Original Article

Effect of Upper Limb Strengthening Exercises On Hand Writing Speed And Hand Grip Strength Among Physiotherapy Students

Mahnoor Jamil,[1] Muhammad Ahmer,[2] Saira Sabir,[3] Ayesha Azhar,[4] Aatiqa Kabir[5]

Abstract

Objective: To assess the impact of upper limb strengthening exercises on hand writing speed and grip strength in physiotherapy students.

Study design: It is a Quasi-experimental study.

Place and duration of study: The study was conducted in Isra Institute of Rehabilitation Sciences (IIRS), Isra University Islamabad campus; over two weeks from December 12, 2022, to December 26, 2022.

Material and Methods: Thirty physiotherapy students underwent pre-intervention readings for hand grip strength (measured with a dynamometer) and hand writing speed (measured in words per minute). Upper limb strengthening exercises were conducted five days a week for two weeks, each session lasting 10 to 15 minutes. Exercises included bicep curls, triceps curls, mass finger flexion, mass finger extension, and tennis ball squeeze. Post-intervention readings were taken.

Results: Significant differences were observed in hand grip strength and writing speed between pre- and post-treatment scores. For female students (50%), significant differences were found in hand grip strength (p=0.002) and hand writing speed (p=0.000). For male students (50%), significant differences were found in hand grip strength (p=0.032) and hand writing speed (p=0.000).

Conclusion: Upper limb strengthening exercises led to significant improvements in hand grip strength and writing speed. Higher significant differences were seen in males compared to females in post-treatment hand grip strength. However, no significant difference was found between male and female post-treatment writing speed.

Keywords: Upper limb strengthening exercises, Hand grip strength, Hand writing speed.

1. Introduction

Development of handwriting begins with writing hurriedly which become more intentional with time and practice.[1] There are different components that has an impact on handwriting speed and strength like age, gender, fine motor control, handedness, working memory, developmental level and writing instrument. It has been found by researchers that after writing for few minutes the students get tired. Hand grip strength indicates overall strength and muscular endurance of a person.[2]

Writing is accompanied by fine, precise and coordinated movements in upper extremity.[3] Two primary movements take part in handwriting, one horizontal to wrist motion and one vertical from finger movements, with the addition of rightward translation of the whole arm.[4]

Handwriting speed affects students' academic achievements because it influences interest, passion and curiosity among students by promoting literary competition.[3] Better hand writing speed helps in quick absorption of knowledge and academic achievements.[5] Hand writing speed plays an important role in examination setting because of fundamental relationship between hand writing speed. Difficult and slow hand writing eventually results in self-restraint writing that causes avoidance of work and behavioral and learning difficulties.[6]

Isra Institute of Rehabilitation Sciences (IIRS), Islamabad,[1,3,4,5] Physiotherapist at Psychiatric Clinic, Islamabad.[2]
Correspondence: Muhammad Ahmar, Physiotherapist at Psychiatric Clinic, Islamabad **Email:** Ahmer.raja97@gmail.com

Hand writing difficulties are faced by 11to 12 % female and 21 to 32% male students but unfortunately our educational institutes lack tools that helps to improve hand writing skill readability.

Average writing speed is 68 letters per minute for an adult population of age 18 to 60 years. Hand writing and hand grip is influenced by strength of muscles, pen holding position and posture. The most frequent used pen holding position is keeping the index and middle finger and held in place by thumb.[7,8]

UL strengthening helps to enhance hand writing speed and grip strength. Strengthening exercises to improve hand writing speed has been neglected. Intramuscular tension tends to be increased by resistive exercises that increases muscle power and hypertrophy with time. Strength and endurance are improved by hypertrophy.[9]

One of a study showed that an average hand writing speed of a girl is 14.7 wpm and of a boy is 13.8 wpm. While the ttools which were used in that study were words per minute test and hand dynamometer. Dynamometers were specially used to measure overall strength of the muscle.[1]

The current study was designed in order to determine upper limb strengthening exercises impact on both hand writing speed and hand grip strength on physiotherapy students. This study also assesses the influence of strengthening exercises on the hand grip strength and hand writing speed, making a comparative analysis between male and female students.

2. Materials & Methods

A quasi-experimental study was conducted in Isra Institute of Rehabilitation Sciences (IIRS) Department, Isra University Islamabad campus. A Quasi-experimental study was conducted on 30[5] physiotherapy students out of which 15 were Males and 15 were Female physiotherapy students. Non probability convenient sampling technique was used. The duration of study was 4 months after approval of synopsis.

Hand Dynamometer was used for hand grip strength measurement. Subjects were standing in an upright posture in front of the examiner with shoulder abducted to 0° and neutrally rotated, elbow flexed to 90° and wrist and forearm kept in neutral position (Hand Grip Strength measurement in sitting position. Subjects were sitting without supporting their forearm on surface with their elbows flexed to 90 degrees. Wrist and forearm were kept in neutral position (Hand Grip Strength measurement in standing position). The readings were measured in pounds. For hand writing speed word per minute test was conducted. The subjects were provided with similar writing surface and seating facility. A standardized pen and A4 sheet were provided to the students. Along with it a paragraph in printed form were given to them. Participants were asked to write as many words as they can from the given paragraph in one minute time. The words were counted afterwards which indicates words per minute of each student.

Right-handed male and female physiotherapy students between the ages of 18 to 24 years were included in this study. Students with any history of visual-hearing impairment and upper and lower limb injury within past 6 months were excluded from the study.

The data was analyzed through SPSS IBM 22. Categorical variables were presented as Frequency and percentages, whereas continuous variables were presented as Mean ± S.D. Pretest-posttest analysis was evaluated through Paired-t test. For Gender wise analysis independent sample-t test was measured.

3. Results

Out of N=15 (50%), for female Physiotherapy students, significant difference was found at pre and post treatment score in Hand grip strength (p value=0.002) and Hand writing speed (p value=0.000). Out of N=15(50%) for male physiotherapy students, significant difference was found at pre and post treatment score in Hand grip strength (p value=0.032) and Hand writing speed (p value=0.000).

The overall age mean±SD of female, male and overall were 23.40±0.51, 23.47±0.64 and 23.43±0.57

respectively. The overall weight mean±SD of female, male and overall were 55.61±7.60, 73.74±8.07and 64.67±12.02 respectively.

The overall height mean±SD of female, male and overall were 5.22±0.20, 5.47±0.39 and 5.34±0.33 respectively. The BMI of female was 22.40± 2.59, male was 23.81±2.70 and overall BMI was 23.10±2.70 respectively. Out of overall Normal=22(73.3); n=10 (66.7%) were females, n=12(80%) were males. Out of overall underweight=1(3.3); n=1 (6.7%) were females, n=0 (0%) were males. Out of overall overweight=6(20); n=4 (26.7%) were females, n=2(13.3%) were males. Out of overall obese=1(3.3); n=0 (0%) were females, n=1 (6.7%) were males.

The overall semesters mean±SD of female 9th, 10th and overall were 2(13.3), 13(86.7), 15(100) respectively.

Within groups-gender wise, significant difference was found between the pre & post treatment scores in males and females.

Table 1: Mean, SD and p-value of male, female & overall pre and post treatment score regarding Hand grip strength

Variable		Mean ± SD	P-Value
Male	Pre-Treatment	60.64±24.57	0.032
	Post Treatment	70.46±18.58	
Female	Pre-Treatment	13.53±10.13	0.002
	Post Treatment	19.12±10.48	
Overall	PreTreatment	37.09±30.26	0.001
	PostTreatment	44.79±30.01	

Significant difference was higher in males vs females at pre-treatment score & post treatment score in Between Groups Analysis.

Table 2: Mean, SD and p-value of male and female pre and post treatment score regarding Hand grip strength

Variable		Mean ± SD	P-Value
Pre-Treatment	Male	60.64±24.58	0.000
	Female	13.53±10.13	
	Overall	37.09±30.25	
Post Treatment	Male	70.466±18.57	0.000
	Female	19.12±10.47	
	Overall	44.79±30.01	

Within group analysis, Significant difference was found between pre &post treatment scores in male and female groups.

Table 3: Mean, SD and p-value of male, female & overall pre and post treatment score regarding Hand writing speed

Variable		Mean ±SD	P-Value
Male	Pre-Treatment	23.40±2.35	0.005
	Post Treatment	24.86±2.85	
Female	Pre-Treatment	24.87±2.85	0.000
	Post Treatment	26.47±3.31	
Overall	Pre-Treatment	24.13±2.67	0.000
	Post Treatment	25.50±3.00	

Between groups, no Significant difference was found in males versus females at pre-treatment score and post treatment score.

Table 4: Mean, SD and p-value of male and female pre and post treatment score regarding Hand writing speed

Variable		Mean ±SD	P-Value
Pre-Treatment	Male	23.40±2.35	0.136
	Female	24.86±2.85	
	Overall	24.13±2.67	
Post Treatment	Male	24.53±2.39	0.078
	Female	26.47±3.31	
	Overall	25.50±3.00	

4. Discussion

The current study was conducted to study the effects of upper limb strengthening exercises on hand grip strength and hand grip speed among physiotherapy students. A total of 30 physiotherapy students were recruited. Pre-readings were taken before applying interventional therapy. Hand grip strength was measured using hand held dynamometer and hand writing speed was measured using word per minute test. Upper limb strengthening exercises were performed for 5 days per week for up to 2 weeks, each session was of duration 10 to 15 minutes. Post readings were taken after 2 weeks. Post reading results showed that there were significant differences in hand grip strength among male and female physiotherapy students. Overall significant difference was found but no significant difference was found between male and female physiotherapy students.

A study was conducted to determine the effect of grip strength and endurance on handwriting speed which included 113 healthy young adult university students. A convenient sampling technique was used. Grip strength and endurance were measured in a standardized manner using a dynamometer. The characters per minute test was used to assess handwriting speed. It was concluded that grip strength and hand endurance have a moderate positive impact on hand writing speed. This supports the results of our study which concluded upper limb strengthening exercises helps to improve hand writing speed and hand grip strength among physiotherapy students.[11]

A study was conducted to evaluate the effects of resisted exercises on hand grip strength among tennis players. Total sample of 30 tennis players were taken with age group 15 to 25 years (male. Hand grip strength were measured before and after 3 weeks of intervention using a hand-held dynamo meter. Resisted exercises were given during a 3-week trial with hand gripper and Thera putty. The results showed that there was significant improvement in hand grip strength. This supports the results of current study in which after upper limb strengthening exercises, significant improvement was observed in hand grip strength among male and female physiotherapy students.[12]

A study was conducted in health science students of Nagpur and its aim was to assess the effectiveness of forearm hand and wrist exercises on hand writing speed and grip strength. The sample size was 100 health science students. Hand writing speed and grip strength was assessed pre and post exercise intervention initially and after 4 weeks of structured exercise program. The result was 2.91%improvement in hand writing speed($p=0.044$) and the improvement in hand grip strength was 5.08%($p=0.000$). The conclusion of the study was that after 4 weeks of forearm wrist and hand exercises there was improvement in hand writing speed. This study supports the results of our study in which there was significant improvement in hand grip strength and hand writing speed.[10]

A study was conducted to investigate whether upper limb strengthening exercises effects hand writing speed in healthy school age children. Randomized control study was conducted in school of Surat city in India in which total 69 school going children were included. Participants were divided into control and experimental group equally. Both resistive and coordinated exercise movements were given to experimental group while in control group handwriting practice was given for 4 days a week for 4 weeks. It was concluded that experimental group shows significant difference in words per minute test and in handwriting proficiency screening questionnaire after 4 weeks of intervention. This

supports the results of current study in which upper limb strengthening exercises show significant improvement in handwriting speed and handgrip strength among physiotherapy students.[13]

Conclusion:

It was concluded regarding hand grip strength, that significant difference was found between the Male, Female and Overall, at pre and post treatment scores. However, higher significant difference was shown in male when compared to female at post treatment score. Regarding hand writing speed, significant difference was found between the Male, Female and overall, at pre and post treatment score while no significant difference was found between Male Vs Female post treatment score when compared.

References:

1. Bohannon RW. Dynamometer measurements of grip and knee extension strength: are they indicative of overall limb and trunk muscle strength? Perceptual and motor skills. 2009 Apr;108(2):339-42.

2. Chulvi-Medrano I, Rial T, Cortell-Tormo JM, Alakhdar Y, Teixeira CV, Masiá-Tortosa L, Dorgo S. Manual resistance versus conventional resistance training: Impact on strength and muscular endurance in recreationally trained men. Journal of sports science & medicine. 2017 Sep;16(3):343.

3. Koppenhaver KM. Forensic document examination. Humana Press Incorporated; 2007.

4. Rosenblum S, Weiss PL, Parush S. Product and process evaluation of handwriting difficulties. Educational psychology review. 2003 Mar;15(1):41-81

5. Galbraith D, Roaf J, Rutherford SC., The role of handwriting in raising achievement [internet]. 2009 [cited 2009 May 02]. Available from: http:/ /www.literacytrust.org.uk/research/ writingreviews.html

6. Berninger VW, Amtmann D. Preventing written expression disabilities through early and continuing assessment and intervention for handwriting and/or spelling problems: Research into practice. In H. L. Swanson, K. R. Harris, & S. Graham (Eds.), Handbook of learning disabilities. New York: Guilford. 2003; pp. 345-363.

7. Mackay N, McCluskey A, Mayes R. The Log Handwriting Program improved children's writing legibility: A pretest–posttest study. The American journal of occupational therapy. 2010 Jan;64(1):30-6.

8. Singh I. Muscles of Upper Extremity. Anatomy and Physiology for physiotherapists, New Delhi, Jaypee Brothers. 2005:197-217.

9. KAO HS. The effects of hand-finger exercise on human handwriting performance. Ergonomics. 1973 Mar 1;16(2):171-5.

10. Gokulakrishnan J, Franklin J. A Study on Upper Limb Strengthening Exercises on Hand Writing Speed for Undergraduates. J Physiother Res. 2020;4(3):3.

11. Butt K, Maqbool S, Fatima U, Arif M, Arooj A, Amir L, Noor F, Zaheer B. Effect Of Hand Grip Strength and Endurance on Writing Speed¬¬ Among Students of DPT In AMNC: Hand Grip Strength on Writing Speed¬¬ Among Students. Pakistan BioMedical Journal. 2022 Aug 31:22-6.

12. CHABUNGBAM S, Saikia P. Effects of Resisted Exercises on Grip Strength in Tennis Players. Journal of Medical and Dental Science Research. 2022;9(6):23-9.

13. Ali SS, Azim FH, El Sobky MA. Effect of Strength Training on Upper Extremity Function in Children with Hemiparesis. International Journal of Science and Healthcare Research. 2016;1(3):1-7.