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ISSN No: 2319-5886

International Journal of Medical Research & Health Sciences, 2016, 5, 6:235-238

An investigation into normative values for fine hand dexterity and its relation with pinch and grip strength among healthy young Indian adults

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ABSTRACT

An investigation into normative values for fine hand dexterity and its relation with pinch and grip strength among healthy young Indian adults. Evaluation of hand function is a crucial component to assess prognosis in hand pathologies. Examinations of dexterity provide unique way of evaluating neuro-motor function of entire hand. There is scarcity of literature on reference values for fine hand dexterity among healthy young adults. To explore normative values for fine hand dexterity and its relation with pinch and grip strength. The 9-Hole Pegboard Test was administered for evaluation of fine hand dexterity among healthy young adults (n= 256) of age group 18 to 35 with the mean age of 20.53 (±2.02). The task was demonstrated and both hands were assessed. Grip and pinch strengths were measured in both hands in a consistent manner. A dynamometer was used for grip strength and a pinch meter was used to measure key (lateral) and tripod pinch and tip to tip pinch strengths. Normative value for fine hand dexterity of dominant hand among males (n= 125) is 19 (± 2.18) and among females (n= 126) is 19.5 (± 2.59) and there was no significant correlation between fine hand dexterity with grip and pinch strength. Normative values generated in this study can be used for clinical reference in the evaluation of hand function to that of normal subjects of the same age and gender.

Key words: Fine hand dexterity, 9-Hole pegboard test, grip strength, pinch strength

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INTRODUCTION

Dexterity is the manual skill requiring rapid coordination of fine and gross movements based on certain number of capacities developed through learning, training, and experience. Fine dexterity is the ability to make rapid, skillful, controlled, manipulative movements of small objects in which the fingers are primarily involved, whereas, gross dexterity is the ability to make skillful, controlled, arm- hand manipulations of larger objects under speed conditions [1]. It is one of the important hand function outcome measures other than range of motion, muscle strength, sensations and physical capacity evaluation [2].

The hand is a receptor of much information from the environment and in everyday life all kinds of grips are of vital importance for ordinary activities of daily life. Handgrip and pinch strength is a good parameter, not only in evaluation of hand as a predictor of hand function, but also, to explore the status of general health [3, 4].

Finger and manual dexterity are assessed with various standardized tests. The 9- Hole peg board test, the Jebsen hand function test, the Purdue peg board test, The Crawford small parts dexterity test & the Bennett hand-tool dexterity test are standardized tests to assess fine dexterity [2, 4, 5]. The nine hole peg board test was first introduced

by Kellor, Frost, Sillberg, Iversen and Cummings in 1971. It is a valid and reliable test to assess fine hand dexterity. Its simplicity, portability, brevity, ease in administration and cost effectiveness make it feasible to use.

It is imperative that hand strength and dexterity be evaluated in order to determine the severity of hand dysfunction and the effect of treatment strategies or effects of different procedures [6]. However normative values for fine hand dexterity have not been established for Indian population. Reliable and valid evaluation of hand strength is of paramount importance in determining the effectiveness of various therapies or treatment procedures. In addition, normative data are required for reference; to set realistic treatment goals; and to assess a patient's ability to return to employment.

Hand dexterity evaluation is an important component to asses hand function. However, normative values for fine hand dexterity have not been established for Indian population. Establishing normative values will enhance setting up goals against a mean performance standard specifically representative to individual. Normative values establishment will help to standardise assessment of fine hand dexterity with 9-HPT and its relation with pinch and grip strength is explored in this study.

MATERIALS AND METHODS

Two hundred and fifty one healthy subjects (n=251) within age group 18 – 35 years were recruited for his cross sectional study. Both males (n= 125) and females (n=126) were consented to participate in the study. Sample size was determined based on statistical method. Subjects were recruited on random sampling method. Sample population was collected from MGM institutes, Navi Mumbai. Ethical approval was received from institutional ethical committee of MGM School of Physiotherapy. Subjects with history of traumatic or pathological hand impairments, neurological pathologies and visual impairments were excluded from the study. The participants were provided oral and written overview of study and each participant signed an informed consent form prior to participation in study.

Materials used for the study were weighing machine, Measuring tape, 9- Hole peg board (9-HPT), Stop watch, Hand grip dynamometer (Jamar) and Pinch meter /Pinch gauge (B and L). The 9-HPT is brief, standardized, quantitative research tool to assess upper extremity function. Both the dominant and non-dominant hands were evaluated twice. The subject was made to stand near a table on which a small, shallow container holding nine pegs and a wood or plastic block containing nine empty holes were kept. On a start command, the subject was instructed to pick up the nine pegs one at a time as quickly as possible and put them in nine holes. The stopwatch was commenced with the start command. Once the nine pegs were in the holes, subjects had to remove them again as quickly as possible one at a time and put back into shallow container. The total time taken to complete the task was recorded. Two consecutive trials with the dominant hand were immediately followed by two consecutive trials with the non-dominant hand [7, 8, 9].

Grip strength was tested first, followed by tip to tip pinch, key (lateral) pinch, and palmar (three-jaw chuck) pinch. For each of the tests of hand strength, thesubjects were seated with their shoulder adducted andneutrally rotated, elbow flexed at 90°, forearm in neutralposition, and wrist between 0° and 30° dorsiflexion andbetween 0° and 15° ulnar deviation [10, 11,12].The scores of three successive trials were recorded for eachhand.

The data collected from all subjects were coded and entered into Microsoft excel 2007 and statistically analyzed with SPSS version 16. Demographic variables were analyzed for age group of 18 to 35years.Normative values of fine hand dexterity were determined by descriptive statistics. The relation of fine hand dexterity with grip and pinch strength was assessed using Pearson's correlation coefficient.

RESULTS

Subjects in the age group of 18 – 35 years (n= 251) were recruited for this study based on inclusion – exclusion criteria. Both males and females were recruited and assessment was done on dominant and non-dominant upper extremities.

The number of males recruited were 125 (n=125) and females were 126 (n= 126) and the mean age was 20.53 (±2.02). The fine hand dexterity using 9 – HPT among males on dominant upper extremity was 19 (±2.18) and on

non-dominant side 20.8 (±2.07). The fine hand dexterity using 9 – HPT among females on dominant upper extremity was 19.5 (±2.59) and on non-dominant side 20.8 (±2.17)

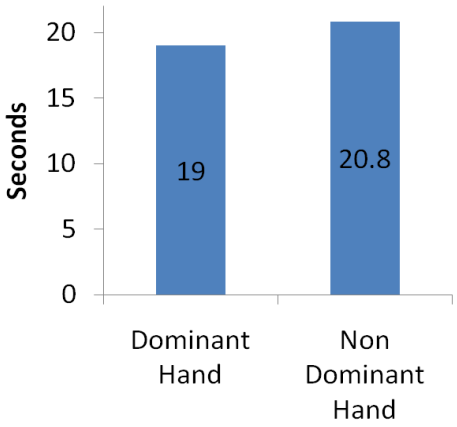

Figure 1: Fine hand dexterity among males

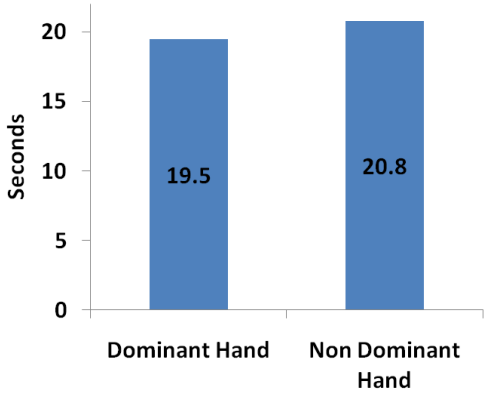

Figure 2: Fine hand dexterity among females

Table 1: Correlation of fine hand dexterity with grip and pinch strength

Correlation of fine dexterity with-	**r- Value**
1. Grip strength	**.025**
2. Lateral pinch strength	**.056**
3. Tip to tip Pinch strength	**.010**
4. Tripod pinch strength	**.007**

DISCUSSION

Subjects (n=251) with mean age of 20.53 (±2.02) were evaluated for fine hand dexterity using Nine hole peg test. Normative value for fine hand dexterity among healthy young maleson dominant upper extremity was found to be 19(±2.18)and on non-dominant side 20.8 (±2.07)and among females dominant side was19.5 (±2.59)and on non-dominant side was 20.8 (±2.17). These normative values can serve as reference values for clinical purposes towards evaluation and assessment of prognosis of various clinical hand pathologies. An examination of dexterity provides a unique way of evaluating neuro-motor function of the entire hand.

The score on the dominant side was found to be lesser than the non-dominant side as the subjects required lesser amount of time to complete the task with the dominant upper extremity. This could be due to comparable use of dominant upper extremity in activities of daily living than non-dominant extremity.

Present study showed no significant correlation of fine dexterity with grip and pinch strength.Grip and pinch are the results of a sequence of opening of hand, positioning the fingers, bringing the fingers to the object and maintaining a static phase that actually constitutes a grip and pinch. This is in contrast to fine dexterity, which shares the first three steps of the sequence but does not contain the static phase at all.Dexterity is being a skill controlled by higher centers in coordination with sensory, motor and visual inputs [13]. Moreover, hand movements are initiated by commands originating from region of primary motor cortex that contain high number of specialized corticospinal neuron, termed corticomotorneuronal (CM cells). CM cells descend into spinal cord to form monosynaptic connections with motor neuron in anterior horn. These monosynaptic connections may account for high amount of manual dexterity.

The application of this study is that normative values generated in this study can be used for clinical reference in the evaluation of hand function. It provides a means of comparing the score of individual patients to that of normal

subjects of the same age and gender. In addition, normative values are needed to interpret evaluation data, to set realistic treatment goals and to assess a patient's ability to return to employment.

Future scope of study is normative values for fine hand dexterity among adolescents and geriatric population need to be explored. The variations in fine hand dexterity among individuals involved in various occupations need to be explored.

CONCLUSION

Reference values for fine hand dexterity for adults were obtained in this study. There is no correlation between fine hand dexterity with grip and pinch strength.

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