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**Review**

# Establishing Normative Data for Fine manual control and manual dexterity composite of Bruininks Ose-retsky test of Motor Proficiency-2nd edition, for Children of 11-14 years in Western Maharashtra region

**Dr. Meenal Chavan (PT) [1], Dr. Aparna Sadhale (PT) [2]**

[1] *M.P.T (Neurosciences), DESBJCOP, Pune, India*
[2] *Principal, DESBJCOP, Pune, India*

*Author for Correspondence: Dr. Meenal Chavan
Email: meenal.g.chavan@gmail.com

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## Abstract

The optimal development of fine motor skills is significant, as they are critical components of most of our self-help skills, the child's learning environment and further activities of daily living. In current study, children of age 11-14 years were selected as mainly this population is in the puberty and adolescent period. The development of a child in a particular country may differ from a child of another. Hence norms of one country cannot be generalized. So, it is important to develop area specific norms of BOT-2 for children of western Maharashtra. Thus the aim of the study was to establish, Normative Data for fine manual control and manual dexterity composite of Bruininks Oseretsky Test of motor proficiency -2 nd edition, for Children of 11-14 years in Western Maharashtra region. BOT-2(test re-test reliability - 0.86 to 0.89, and validity - 0.78), is a standardized measure to evaluate Fine and Gross Motor Skills in individuals aged 4-21 year. The present study involves the Fine Manual control Composite and one component of Manual Coordination of BOT-2. The study is a cross-sectional observational study; performed on 104 (45 females and 59 males) healthy individuals from community. The normative data for the same was obtained using Mean and standard deviation. The normal range of standard composite scores of Fine Manual Control of BOT-2 were in 39-60, 35-56 and 37-58 for females, males and combined respectively and for scale score of Manual Dexterity BOT-2 were 13-21, 13-20 and 13-20 for females, males and combined respectively. The Obtained data can be used for appropriate analysis, motor delay detection, clinical analysis and future researches.

**Keywords:** Normative data, Fine motor skills, Bruininks Oseretsky Test of motor proficiency -2 nd edition (BOT-2), Fine Manual control, Manual dexterity, Manual Coordination

## INTRODUCTION

Child development involves a variety of interrelated factors such as sensory, motor, cognitive, social and emotional domains. Attainment of specific behavioral, physical, socio-emotional and cognitive milestones at specific age of life is termed as a normal development.[2]

Motor or physical development is a process by which a child learns to use and to coordinate large muscles of trunk, arms and legs and smaller muscles of hand. It consists of gross motor skill (GMS) and fine motor skill (FMS).Gross motor skills refer to motor behaviors related to posture and locomotion, from early developmental milestones to finely tuned balance; for example-one leg standing, jumping etc. and, the Fine Motor Skills involves motor behavior such as discrete finger movements, manipulation, and eye-hand coordination; for example Folding a paper, writing, building blocks etc.[2]

The development of fine motor skills is an important part of the overall development of the young child. The optimal development of fine motor skills is significant, as they are critical components of most of our self-help skills (e.g., eating, dressing, buttoning, zipping), the child's learning environment (e.g., writing, coloring, drawing, cutting, pasting), and further activities of daily living (ADLs; e.g., typing, turning the pages of a book, threading a needle).

The first few years of life are the most critical and sensitive period of motor development. [6] The first stage of fine motor development begins when we are 2-3 months old, when 5 the baby begins to try to reach for the toy, but can only swipe at it somewhat inaccurately. All Hand skills are developed over two years except handling and manual dexterity which improves in kindergarten age and reaches maturity by 5 years of life. [4]

Some children have exceptional difficulties performing motor tasks in-spite of not having neurological disease, physical abnormality or generalized developmental delay. This lack of coordination, clumsiness and awkwardness in movement or action is explained as Developmental Coordination Disorder (DCD). [4] [7] [8] It may be due to decreased wrist and hand strength, leading to immature grasping, use of excess or not enough pressure, dropping or breaking of objects, delay in dressing, trouble with eating, difficulty with tool use, laborious writing, drawing and coloring, and reduced ability with pasting, gluing, manipulating stickers and other art materials.[3]

Such problems if diagnosed early can help early intervention and prevention of above stated deficits that could have serious consequences for the child's health. Thus early assessment, proper analysis and precise treatment play a very key role in normal and proper on time development of a child. Earlier the treatment, more opportunity is given for the potential for developing any normal abilities and for decreasing the abnormal movement patterns and postural difficulties,[4] thus achieving near normal pattern of movement and function. Assessment tools used for the same should have good validity and reliability. There are a few tests that can be used to test children's motor skills-

- Movement Assessment Battery for Children (Movement-ABC)
- Peabody Development Scales (PDMS)
- Test of Gross Motor Development (TGMD)
- Nine Hole Peg Test
- MAc Test of SIPT
- Motor Performance School Readiness Test
- Test of Visual Motor skill
- The Bruininks-Oseretsky Test of Motor Proficiency (BOTMP).

The Bruininks-Oseretsky Test of Motor Proficiency, Second Edition (BOT-2), a revision of the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP, Bruininks, 1978), is an independent test designed to measure fine and gross motor skills for children and adolescents aged 4 to 21 years old. This rating has a Complete Form and a Short Form. It has a validity of 0.78 and reliability of 0.86 to 0.89. [9] The BOT-2 is made up of a combination of four motor areas- Fine Manual Control, Manual Coordination, Body Coordination, Strength and Agility.[5]

Different studies suggested that different factors influence motor proficiency in children. Motor proficiency is directly associated with physical activity in children and inversely proportionate with sedentary activity in children. Children and adolescents ability to perform Fundamental Movement Skill was significantly related to BMI and waist circumference. [11] Breast feeding has a positive effect on the overall development of the child and should be promoted in the present generation. Also, low socio economic status children had lower manual coordination, body coordination, strength and agility. Thus, it can be noted that, culture, nutrition, physical activity, socioeconomic conditions, geographic variation, ethnicity can affect motor development.

The development of a child in a particular area / country may differ from a child of another. Hence Norms of one country cannot be generalized for the population of other countries.

In current study, secondary section school going children were selected i.e. 11-14 years of age as mainly this population is in the puberty and adolescent period. The growth and maturation accelerates in this age group; i.e. 10 to 12 years in girls and 12 to 14 in boys. Some differences are seen in the anthropometric and physical

stature which may affect the motor performance. [14] Children from western Maharashtra, differ from USA children in all the aforementioned aspects. With same logic, the pre-established BOT-2 norms used for USA population may be used with the caution for a population of western Maharashtra. Thus it is important to develop area specific norms of BOT-2 for children of western Maharashtra. Thus the aim of the study was to establish, Normative Data for fine motor precision, fine motor integration and manual dexterity composite of Bruininks Oseretsky. Test of motor proficiency -2 nd edition, for healthy children of 11-14 years in Urban Area of Western Maharashtra region.

Data from this study can be used to set normative values for fine motor precision, fine motor integration and manual dexterity composite of BOT2 in Children of 11-14 years of western Maharashtra region and which can be used for the assessment and comparison of child's performance and development. This will help in rating and grading of an individual's performance, and so for the decision of continuation or the modification of the treatment.

## METHODOLOGY

The study is a cross-sectional observational study; performed on 104 healthy individuals between 11 to 14 years of age from community in western Maharashtra region. Individuals with known musculo-skeletal, cognitive or neurological impairment, with attention deficits, Upper limb fractures or surgeries in past 3 months, with any history of seizures or convulsions were excluded from the study. Materials included- BOT-2 kit (Examine Booklet, Red pencil, A pair of scissors, Pegs and peg board, Blocks and string, Pennies and penny board, Cards), Table, Chair, Individual record form, Pen, Paper and Timer.

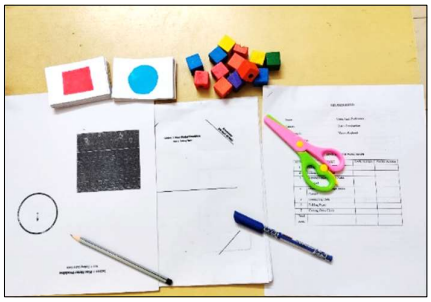


**Fig 1: Materials**

## PROCEDURE

The clearance from the college Ethics committee was taken prior to the beginning of the project. Children for the study were selected according to inclusion and exclusion criteria. Purpose of the study was explained to the subjects. Assent was taken from the child and a Consent was taken for each child from his/her parent/guardian. Standard instructions as per BOT-2 manual for each task were given. Before administrating, each task was explained to the child, using verbal and non-verbal directions as necessary. After ensuring the examinee's understanding, each task was assessed. At given time, only one child was assessed so as to ensure complete concentration and attention of that child. The present study involves the Fine Manual control Composite (Fine Motor Precision and Fine Motor Integration) and one component of Manual Coordination (Manual Dexterity) of BOT-2.

Fine Motor Integration involved seven sub-items which were as follows

1. Colouring a Circle
2. Colouring a star
3. Drawing lines through crooked path
4. Drawing lines through curved path
5. Connecting dots
6. Folding a paper
7. Cutting out a circle

Fine Motor Precision involved eight sub-items which were Copying a Circle

1. Copying a Square
2. Copying Overlapping Circles
3. Copying a Wavy Line
4. Copying a Triangle
5. Copying a Diamond
6. Copying a Star

7. Copying Overlapping Pencils

While, Manual Dexterity involved five sub-items which were

1. Making Dots in Circles
2. Transferring Pennies
3. Placing Pegs into a Pegboard
4. Sorting Cards
5. Stringing Blocks [15]

Scoring was done for each task according to the guidelines explained in examiner's manual of BOT-2. Raw scores obtained were entered in the record sheet of each child. Finally, the initial raw scores were converted into the Standard composite score.

Raw score ➡ Point score ➡ Scale score ➡ Standard Composite score.

According to the standard composite score, percentile rank of the subject and descriptive category of the subjects was recorded.

Data management and analysis procedure: As the present study was cross sectional observational study focusing on establishing normative data, scores obtained were entered in the Excel sheet. The normative data was established with Arithmetic Mean and SD with confidence interval of 95%.



**Fig 2: Child performing task**

**Statistical Analysis and Graphs**

**Table 1: Normative Data For Standard Scores Of Fine Manual Control Composite For Children Of 11 To 14 Years**

| | |
|---|---|
| FEMALES | 39-60 |
| MALES | 35-56 |
| COMBINED | 37-58 |

The normal ranges of Standard scores of Fine Manual Control Composite for females is 39-60, males is 35-56 and combined is 37-58.

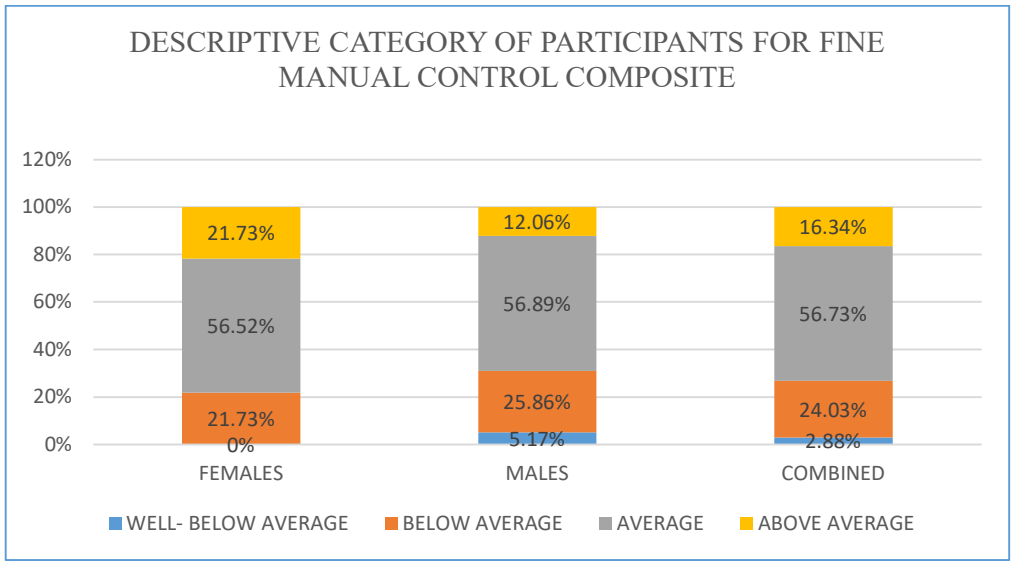
**Table 2: Normative Data For Scale Scores Of Manual Dexterity For Children Of 11 To 14 Years**

| | |
|---|---|
| FEMALES | 13-21 |
| MALES | 13-20 |
| COMBINED | 13-20 |

The normal ranges of Scale scores of Manual Dexterity Composite for females is 13-21, males is 13-20 and combined is 13-20.

**Table 3: Descriptive Category Of Participants For Fine Manual Control Composite**

| | FEMALES | MALES | COMBINED |
|---|---|---|---|
| Above Average | 21.73% | 12.06% | 16.34% |
| Average | 56.52% | 56.89% | 56.73% |
| Below Average | 21.73% | 25.86% | 24.03% |
| Well-Below Average | 0% | 5.17% | 2.88% |

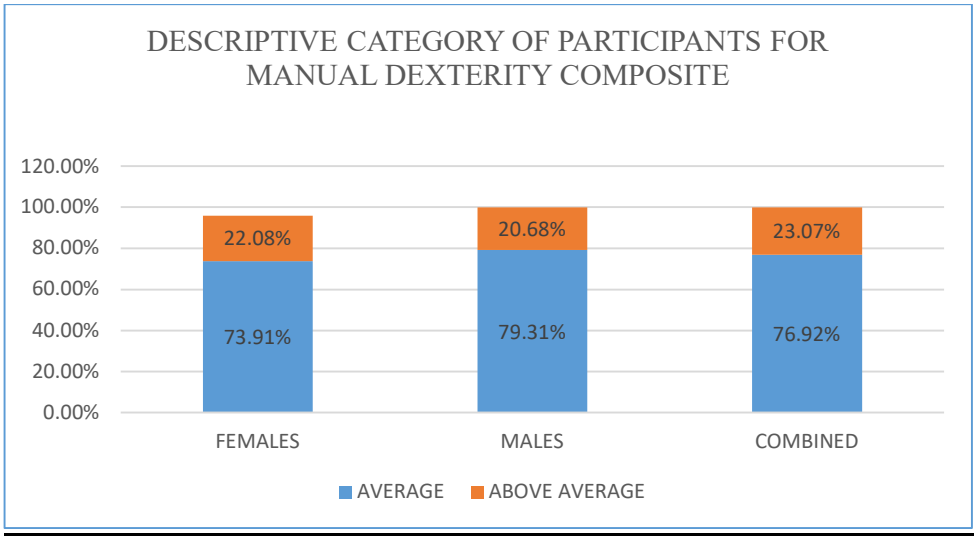



**Graph 1: Descriptive Category Of Participants For Fine Manual Control Composite**

**INFERENCE:** Maximum participants (56.89%) were average amongst the male participants, (56.52%) were average amongst the female participants and 56.73% % were average in combined category.

**Table 4: Descriptive Category Of Participants For Manual Dexterity Composite**

| | FEMALES | MALES | COMBINED |
|---|---|---|---|
| Above Average | 22.08% | 20.68% | 23.07% |
| Average | 73.91% | 79.31% | 76.92% |




**Graph 2: Descriptive Category Of Participants For Manual Dexterity Composite**

Maximum participants were average (79.31%) in male participants, (73.91%) were average in female participants and (76.92%) were average in combined category.

## DISCUSSION

Aim of the study was to establish normal range of scores for fine motor precision, fine motor integration and manual dexterity composites of BOT-2 for children of 11-14 years in western Maharashtra.

Table-1, graph-1 denotes the normative data of standard scores of fine manual composites in range for standard score for fine manual composite for female population was 39-60, for male population was 35-56 and for combined population was 37-58. Similarly, table-2, graph-2 denotes the normal range for scale score for manual dexterity composite for female population was 13-21, male population was 13 -20 and for combined population was 13-20. The obtained normal values in the present study can be used for appropriate assessment and evaluation of child‟s functional skills and to know whether he/ she is normal or has some difficulties or delays in fine motor performance.

Cross- cultural difference in motor development is an important issue studied by previous researchers. [1,6,14,16] Differences in Fine motor scores of Bruininks Ose-retsky scale of Motor Proficiency was observed between healthy children in Hong Kong and those in the 57 United States. The children in Hong Kong performed better in the Upper limb speed and dexterity component which might be due to early exposure of fine manipulation tools like chopsticks by Hong Kong children at early age (Mandy et al). [17] The comparison of performances in Australian preschoolers with the US norms also indicated the differences between the two groups (Annabel et. al). [18] Another study was performed in an Indian population by Dr. Bhagyashree Gokhale, Dr. Atiya Shaikh in Children aged 4-5 years. In this study normative data for fine manual composite of BOT-2 was obtained and were concluded that it was same as per USA norms. [19] Jaya Shankar Tedla et. al performed two studies on Indian children of age group 6 ½ to 9 ½ and 9 ½ to 14 ½ . Both the studies established normative data for all subsets of BOTMP and also concluded that age strongly affects the motor proficiency, whereas gender has influence on only running speed and agility. ([6,7]

Considering above information it was decided to observe the category of participants with respect to that of the USA children. Descriptive category provides another tool for communicating test results. According to the descriptive category described in table-3, graph-3 of manual control composite maximum participants were average in both the genders with females 56.52%, males 56.89% and combined category with 56.73% According to table-4, graph-4 in descriptive category of manual dexterity, the maximum participants were average in both genders with females 73.91%, males 79.31% and combined category with 76.92%. [8]

Thus, it was noted that in spite of all cultural, environmental and social differences in children of western Maharashtra and USA, the Fine motor skills were seen to be developing at same rates in both regions. The reasons for the same may be explained on the basis of increasing globalization. Moumita et.al in 2017 explained the impact of Globalization on childhood. In India globalization is a recent phenomenon that has emerged in the last two decades. [21, 22] Globalization has changed the lifestyle, recreational approach, dressing and habits, this is reflected as mirroring of USA lifestyle and culture in India. [21] Improved parental education leading to revision of parenting skills have been observed in the 21st century in India. [21] The educational system in India might also have changed with set up of International schools with the generalized pattern and syllabus of learning and teaching which has a vast influence of US. Thus fine motor skills in children were seen to be developing at similar rates in both the regions (western Maharashtra and US). It may be possible that in spite of geographical and cultural differences, children of both the regions are getting similar stimulation and training which might be responsible for similar rates of development of Fine motor skills (FMS).[9]

To conclude, current study provided the normal range of 11-14 years children of western Maharashtra for fine manual composite for female population is 39-60, for male population is 35-56 and for combined population is 37-58. Similarly, the normal range for scale score for manual dexterity composite for female population is 13-21, male population is 13 -20 and for combined population is 13-20. [10]

## CONCLUSION

The normal range of standard composite scores of Fine Manual Control of BOT-2 were in 39-60, 35-56 and 37-58 for females, males and combined respectively. The normal range of scale score of Manual Dexterity BOT-2 were 13-21, 13-20 and 13-20 for females, males and combined respectively.

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