

## Effects of Upper Limb Strengthening Exercises on Handwriting Speed in Undergraduate Students

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### ABSTRACT

**Back ground:-** Handwriting is an essential tool required by students. It is a complex process which involves close coordination between musculoskeletal and nervous system. **Objective:-** To assess the effects of upper limb strengthening exercises on handwriting speed in undergraduate students **Study design:-** Experimental Design. **Subjects:-** Applying inclusion and exclusion criteria, 30 subjects were Randomly selected and Group A (15 subjects) who underwent Strengthening exercises for upper limb and Group B (15 subjects) who underwent Writing Practice. **Results:-** Statistical analysis was done by using Paired 't' test in which Group A ( $p < .01$ ) showed significant improvement in handwriting speed when compared with Group B. **Conclusion:-** Upper limb strengthening exercise programmes can be used to improve the hand writing speed.

**Keywords:** Upper Limb Exercise, Hand Writing Speed.

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### INTRODUCTION

Handwriting speed plays an important role in academic success since it is directly related to the ability to express knowledge about different subjects. It is one of the most unique features of human's cultural development. It continues to be an essential life skill, in daily-life, as a form of communication, archiving, expression of creativity and knowledge. Therefore it is an essential skill one should possess in today's context and it forms an integral part of a student's life whether primary, secondary, or tertiary<sup>3</sup>.

It is a complex process which involves close coordination between musculoskeletal and nervous system. It is a complex, fine motor skill, where fine, precise, coordinated movements occurs in the extremity. Many factors influence handwriting such as anatomy of extremity, general health, mental acuity, writing instrument and surface. During the process of handwriting most of the movements come from the forearm while shoulder provides the power with minimum movement occurring at fingers and wrist<sup>1</sup>.

Strength and flexibility of the muscles and the overall posture of the writer affects the final output. The most common pen-holding position, is keeping the pen between the index and middle fingers, and holding it in place by the thumb. Joint position sensation is the most important factor in determine handwriting. Though it seems paradoxical, since small muscles having better control, the shoulder-girdle group once trained, does the job better<sup>1</sup>.

A study showed that Handwriting speed varies with age and also the skills such as word spacing and letter size decreased gradually with advancing age<sup>7</sup>.

Handwriting speed is a factor in student's achievement, regardless of ability. Academic note-taking is a critical

educational skill and learning to take fast notes improves Comprehension, Listening and Studying skills. Better Handwriting speeds will help in quick assimilations thus achieving higher academic grades<sup>8</sup>.

Ellen Linthorst-Bakker (2009) demonstrated that students were seven times more likely to recall class material a week after it was presented if the information had been recorded in their notes. Also, it has proven that the ability to take comprehensive notes is related to academic achievement and progress<sup>7</sup>.

Slow Handwriting may be due to delays in formation processing, difficulties with spelling, improper motor coordination and adopting labor intensive writing styles. Writing researchers stated that slow handwriting can lead to loss of motivation and evasion of school work (Hedderly, 1992). It can affect everything from completing written assignments to taking notes during lectures<sup>5</sup>.

Slow handwriting or typing not only increases the time required to complete assignments, but it also changes the whole nature of writing. When the tempo of writing is slowed way down or the writing is constantly interrupted by the manual task, students never learn to flow through ideas and words.

In competitive exams or regular school exams, a particular method for assessing an individual's ability is followed, wherein one's knowledge is tested within a particular time. Failure to do so not only affects the performance, but also has an adverse effect on the confidence of the student. Further, research has indicated that slow handwriting leads to avoidance of writing thus resulting in low self-esteem, evading academic work and possibly ending with learning difficulties and behavior problems<sup>19</sup>. Physical exercise is any bodily activity that enhances or maintains physical

fitness and overall health and wellness. It is performed for various reasons, including strengthening muscles and the cardiovascular system, athletic skills, weight loss or maintenance, and merely enjoyment.

Strength training is a type of physical exercise specializing in the use of resistance to induce muscular contraction which builds the strength, anaerobic endurance, and size of skeletal muscle. The benefits of strengthening exercises are Increase in energy levels and decrease in muscle fatigue level<sup>12</sup>.

Muscle activity of proximal parts is necessary for activation of distal parts. In fact, the stable activity of distal parts needs controlling the proximal parts. Thus, the stability of shoulder girdle is required for activity of distal parts such as fingers, wrists and elbows<sup>23</sup>.

Considering the kinetic chain perspective that emphasizes the extremities segments are related kinematically, it is assumed that even in hand neutral position (requiring no direct participation of shoulder), there is increased activity of major shoulder stabilizers during severe hand activity resulted from co-activation of proximal and distal muscle<sup>23</sup>.

For example, the study of Aliza- dekhaiyat (2011), P. Herbert (1976) and H. Sporrang (1996,1998) showed that grip task activates rotator cuff, especially the supraspinatus muscle that can be used for shoulder rehabilitation. So this study attempts to find the effects of strengthening exercises of upper limb muscles on handwriting speed in a group of undergraduate students.

## METHODOLOGY

This study protocol was approved by institutional ethical committee of SRM College of Physiotherapy, SRM University, kattankulathur. A total of 30 samples were recruited based on the criteria from target population of this college by simple random sampling method. The students were excluded if they have any neurological, orthopedic, any other motor problems. The study protocol clearly explained to them and obtained informed consent. They were randomly allocated into two groups, the group A was experimental and group B is control. The experimental group were given upper limb strengthening exercises under my supervision and each student was given advice to perform the exercises with 10 repetitions on each day, 5 times a week. The control group was given instructions to do handwriting practise for 1 page per day for 5 times a week. Handwriting test was taken for both the groups, 3 times during the complete study.

### Outcome measure

The test was taken in a single lecture room with similar writing surface and seating facilities. Both the groups were provided with a standardized pen and a A4 sheet to perform handwriting test. The students were asked to copy a paragraph on a A4 sheet in 1 minute (Time was noted using a stop watch). At the end of 1 minute the total number of words written by each student was counted and the handwriting speed was calculated.

The test was performed 3 times during the complete study  
First Test - At the beginning of the study

Second Test - 2 weeks late  
Third Test - 4 weeks later

### Data Analysis

The collected data were tabulated and analyzed using descriptive and inferential statistics. Mean and standard deviation were used to assess all the parameters of the data using statistical package for social science (SPSS) version 17. Paired t- test was adopted to find out the effect resisted exercise and stretching program on postmenopausal women.

Comparison of the mean values of Mid test and posttest of handwriting speed test between group a subjects trained with strengthening exercises and group b subjects trained with writing practice

## RESULT

The obtained data was analyzed by using the student t test and paired t test (VERSION 17).

Comparison of the mean values of mid and post test of Handwriting speed test between Group A and Group B. As  $p < 0.01$ , this table shows that there is a significant difference between mid- Test and Post Test of Handwriting Speed Test between Strengthening Exercises group and Writing Practice group.

## DISCUSSION

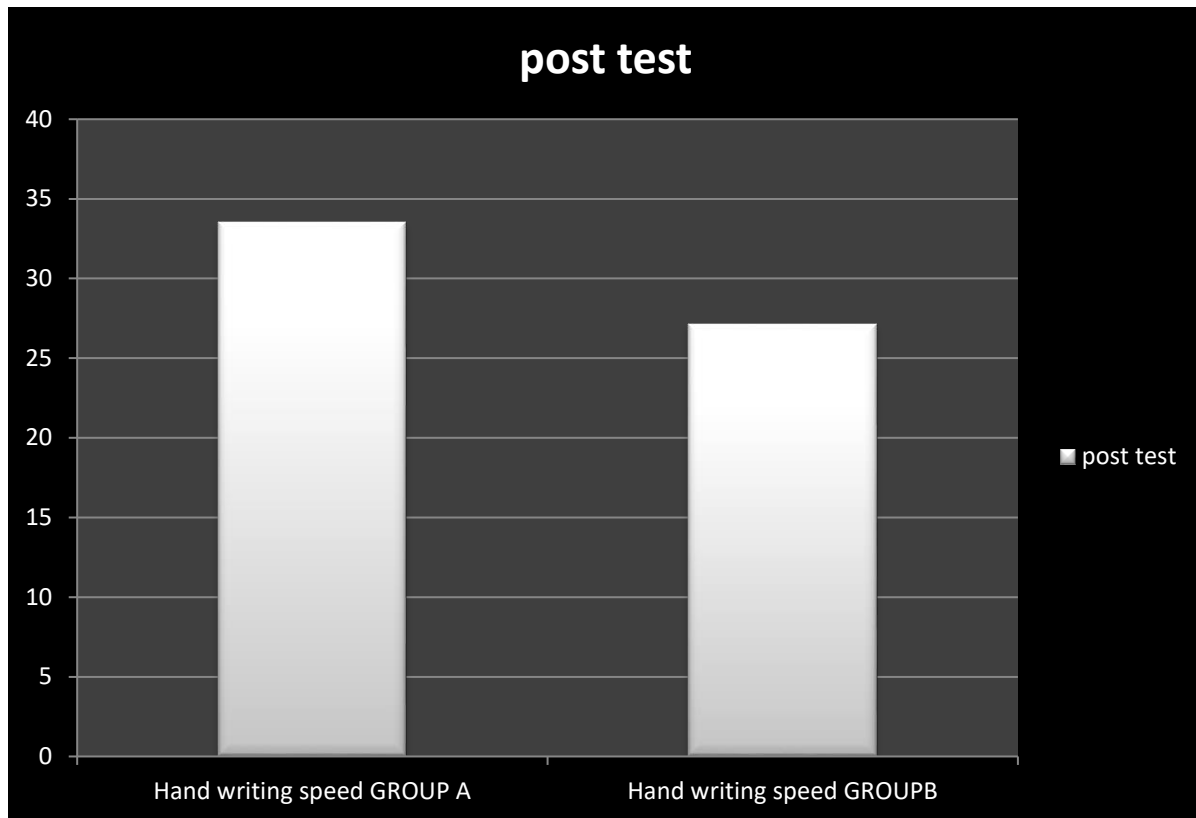
This study was focused on to assess the effects of upper limb strengthening exercises on handwriting speed in Undergraduate students. Handwriting speed is commonly measured as the average number of words written per minute

Margaret Wallen et al.,(1998) concluded that The Handwriting Speed Test (HST), is a standardized, norm by increasing the speed of handwriting of an individual through exercise, their educational skills will be increased. The intervention targeted primarily at improving the proximal muscle stabilization of the upper extremity. This is supported by the proximal distal muscle principle it states that "Proximal Muscle Stability is a pre-requisite for manipulative hand use<sup>12</sup>.

Handwriting is an important skill for college students. Handwriting difficulties can have implications for a successful participation in academic and cultural activities, potentially leading to problems in academic performance and lowered self-esteem. A number of correlative studies have identified the performance components that are associated with handwriting, namely, motor planning, eye-hand coordination, visual perception, visual motor integration, kinesthetic perception and in-hand manipulation. Only few studies had documented the effect of upperlimb strengthening over Handwriting<sup>18</sup>. So, this study was done to throw some light over the area of upper limb strengthening exercises on handwriting speed in Undergraduate students.

The statistical result of this study showed that there was a statistically significant difference in pre-test and mid-test in group A subjects who underwent strengthening exercises ( $p < 0.01$ ). This result goes in hand with Nilukshika KVK et al., (2012) who concluded that Upper

	Mean	std. deviation	std. error	t-value	sig.
group A mid- test	28.4	1.76473	.45565	5.303	.000
group B mid-test	25.4	1.29835	.33523		
GROUP A Post- Test	33.5333	2.77403	.71625	8.089	.000
GROUP B Post-Test	27.1333	1.30201	.33618		



Graph:

limb exercise programmes can be used to improve the handwriting speed.

This study revealed that the post-test values of handwriting test is improved when compared to mid-test values of group A. The statistical result of this study showed that there was a statistically significant difference in pre-test and post-test values in group A. The result goes in hand with Singh .I (2009) who concluded that Exercises were designed to strengthen the muscles involved in handwriting.

The Influence of the Upper limb strength over Handwriting skills can be improved When the large muscles of the shoulder girdle (the pectorals in front and the trapezius and rhomboidus muscles at the back) work effectively together, they provide stability for the smaller muscles in the hand and arm to do their job effectively. Other fine motor tasks such as craft work, tying shoelaces etc are also much easier to carry out when the shoulder girdle muscles give good stability. So Hand Gross and Fine motor skills are highly influenced by Upperlimb strength<sup>4</sup>.

The above view was supported by D. Mandalidis et al (2008) who concluded that there is positive relationship between hand isometric strength and arm isokinetic torque cuff, arm abductor and elbow flexors. Also, according to R. P. & Meade, V. (2005), Shoulder integrity is an essential component in Handwriting. Shoulder integrity starts to develop from infancy like prone lying to facilitate crawling. So, For the hands to work well, strength, stability and mobility are necessary in the shoulders and forearms. So, in addition to the shoulders being strong, wrist stability is an important component for having precise finger control and thus improves Handwriting. Gesell & Amatruda, (1947) also approves the fact that as Motor development codes, none of the fine motor skills can develop smoothly without the concurrent development of gross motor (large muscle) skills. In fact, typically, development proceeds in a cephalo-caudal (head to toe) and proximal-distal (moving from the body parts closest to the trunk to those furthest away pattern. So, in simple terms, development of stable shoulders and upper arms provides a solid base for the development of

skills using writing tools. The statistical result of this study showed that there was a statistically significant difference in pre-test and mid-test in group B subjects who underwent handwriting practice. ( $p < 0.01$ ). The result goes in hand with Jenny Ziviani (2006) who concluded that handwriting was faster using modern cursive handwriting than performance reported earlier using a combination of print and cursive writing. The statistical result of this study showed that there was a significant difference in mid-test and post-test in group B ( $p < 0.01$ ).

The statistical results of this study showed that there was a statistically significant difference in pre-test and post-test in group B ( $p < 0.01$ ). The result goes in hand with Sovik et al., (1991) has concluded that the study revealed effects of different writing tasks on children's writing speed and writing accuracy. Practice is the act of rehearsing a behavior over and over, or engaging in an activity again and again, for the purpose of improving or mastering it, as in the phrase "practice makes perfect". As with everything in life, the key to successfully improving your penmanship is consistent practice. So as one practice, they trigger a pattern of electrical signals through our neurons. Over time, that triggers the glial cell to myelinate those axons, increasing the speed and strength of the signal.

A study suggest that the estimated amount of practice an expert piano player did in childhood and adolescence, was correlated with the white matter density in regions of the brain related to finger motor skills, visual and auditory processing centers, and others compared to regular people. And most significantly was that there was a direct correlation between how many hours they practiced and how dense their white/myelin matter was. Understanding the role of myelin means explains why quantity of practice is important to improving the skills.

The statistical result of this study showed that there was statistically significant difference in handwriting speed between group A pre-test, mid-test and post-test who undergone the upper limb strengthening exercises and group B who undergone handwriting practice in pre-test, mid-test and post-test ( $p < 0.01$ )

Upper limb strengthening exercise has an effect on handwriting speed when compared with handwriting practice. Though the handwriting practice (Group B) also had an effect on handwriting speed, the effects was significantly more with strengthening exercises (Group A) when compared with writing practice. So, Upper limb strengthening exercises can be added clinically to improvise handwriting skills than simple constant practice in Undergraduate student

## CONCLUSION

This study can be concluded that Upperlimb strengthening exercises showed a s greater improvement in handwriting test at end of 4 weeks.

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