

A Study to Establish Normative Data of Box and Block Test for Manual Dexterity in Children with 12-16 Years of Age.

Dr. Jaya Makhija¹, Dr. Amit M. Patel²

¹Second Year MPT Student, JG College of Physiotherapy, Ahmedabad.

²PG Guide (Orthopaedics) and Senior Lecturer, JG College of Physiotherapy, Ahmedabad.

Corresponding Author: Dr. Jaya Makhija

ABSTRACT

Background: The box and block test is a functional outcome measure that is used across various clinical population due to its ease and speed of implementation.

Introduction: Box and Block test is normally utilized in focus of gross manual skill. In clinical practice it is essential to compare scores of typically and atypically developing children which in turn offers information about rehabilitation. Thus, it is vital to have normal scores. This study aims to provide normal scores for both right and left hand in healthy children.

Method: An observational quantitative study was conducted in Ahmedabad city to establish developmental norms for children on box and block test. Study included total of 297 volunteers; 160 male and 137 female with age of 12-16 years. Each participant had 60 seconds to transfer block from one side of box to other with each hand simultaneously. Trial was given for 15 seconds before performing the test. Number of blocks transferred via each hand within the time limit was noted.

Result: Using summary statistics (mean, standard deviation and 95% confidence interval) reference values for box and block test are presented. Mean scores for male's right hand ranged from 67.61-62.89 and 64.00-59.72 for left hand whereas mean score for female's right hand ranged from 65.33-62.55 and 61.29-57.27 for left hand.

Conclusion: The normative reference values provided in this study may serve as a guide for interpreting box and block test measurements obtained from tested individuals.

Key words: children, box and block test, manual dexterity, normative, Ahmedabad

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I. INTRODUCTION:

Functional independence of children is determined by multiple factors such as cognitive ability, gross motor function and manual dexterity. Atypical children such as those with cerebral palsy, muscle dystrophy or any other condition involving musculoskeletal or nervous system must have one or more factor of independence being affected. Manual dexterity involves complex abilities that allow for rapid and coordinated hand movements and that require proper integration of upper limb with central nervous system. Gross manual dexterity is strongly related to manual abilities required for child's functional independence.

Manual dexterity is outlined as the potential to use the hands and fingers to execute accurate and delicate movements. ^[1] It relies on integration of sensory and motor function, which allow for easy grasping and release of an object. ^[2] Impaired manual dexterity is a common clinical problem for individuals with various diagnoses which abate activities of daily living. ^[2]

In order to address these deficits with patients, clinical therapists rely on valid tool which can accurately measure manual dexterity. ^[3] Norm referenced assessment are important for clinical evaluation before giving treatment.

Of many dexterity tests, Box and Block test (BBT) is one maximum extensively used approach to evaluate manual dexterity ^[2, 3] Validity and reliability have been established for BBT and high inter-rater reliability and concurrent validity have also been shown in other studies. ^[3]

Box and Block test is a functional outcome measurement that is commonly used across a couple of clinical populations due to its ease and speed of implementation. ^[4] This is a basic test that can be utilized to gauge gross manual smoothness. ^[5] Box and Block test can be constructed in most clinics at a reasonable cost and blocks are available commercially; also it is appropriate for evaluating dexterity of individuals with low

intelligence and or limited manual dexterity such as in patients with hemiparesis, cerebral palsy and other diagnosis involving upper extremity.^[6]

Currently, to my knowledge, norms for box and block test for children with 12-16 years of age have not been established among Indian population. Thus, it is necessary to develop norms for clinical assessment and evaluation.

The aim of this study was to establish normative data of Box and block test for manual dexterity in children with 12-16 years of age.

II. MATERIALS AND METHOD:

Research and Sample design: In this study, investigation received an observational quantitative examination and samples were collected via simple random sampling.

Participants: BBT was administered to typically developing children^[4, 7] aged 12-16 years who were recruited from different schools across Ahmedabad city. 297 volunteers were recruited for the study, among which 160 were male and 137 were female.^[2]

All the participants were dominant for right hand and non-dominant for left hand.

Inclusion Criteria: Children with 12-16 years; both male and female; participants willing to participate. **Exclusion to the study** were participants with recent history of fracture or any musculoskeletal condition involving upper limb which can affect hand dexterity.

All the participants were able to follow verbal commands and written informed consent was taken.

Test administration: Test procedures followed those established by Mathiowetz et al. (1985). The idea of box and block test originated with A.Jean and Patrica Holser Buehler^[6]

Dimension of box were 25.4 cm X 53.7 cm X 8.5 cm divided by 15.2 cm length wooden piece at the center converting it into two areas. 150 cubes measuring 2.5 cm on each side were used^[2, 6, 8]

Participants were seated on an upright chair with test apparatus in front of the table.

Instructions were given and a trial of 15 seconds was provided. If any mistakes during the trial session were seen, the experimenter would give proper and correct instructions before starting the test. On starting the test, with dominant hand first one block is picked up and transferred to other side without dropping and no more than one block should be picked up at a single time. Test time is 1 minute (60 seconds).

The procedure should be repeated with non-dominant hand then. A block dropped shall be counted only if it has crossed the midline of box, and no time shall be wasted in picking it up.

Therapist is seated in front to assess any mistake during the test. At the end of each trial, the experimenter or researcher counts the total number of blocks transferred in one minute and the count was recorded as score^[6, 7]

III. RESULT

Data for dominant and non-dominant hand for each age group was analyzed via Spss v.20 for windows.

Summary statistics as mean, confidence interval and standard deviation were used.

Alpha level was set at 0.05(p<0.05).

Age	Gender	N(sample size)	Dominant hand Mean(SD)	Nondominant hand Mean(SD)
12 years	Male	36	67.61(7.19)	64.00(6.81)
	Female	24	65.33(7.27)	61.29(8.58)
13 years	Male	36	69.36(8.04)	64.77(8.15)
	Female	22	66.77(6.21)	60.81(7.71)
14 years	Male	32	65.87(6.42)	63.21(7.03)
	Female	30	64.13(6.54)	60.46(7.15)
15 years	Male	27	66.40(6.33)	59.03(8.54)
	Female	32	66.93(8.09)	62.03(7.92)
16 years	Male	29	62.89(8.01)	59.72(8.52)
	Female	29	62.55(6.87)	57.27(7.87)

Table 1: Descriptive Statistics of each age group

Age	Gender	95% Confidence Interval Right hand		95% Confidence Interval Left hand	
		Lower bound	Upper bound	Lower bound	Upper bound
12years	Male	65.28	69.94	61.78	66.22
	Female	62.43	68.23	57.86	64.72
13years	Male	67.04	71.68	62.13	67.41
	Female	64.19	69.35	57.06	64.02
14years	Male	63.66	68.08	60.78	65.64
	Female	61.08	66.46	57.92	63.00

15years	Male	64.03	68.77	55.82	62.24
	Female	64.13	69.73	59.29	64.77
16years	Male	59.99	65.79	56.63	62.81
	Female	60.18	65.03	54.41	60.13

Table 2: Normative range of box and block test for each group using 95% Confidence Interval

IV. Discussion

Various elements of child development play a vital role, amongst which manual dexterity was the focus of this study. Manual dexterity develops during early childhood^[10, 14] and this curriculum pays attention to development of the dispositions toward learning, solid emotional foundation for all future academics, skills and learning which facilitates child to grow^[9, 14]

Development of manual dexterity like development of motor skills in whole body is intimately related to development of nervous system^[10]

Between 3-10 years of age, the wrist becomes stabilized on internal aspect. This allows children to start performing activities that prepare them for writing and other activities, which are important skills. In a study involving robot assisted therapy, Gilliaux et al. included use of BBT for evaluation of body structure and function. The interaction between treatment time and group revealed that smooth, discrete, unidirectional movements improved in the experimental group, demonstrating an improvement in dexterity in the affected hand^[12]

Keh-chung Lin et al. used BBT to evaluate manual dexterity and found large, significant effects on motor function^[12]

Regarding test-retest reliability, high ICC value 0.96 demonstrated that BBT is a stable measure across period of time^[13, 15, 16]

Given clinical focus on hand related intervention by occupational therapist's development of standardized norm referenced assessment tools for manual dexterity is crucial. As resources concerning Indian population mainly children are scanty, accurate and timely initial assessment is a necessity for screening and identification of possible manual dexterity deficits in clinical population we treat. Thus, this study results provide norms for BBT in healthy children between 12 and 16 years of age. Methiowetz reported that right hand dominant scored best with right and left hand non-dominant scored less with left hand^[6] Also, this study showed that dominant hand score was higher when compared to non-dominant hand and these results are consistent with other such study.

Limitation of this study: Samples were not equally distributed for each age group; participants with left hand dominant were not taken; data were not same at baseline.

Future recommendation: Can be done with different population and different age group in other state/place with larger sample size and equal distribution of participants; participants with left hand dominance should be considered.

V. Conclusion

Studies analyzed suggest that box and block test is fast, easy, safe measure of manual dexterity with good applicability for both adults and children with neurofunctional disease^[11]

This study collected BBT scores from 297 healthy children and provides norm scores for BBT for gross manual dexterity in children with 12-16 years of age. Obtained norms can be used in clinical setting to compare gross manual dexterity of atypically developing children with that of age related peers^{[17][18]}

Furthermore, this test is worthwhile to evaluate the efficacy of treatment technique tailored to enhance manual dexterity. In clinical setting, in case of children with neurological or muscular condition where dexterity is affected, occupational therapist as well as pediatric physiotherapist shall use these norms as reference.

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