

Prevalence and Pattern of Handwriting Difficulties among School Going Children

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ABSTRACT

School students spend up to one-half of their school day in performing handwriting and other paper-pencil tasks. Handwriting difficulties can significantly affect the child progress in the classroom and lead to academic underachievement. Limited data exists in India regarding the Handwriting difficulties among school students. Hence the study was set out to find out the Prevalence and Pattern of Handwriting difficulties among school children. A convenience sample of 1296 students was taken from the regular schools in south Delhi, India. Both boys and girls of 7-12 years old, attending school in a regular educational environment were included. The mean age of children was 9.15 ± 1.89 years and ranged from 2nd to 6th grade. Children were screened out for handwriting deficiency using Handwriting proficiency screening questionnaire and based on HPSQ scores children were divided into Non-proficient and proficient groups. The handwriting pattern of the students in the non-proficient group was assessed using the Test of handwriting skill-Revised. It was found that out of 1296 students, 854 (66%) students had Proficient handwriting and 442 (34%) students had non-proficient handwriting. The mean HPSQ score of the Non-proficient group was 11.21 ± 1.18 and the Proficient group was 23.6 ± 6.33 . Result also showed the negative correlation between the Writing speed and legibility ($r = -0.94$). From the result, we concluded that the prevalence of handwriting difficulties among the school children was 34%. Overall 67% of boys and 33% of girls had handwriting difficulties. The students with handwriting difficulties showed difficulties with Writing speed, Letter reversal, and Spacing.

KEYWORDS: Academic performance, Child development, Handwriting, Manuscript, Students

1. INTRODUCTION

Handwriting is a complex process of managing written language by coordinating eyes, arms, hands, pencil grip, letter formation, and body posture. (American occupational therapy association-2019) For children, academic school activities can be considered as a major domain of their occupational work performance (Ms. Sid Nour El Houda-et-al, 2016)

Handwriting is an important means of communication that enables the expression, recording, and transmission of ideas of students throughout their educational careers. It has been estimated that elementary school-age students may spend up to one-quarter to one-half of their school day engaged in paper-and-pencil tasks, with writing as the predominant task (Duval-White-et-al, 2013).

While addressing the actual task of children's handwriting the major Functional performance areas that must be considered are Legibility, Writing Speed, and Domains of Handwriting. *Legibility* is categorized as the components of letter formation, alignment, spacing, and size. *Writing Speed*, it is defined as the number of letters written per minute and often determined if the child's performance meets the standards of a teacher or not and *Domains of Handwriting* i.e.

writing the alphabets in both upper and lower case from memory, dictation, near and far point copying, manuscript-to-cursive transition. (Jane Case-Smith, Jane Clifford O'Brien, 2015, Nazia Ali, Kiran Sharma, 2020)

The children in school often struggle with the following patterns of handwriting difficulties: poor writing speed, the inappropriate spacing between letters or words, incorrect or inconsistent shaping of the letter, letter reversals, and mixing of upper and lower case letters. The reason can be attributed to the current pattern of education in which the child has to study two sets of alphabets (upper case and lowercase) simultaneously which are entirely different shapes. Dealing with letter formation, spacing, and posture all at the same time can be cognitively and physically exhausting for the child. The handwriting quality of children with difficulties has been described as "poor". Those children who do not succeed in developing proficient handwriting are defined by some authors as "poor hand writers" and by others as "dysgraphic" (Sara Rosenbulm-et-al, 2006).

Children who cannot write properly may have difficulty in maintaining the required pace of writing in class. Also, doing homework requires continuous long hours and leads to

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frustration. The children with handwriting difficulties often face problems in the fluency and quality of their compositions. Illegible handwriting often results in lower scores in class and significantly affects the progress of a child in the classroom leading to academic underachievement (Mellissa Prunty & Anna L. Barnett, 2017, Sara Rosenbulm-et-al, 2009).

Unfortunately, handwriting difficulties are commonly observed in children at primary schools and particularly in boys (Sara Rosenbulm-et-al, 2006).

Limited data exists in India regarding the Handwriting difficulties among school students. Hence the study was set out to find out the Prevalence of Handwriting difficulties and the patterns that lead to handwriting difficulties among school children.

2. MATERIAL AND METHODS

2.1. Subjects

A convenience sample of 1296 students was taken from the regular schools in south Delhi, India. Both boys and girls age between 7-12 years, attending school in a regular educational environment were eligible for inclusion. Students having other medical, psychiatric, or neurological disorders were excluded. The mean age of children was 9.15 ± 1.89 years. Overall 70% of boys and 30% of girls participated in the study. 87% of students were right-handed and 13% of students were left-handed. 74% of children used manuscripts and 26% of children used cursive handwriting format. (Table-1)

**Table 1: Participant Characteristics
(N=1296)**

Demographics	Frequency	Percentage
Age (M = 9.15 years, SD = 1.89 years)		
7 -8years old	337	26%
9-10 years old	609	47%
11-12 years old	350	27%
Gender		
Boys	907	70%
Girls	389	30%
Grade Level		
Second	146	11.3%
Third	184	14.2%
Fourth	265	20.5%
Fifth	350	27%
Sixth	324	25%
Handwriting Format		
Manuscript	959	74%
Cursive	337	26%
Handedness		
Right	1127	87%
Left	169	13%

2.2. Procedure

Permission was taken from the school. Written consent was taken from each child's parents/guardians. Based on the inclusion criteria the student's age 7 to 12 years were selected for the study. Their age was confirmed from the school records with the help of class teachers. Handwriting proficiency screening questionnaire was applied for all the children (filled in by school teachers). The students were divided into proficient and non-proficient groups. The handwriting pattern of the students in the Non-proficient group was assessed using the Test of handwriting skill- Revised.

2.3. Outcome Measures/Scales

2.3.1. Handwriting proficiency screening questionnaire (HPSQ): Rosenblum, S. (2008)

Handwriting Proficiency Screening Questionnaire (HPSQ) developed by Sara Rosenblum. The HPSQ is a ten-item, reliable, and valid questionnaire developed to identify school-aged children with handwriting deficiency based on their teacher's observation. Items are scored on a 5-point Likert scale from 0-never to 4-always, and then summed to a final score. It indicates the handwriting deficiencies, considering the following three domains: *legibility* (Items 1, 2, 10), *performance time* (Items 3, 4, 9), and *physical and emotional well-being* (Items 5, 6, 7, 8). The score of 14 or above determines the handwriting deficiency.

2.3.2. Test of handwriting skill- Revised (TSH-R): Michael Milone (2007)

The THS-R is a standardized test developed by Michael Milone, to measure how a child writes with his or her hand, letters and words and sentences and numbers, either spontaneously or from dictation or by copying and can be administered individually or to a group of children with age range up to 18 years, 11 months. The THS-R also assesses writing speed, letter reversal, and case substitutions.

2.4. Data Analysis

Complete data was gathered in the form of a master chart made on Microsoft Excel 2010. The statistical analysis was conducted using Statistical Package for the Social Sciences 21 (SPSS v.21). Pearson correlation analysis was performed to find out the correlation between writing speed and legibility. Descriptive analysis included percentages, means, and SD.

3. Result

3.1. Handwriting difficulty

A total of 1296 students of 7-12 years old were screened out using Handwriting Proficiency Screening Questionnaire, out of which 854 students achieved the score between 0-13 (Proficient handwriting) and 442 achieved the score above 14 (non-proficient handwriting). Hence based on HPSQ scores children were divided into the proficient handwriting group (66%) and non-proficient handwriting group (34%) to further assess the handwriting pattern.

The mean HPSQ score of the Non-proficient group was 11.21 ± 1.18 and the Proficient group was 23.6 ± 6.33 . Mean, SD value of legibility, performance time, and physical and emotional well-being domain of HPSQ is given in Table-2

Table 2: Comparison of Mean, SD value of HPSQ score of proficient and non-proficient group

Variables	Proficient handwriting N=854	Non proficient handwriting N=442
HPSQ	M \pm SD	M \pm SD
Legibility	3.89 ± 1.91	9.47 ± 6.77
Time	3.67 ± 1.22	5.40 ± 2.02
Emotional well-being	3.93 ± 2.54	8.85 ± 2.37
Total HPSQ Score	11.21 ± 1.18	23.66 ± 6.77

3.2. Handwriting pattern

The Handwriting pattern of the students was assessed using the Test of handwriting skill- Revised (sub-tests 1-4). Sub-tests 1 and 2 involve writing the capital letters A-Z and lower case letters a-z spontaneously from memory and these are timed sections, involves writing as many capital and lower-case letters in order within 20 seconds. Sub-test 3 and 4 involve writing each capital letter and lower case letter of the alphabet that are dictated in random order. Within the study, *writing speed*: Average Letter/ 20 seconds, Sub-test 1&2 (M \pm SD = 23.04 ± 4.15), *Letter touching*: only manuscript (M \pm SD = 10.73 ± 2.84) and *letter reversals* (M \pm SD = 5.98 ± 0.8) was analysed.

Mean and SD value of HPSQ and TSH score of Non-proficient group for each grade is given in Table- 3

Table 3: Mean, SD value of HPSQ and TSH score of Non proficient group for each grade

Grade (N=442)	HPSQ M \pm SD	Writing speed M \pm SD (Average Letter/ 20 seconds) Sub-test 1&2	Letter reversal M \pm SD	Letter touching M \pm SD
Second (N=50)	25.8 ± 2.68	16.15 ± 1.22	16.2 ± 1.32	5.95 ± 0.82
Third (N=63)	26.5 ± 2.50	19.15 ± 2.07	13.2 ± 1.19	4.05 ± 0.83
Fourth (N=90)	25.05 ± 3.95	21.4 ± 2.02	11.1 ± 1.61	3.4 ± 1.09
Fifth (N=118)	26.15 ± 2.58	25.75 ± 3.39	9.65 ± 1.53	2.2 ± 1.30
Sixth (N=121)	21.13 ± 4.89	26.18 ± 1.47	8.79 ± 1.14	1.60 ± 0.8

4. Discussions

This study was set out to find out the Prevalence and Pattern of Handwriting difficulties among 7-12 years old school children. A total of 1296 students participated in the study.

Most of the children in the study were right-handed as compared to left-handed. Yuriy Zverev (2005) in a cross-sectional study of the prevalence of left, right, and mixed handedness among 512 school children aged 6-17 years found that left, right, and mixed handers were 3.9%, 90.4%, 5.7% respectively. 28% of pupils indicated that they stopped using left hand under the pressure from guardians and teachers.

It was found most of the children used manuscript writing style as compare to cursive style Herrick in 1963 favoured the retention of manuscript writing beyond primary grades and experimentally evident that manuscript writing tends to be written faster in the beginning grades and cursive writing faster in the later grades and at the adult level.

Prevalence of handwriting difficulties

Within the study we found that out of 1296 students 442 students were found to have Handwriting deficiency (non-proficient handwriting), indicating that the prevalence of handwriting difficulty was 34%. The result is supported by Kartsdottir and Stefansson (2002), who did the study to assess the handwriting dysfunction among the students of 1-5th grade. Within the study, they found that 10-34% of school children failed to develop efficient handwriting performance required to cope at school.

Gender-related differences in Handwriting difficulties

Our result showed that 67% of boys (N=296) and 33% of girls (N=146) had handwriting difficulties in non- proficient group. Our result is again supported by Kartsdottir and Stefansson (2002) who found that, when the development of handwriting performance is analysed by gender, girls performed better than the boys both in handwriting quality and speed.

Our study had also indicated that the students in the non-proficient group showed handwriting deficiencies in the legibility domain (M=9.47) more as compared to performance time (M=5.40), and physical and emotional well-being domain (M=8.85) as shown in Table-2

Handwriting pattern in Non-Proficient Group

Within the study, we found that the students in the non-proficient group faced difficulties with writing speed, a spacing of letters and letter reversals Table-2

Writing Speed

The average numbers of upper and lower case letters written by students in 40 seconds (20 seconds each for subtest 1 and 2) were 16 letters in second grade, 19 letters in third grade, 21 letters in fourth grade, 25 letters in fifth grade and 26 letters in sixth grade. Our result was supported by Feder, K. & Majnemer, A. (2007) who concluded that kids achieve speed and fluency with printing and become more automatic in their writing by the end of second grade (ages 8-9).

The average writing speed of the children in primary School (No of letters per minute) in accordance with the gender and grade by Graham et-al 1998 is given in Table-4,(Memiş, Aysel, 2018)

Table: 4 Average writing speed of the children in primary School (No of letters per minute) in accordance with the gender and grade (Graham et-al 1998)

Grades	1	2	3	4	5
Girls	20.51	36.77	49.80	65.78	74.57
Boys	17.44	31.55	44.80	60.58	70.91

Letter Reversals

Within the study we found that most commonly reversed letters in the upper case were B, D, J, K, N, P, S, and Z and in the lower case were b, d, h, j, p, q, s, t, and z. Most of the students of grade second and third as compared to the students in other grades showed the reversals. Our result was supported by Jean-Paul Fischer (2018) and Janet Richmond (2012) who did a study on Letter and Number Reversals among typically developing children (age range between 4-7 years old) and found that most of the children had letter reversals in (Lower case letters) j, z, b, c, q, i, t, d, l, p, s and (upper case letters) B, C, D, E, G, J, K, L, N, P, Q, R, S, Z. Independently written letters reversed more often than those written within words.

Letter touching

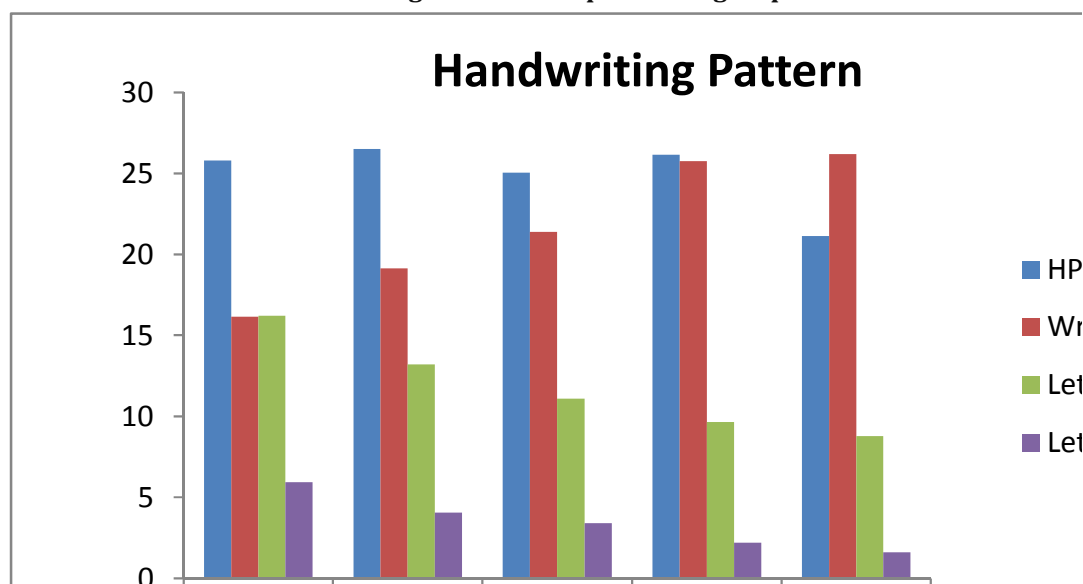
The following were the most commonly touched letters (manuscript) recorded. Upper case: E, F, M, N, X, Y. and lower case: a, c, d, e, h, i, k, l, o, q, t, u, x. The students of second and third grade reported maximum difficulties with the spacing of letters as compared to the students in other grades. The result is supported by Claire Heffron (2016) who concluded that with the increase in age and grade kids become stronger, more confident readers and writers, they begin to have a better sense of where the letters or words will end and where the next word or letter begins. Thus the child gets a better understanding of the spacing between their words when writing.

Handwriting pattern among the students of different grades

When analysing the HPSQ and TSH scores of each grade (Table-3) we found the improvement in the score of legibility, writing speed, Letter reversal, and Spacing (Letter touching) from grade second to grade sixth. Thus our result suggested that handwriting patterns are expected to improve with age and grade.

Our result was supported by Dr. Michael Milone (Test of handwriting skill- Revised manual pg-157) suggested that the ancillary scores are expected to increase with age and grade. Hamstra-Bletz & Blöte, (1990) also found the gradual improvement of handwriting legibility from grade 1 or grade 3 to grade 6 onward. (Figure-1)

Figure: 1 Handwriting deficiency, Writing speed, Letter reversals, Letter touching reported by the students of different grades in Non-proficient group



Correlation between Writing speed and legibility

A Pearson correlational analysis was performed to find out the correlation between Writing speed and legibility. The result showed the negative correlation between Writing speed and legibility (HPSQ) ($r = -0.94$). Thus the finding indicated that with the increase in children's handwriting speed there would be a corresponding decline in the legibility.

Similar results were found in the study by Graham et al (1998) who assessed the relationship between the handwriting speed and legibility in 1-9 grade students and found that the correlation between Writing speed and legibility was weak ($p = .20$ for copy legibility, $p = .16$ for narrative writing task and $p = .27$ for expository writing task) and concluded that when children were directed to write quickly there would be a decline in the legibility.

4.1. Limitations

It should be noted that convenience sampling was used within the study and all the students were from the same geographic area thus; the scope of the study was limited primarily to the population of one area. Secondly, the teachers were not blinded while scoring their child on the Handwriting proficiency screening questionnaire so there could be the possibility of teacher bias influencing the scoring. Also, the students were not completing the Test of handwriting skill questionnaire in their classrooms but the students were invited to another room in the school so that other students could not be disturbed. So student sensitivity to testing separately could increase the students' anxiety when completing the questionnaire and might have influenced the result.

4.2. Future Recommendations

Several recommendations for future research can be identified from the findings of our study.

Future studies could focus on assessing the Handwriting difficulties pattern from more than one school of the different geographic area this will provide a better representation of the population. It may also be beneficial to compare the handwriting patterns among the right-handed and left-handed students and focus could also be given on comparison of the pattern of handwriting difficulties among boys and girls.

Other areas to consider exploring would be, assessing the pattern of handwriting difficulties among the students in urban and rural areas.

Studies could also focus on the prevalence of handwriting difficulties among students with different socioeconomic backgrounds.

5. Conclusions

Within the study, we found that 34% of schoolchildren had Handwriting difficulties as measured by the Handwriting proficiency screening questionnaire. This study had provided evidence that Handwriting difficulties were more common in boys as compared to the girls. Students with non-proficient handwriting faced difficulties with writing speed, letter touching and letter reversals with J, K, N, P, S, Z, j, z, b, c, q, i, t, d, l, p, s were most commonly reversed letters. When Handwriting patterns were analysed according to the grades

study showed the improvement in the score of legibility, writing speed, Letter reversal, and Letter touching from grade second to grade sixth. Overall this study suggested that student's screening for handwriting difficulties should be carried out by the school authorities on a regular basis and appropriate referral should be made to occupational therapists for addressing the Handwriting issues as early as possible.

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Declarations

Conflicts of interest: The authors report no conflicts of interest in this work.

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Ethical clearance: Verbal consent and written consent were taken from each child's parents/guardians who participated in the study.

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