International Journal of Health Sciences and Research
Vol.13; Issue: 3; March 2023
Website: www.ijhsr.org
ISSN: 2249-9571

Original Research Article

Relationship Between Handgrip Endurance with Handwriting Legibility Scale Among School Going Children Between Age Group of 9-16 Years: A Correlational Study

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DOI: https://doi.org/10.52403/ijhsr.20230322

ABSTRACT

INTRODUCTION: The objective of the study was to find the relationship between handgrip endurance and handwriting legibility among school going children between age 9-16 years.
METHOD: 100 students between age group of 9-16 years were selected from various schools in and around Pune for the study using convenient sampling method. An assent form was obtained from parent of each participant and a thorough explanation about the procedure was provided to them. Static and dynamic handgrip endurance tests were carried out using the dynamometer. Handwriting samples were obtained and handwriting legibility was assessed using the handwriting legibility scale.
RESULT: The co-relation coefficient (r) between Static Handgrip Endurance and Handwriting Legibility Score was -0.25 which signifies negative co-relation between them. This means as static handgrip endurance increases the HLS score decreases, i.e, more the endurance better is the handwriting. The co-relation coefficient (r) between Dynamic Handgrip Endurance and Handwriting Legibility Score was 0.68 which signifies negative co-relation between them. This means as dynamic handgrip endurance increases the HLS score decreases, i.e. more the endurance better is the handwriting.
CONCLUSION: This study provides evidence that there is significant negative correlation between handgrip endurance and handwriting legibility score among school going children between age group of 9-16 years. We conclude that if static or dynamic handgrip endurance is less than the handwriting is poor and higher handgrip endurance denotes good handwriting.

Keywords: Handwriting, handgrip endurance, handwriting legibility scale

INTRODUCTION

The evolution of the hand has reached its highest degree of development in humans, and it has determined many of the unique functional capabilities of the species. A relatively large area of the central nervous system (CNS), far exceeding that of any other primate, has evolved specifically devoted to controlling the hands, and particularly the thumb. The hand is the most active part of the upper limb. The anatomy and functional biomechanics of the hand are extremely complex and delicate.[1] The hand serves as an important creative tool and a means of nonverbal communication. The evolution of the opposing thumb and prehensile grasp are refinements of hand control that have been major factors leading to the dominance of the human species throughout the world.[1] Prehension includes various aspects of hand movement, including reaching, and postural motility.

The conventional classification of prehension according to Sollerman and Sperling divides the hand grip into three main prehensions:
precision thumb–finger pinch grips (tip to tip, pad to pad, pad to side, and three fingers pad to pad),
passive palm pinch grips (buttresses pad to side, extended three-jaw chuck, cradle four and five-jaw chuck), and
power grip (cylindrical–diagonal, spherical, and hook–extension grip).
Although it is fairly difficult to isolate any single prehension function as being the most important among those examined, grasp or hand grip has been the most researched.[1]There are 11 intrinsic muscles and 15 extrinsic muscles with functional roles in the hand. Extrinsic and intrinsic hand muscles produce the force required for gripping objects (grip force).[1]Tendons are made up of dense connective tissue, primarily formed by densely packed, orderly arranged, collagen fibers which contribute to the white color of tendons and also provide them with extremely high tensile strength. To a large degree, the tendons have a poor blood supply and are virtually avascular in the regions of tendon insertion. These long hand tendons possess very high tensile strength. The tendons in the distal palm and digits are wrapped in synovial sheaths lined by a glistening smooth synovial layer continuous with a proximal mesotendon. Synovial sheaths enhance the gliding of the tendon and are thickened in segments to form pulleys (Vinculum breve and longum), which are biomechanically important for efficient tendon functioning and muscle force.[1]Handwriting is an important skill for the school aged children who need to produce fluent and legible handwriting for expressing and recording ideas.[2]Fine motor skills may be considered enabling behaviors and may affect the child in school in different ways. They may influence the quality and quantity of the child's learning and achievements, the validity of assessments for instructional planning, educational placement and eligibility for services, and the development of the child's self-esteem and motivation.[3] For example, when a child with fine motor problems must copy math problems out of a textbook to solve them, she may not physically be able to do enough problems to get enough practice, thus her achievement in math might get affected. Another child may not be able to demonstrate that his ability to do long division if he cannot write legibly to read back to himself correctly the numbers he has written. This situation may lead the teacher to assume that the child does not know how to do math, thus showing the effect of fine motor skills on assessment for instruction. A third child who writes very slowly may not be able to complete many math problems on the final annual examinations.[3]Although it is uniformly recognized that school work requires fine motor tasks, there is little documentation about the percentage of time spent on such tasks or the specific types of tasks with fine motor requirements that children are expected to perform.[3]Muscle fatigue can be defined as an exercise-induced reduction in the maximal force capacity of muscle. The intense and excess use of muscles that leads to a decline in performance is known as fatigue.[4]Characteristic of muscle fatigue include reduction in muscle force production and shortening velocity, as well as prolonged relaxation of motor units between recruitment.[4]It is assumed that when a child has to write, he or she first has to retrieve the correct letters or words from memory, put them in the right order, and convert phonemes into graphemes, before the corresponding motor program can be selected and executed. Although higher-level processes precede lower-level ones, it is further assumed that handwriting also involves parallel processing; for example, during the evaluation and revision of what was written (Berninger & Swanson, 1994). Perceptual motor processes in handwriting consist of perception of either visual or auditory information, fine motor coordination, and visual-motor integration.[5]

MATERIALS & METHODS

100 students between age group of 9-16 years were selected from various schools in and around Pune for the study using convenient sampling method. An assent form was obtained from parent of each participant and a thorough explanation about the procedure was provided to them. Static and dynamic handgrip endurance tests were carried out using the dynamometer. Handwriting samples were obtained and handwriting legibility was assessed using the handwriting legibility scale.

1.Static Hand Grip Endurance Test

Position:

Peak grip strength was measured on dominant hand using Jamar Dynamometer, with the subject seated upright with feet fully resting on the floor, hips as far back in chair as possible, and the hips and knees positioned at 90degrees approximately. The elbow was on the armrest at approximately 90degrees and the shoulder of gripping arm was maintained in adduction; the elbow was flexed comfortably between about 90degrees and 120degrees. The wrist was position between 0o and 30o of extension, and between 0degrees and 15degrees ulnar deviation.

Measurement of the peak grip strength will be carried out using a dynamometer and maximum voluntary contraction(MVC) will be recorded.

The subjects will be asked to grip the handheld dynamometer at 60% of their maximum voluntary contraction (MVC). The duration for which they maintain the grip strength will be noted in seconds. Subjects will be verbally encouraged to maintain the contraction at the set target for as long as possible.

The test will be terminated when the subjects fail to maintain the 60% MVC for two consecutive times.

Two recordings will be obtained with a gap of five minutes between each effort.

2.Dynamic Handgrip Endurance Test

Subjects will be instructed to give repetitive contractions at 60% of their maximal voluntary contraction (MVC) on the beat of the metronome set at 70 beeps per minute until fatigue sets in and they will no longer be able to produce the same intensity of contraction (i.e,target force was missed three consecutive times).

The metronome is introduced to set uniformity in the rhythm of contraction.

Subjects will be given visual feedback to view the target force they are supposed to generate during this with the help of a mirror.

3.Handwriting legibility assessment

The assessment was based on a piece of ‘free writing’ produced by the child, on an A4 sized sheet of lined paper. The text was approximately 10 lines in length. A total time of six minutes was given to each child after he/she began writing and the sample was assessed at the end of it according to the handwriting legibility scale.

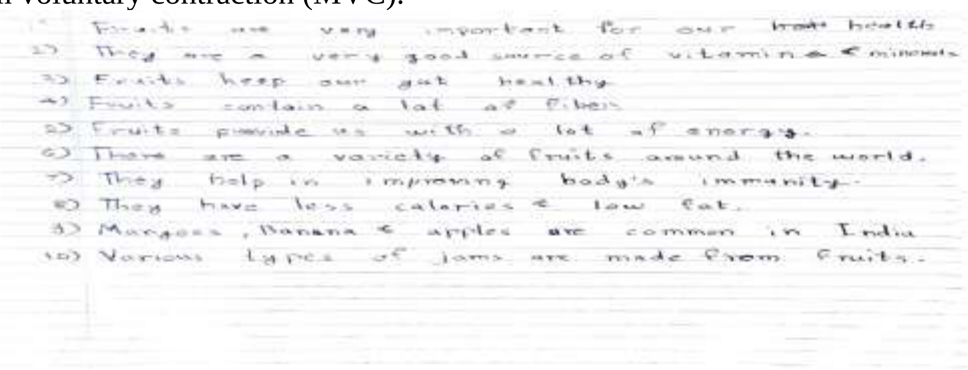


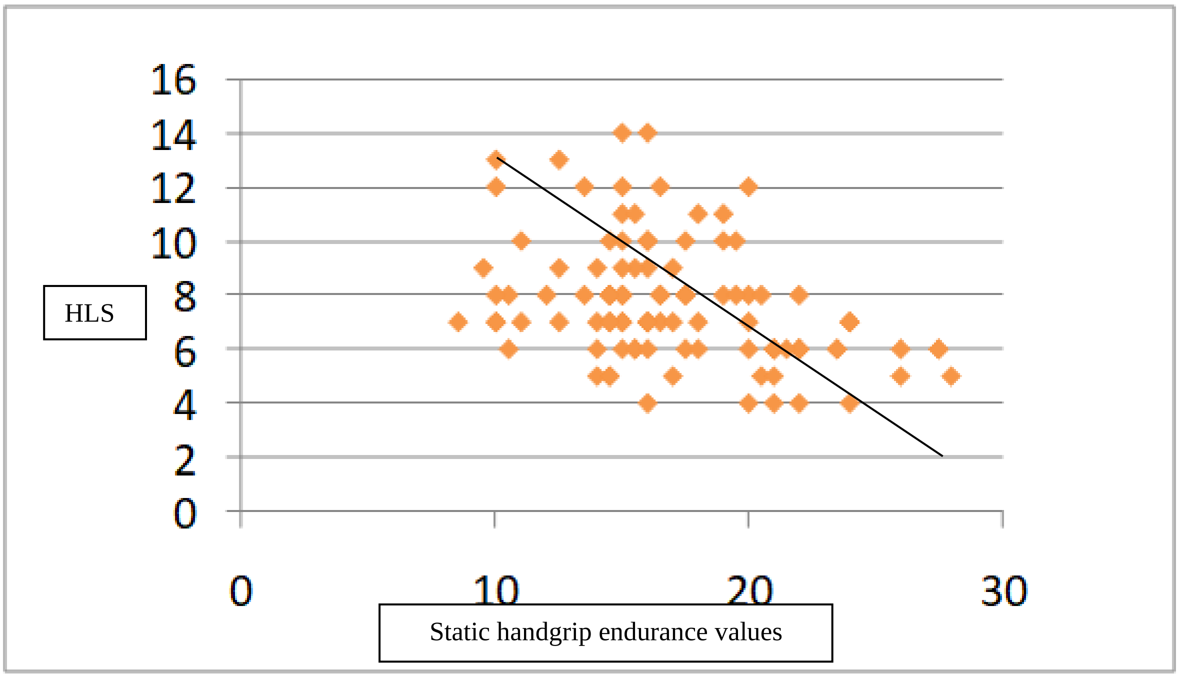
Image 1: Sample taken for Handwriting Legibility assessment

RESULT AND DATA ANALYSIS

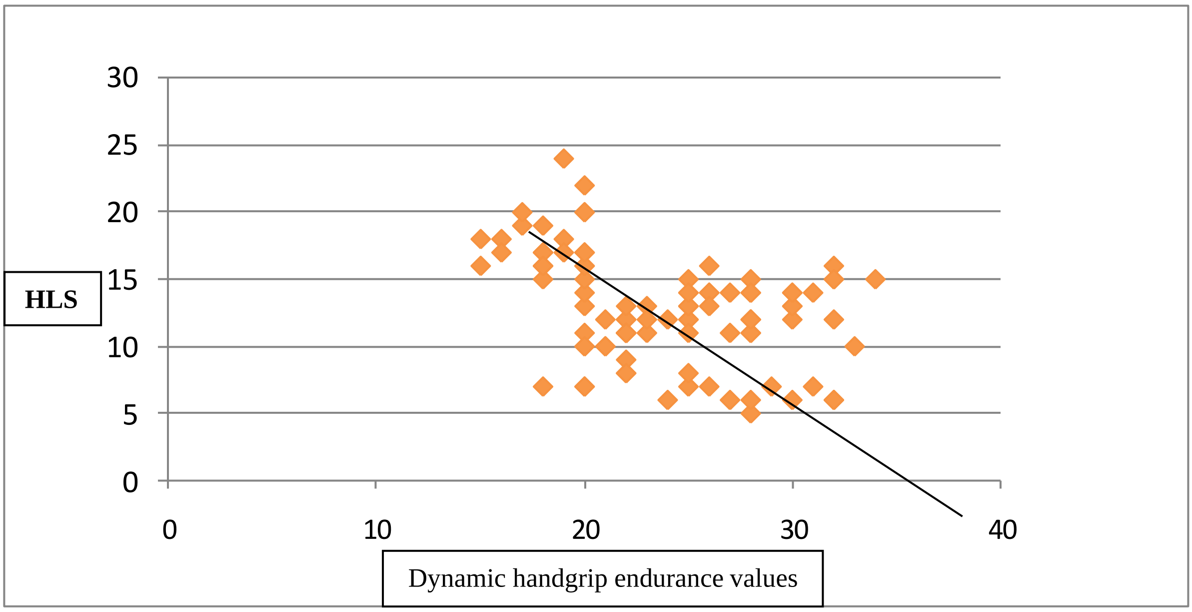
Total 100 students between the age group of 9-16 years participated in the study.

	Mean	S.D	Co-relation coefficient(r)	Interpretation
Static Handgrip Endurance	17	4.29	-0.25	Negative Corelation
Dynamic Handgrip Endurance	23.71	4.76	-0.68	Negative Corelation

Table no.1: Data analysis



Graph 1: Correlation between static handgrip endurance and Handwriting Legibility Scores where X-axis represents static handgrip endurance measurements and Y-axis represents Handwriting legibility scale scores.



Graph 2: Correlation between dynamic handgrip endurance and Handwriting Legibility Scores where X-axis represents static handgrip endurance measurements and Y-axis represents Handwriting legibility scale scores.

DISCUSSION

The present study was conducted to find the co-relation between static handgrip endurance and dynamic handgrip endurance with handwriting legibility among school going children between age group of 9 to 16 years. Handwriting is an important skill for school going children.[2] Handwriting difficulties can have implications for participation in academic activities.[2]

Studies have documented that force which can be sustained is less than the peak force, and grip force was found to decrease as the time duration of the test progressed(9). This is in consistence with the findings of this study. This can be because when sub maximal constant load is applied for a prolonged period of time, static gripping produces an obstruction in blood flow affecting the recruitment and fatigue of the fast twitch fibres. Dynamic handgrip endurance measurements were noticeably higher in most of the subjects than static handgrip endurance, indicating the contingent contributions of physiological sources of fatigue difference between the two respective tasks. In repetitive dynamic gripping, fibres have more time between contractions than prolonged static holds. Hence, individuals vary in resistance to different sources of fatigue as well as due to difference in motivation and tolerance. The ability to grip is one of the most important functions of the hand. If this ability is hampered then performance of activities of daily living is affected .[11] Since writing involves prolonged grasp, endurance plays an important part in its quality. There have been studies regarding correlation between pinch grip endurance and handwriting legibility so this study was aimed to throw some light over the area of handgrip endurance with handwriting legibility. A total of 100 children participated in the study. Static and dynamic handgrip endurance was measured using a dynamometer. Visual feedback was provided during this process with the help of a mirror. Appropriate position for measuring the handgrip endurance was ensured. Handwriting legibility was assessed using the handwriting legibility scale which had five components: Legibility, effort, layout on the page, letter formation and alterations. The reliability of HLS is 0.92 while the validity is 0.75. The result of the study showed negative co-relation between static and dynamic handgrip endurance along with handwriting legibility score. This means that the better was the static or dynamic handgrip endurance more legible was the handwriting.

CONCLUSION

This study provides evidence that there is significant negative correlation between handgrip endurance and handwriting legibility score among school going children between age group of 9-16 years. We conclude that if static or dynamic handgrip endurance is less than the handwriting is poor and higher handgrip endurance denotes good handwriting.

Declaration by Authors

Ethical Approval: Approved
Acknowledgement: None
Source of Funding: None
Conflict of Interest: The authors declare no conflict of interest.

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How to cite this article: Priyanka Bapat, Abhijit Satralkar. Relationship between handgrip endurance with handwriting legibility scale among school going children between age group of 9-16 years: a correlational study. *Int J Health Sci Res.* 2023; 13(3):217-222. DOI: *https://doi.org/10.52403/ijhsr.20230322*

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