Original Research Article

# A study to compare the hand motor functions of right-handed and left-handed children

Karthik M*

Assistant Professor, Department of Physiology, Nimra Institute of Medical Sciences, Vijayawada, Andhra Pradesh, INDIA.
**Email:** mkmy46@gmail.com

## Abstract

**Background:** Humans are predominantly right-handed (90%-10%). Also handedness is related to socio-cultural context such that in non-western cultures like India the preferred hand is the right hand and strict sanctions are observed about the use of left hand. Earlier studies have contested that right-handers significantly outperform the left-handers on motor performance, explaining that maturational differences provide an advantage to those with left hemispheric dominance. The present study seeks to investigate whether left-handed children are in a disadvantage to right-handed children with respect to hand motor performance and whether socio-cultural pressures have validation. **Methods:** 100 school children in the age group 10-14 years were the subjects. Their handedness was first established using Edinburg Handedness Inventory. Three reliable tests of motor performance: hand grip, finger tapping, hand steadiness were measured using dynamometer, mechanical tapper, hand steadiness machine respectively. **Results:** There were no significant difference for all the three motor tests between the dominant hands, and between the non-dominant hands of right- and left- handed children of this age group. **Conclusion:** The study shows that left-handers perform similarly to right-handers on all three measures. This is in contrast to earlier suggestions that right-handers with left hemispheric dominance outperformed the left-handers. This reflects that there is no difference in development pattern and maturation between the two groups of this age group. And suggest that left-handers are not at a disadvantage, and children should be allowed to choose their own handedness without any socio-cultural pressures.

**Key Words:** Right-handed children, left-handed children, dominant-hand, non-dominant hand, hand grip, finger tapping, hand steadiness.

***Address for Correspondence:**
Dr. Karthik M., Assistant Professor, Department of Physiology, Nimra Institute of Medical Sciences, Vijayawada, Andhra Pradesh, INDIA.
**Email:** mkmy46@gmail.com
Received Date: 23/07/2018 Revised Date: 12/08/2018 Accepted Date: 07/09/2018
DOI: https://doi.org/10.26611/103732

| Access this article online | |
|---|---|
| Quick Response Code: | Website: www.medpulse.in |
| | Accessed Date: 12 September 2018 |

## INTRODUCTION

An individual who is more skilled with the right hand is called right-handed, and one who is more dextrous with the left is said to be left-handed. Humans are predominantly right-handed (90%-10%). Also handedness is related to socio-cultural context such that in non-western cultures like India the preferred hand is the right hand and strict sanctions are observed about the use of left hand.[1] About 97% of right-handers are left-brain dominant. Contrary to what might be expected, only 19% of left-handers and 3% of right-handers are right-brain dominant. The preferred hand is suggested to be a genetic attribute. Handedness is also accounted by basic motor asymmetry. And handedness is also linked with language lateralization following the observation that right handedness is closely related to left hemispheric dominance for language. Handedness in very preterm children at school age is predicted by the integrity of neonatal corpus callosum.[2]Learning theory proposes that handedness is influenced by cultural and social pressures. Another study showed the probability of handedness shifting in hemiplegic children.[3] The left cerebral hemisphere is related to logical processing and language whereas the right hemisphere is implicated in spatial recognition. With respect to motor control in humans, a striking feature is that more than 90% of the population are right-handed, that which is controlled by the left hemisphere.[4,5,6,7] Measures of motor function of non-right

How to cite this article: Karthik M. A study to compare the hand motor functions of right-handed and left-handed children. *MedPulse International Journal of Physiology*. September 2018; 7(3): 50-53. https://www.medpulse.in/Physiology/

handedness reflects effective hemispheric lateralization.[8] The association of handedness and motor performance has important implications at the work place and whether use of right handed norms for left-handed subjects is justified. Relationship between handedness and motor cortical organization has interactive effects with age.[9]Handedness arises from the interaction between individual and environmental characteristics, interaction with the object, task and can be deemed adult-like between the ages 10 and 12.[10]The present study tries to evaluate the hand motor performance in right-handed and left-handed children aged 10 to 14 years. Unlike earlier studies, the present study considers three dependable characteristic measures of motor performance (hand grip strength, finger tapping and hand steadiness) to assess the hand's multidimentional motor attribute.[11,12]Also earlier studies have contested that right-handers significantly outperform the left-handers on motor performance, explaining that maturational differences provide an advantage to those with left hemispheric dominance.[13]When children are left to their own choice, they will normally develop their own right or left hand preference around or shortly after the age of three. But hand functions develop as children grow. Since hand is a necessary organ for various activities of daily life, it is vital that dexterity and hand motor skills in children be investigated.[14,15]The present study seeks to investigate whether left-handed children are in a disadvantage to right-handed children with respect to hand motor performance. And whether socio-cultural sanctions and norms against the use of left hand in children in countries like India has any validation.

## MATERIAL AND METHODS

Source of data: 100 school students in the age group 10 to 14 years (90 right-handed and 10 left-handed in accordance with the universal incidence of handedness in humans). Both boys and girls were included.

**Inclusion Criteria:** healthy school children in the age group of 10-14 years, both boys and girls.

**Exclusion Criteria:** children with upper limb fractures or deformities, neuromuscular diseases, those under medication. Methods of collection of data: The permits from the Institutional ethical committee and School board and informed written consents from the parents were obtained. The handedness of the children was determined using the reliable Edinburgh Handedness Inventory[16]. This gives the laterality quotient (L.Q) using a ten item inventory. The L.Q is arrived by first adding all the +'s(hand preference for the items). The total of pro left items was subtracted from that of pro right items, which was then divided by the sum of both and multiplied by 100. Positive value signifies right-handedness and negative value suggests left-handedness. All tests were explained and demonstrated to the children and its non-invasive nature was emphasized. The data was analyzed using SPSS 20 software. Equal variance was assumed for the Independent Samples t-test.

**Hand motor performance Tests**

- Hand grip strength: Improved Smedley's Dynamometer was used to record the hand grip strength. Optimum adjustment was done to the dynamometer by whirling the inner stirrup to one half the distance from where the subject's thumb joins his/her hand to the end of his fingers. Or else it could be altered to conform to the subject's hand. The grip strength of each hand alternately was recorded in kilograms, three trials with 60 seconds interval between each. The highest reading was taken for statistical analysis, The children were asked to exert his/her maximal grip, and in each trial were encouraged to do his/her best.
- Finger tapping: Subjects were instructed to use their forefinger to tap a mechanical tapper, with each hand alternately. The total number of taps in 15 seconds by each hand was determined. The subjects had to hold their arm firm and steady during the finger tapping test.
- Arm-hand steadiness machine: The steadiness tester has holes in them of decreasing diameters for subsequent holes (10 mm,9,8,7,5,4,3.5 and 2.5mm). Subjects were required to hold a stylus within a hole without touching the edge of the hole. If touched, the machine would beep. The smallest hole in which the subject held the stylus without touching the edge with each hand was considered for statistical analysis.

## RESULTS

**Table 1:** Comparison of Hand Grip Strength(kg) of dominant hands of Right-handers and Left-handers

| Hand | N | Mean | SD | t | P |
|---|---|---|---|---|---|
| Right -Handers (Right hand dominant) | 90 | 15.300 | 5.711 | 1.562 | .121 |
| Left –Handers (Left hand dominant) | 10 | 18.300 | 6.236 | | |

**Table 2:**Comparison of Finger Tapping(number/15 seconds) of dominant hands of Right-handers and Left-handers

| Hand | N | Mean | SD | t | P |
|---|---|---|---|---|---|
| Right -Handers (Right hand dominant) | 90 | 69.611 | 8.670 | .788 | .433 |
| Left –Handers (Left hand dominant) | 10 | 67.300 | 9.978 | | |

**Table 3:** Comparison of Steadiness(smallest hole in mm without touching the edges) of dominant hands of Right-handers and Left-handers

| Hand | N | Mean | SD | t | P |
|---|---|---|---|---|---|
| Right -Handers (Right hand dominant) | 90 | 7.888 | 1.575 | .357 | .722 |
| Left –Handers (Left hand dominant) | 10 | 7.700 | 1.702 | | |

**Table 4:**Comparison of Hand Grip Strength(kg) of non-dominant hands of Right-handers and Left-handers

| H | N | Mean | SD | t | P |
|---|---|---|---|---|---|
| Right -Handers (Left hand non-dominant) | 90 | 13.544 | 4.780 | 1.464 | .146 |
| Left –Handers (Right hand non-dominant) | 10 | 15.900 | 5.258 | | |

**Table 5:**Comparison of Finger Tapping(number/15 seconds) of non-dominant hands of Right-handers and Left-handers.

| Hand | N | Mean | SD | T | P |
|---|---|---|---|---|---|
| Right -Handers (Left hand non-dominant) | 90 | 60.711 | 8.732 | 1.117 | .267 |
| Left –Handers (Right hand non-dominant) | 10 | 64.000 | 9.763 | | |

**Table 6:**Comparison of Steadiness(smallest hole in mm without touching the edges) of non-dominant hands of Right-handers and Left-handers

| Hand | N | Mean | SD | t | P |
|---|---|---|---|---|---|
| Right -Handers (Left hand non-dominant) | 90 | 9.266 | 1.119 | 1.938 | .056 |
| Left –Handers (Right hand non-dominant) | 10 | 8.500 | 1.715 | | |

Conventional test threshold of $P<0.05$ was considered to compare the data for statistical significance. Table 1, 2 and 3 presents the data for the dominant hands of the right-handed and left-handed children. The Mean and Standard Deviation (S.D) of the hand grip strength, finger tapping, hand steadiness are depicted in these tables respectively. The Independent-Samples t-test when equal variances are assumed shows that the difference between the three measures of dominant hand of right-handers and the dominant hand of left-handers are not significant (Table 1: t=1.562 and p=.121, Table2: t=.788 and p=.433, Table 3: t=.357 and p=.722). Furthermore the three measures of motor performance for the non-dominant hands of right-handers and left-handers are shown in the tables 4, 5 and 6. Likewise, the non-dominant hand of the left-handers did not differ significantly from that of the right-handers for all the three measures (Table 4: t=1.464 and p=.146, Table 5: t=1.117 and p=.267, Table 6: t=1.938 and p=.056). Though the left-handed children performed poorly with their non-dominant hand for hand steadiness, it was not statistically significant. The results thus furnish evidence that the left-handed children performed the hand motor tasks similarly to the right-handed children.

## DISCUSSION

The motor performance of the dominant hands of right-handed and left-handed children were evaluated and compared. Likewise the non-dominant hands were compared. The Independent-Samples t-test when equal variances are assumed shows that the difference between the dominant hand of right-handers and the dominant hand of left-handers on all three measures are not significant. The Independent-Samples t-test when equal variances are assumed shows that the difference between the non-dominant hand of right-handers and the non-dominant hand of left-handers on all three measures are not significant. The results furnish evidence that there is no significant difference in motor performance between the dominant hands of right- and left-handers and between the non-dominant hands of right- and left-handers of this age group. It is viewed that right-handers prefer more often to use their right hand for manual activities and also their language lateralization is homogeneous in that it is lateralized to the contralateral left cerebral hemisphere. Hence right-handers are considered to be more powerful with their right hand. Whereas 60% of left-handers have language lateralized in the left hemisphere, which is ipsilateral to the preferred hand. Thus, left-handers have heterogeneous lateralization pattern and are dissociated on measures of hand preference and strength than right-handers. This is in support of study by Gurd, Schulz, Cherkas and Ebers who showed that among monozygotic twins, the right-handers are more strongly lateralized than their left-handed sisters.[17] And they infer that right-handers being more lateralized people than left-handers, display more functional asymmetries than left-handers. But our study on children aged 10 to 14 years shows that left-handers also show motor performance asymmetries between their dominant and non-dominant hand similar to right-handers. This implies that the lateralization pattern and its extent are not yet dissimilarly established between right-handers and left-handers of this age group. Finger tapping being a sequential movement, hemispheric specialization was considered for the asymmetry in skill. This view was supported by Todor, Kyprie and Price and Todor and Smiley who showed a right hand advantage in finger tapping and they attributed this to the left hemispheric specialization for the organization and control of sequential movement and in timing the forces involved in accelerating and decelerating the movement[18,19]. But our study shows that the dominant hands of both right- and

left-handers (right hand and left hand respectively) exceed in finger tapping. This is in support of Peters who viewed that increased use of the preferred hand would induce asymmetry in a given skill[20]. Finger tapping being a skill, can also be attributed to the better learning rate and skill performance of the dominant hand of both right- and left-handers.The results provide evidence that left-handers perform in a similar manner as right-handers on all three measures. This is in support of Smith SM who showed that left-handed children performed very similarly to right-handed children[21]. This validates the use of right-handed norms for left-handed subjects. This reflects that there is no maturational difference and developmental pattern between the two groups of this age group. This implies that left-handers are not in a disadvantage over right-handers. Thus disproves earlier suggestions that right-handers with left hemispheric dominance outperform the left-handers. Children should be allowed to choose their own handedness without any socio-cultural pressures.Future studies should include other motor performance tests along with the three tests used in the present study, across other age groups to yield a comprehensive understanding of the difference between the two groups.

## CONCLUSION

The dominant hands of right- and left-handed children in this study do not show any significant difference on all three motor performance tests. Likewise, there is no significant difference between the non-dominant hands of right- and left-handed children. This provides evidence that there is no advantage for either right- or left-handers on motor performance. And disproves earlier suggestion that right-handers with left-hemispheric dominance outperform left-handers on motor performance. This indicates no maturational differences between right- and left-handed children of this age group. So, it is suggested that children should be allowed to normally develop their own right- or left-hand preference. The socio-cultural pressures and sanctions against left-hand use should be curtailed especially in India.

## REFERENCES


1. Manas MK, Dutta T. Left handedness: Facts and Figures across Cultures. Psychology and Developing Societies 2001; 13(2): 173-191.
2. Pascoe et al, Neurodevelopmental outcomes and neural mechanisms associated with non-right handedness in children born very preterm, J IntNeuropsychol Soc. 2015 September; 21(8): 610–621.
3. Jinwhan Cho, Kyung-Seok Pak, manho Kim, Seong-ho Park.Handedness and Asymmetry of Motor Skill Learning in Right-handers. Journal of Clinical Neurology 2006 Jun; 2(2): 113-117.
4. IndiwarMisra. Laterality and Its Assessment: Emerging Perspectives and Issues. ICSSR Indian Psychological Abstracts and Reviews 2007; 13(1and2).
5. Tao Sun, Christopher A Walsh. Molecular approaches to brain asymmetry and handedness. Neuroscience 2006 Aug; 7: 655-662.
6. Lewis Sudarsky. Pathophysiology of the Nervous System. 1st ed., Boston, Massachusetts: Little Brown and Company, 1990.
7. Briar, Lasserson, Gabriel, Sharrack. Nervous System. 2nd ed., London, New York: Mosby, 2003.
8. Bjo¨rk T, Brus O, Osika W, et al. Laterality, hand control and scholastic performance: a British birth cohort study. BMJ Open 2012; 2:e000314.
9. Bernard JA, Seidler RD, Hand Dominance and Age Have Interactive Effects on Motor Cortical Representations. PLoS ONE 2012; 7(9): e45443.
10. ScharounSMandBrydenPJ, Hand preference, performance abilities, and handselectioninchildren. Front.Psychol 2014;.5:82.
11. Robert A Rigal. Which handedness: Preference or Performance? Perceptual and Motor Skills 1992; 75: 851-866.
12. Corey DM, Hurley MM, Foundas AL. Right and left handedness defined: a multivariate approach using hand preference and hand performance measures. Neuropsychiatry Neuropsychology Behavioural Neurology 2001 Jul-Sep; 14(3): 144-52.
13. Carl Gabbard, Susan Hart, Vickie Gentry. General Motor Proficiency and Handedness in Children. The Journal of Genetic Psychology 1995; 156(4): 1-5.
14. Shin Young Yim, JaRyong Cho, II Yung Lee. Normative data and developmental characteristics of hand function for elementary school children in Suwon area of Korea: Grip, Pinch and Dexterity study. Journal of Korean Medical Science 2003; 18; 552-8.
15. Carlier M, Dumont AM, Beau J, Michel F. Hand performance of French children on a finger-tapping test in relation to handedness, sex, and age. Percept-Motor Skills 1993 Jun; 76(3 Pt 1): 931-40.
16. R.C. Oldfield. The assessment and analysis of handedness: The Edinburg Inventory. Neuropsychology 1971; 9: 97-113.
17. Gurd, J.M., Sculz, J., Cherkas, L., andEbers, G.C. Hand preference and performance in 20 pairs of monozygotic twins with discordant handedness. Cortex 2006; 42 (6): 934-945.
18. Todor, J. I., Kyprie, P.M., Price, H.L. Lateral asymmetries in arm, wrist and finger movements. Cortex 1982; 18(4): 515-523.
19. Todor, J.I., and Smiley, A. Manual asymmetries in motor control. In E.A. Roy (Ed.) Advances in psychology, Volume 23, Neuropsychological studies of apraxia and related disorders1985:309-344.
20. Peters, M. Handedness and its relation to other indices of cerebral lateralization. In R.J. Davidson, and K. Hugdahl (Eds.), Brain asymmetry 1995: 183-214.
21. Smith Sm. Performance difference between hands in children on the motor accuracy test-revised. American Journal of Occupational Therapy 1983 Feb; 37(2): 96-101.


Source of Support: None Declared
Conflict of Interest: None Declared