

Catch the Moving Ruler and Estimate Reaction Time in Children

Vencita Priyanka Aranha*, Ruchi Joshi**, Asir John Samuel***, Kavita Sharma****

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Abstract

Background: Advances in mobile based software application made the estimation of one's reaction time (RT) with more accuracy and reliable. But whether the same can be established by the Ruler Drop Method (RDM) in children are not yet explored. **Objective:** To establish the validity of RDM in typically developing children (TDC). **Method:** Eighteen TDC were recruited for the cross-sectional study by the simple random sampling from recognized school. All the anthropometric measurement were taken prior to commencement of the study. In RDM, the child were made to sit with their dominant forearm resting on a flat horizontal table surface, with their open hand at the edge of the surface. When the examiner suspend and release the ruler vertically the child were instructed to catch it as quickly as possible. The distance the ruler fell was recorded, in centimetres, by measuring from the end of the ruler to superior aspect of the child's hand. This distance was converted to reaction time in milliseconds (ms). Spearman's Rank-Order correlation was used to establish the validity with the mobile based software application (MBSA) in estimating RT as the criterion referenced. **Result:** RDM shows moderate to good degree of relationship with MBSA with Spearman's

$\rho = 0.54$ ($p=0.031$). **Conclusion:** RDM is proved to be valid among TDC.

Keywords: Boys; Children; Girls; Reaction Time Ruler; Ruler; Ruler Drop Test; Validity.

Introduction

Reaction time (RT) is the delay between presence of stimulus and beginning of response [1]. It is a measure how quickly an organism can respond to a particular stimulus. Lesser the reaction time it multiplies ones achievements in many areas such as, sports, academics, music, dance, driving, defence etc. By identifying the person's reaction time, we can predict reacting abilities in the above mentioned situations. In case of children, this helps us to identify the children with prolonged reaction time and to identify the cause. Thereby individual attention can be given to these children at their younger age. Thus, estimating the reaction time of children at their younger age is more prior. Reaction time of an individual is estimated clinically by computerized neuropsychological test [2, 3]. But high professional guidance in estimating reaction time makes this unavailable cost and for the school children. Though mobile based android applications are available for estimating reaction time, but the restricted usage of mobiles at schools makes this as a tough task. Eckner et al [4, 5] validated his simple instrument for the estimation of reaction time in college students. In our preliminary study, we established the reliability of ruler drop method (RDM) in estimating RT and it was found to have excellent reliability among typically developing children (TDC). Hence, there is a definite need to validate a simple instrument to be used in schools like ruler.

Author's Affiliation: *,****Post Graduate student
,*Assistant Professor, Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Maharishi Markandeshwar University, Mullana University Road, Mullana, Ambala, Haryana- 133 207

Reprint request: Asir John Samuel, MPT, Assistant Professor, Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Maharishi Markandeshwar University, Mullana University Road, Mullana, Ambala, Haryana- 133 207

E-mail: asirjohnsamuel@mmumullana.org,
asirjohnsamuel@gmail.com

Methodology

Subject recruitment

A sample of 12 children, age range from 6 to 12 years were recruited by simple random sampling, participated in the cross-sectional study with the prior permission from the principal of participating school and also parents/legal guardians. The study protocol was approved by the university ethics committee as well as the institutional research committee and registered in clinical trial registry of India (CTRI/C2014/11/5161). The studies were done by the guidelines laid by Indian Council for Medical Research (ICMR) and Helsinki Declaration (Revised 2010). The

assent from children and consent from their parents/legal guardians were obtained prior to the study.

Procedure

All anthropometric measurement will be taken before the initiation of study. To measure RT by RDM, the child were made to sit with their dominant side elbow flexed at 90° with mid-pronated forearm resting on a flat horizontal table surface, with the open hand at the edge of the surface. The stainless steel ruler were suspended vertically by the examiner, such that 5 cm graduations of the ruler were aligned between the web space (the space between thumb and index finger) of the child's hand. Then the child was asked to catch the ruler once it was released from the examiner's hand.

Fig. 1: Measuring reaction time (RT) using ruler drop method (RDM), starting point (Figure 1a) and end point (Figure 1b).



Distance the ruler travelled from starting 5 cm was recorded. Then this distance was converted into time by using following formula, $t = (2d/g)^{1/2}$. Here, t = reaction time; d = distance travelled by the ruler and $g = 9.81\text{m/s}^2$ (gravitational constant). Three trials were taken and their mean were taken into analysis.

Validity

To establish the concurrent validity of RDM among TDC, the RT of the sample of 12 children were determined using the mobile based software application (MBSA) for Android phones, *Reaction speed*[®] as criterion referenced. In similar to the above, the mean RT of three trials was considered for analysis.

Figure 2: Measuring reaction time (RT) using mobile based software application (MBSA).



Data Analysis

Data analysis was performed using the software, statistical package for social sciences (SPSS®v16 Inc., Chicago, IL) for Windows 7 student edition. Normality of collected data was established by Shapiro-Wilk test as the sample size is < 50. As the demographic data follow normal distribution and it was expressed as mean ± standard deviation (SD). While RT established by RDM and MBSA does not follow normal distribution. So, RT were transformed logarithmically and then back transformed to report the geometric mean and 95% confidence interval (CI). When data are skewed geometric mean and 95% CI are appropriate than to express the arithmetic mean. Thus, central tendency of demographics and RT were reported.

To analyse the validity of RT established by RDM, the data were compared with RT established by MBSA. Spearman’s Rank-Order correlation were used for the above cause and it was expressed in Spearman’s Rank-Order correlation coefficient, \hat{A} (rho). Significant level was set to p less than 0.05 (p < 0.05) to minimize the type-I error.

Results

Total of 12 TDC were recruited for the study, four (04) were boys and eight (08) were girls. Though unequal representation exists between the gender, there is no significance difference (p<0.05) exists between the mean demographic parameters, from Table 1.

Table 1: Demographic characteristics of typically developing children (TDC) recruited.

Characteristics	Boys Mean±SD (n=4)	Girls Mean±SD (n=8)	p-value
Age (yrs)	9.5±2.4	9.5±1.9	0.99
Height (cm)	142.8±11.7	138±12.9	0.55
Weight (kg)	29±6.7	34.9±14.3	0.46
BMI (kg/m ²)	14.1±2.4	17.7±3.9	0.14

Abbreviations: BMI-Body Mass Index; SD-Standard Deviation

Table 2 shows the geometric mean with 95% confidence interval (CI) and range of RT established by RDM and MBSA. The relationship between RDM and the criterion referenced MBSA is expressed in

terms of Spearman’s \hat{A} (rho) = 0.54 (p=0.031). Thus RT by RDM has moderate to good degree of validity, according to Porteney and Watkins criteria in judging the relationship, used in the similar study by the author, [6] which is displayed in Figure 3.

Fig. 3: Scatter block displaying the correlation plot between ruler drop method (RDM) and mobile based software application (MBSA) in estimating reaction time (RT).

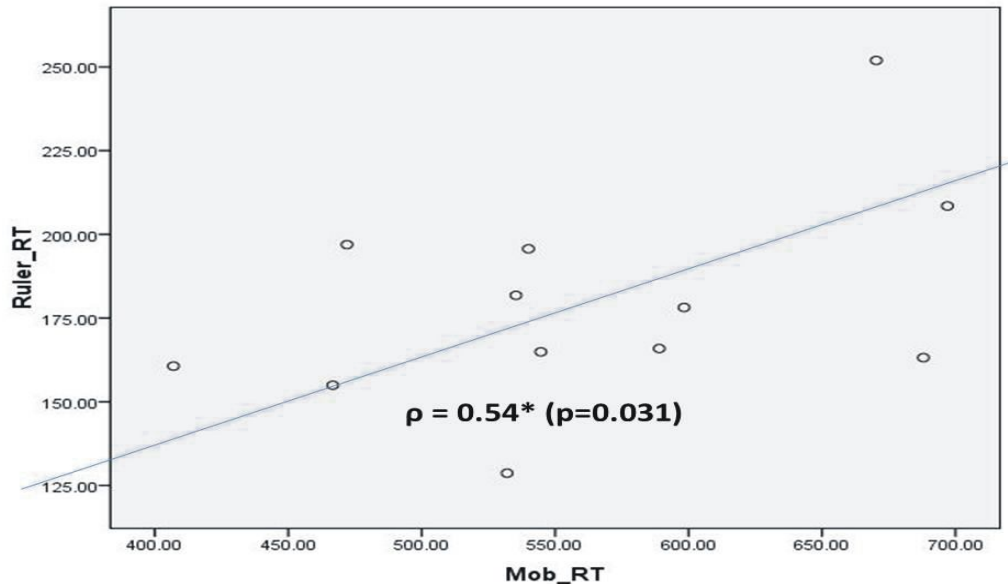


Table 2: Mean reaction time (RT) established by ruler drop method (RDM) and mobile based software application (MBSA)

Reaction time (ms)	Geometric Mean (95% CI) in (ms)	Range (ms)
RDM	177.83 (158.48 – 194.98)	128.68 – 251.95
MBSA	224.67 (186.92 – 261.73)	149.16 – 293.71

Abbreviations: RDM-Ruler drop method; MBSA-mobile based software application; CI-confidence interval; ms-milliseconds.

Discussion

The mean RT of TDC estimated by MBSA (224.67 ms) is slower than RDM (177.83 ms). The reason might be due to the interesting task of catching the moving ruler than the more familiar mobile phones among present generations. All the children were found being motivated throughout task through the curiosity and competitiveness created among peers in completion of the task. Small sample size and minimal unavoidable human error during measurement of distance travelled by the ruler are the limitations of the study. As the availability of ruler is more easier, RT can be estimated conveniently even in classrooms, out patients department, hospital wards, etc without the help of more sophisticated laboratory.

Conflict of interest:

None declared.

Conclusion

Reaction time (RT) established by ruler drop method (RDM) were found to have moderate to good degree of validity among the typically developing children (TDC).

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