

Original Research

Turkish Version, Validity and Reliability of the Handwriting Proficiency Screening Questionnaire

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Abstract

Objectives: Writing proficiency is important for a student's academic success in school. In our country, the number of questionnaires evaluating the factors related to the writing skills of school-age children is quite limited. For this reason, the aim of our study is to investigate the validity and reliability of the Handwriting Proficiency Screening Questionnaire (HPSQ) in Turkish.

Materials and Methods: This study included 200 children recruited from primary public schools. We evaluated the validity of the HPSQ using the Jebsen Hand Function Test (JHFT) to assess writing speed and legibility.

Results: The Cronbach's alpha was found to be 0.76 for the legibility items (1, 2, 10), 0.72 for the performance time items (3, 4, 9), and 0.74 for the physical and emotional wellbeing items (5, 6, 7, 8). The intraclass correlation coefficient test-retest score was 0.96, and it was highly reliable.

Conclusion: In our study, there was a significant relationship between the HPSQ score and the legibility of the students' handwriting. The HPSQ, which is used to evaluate the handwriting of school children, was found to be valid and reliable in Turkish.

Keywords: children, handwriting, questionnaire, validity, reliability

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Introduction

Handwriting is the process of creating letters and symbols on paper. Correct letter formation in the writing process, a result of a combination of cognitive and motor processes, is essential, as is maintaining normal writing speed and fluency (Prunty & Barnett, 2017). Research has proven that elementary school-age children engage in paper and pencil tasks more frequently than other tasks during school activities (McHale & Cermak, 1992). At the same time, writing plays an important role in completing school-based activities and ensuring academic achievement (Graham et al., 1998). However, research indicates that between 13% and 27% of school-age children struggle with writing. The difficulties that children experience in writing also negatively affect their participation in class activities, cause a loss of self-esteem, and affect personal relationships and psychosocial well-being (Kushki et al., 2011).

Legibility and speed are the most important considerations for children's handwriting skills. The legibility of text was found to be affected by letter formation (Graham et al., 2001), size, alignment, and spacing (Graham et al., 2006; Ziviani & Elkins, 1984). The low level of legibility of text written by students may affect the perception level of the teacher and the student's academic knowledge and may lead to negative effects on the development of symbol memory and recall skills (Duval-White et al., 2013).

In school, some children may have difficulty using pencils while writing letters and words; they may write slowly and illegibly. This difficulty in writing may be caused by motor control and coordination weakness or may be associated with other learning disabilities (Prunty & Barnett, 2017). For these reasons, evaluation tools are needed to identify children with low writing performance and to analyze their writing. Teachers and therapists need practical test methods that they can apply in the clinic. A lot of different handwriting assessments are used to measure speed, legibility, etc. in the literature (Feder & Majnemer, 2003). However, the number of questionnaires that quickly identify problems and are practical is low (Daniel & Froude, 1998). Inexpensive, simple, and also used in school environments, questionnaires are the preferred method when the problem is identified early (Rosenblum, 2008).

The Jebsen Hand Function Test (JHFT) was developed to evaluate the effectiveness of treatments and the level of disability in individuals with hand injuries. It is a reliable and valid assessment tool that helps differentiate individuals with impaired hand function from those with normal hand function (Sığirtmaç & Öksüz, 2021). The JHFT has been recognized as an effective method for assessing hand functions in individuals with various hand disabilities,

including rheumatoid arthritis, osteoarthritis, stroke, spinal cord injury, and traumatic brain injury (Beebe & Lang, 2009; Beekhuizen & Field-Fote, 2005; Sharma et al., 1994).

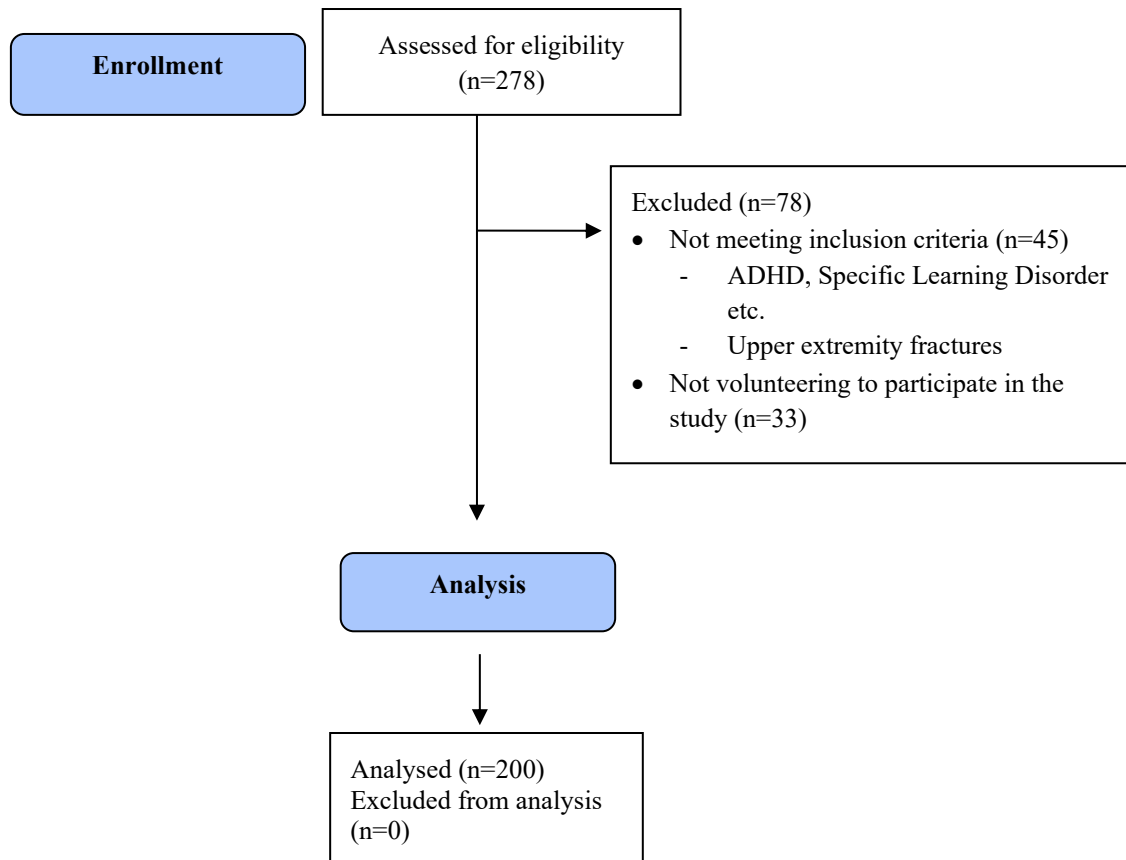
Additionally, a study by Reedman et al. found that for typically developing children aged 6 to 10 years, the test-retest reliability of the JHFT was good for both the dominant hand (ICC: 0.74) and the nondominant hand (ICC: 0.72). Notably, in this study, the writing subtest of the JHFT demonstrated the highest reliability among different subjects. variability (ICC = 0.96) (Reedman et al., 2016).

Although JHFT's writing subtest is a valid and reliable test for typically developing children, Turkish scales for evaluating handwriting are quite limited. The aim of the present study is to investigate the Turkish validity and reliability of the practical and standardized Handwriting Proficiency Screening Questionnaire (HPSQ) for school-age children.

Material and Methods

This study recruited a total of 8 classes from primary schools in Ankara, Turkey. The study enrolled 200 students, 87 boys and 113 girls, from the 2018–2019 school year. The Hacettepe University Human Research Ethics Committee approved the study (Decision number: 410.01-2854, 20.09.2011), and both parents and participants provided written informed consent.

This study included children with typical development who had no cognitive, emotional, or orthopedic complaints and did not require a physician's consultation. The presence of any health complaint or condition requiring hospital admission was decided by discussing it with both parents and teachers. The study excluded children with cognitive, emotional, or orthopedic complaints or problems. A flow diagram of the study was added as Figure 1.

Figure 1. Flow Diagram

Physical therapists evaluated the JHFT, while eight teachers evaluated the HPSQ. The “writing” subtest of the JHFT assesses writing speed and legibility (Reedman et al., 2016). The test evaluates unilateral hand use in seven subtests: (1) writing a sentence with 20 words, (2) turning over cards, (3) picking up small objects, (4) stacking checkers, (5) simulated feeding, (6) moving large empty cans, and (7) moving large, weighted cans. However, the present study only used the “writing” subtest. The white paper featured a sentence consisting of 20 words, written in 12-point Verdana font in bold, black Turkish letters. The students composed the sentence and recorded their completion time in seconds (Jebsen, 1969). Legibility was evaluated by keeping a score of readable written letters and dividing it by the total number of written letters in a writing sample. Also, the percentage of word readability was calculated (Amundson, 2005).

The HPSQ was developed by Rosenblum (Rosenblum, 2008). The test includes 10 items and three domains: (1) legibility (items 1, 2, 10), (2) performance items (items 3, 4, 9), and (3) physical and emotional well-being (items 5, 6, 7, 8). Teachers observed students' writing style in the classroom and assessed it using a 5-point Likert scale. “0” refers to never and “4” refers

to always; lower scores indicate good performance on the questionnaire. The total score was computed by summing the scores of all 10 test items.

The translation process for the original English version of the HPSQ was applied according to the guidelines of Guillemin et al. (Guillemin et al., 1993) after permission was obtained from the developers of the HPSQ. Three experienced physiotherapists translated the original English version into Turkish. They are all native Turkish speakers, and the three Turkish translations were compared for inconsistencies. Finally, a professional translator, who is a native English speaker, translated the HPSQ-Turkish back into English blindly and independently. This translator had no medical knowledge and was unfamiliar with HPSQ. The back-translated version was compared with the original English version. It was then applied to 20 children, and it was understood that the scale was clear. Then 20% (n = 55) of the children completed HPSQ a second time one week later for reliability.

Statistical Analysis

Descriptive statistics for HPSQ and JHFT include mean and standard deviation values for quantitative variables and n (%) for qualitative factors. The reliability analysis was conducted using test-retest methodologies and internal consistency. The intraclass correlation coefficient (ICC) was used to examine test-retest reliability (with a seven-day interval between two HPSQ administrations). Cronbach's alpha coefficient was used to assess internal consistency of items, with a value of 0.7 being acceptable. The Spearman correlation coefficient was utilized to assess convergent validity between HPSQ and JHFT. The HPSQ's structure was evaluated using exploratory factor analysis. The necessity for factor analysis was determined using the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's test of sphericity. The analysis revealed the need for factor analysis, therefore principal component analysis was used. A rotated component matrix was used to make factor loadings easier to read. The statistical significance criterion for all tests was $p < 0.05$. The data were examined with IBM SPSS vn.22.0 software.

Results

The mean score from the questionnaire in 200 children in the present study sample was 10.97 ± 6.89 points. Table 1 provides the gender distribution, mean score, and standard deviation of HPSQ for each grade.

Table 1. Distribution of the Total Participant Sample Across Different Grades and HPSQ Means and Standard Deviations for Each Grade

Grade	Boys n (%)	Girls n (%)	Total n (%)	HPSQ Score $\bar{x} \pm SD$
1	1 (50)	1 (50)	2 (100)	5.5±7.77
2	21 (50)	21 (50)	42 (100)	12.71±8.45
3	18 (46.2)	21 (53.8)	39 (100)	7.17±7.83
4	13 (38.2)	21 (61.8)	34 (100)	12.76±5.75
5	11 (57.9)	8 (42.1)	19 (100)	12.84±6.04
6	13 (48.1)	14 (51.9)	27 (100)	13.37±4.83
7	6 (31.6)	13 (68.4)	19 (100)	7.21±3.24
8	4 (22.2)	14 (77.8)	18 (100)	10.77±3.67
Total	87 (43.5)	113 (56.5)	200 (100)	10.97±6.89

HPSQ: Handwriting Proficiency Screening Questionnaire, SD: Standard Deviation

The Cronbach's alpha was found to be 0.76 for the legibility items (1, 2, 10), 0.72 for the performance time items (3, 4, 9), and 0.74 for the physical and emotional well-being items (5, 6, 7, 8). Cronbach's alpha value for the total score was calculated as 0.851. ICC values <0.40 indicate that a test is not reliable, 0.40–0.59 indicate the reliability level is low, 0.60–0.79 indicate the test is relatively reliable, and >0.79 indicates that the scale is highly reliable. In this context, the items were found to be compatible with each other and relatively reliable. The ICC test-retest score was 0.96, making it highly reliable. ICC values for each of the questionnaire items and the HPSQ final score are presented in Table 2.

Table 2. Intraclass Correlation Coefficient Values for Each of the Questionnaire Items and for the HPSQ Final Score

Item No.	Questionnaire Item	ICC Value
1	Unreadable handwriting	0.93
2	Unsuccessful in reading his/her own handwriting	0.89
3	A lack of time to copy	0.93
4	Often erases	0.94
5	Does not want to write	0.80
6	Does not do homework	0.79
7	Complaints about pain	0.95
8	Tired while writing	0.95
9	Needs to look often when copying	0.92
10	Not satisfied with his/her handwriting	0.88
HPSQ total score		0.96

ICC: Intraclass Correlation Coefficient, HPSQ: Handwriting Proficiency Screening Questionnaire

Table 3 presents the means and standard deviations for handwriting legibility and speed. There was no relationship between handwriting speed and the HPSQ score ($p > 0.05$), although there was a statistically significant negative correlation between handwriting legibility and the HPSQ score ($p < 0.05$). The relationship between handwriting legibility, speed, and HPSQ score is shown in Table 4.

Table 3. Handwriting Legibility and Handwriting Speed Means and Standard Deviations

	n=200 $\bar{x} \pm SD$
Handwriting Legibility (%)	61.17 \pm 25.63
Handwriting Speed (sec)	268.14 \pm 252.71

Sec: Second, SD: Standard Deviation

Table 4. Relationship Between Handwriting Legibility, Speed and HPSQ Score

	HPSQ Score (n=200)	
	r	p
Handwriting Legibility	-0.39	<0.001*
Handwriting Speed	0.11	0.09
HPSQ Score (n=55)	0.92	<0.001*

HPSQ: Handwriting Proficiency Screening Questionnaire

The rotated component matrix for the 10 items on the HPSQ is presented in Table 5. Exploratory factor analysis yielded three factors with eigenvalues higher than 1 (4.393, 1.591, 1.017). Fit indices for the three-factor solution in the exploratory factor analysis were as follows: Bartlett's $\chi^2 = 892.7$ (df = 45, $p < 0.001$) and KMO = 0.81. Both measures indicated that the data sampled were adequate to carry out factor analysis.

Table 5. Rotated Component Matrix for the 10 Items

Item No.	Questionnaire Item	Factor 1	Factor 2	Factor 3
1	Unreadable handwriting	0.861		
2	Unsuccessful in reading his/her own handwriting	0.867		
3	A lack of time to copy			0.814
4	Often erases	0.697		
5	Does not want to write		0.642	
6	Does not do homework			0.805
7	Complaints about pain		0.868	
8	Tired while writing		0.891	
9	Needs to look often when copying	0.667		
10	Not satisfied with his/her handwriting	0.632		

Discussion

The present study found a significant relationship between the HPSQ score and the legibility of the students' handwriting. It was revealed that the validity and reliability of the HPSQ in Turkish. HPSQ is useful for early detection of handwriting problems for teachers and therapists. Teachers can help improve students' handwriting by referring them to therapists, who can then provide targeted interventions to address difficulties of children. Given the significance of writing skills in students' academic lives, it is crucial to include this questionnaire in the literature.

There are several ways to assess handwriting proficiency, but each has its own limitations. (a) Some methods only consider a specific element of the handwriting; (b) evaluation norms may be outdated or unavailable; (c) language adaptations vary, especially in the English environment; and (d) some techniques are time-consuming. However, HPSQ is a fast, practical, and up-to-date method that evaluates multiple parameters of handwriting proficiency., there is a need for validation of a screening method such as HPSQ, especially in children for Turkish population. Teachers, students, and parents in this population lack an acceptable screening technique to diagnose handwriting problems. We customized the HPSQ for Turkish children and evaluated its reliability and validity in this study.

Rosenblum found that the test-retest reliability of the score was determined to have an ICC of 0.84, while the interrater reliability for all of the survey scores was found to be ICC = 0.92 (Rosenblum, 2008). In the current study, it was found that an ICC of 0.96 was a suitable evaluation method for the use of HPSQ by therapists and teachers in clinical and academic settings.

The validation of the study was carried out with the duration of the JHFT sentence writing and the calculation of readable words. There was a significant correlation between the total score and legibility. However, the same relationship could not be obtained between the total score of the questionnaire and the duration of the sentence writing. The evaluation method for legibility is consistent with the questionnaire. However, there may be a discrepancy between the stopwatch measurement and the survey questions. The JHFT was chosen in our study because there is no valid and reliable questionnaire in Turkish, and this method is preferred in clinical practice (Atasavun Uysal & Aki, 2012; Atasavun Uysal & Duger, 2012).

In order to minimize the difficulties that children experience in writing, identifying and defining these problems is of extreme importance. We should evaluate the legibility, speed, and physical and emotional well-being of children's writing in this context. This aim necessitates

the application of practical assessment methods with ease and speed (Parush et al., 2010). This study found that the HPSQ, a measurement method that allows both therapists and teachers to evaluate students' handwriting deficiencies without requiring extensive time in clinical and academic settings, is a valid and reliable questionnaire in Turkish.

Over time, children's duties and responsibilities are increasing due to their changing age and class. Teachers of children included in our study stated that the children have difficulty with these roles. In our study, it is thought that the children's results from the questionnaires are not in a certain order between the classes, and it may be related to teacher success and the difficulties of teachers in terms of decision-making.

The present study found that grade progression did not directly affect handwriting proficiency. There are many intrinsic (academic success, school starting age, upper extremity muscle strength, etc.) and extrinsic (parental socio-cultural level, physical environment inequality, etc.) factors that affect handwriting proficiency (Pade et al., 2018; Yıldız et al., 2015; Seo, 2018; Uyanık et al., 2001). Our next research goal is to compare handwriting proficiency across classrooms and investigate the factors that influence handwriting proficiency. Additionally, handwriting proficiency can be compared between age groups. The target population in this study consisted of typically developing children. Examining the psychometric properties of HPSQ in different neurodevelopmental disorders such as cerebral palsy, learning disorder, attention deficit and hyperactivity disorder, and autism spectrum disorder will contribute to the literature.

Limitation

The study has several limitations. Firstly, our study was the inability to use computerized writing analysis systems which are more reliable methods for evaluating writing in validity analysis. Secondly, we did not control the IQ variable of children. Another limitation is also associated with the teachers who participate in the study such as sex, age, and years of experience. To better understand the impact of these variables on HPSQ results, future research should include them in questionnaire.

Conclusion

As a result, the HPSQ proved to be a valid and reliable method for assessing handwriting proficiency in the Turkish population. It is crucial to conduct screening with these tests to identify potential problems at an early stage, thereby enhancing academic success for both children and families. Assessment of handwriting proficiency by teachers and clinicians should

be considered. Thus, it will be possible to solve the problems detected in the early period with appropriate rehabilitation programs.

Conflict of Interest

The authors declare no conflict of interest.

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Appendix 1**HANDWRITING PROFICIENCY SCREENING QUESTIONNAIRE**

Question	Never 0	Rarely 1	Sometimes 2	Often 3	Always 4
1.Is the child's writing unreadable?					
2.Is the child unsuccessful in reading his/her own handwriting?					
3.Does the child not have enough time to copy tasks from the blackboard?					
4.Does the child often erase while writing?					
5.Does the child often feel he/she does not want to write?					
6.Does the child not do his/her homework?					
7.Does the child complain about pain while writing?					
8.Does the child tire while writing?					
9.Does the child need to look at the page/blackboard often when copying?					
10.Is the child not satisfied with his/her handwriting?					

Appendix 2**EL YAZISI YETERLİLİĞİ TARAMA ANKETİ (EYYTA)**

Soru	Asla 0	Nadiren 1	Bazen 2	Sıklıkla 3	Her zaman 4
1.Çocuğun yazısı okunaksız mı?					
2.Çocuk kendi el yazısını okumada başarısız mı?					
3.Çocuğun tahtada yazılanları kopyalamada zamanı yetmiyor mu?					
4.Çocuk yazarken sıklıkla yazdıklarını siliyor mu?					
5.Çocuk sıklıkla yazı yazmak istemiyor gibi mi hissediyor?					
6.Çocuk ödevini yapmıyor mu?					
7.Çocuk yazı yazarken ağrıdan şikayet ediyor mu?					
8.Çocuk yazı yazarken yoruluyor mu?					
9.Çocuk kopyalama sırasında tahtaya/kağıda çok sık bakmaya ihtiyaç duyuyor mu?					
10.Çocuk kendi el yazısından mutsuz oluyor mu?					