



CORRELATION OF CHANGES IN HAND FUNCTION AND HAND GRIP STRENGTH IN GERIATRIC POPULATION

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ABSTRACT

Distal muscles are affected more than proximal muscles as per the reports. As the person ages, changes in muscular, nervous and cardiovascular system occur. Muscle mass is correlated with muscle strength due to which along with aging decrease in muscle strength and muscle mass occurs. The decreasing muscle mass is directly correlated to the diminished muscle strength of aging hand and so assessment of hand function is important. Effective measures can be taken after 50 years of age in the general population so that strength and changes in hand functions that hamper the activities required for independent functioning can be prevented. Changes in hand functions occur due to aging, but it is still unclear whether these effects of physiological aging can cause disability. Hand grip strength is found to reduce with aging. This study attempted to find if correlation exists between hand grip strength and hand function in elderly.

Result: There was a positive correlation between all the domains and its total score of Michigan Hand Outcome Questionnaire with the handgrip strength in young geriatric population.

Conclusion: all the domains of MHQ, overall hand function, activities of daily living, work performance and aesthetics domain had moderate positive correlation with handgrip strength while pain domain had severe positive correlation.

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INTRODUCTION

“Aging can accelerate or decelerate due to lifestyle choices, that include diet, physical activity, and other health habits, and behavioral and social factors have a potent effect on it”. Evidence to initially support this was derived from a 10 year study conducted by Rowe and Kahn.

Although controversial, Shinohara M. stated that loss of muscle strength with aging is associated with its anatomic location, where distal muscles are affected more than proximal. Muscle mass is correlated with muscle strength due to which along with aging decrease in muscle strength and muscle mass is there. Most frequently used muscles show less deterioration in strength.

The force required for gripping objects is produced by extrinsic and intrinsic hand muscles. Along with substantial loss of muscle fibers and reduced muscle-fiber length, there is a rapid decline in hand-grip strength, by as much as 20–25% after 60 years of age particularly in the thenar muscle group. Out of total intrinsic musculature of the hand, 40% is contributed by thumb intrinsic musculature as found by Chao-Ying Chen.

Research shows that in elderly people the largest declines in upper extremity functioning (greater than 50%) are in-speed of

hand-arm movements, hand-force steadiness, and vibration sense. Until the age of 65 years, hand function remains fairly stable and declines slowly after that while, age differences in performance become more apparent as seen in prehensile pattern frequency, hand strength, performance time, and range of motion after the age of 75 years. With age, the percentage decrease in strength is similar for men and women regardless of their lifestyle.

Age-related declines in hand and finger strength and the ability to control sub maximal pinch posture, manual speed, and hand sensation occur while aging as there is marked degenerative effects on hand function. Elderly women had serious reduction in fine manual dexterity and strength than men of a similar age as observed by Eli Carmeli.

Michigan hand function assessment scale is a commonly used standardized test for assessing functional hand use. The Michigan Hand Outcome Questionnaire (MHQ) was developed in 1998 by Chung and his colleagues that intend to focus on the domains like overall hand function, activities of daily living, work performance, pain, aesthetics and satisfaction with hand function that were hard to quantify.

According to George *et al.* 2018, hand grip strength is a fundamental procedure that therapists and physicians use to assess client's status following injury, surgical techniques, and

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treatment procedures to the hand and Upper Extremity. Martins *et al.*, (2015) stated that the modified sphygmomanometer test (MST) is a method for muscle strength assessment in clinical settings.

Eli Carmeli found deterioration in hand muscle function reduces quality and independency in old age population on the basis of importance of hand manipulation in normal activities of daily living. Because of weakened muscle mass, strength and coordinating finger dexterity, sensation of hand along with degeneration of central nervous system, there is decline in manual function. Also as per a study by RA Wong *et al*, their clearly exists muscle imbalance in this population. Hence a need arises to assess the hand function changes occurring in the young old age groups from 65 to 74 years of age and see if it is leading to disability or not.

MATERIAL AND METHOD

This was a Correlation Study, conducted on both male and female subjects aged between 65 to 74 years old. Sample size was calculated as 111 from a pilot study of 8 subjects using primer of biostatistics software. Sample of convenience was used for this study. Subjects with functional range of motion in hand and upper limb were included whereas those with congenital disease, acquired musculoskeletal and neurological disorder, and congenital and/or acquired hand deformities were excluded.

Procedure

On receiving Ethical committee clearance, subjects were explained about the study. Written consent was taken at the beginning of the session. Subjects screening was done as per the exclusion & inclusion criteria. The hand grip strength was assessed using Aneroid Sphygmomanometer, three readings were taken and the average value was considered and converted to Jammer unit. Using the formula [Jammer unit = (.54 X Sphygmomanometer - 45.12)]. The hand grip strength was assessed as per the standard guidelines from American Society of Hand Therapists.

The hand function was assessed with Michigan Hand Outcome Questionnaire that has six domains- overall hand function, activities of daily living, work performance, pain, aesthetics and satisfaction with hand function. Scoring of each domain was done and total score was calculated. The reliability of Michigan hand outcome questionnaire was found to be ICC 0.97 (Henk J A *et al*). The statistical analysis was performed using statistical software MedCalc Version 18.2.1.2018. Shapiro-Francis test was used to check the normal distribution of the data. The calculated p value being less than 0.05, the normality was rejected hence Spearman’s rank correlation coefficient test was used for analysis.

RESULT

Table 1 Descriptive statistics of Hand grip strength and Michigan Hand Outcome Questionnaire.

Outcome Measure	Mean	SD	95% CI of Mean	Median	IQR
Hand grip strength	52.26	31.30	46.37 to 58.14	48.47	26.340 to 76.650
MHQ 1	83.01	17.57	79.71 to 86.32	85	75 to 100
MHQ 2	96.88	12.9145	94.45 to 99.31	100	100 to 100
MHQ 3	87.0450	18.8763	83.49 to 90.59	95	80 to 100
MHQ 4	52.2603	31.3085	40.12 to 56.22	48.47	96.25 to 100
MHQ 5	96.9932	12.1056	94.71 to 99.27	100	100 to 100
MHQ 6	93.00	9.1172	91.29 to 94.72	95.83	88.52 to 100
Total Score of MHQ	92.3757	8.0583	90.85 to 93.89	94.160	89.94 to 99.09

Graphs

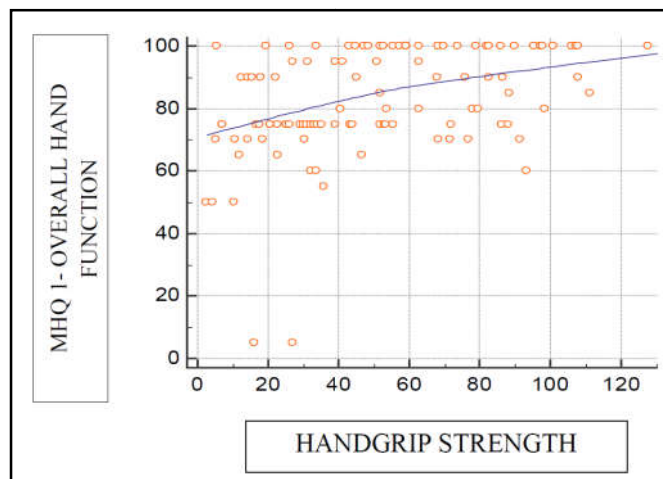


Figure 1 Graph depicting correlation of overall hand function and handgrip strength.

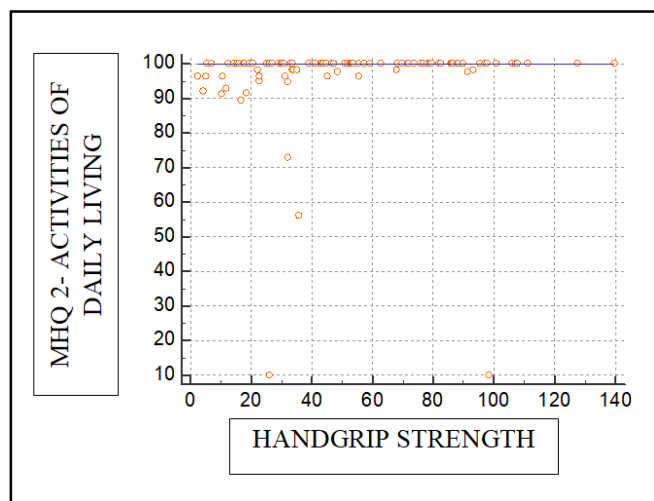


Figure 2 Graph depicting correlation of activities of daily living and handgrip strength.

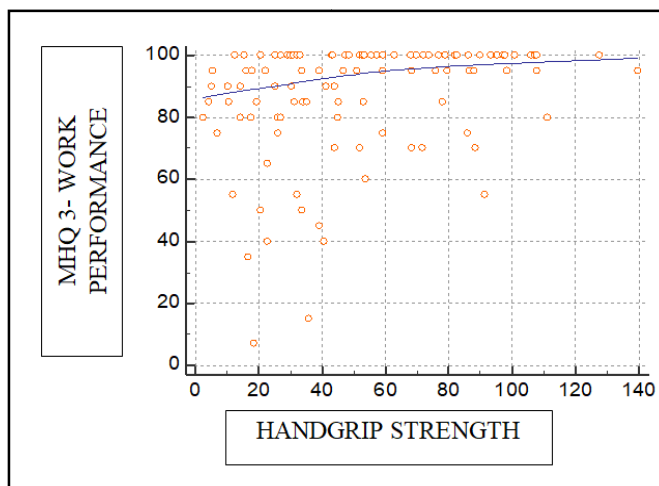


Figure 3 Graph depicting correlation of work performance and handgrip strength.

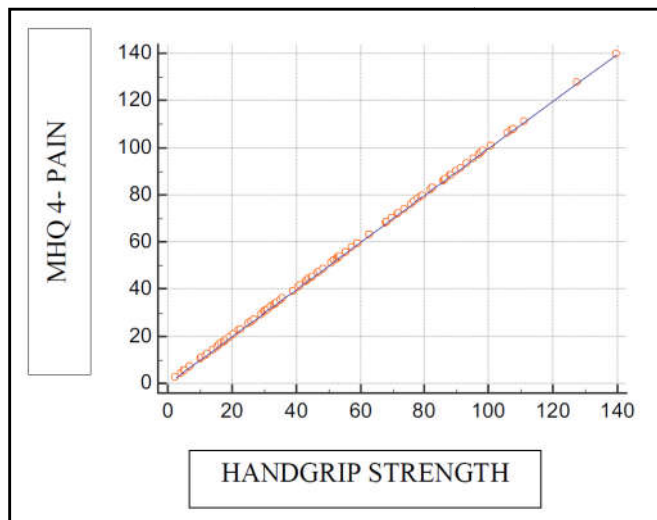


Figure 4 Graph depicting correlation of pain and handgrip strength.

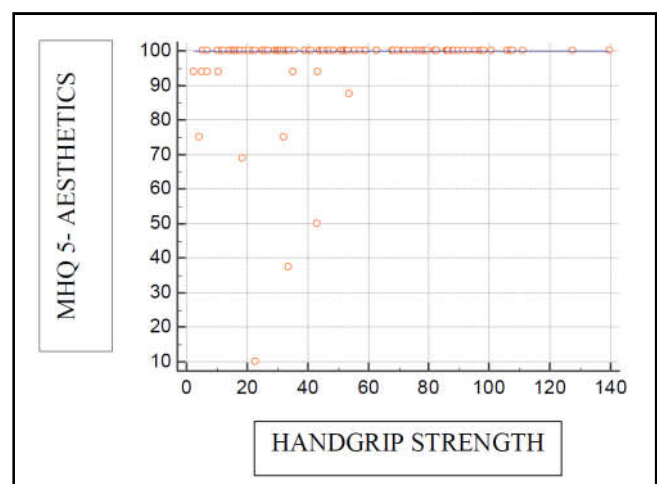


Figure 5 Graph depicting correlation of aesthetics and handgrip strength.

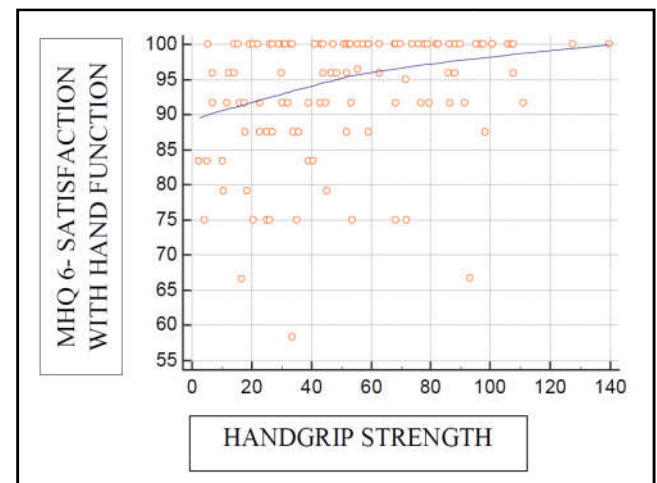


Figure 6 Graph depicting correlation of satisfaction with hand function and handgrip strength.

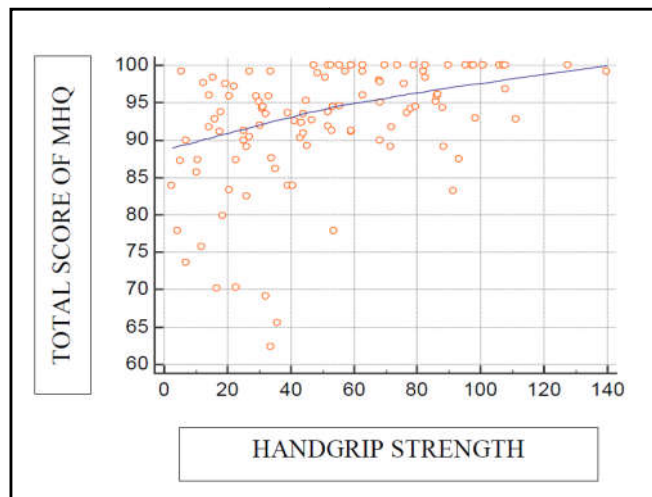


Figure 7 Graph depicting correlation of total score of MHQ and handgrip strength

DISCUSSION

There's paucity in data to comment if with the increasing age, the changes that occur in hand will lead to any difficulties in hand function that will hamper the geriatric population from living their life independently or not. According to M E Heckel decline in strength, speed and co-ordination of movement is related to the decline in neuro-muscular function. These nervous system changes include decrease in nerve conduction velocity, sensory activity, rate and magnitude of reflex responses, and arousal threshold.

Eli Carmeli found in her study that in the elderly population, almost 25% of the motor axons in hand muscles are lost in old age therefore loss of functioning motor neuron and ventral root axon is seen.

Though number is less, there is loss of motor units after age of 60 in the hypothenar group of muscles. With age, significant decrease in motor units in thenar and dorsal interossei muscles occurs. Both motor control and function has impact of functional motor units. Age related changes are seen in both neurohistology and also in response to neurotransmitters as suggested by the research. NA Incel quotes, as the hand muscle function correlates with the functional dependency. So as one ages due to these factors, changes in hand function may also occur. And according to Julia W *et al*, if the grip strength is low, it leads to poor mobility, and dependence of activities of daily living that predicts reduction in body function and mortality.

The measurement of grip strength has been widely adopted as a singular indicator of overall strength, based on the research conducted by Richard W.

A moderate positive correlation with r value 0.47 between hand grip strength and overall hand function was found. Change in handgrip strength has a positive correlation with the overall hand function. This finding was supported by a study done by Shivananda VR that stated limited finger ROM and hand ROM affecting grip restricts the overall hand function in geriatrics.

For activities of daily living a moderate positive correlation with r value 0.33 was observed with hand grip strength describing a direct impact of handgrip strength on the activities of daily living. Hadeel Halaweh also showed there is

considerable reduction in physical functioning domain in hand related quality of life. This interprets self-care like washing and dressing independently and the older person's ability to maintain usual activities (e.g. household chores, work, family or leisure activities). These are the major dimensions of functioning domain that might be influenced by hand grip strength.

Similar results were observed with moderate positive correlation between the hand grip strength and work performance with r value 0.386. This is supported by study of Hadeel Halaweh stating that the activity restriction and reduced quality of life in older adults may cause weakness of hand grip strength that affects work performance.

A severe positive correlation was observed between the hand grip strength and pain with r value 1.00, better the strength less will be pain experienced by the subject. Hadeel Halaweh's study found a similar result where men and women recorded a significant correlation between the hand grip strength and pain/discomfort, anxiety/ depression dimensions of hand related quality of life. Paulo R W carried out a study with general population of Portugal that shows 54.2% of people between 60 and 64 years age, 55.9% people between 65 and 69 years of age, 65.7% of people between 70 to 74 years of age and 62.5% of people above 75 years of age are affected by chronic pain. Results showed that pain affected mostly the domestic responsibilities, leisure and occupational capacity and sleep capacity. Chronic pain refers moderate to severe in capacity in 35% of people. This is because pain has a detrimental impact on function.

It was found that there's moderate correlation between the hand grip strength and aesthetics with r value 0.334. Mostly this population has acceptance to the changes that occur due to aging irrespective of their hand grip strength. This is supported by other study done by Packer M where in healthy geriatric population; there is less correlation for hand grip strength and aesthetics.

The study shows moderate correlation between the hand grip strength and overall satisfaction of the subjects with their hand with r value being 0.351. This is supported by Packer M *et al*, where they found significance in overall satisfaction in geriatric population.

A severe positive correlation between the hand grip strength and total score of Michigan Hand Outcome Questionnaire with r value 0.512 was observed. This is again supported by a Packer M *et al*, where they found significance in overall satisfaction in geriatric population.

Forrest *et al*. reported that physical limitations including standing from a chair, walking, climbing steps, and going out in older Americans was related to significant lower grip strength. Also low ($r=0.36$) relationship between grip strength and the distance walked during the 6 min walk test was demonstrated by Zhang *et al*.

Limitations: Though healthy young old geriatric population was included in this study, cognitive domain was not assessed.

Future Scope of the Study: Handgrip strength in all the three groups of geriatric population can be assessed and compared with the changes in hand function with Michigan Hand Questionnaire. Also after the results, the rehabilitation protocol can be planned in the young old geriatric population. Effective

measures can be taken after 50 years of age in the general population so that strength and changes in hand functions that hamper the activities required to live life independently can be prevented.

CONCLUSION

It was concluded that there is a correlation of handgrip strength with hand function in young geriatric population.

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Conflict of Interest: NONE

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