantly affects the day-to-day life of individuals with DM. Musculoskeletal disorders are also reported as complications of DM which is ignored in comparison to life threatening vascular complications. The early recognition and management of musculoskeletal complications in DM can ensure better quality of life and physical function.[2,8] The research conducted in central part of Kerala reported that more than forty percentage of diabetics suffer from musculoskeletal complications which warns regular musculoskeletal assessments to prevent deterioration of function.[9]

Literature reported decline in hand muscle strength, hand dexterity, joint mobility and hand function among persons with DM.[8,10–12] The long duration of DM and the presence of comorbidities can decline the physical performance of individuals with DM. The diabetic complications of the foot are researched extensively, whereas the hand complications have not received that attention. There is a critical need for targeted exercises for hands considering the rising prevalence of hand function impairments in DM.

This scoping review was designed to explore the existing evidence on targeted hand exercise programs for individuals with DM.

METHODS

Comprehensive literature search was performed in electronic databases including PubMed, Cochrane library, Scopus and Google Scholar in July 2023. Articles published in English language, randomized control studies or pre-post control group designs with full text articles were included for the review. The literature search was performed with key words and Boolean operators' diabetes mellitus OR type2 diabetes mellitus OR T2DM OR diabetic neuropathy AND hand OR hand exercises OR strengthening exercises OR hand protocol OR hand function.

Eighteen articles were retrieved from the four databases and initial review commenced with screening the titles and abstracts. Seven articles were found relevant to the present review. A comprehensive evaluation of all seven articles was conducted by the authors based on the inclusion and exclusion criteria. The articles published after 2000 and in English language only were selected. Articles that mentioned the design as randomized control trials and pre-post control design were only included. Two articles were excluded from review as there was no control group and the sample size was too low. Out of remaining five articles, three were randomized control trials and two were experimental pre-post control design. All five articles were evaluated through all the contents and sections to confirm the relevance and alignment with the review objectives. The data on hand exercise interventions were retrieved from the articles for tabular presentation.

RESULTS

The five articles which were selected after screening were explored in detail for the type of exercises implemented along with dosimetry and the outcome measures used to evaluate dependent variables. The studies presented strengthening exercises, stretching exercises, proprioceptive training, functional training, task-oriented biofeedback and tendon gliding exercises. The relevant data is presented in table 1.

Table 1: Overview of reviewed study characteristics

Author & Year	Design	Study location & sample	Intervention	Dosimetry of Intervention	Outcome measure	Result
Mi Mi Thet Mon Win et al.[13] 2019	RCT	Myanmar 51 in Experimental & 53 controls	Wrist stretching, finger tapping, rolling a golf ball, circling and stretching the fingers, tendon gliding finger rolls, circling of thumbs	10 minutes per day Three days per week For eight weeks	• Patient Neurotoxicity Questionnaire • Visual Analogue Scale • Diabetic Peripheral Neuropathy signs & symptoms • Hand grip • Pinch force	• Improved ADL • No change in DPN & Pain • No change in hand grip & pinch force
Nagwa Ibrahim Reab et al.[14] 2021	RCT	Egypt 20 experimental & 20 controls	Proprioceptive exercises, strength training, active exercises, stretching & functional training	30 mts per day, 3 times per week, for 4 weeks	Wrist joint position sense, Hand grip strength, Jebsen Taylor hand function test	Significant change in all outcome variables
Elvis I Agbonlahor et al.[15] 2017	Experimental design	Nigeria 18 experimental & 18 controls	Strength training	50 mts per day, 2 sets of 8 reps, 3 mts rest, 3 times per week, 12 weeks	Hand function	Improved hand function
Elvis I Agbonlahor et al.[16] 2017	Experimental design	Nigeria 18 experimental & 18 controls	Strength training	50 mts per day, 2 sets of 8 reps, 3 mts rest, 3 times per week, 12 weeks	Grip strength- Dynamometer Pinch strength- Pinch gauge	Improved hand grip and pinch strength
Li Chei KUO et al.[17] 2019	RCT	Taiwan	Re-education Biofeedback, Home based exercises	30 mts per day, 2 times per week, 6 weeks	PHUA test, Touch pressure threshold, Two-point discrimination, Purdue pegboard test, Michigan Hand outcome Questionnaire	Significant improvement in sensory function, precision pinch, hand function,QoL

RCT- Randomized Control Trial, ADL- Activities of Daily Living, DPN- Diabetic Peripheral Neuropathy, PHUA- Pinch Holding Up Activity, QoL- Quality of Life

DISCUSSIONS

This scoping review was conducted for a comprehensive information on hand exercises for persons with DM. Five articles were selected based on the criteria and reviewed for the interventions and its outcome.

Strengthening exercises was implemented in three researches and reported an improvement in hand grip strength, pinch strength and hand function. Hand strengthening exercises which are integral part of rehabilitation aims to enhance hand muscle strength, dexterity and function. These exercises typically involve resistance training with tools like grippers, hand springs and exercise balls progressing from isometric holds to dynamic repetitions.[16] The improvement in strength could be the result of muscle hypertrophy and adaptations at a neural level.[18] The resistance training enhances muscle strength, endurance and dexterity as there will be increased muscle mass and volume.[14]

The adherence rate was mentioned in only two articles, which has major influence in the outcome. In all these studies there was a lack of follow up to determine long term effects of hand exercise program on muscle strength and function. The selection of samples and sample size was not well documented in these studies, whereas the research conducted by Nagwa et al. had detailed the randomization technique.[14]

It was observed that the dosimetry of exercises was not detailed and there was lack of structured hand exercise program for diabetes mellitus. Moreover, the exercise programs implemented in these researches were missing either one of the components that influence hand muscle strength, dexterity, joint mobility, sensory component and hand function. There is a need for development of structured hand exercise program with well defined dosimetry and considering improvement in hand muscle strength, dexterity, joint mobility and hand function.

CONCLUSION

There is a need for development of structured hand exercise program with well-defined dosimetry and considering improvement in hand muscle strength, dexterity, joint mobility and hand function.

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