Research in Education and Rehabilitation 2026; 9(1): 1-11 **DOI**: **10.51558/2744-1555.2026.9.1.1**

GRAPHOMOTOR SKILLS IN CHILDREN WITH HEARING IMPAIRMENT

GRAFOMOTORNE VJEŠTINE KOD DJECE S OŠTEĆENJEM SLUHA

Alma Huremović[1*], Azra Mujić Sujoldžić[2], Admira Beha[1]

[1]Faculty of Education and Rehabilitation, University of Tuzla, Tuzla, Bosnia and Herzegovina

[2]Dr. Alabajci Polyclinic, Tuzla, Bosnia and Herzegovina

Original Scientific Article

Received: 13/03/26
Revised: 15/04/26
Accepted: 20/05/26

ABSTRACT

The introductory section defines the concepts of graphomotor skills and hearing impairment. The aim of this study was to examine the characteristics of graphomotor skills in children with hearing impairments compared to hearing children. Additionally, one of the objectives was to investigate whether there are differences in graphomotor skills depending on the quality of hearing, as well as to identify the factors that influence these skills.

For assessment purposes, the Diagnostic Set for Testing Speech, Language, Reading, and Writing Abilities in Children – Diagnostic Material for Identifying Specific Difficulties in Reading and Writing was used, focusing on variables related to graphomotor skills. Descriptive statistics, optimal scaling regression analysis, and linear regression analysis were employed for statistical data processing.

The study revealed that hearing participants achieved statistically significantly better results in graphomotor skills compared to participants with hearing impairments. The degree of hearing impairment affects the graphomotor skills of children with hearing impairment, while educational conditions and gender did not show any influence on these skills. Age also impacts the graphomotor skills of children with hearing impairment.

These findings provide insight into the specific needs of children with hearing impairments and emphasize the importance of individualized education, taking into account the unique characteristics of each child with hearing impairment.

Keywords: graphomotor skills, graphomotor development, children with hearing impairment

[*] **Correspondence author: Alma Huremović**, Faculty of Education and Rehabilitation, University of Tuzla
E-mail: **alma.huremovic@untz.ba**

Research in Education and Rehabilitation 2026; 9(1): 1-11 **DOI**: **10.51558/2744-1555.2026.9.1.1**

SAŽETAK

U uvodnom dijelu definirani su pojmovi grafomotoričkih vještina i oštećenja sluha. Cilj ovog istraživanja bio je ispitati karakteristike grafomotoričkih vještina kod djece s oštećenjem sluha u poređenju s djecom urednog sluha. Također, jedan od ciljeva bio je ispitati postoje li razlike u grafomotoričkim vještinama u odnosu na stepen oštećenja sluha, kao i utvrditi faktore koji utiču na razvoj ovih vještina.

Za procjenu grafomotoričkih vještina korišten je Dijagnostički komplet za ispitivanje sposobnosti govora, jezika, čitanja i pisanja kod djece – Dijagnostički materijal za utvrđivanje specifičnih teškoća u čitanju i pisanju, pri čemu su analizirane varijable koje se odnose na grafomotoričke vještine. Za obradu podataka primijenjene su deskriptivna statistika, regresijska analiza s optimalnim skaliranjem i linearna regresijska analiza.

Rezultati istraživanja pokazali su da su ispitanici urednog sluha postigli statistički značajno bolje rezultate u grafomotoričkim vještinama u odnosu na ispitanike s oštećenjem sluha. Stepen oštećenja sluha utiče na grafomotoričke vještine djece s oštećenjem sluha, dok odgojno-obrazovni uvjeti i spol nisu pokazali uticaj na ove vještine. Također, utvrđeno je da dob ima značajan uticaj na grafomotoričke vještine djece s oštećenjem sluha.

Dobijeni rezultati pružaju bolji uvid u specifične potrebe djece s oštećenjem sluha te naglašavaju važnost individualiziranog odgojno-obrazovnog pristupa, uz uvažavanje jedinstvenih karakteristika svakog djeteta s oštećenjem sluha.

Ključne riječi: grafomotoričke vještine, grafomotorički razvoj, djeca s oštećenjem sluha.

INTRODUCTION

Graphomotor skills describe several technical motor processes necessary for writing, coloring, or drawing. The concept has also been expanded to include interactive external factors affecting writing. However, systematic distinctions between copying or drawing letters and actual rapid writing are often not considered in various definitions. Graphomotor skills refer to writing and drawing activities. The adequate development of graphomotor skills requires visuomotor integration skills and fine hand motor skills (Carlson et al., 2013). The development of drawing skills precedes the development of writing skills, but writing skills involve more complex coordination and precision development in children (Smits-Engelsman et al., 2001). Graphomotor skills are fundamental for acquiring writing abilities and for the successful functioning of students within the school environment. These skills enable a child to perform controlled hand movements while writing, drawing, and engaging in other activities requiring fine motor skills. The development of graphomotorics involves not only technical execution of movements, but also perceptual-motor coordination, spatial orientation, and visual perception, making writing a complex cognitive-motor process. Hearing impairment can be defined as the inability or reduced ability to receive, conduct, and register auditory stimuli due to congenital or acquired damage, underdevelopment, or decreased functionality of the auditory organ, auditory nerve, or auditory centers in the brain (Dulčić & Kondić, 2002). According to the World Health Organization (WHO, 2008), hearing

Research in Education and Rehabilitation 2026; 9(1): 1-11 **DOI**: **10.51558/2744-1555.2026.9.1.1**

impairment in adults is considered to exist when a loss of 40 dB or more is detected in the better ear, while for children, this threshold is set at 30 dB in the ear with better residual hearing. The same classification divides the degree of hearing loss into several subgroups: mild hearing loss (ISO audiometric value of 26–40 dB in the better ear), moderate hearing loss (41–60 dB), severe hearing loss (61–80 dB), and profound hearing loss, including practical deafness (81 dB or more in the better ear). Hearing impairment is generally classified as either deafness or hearing loss. Children with a hearing loss of 80 decibels or more, who cannot fully perceive speech even with hearing aids, are considered deaf. Children with a hearing loss of 25 to 80 decibels, where speech is partially or fully developed, are considered hard of hearing (Huremović, Nikolić, Beha, Šarić, Radžo Alibegović, & Mehmedinović, 2025). Hearing impairment can occur in one of three periods: prenatal (before birth), perinatal (during birth), or postnatal (after birth). The perinatal period accounts for 10% of all hearing impairments, most often resulting from reduced oxygen supply to the child or intracranial hemorrhages, while the postnatal period accounts for about 30% of cases, including middle ear inflammation, use of ototoxic drugs (salicylates, streptomycin), traumatic head injuries (temporal bone fractures), noise exposure (acoustic trauma), and, in older age, presbycusis (age-related hearing loss) (Bradarić-Jončić & Mohr, 2010). Hearing impairment adversely affects the development of speech and cognitive processes, and in adulthood, it can significantly impact work and social adaptation. Therefore, hearing loss and deafness are important public health issues, affecting a large part of the general population (Barišić et al., 2004). In students with hearing impairment, the development of graphomotor skills may be delayed or atypical due to several factors. Most research indicates that hearing impairment does not directly affect motor functions; however, inadequate verbal communication, reduced ability to imitate speech, and a lack of auditory feedback can hinder the acquisition of certain motor patterns and the understanding of verbal instructions, which indirectly impacts grapho-motor development. The errors made by children with hearing impairment while writing or copying are mainly optical and phonological-phonematic in nature, as well as errors in language analysis and synthesis, while kinetic errors are very rare (Huremović & Islamović, 2019; Huremović, Islamović & Numanović Senyz, 2019). Some studies suggest that children with hearing impairment often display weaker fine motor skills and lower scores on tasks requiring visual-motor integration (Kurucz, Potočnik & Vlah, 2020).

The objective of this research was to examine the characteristics of graphomotor skills in children with hearing impairment and to identify the factors that influence these skills. In line with the main objective, the following sub-objectives were defined: – To determine whether there is a difference in graphomotor skills based on the quality of hearing; – To identify the factors that affect the graphomotor skills of children with hearing impairment.

MATERIAL AND METHODS

Sample of participants

The sample consisted of a total of 62 students aged 6 to 11, divided into two groups. The experimental group included 31 participants with hearing impairment, of whom 21 (67.7%) were female and 10 (32.3%) were male. In the control group of 31 participants, 19 (61.3%)

Research in Education and Rehabilitation 2026; 9(1): 1-11 **DOI**: **10.51558/2744-1555.2026.9.1.1**

were female and 12 (38.7%) were male. Within the experimental group, 21 participants (67.7%) had total deafness, while 10 participants (32.3%) had severe hearing loss. All participants had prelingual hearing impairment, meaning the impairment occurred before language development—they were born deaf. Of the total number of participants with hearing impairment, 28 (90.3%) were educated in homogeneous educational settings, while 3 (9.7%) were educated in heterogeneous settings. In the experimental group, 7 participants (22.6%) were 6 years old, 7 (22.6%) were 7 years old, 2 (6.5%) were 8 years old, 4 (12.9%) were 9 years old, 4 (12.9%) were 10 years old, and 7 (22.6%) were 11 years old. In the control group, 6 participants (19.4%) were 6 years old, 10 (32.3%) were 7 years old, 11 (35.5%) were 8 years old, 2 (6.5%) were 9 years old, and 2 were 10 years old.

Measuring instruments

For assessment, the Diagnostic Kit for Examining Speech, Language, Reading, and Writing Abilities in Children – Diagnostic Material for Detecting Specific Difficulties in Reading and Writing (Bjelica-Posokhova, 2001) was used, focusing on variables related to graphomotor skills. Preparation preceded the data collection process.

Data processing methods

For statistical data analysis, descriptive statistics, the Mann-Whitney U test, measures of central tendency, and measures of dispersion were used. The normality of the data distribution was also examined to determine the appropriate statistical methods. The Kolmogorov-Smirnov test and the Shapiro-Wilk test indicated that the data were not normally distributed; therefore, nonparametric statistics were used to test the hypotheses. To examine the influence of predictor systems on criterion variables and the effect of independent variables on dependent variables, optimal scaling regression analysis and linear regression analysis were employed. Data preparation and storage for statistical analysis were carried out using MS Excel 2019, while IBM SPSS Statistics v25.0 was used for data processing. The results were presented in tables and graphs.

RESULTS AND DISCUSSION

The study included 62 participants, with an equal proportion of hearing individuals (50%) and participants with hearing impairment (50%). Of the 31 participants with hearing impairment included in the research, 21 (67.7%) had severe hearing loss, while 10 (32.3%) had total hearing loss. All participants (N=31) with hearing impairment had prelingual hearing loss, meaning the impairment occurred before speech and language were acquired.

Research in Education and Rehabilitation 2026; 9(1): 1-11 **DOI**: **10.51558/2744-1555.2026.9.1.1**

Table 1. Distribution of participants' results on the "hand-fist-palm" subtest

Hand-fist-palm		Points				Total
		0	1	2	3	
Experimental group	N	5	2	5	19	31
	%	16.1	6.5	16.1	61.3	100
Control group	N	0	0	0	31	31
	%	0	0	0	100	100
Total	N	5	2	5	50	62
	%	8.1	3.2	8.1	80.6	100

Table 1 shows the distribution of participants' results on the "hand-fist-palm" subtest, which assesses the condition of the pre-motor system of the brain and motor successive processes. From the table, it can be observed that out of 31 participants with hearing impairment, 19 (61.3%) achieved 3 points, 5 (16.1%) achieved 2 points, 2 (6.5%) scored 1 point, while 5 (16.1%) participants scored 0 points. All hearing participants achieved 3 points on this subtest.

Table 2. Distribution of participants' results on the "copying figure" subtest

Copying figure		Points				Total
		0	1	2	3	
Experimental group	N	8	9	8	6	31
	%	25.8	29.0	25.8	19.4	100
Control group	N	0	0	0	31	31
	%	0	0	0	100	100
Total	N	8	9	8	37	62
	%	12.9	14.5	12.9	59.7	100

Table 2 presents the distribution of participants' results on the "figure copying" subtest. From Table 2, it can be seen that out of 31 participants with hearing impairment, 6 (19.4%) scored 3 points, 8 (25.8%) scored 2 points, 9 (29%) scored 1 point, while 8 (25.8%) participants scored 0 points. All hearing participants scored 3 points on the "figure copying" subtest.

Table 3. Distribution of participants' results on the "general motor skills" subtest

General motor skills		Points		Total
		0	1	
Experimental group	N	9	22	31
	%	29.0	71.0	100
Control group	N	0	31	31
	%	0	100	100
Total	N	9	53	62
	%	14.5	85.5	100

Table 3 shows the distribution of participants' results on the "general motor skills" subtest. Among participants with hearing impairment, general motor skills were developed in accordance with chronological age in 22 cases (71%), while in 8 participants (25.8%) these skills were not developed. In all hearing participants, general motor skills were developed in

Research in Education and Rehabilitation 2026; 9(1): 1-11 **DOI**: **10.51558/2744-1555.2026.9.1.1**

line with chronological age. The variables used to assess the state of general motor skills included standing, sitting, jumping, walking, and running.

Table 4. Distribution of participants' results on the "fine motor skills" subtest

Fine motor skills		Points		Total
		0	1	
Experimental group	N	14	17	31
	%	45.2	54.8	100
Control group	N	0	31	31
	%	0	100	100
Total	N	14	48	62
	%	22.6	77.4	100

Table 4 shows the distribution of participants' results on the "fine motor skills" subtest. The results in Table 4 indicate that fine motor skills were developed in accordance with chronological age in 17 (54.8%) participants with hearing impairment, while in 14 (45.2%) participants these skills were not developed. In all hearing participants, fine motor skills were developed in accordance with chronological age. The assessment of fine motor skills was based on the evaluation of micro-motor abilities through finger manipulation tasks: the "finger counting" test and manual praxis tasks (such as imitating playing the piano, sewing, and demonstrating gestures for "super," "be careful," etc.), as well as the figure copying task.

Table 5. Descriptive statistics results for the graphomotor skills variable

Variable	Group	AS	SD	SG	MED	MOD	MIN	MAX
Hand-fist-palm	Experimental	2.23	1.15	0.21	3.00	3.00	0	3.00
	Control	3.00	0	0	3.00	3.00	3.00	3.00
Copying figure	Experimental	1.39	1.09	0.19	1.00	1.00	0	3.00
	Control	3.00	0	0	3.00	3.00	3.00	3.00
General motor skills	Experimental	0.71	0.46	0.08	1.00	1.00	0	1.00
	Control	1.00	0	0	1.00	1.00	1.00	1.00
Fine motor skills	Experimental	0.55	0.51	0.09	1.00	1.00	0	1.00
	Control	1.00	0	0	1.00	1.00	1.00	1.00
Total	Experimental	4.87	2.25	0.40	5.00	7.00	1.00	8.00
	Control	8.00	0	0	8.00	8.00	8.00	8.00

Table 5 presents the results of descriptive statistics for both hearing participants and participants with hearing impairment regarding the graphomotor skills variable. The arithmetic mean on the "hand-fist-palm" subtest for participants with hearing impairment is 2.23, with a standard deviation of 1.15; the median and mode are 3, and the minimum and maximum scores range from 0 to 3. For hearing participants, the arithmetic mean is 3, as all participants achieved the maximum score. The average score obtained by participants with hearing impairment on the "figure copying" subtest is 1.39, with a standard deviation of 1.09; the median and mode are 1, and the minimum and maximum results range from 0 to 3. All hearing participants also achieved the maximum score of 3 on this subtest. The overall mean score on the "general motor skills" subtest for participants with hearing impairment is 0.71,

Research in Education and Rehabilitation 2026; 9(1): 1-11 **DOI**: **10.51558/2744-1555.2026.9.1.1**

with a standard deviation of 0.46; the median and mode are 1, and the minimum and maximum results range from 0 to 1. For the "fine motor skills" subtest, the overall mean for participants with hearing impairment is 0.55, with a standard deviation of 0.51; the median and mode are 1, and the minimum and maximum results range from 0 to 1. All hearing participants achieved the maximum score on both the "general motor skills" and "fine motor skills" subtests. The arithmetic mean of the total score for the graphomotor skills variable in participants with hearing impairment is 4.87, with a standard deviation of 2.25; the median is 5, the mode is 5, and the minimum and maximum scores range from 1 to 8. For hearing participants, the arithmetic mean is 8, as all achieved the maximum total score of 8 across all graphomotor skills subtests. Given that the results of the Kolmogorov-Smirnov and Shapiro-Wilk tests showed that the data were not normally distributed, the Mann-Whitney U test was used to test the stated hypothesis.

Table 6. Results of the Mann-Whitney U test for the graphomotor skills variable

Variable	Group	N	Average rank	Sum of ranks	Z	P
Graphomotor skills	Experimental	31	18.50	573.50	-6,33	.000
	Control	31	44.50	1379.50		
	Total	62				

Table 6 presents the results of the Mann-Whitney U test for the graphomotor skills variable. Based on the obtained results, it can be concluded that hearing participants achieved significantly better results in graphomotor skills compared to participants with hearing impairment, with statistical significance at the 0.01 level ($Z = -6.33$; $p = 0.000$).In order to examine the influence of the degree of hearing impairment, the timing of onset of hearing loss, age, gender, and educational conditions on the graphomotor skills of students with hearing impairment, we applied optimal scaling regression analysis. The predictor (independent) variables included degree of hearing impairment, gender, and educational conditions, while the dependent variable was the total result in graphomotor skills. The timing of onset of hearing loss was not considered as a predictor variable because the obtained results were constant, and age was not included in the optimal scaling analysis since it is not appropriate to use continuous variables for optimal scaling, which requires nominal or ordinal predictors. Therefore, age was analyzed separately using linear regression analysis.

Table 7. Results of regression analysis, influence of the predictor system on criterion variables

Model	Sum of squares	Df	Average sum of squares	F	P
Regressive	6.69	6	1.16	1.15	.360
Residual	24.03	14	1.00		
Total	31.00	20			

$R = 0.147$; $R^2 = 0.22$; adjusted $R^2 = 0.03$ (Dependent variable: "Graphomotor skills")

Table 7 shows the results of the regression analysis for the influence of the predictor system on the criterion variable. From Table 7, it can be concluded that gender, degree of hearing impairment, and educational conditions do not have a statistically significant effect on graphomotor skills ($F = 1.15$; $p = 0.360$).

Research in Education and Rehabilitation 2026; 9(1): 1-11 **DOI**: **10.51558/2744-1555.2026.9.1.1**

Table 8. The influence of independent variables on the dependent variable graphomotor skills

Variable	Beta	Df	F	P
Degree of hearing loss	.45	2	5.83	.009
Gender	.19	2	2.13	.140
School conditions	.08	2	.92	.411

Table 8 shows the individual influence of independent variables on the dependent variable, graphomotor skills. The table indicates that the degree of hearing impairment has a statistically significant effect on graphomotor skills at the 0.05 significance level ($F = 5.83$; $p = 0.009$).

Table 9. The influence of the child's age on graphomotor skills

Model	Sum of squares	Df	Average sum of squares	F	P
Regressive	22.541	1	22.541	5.070	.32
Residual	128.943	29	4.446		
Total	151.484	30			

$R = 0.38$; $R^2 = 0.14$; adjusted $R^2 = 0.11$ (Dependent variable: "Graphomotor skills")

Table 9 presents the influence of age as a predictor on the criterion variable, graphomotor skills. Age has a statistically significant effect on graphomotor skills ($F = 5.07$; $p = 0.032$), meaning that as the age of a child with hearing impairment increases, their graphomotor abilities also improve.

DISCUSSION

Research assessing the graphomotor skills of children with hearing impairment highlights several key findings related to the development of these skills in this population. Veiskarami et al. (2022) evaluated fine motor skills in both hearing children and children with hearing impairment at an early developmental age. Fine motor skills in hearing children (9.63±28.83) were significantly more developed than in children with hearing impairment who were undergoing rehabilitation (–18±26.83), as well as in those not receiving rehabilitation (–21.25±30.26). However, there was no significant difference in fine motor skill results between children with hearing impairment who were and were not included in rehabilitation programs. The authors concluded that auditory rehabilitation can partially compensate for developmental delays in gross motor skills, but it cannot compensate for the development of fine motor skills. The development of fine motor skills requires precise synergy between small muscles and the nervous system. Kamel et al. (2021) investigated the consequences of sensorineural hearing loss in relation to fine motor skills in children and adolescents. Their results showed that children with sensorineural hearing loss have deficits in their fine motor skills compared to hearing children of the same gender and age. Gkouvatzi et al. (2010) examined visuomotor control, speed, and dexterity of the upper limbs. The results indicated that visuomotor control, speed, and dexterity of the upper limbs differed significantly with age, but not with the degree of hearing loss. Ivanović et al. (2011) assessed the graphomotor skills of school-aged children with hearing impairment by evaluating constructive praxis in relation to the achievements of hearing students. The findings showed a difference in constructive abilities between the

Research in Education and Rehabilitation 2026; 9(1): 1-11 **DOI**: **10.51558/2744-1555.2026.9.1.1**

groups, favoring the hearing group. They also established that, in both hearing children and those with hearing impairment, constructive abilities positively correlated with the grade level, but there was no link between constructive abilities and academic achievement. Vidranski, Tomac, and Farkaš (2015) compared the motor skills of children with cochlear implants to those of hearing children. The research showed that children with cochlear implants scored significantly lower on all motor subtests, including coordination, balance, and bilateral coordination—compared to children without hearing impairments. A similar trend was observed in the study by Metref, Sahraoui, and Baziz (2024), which analyzed the graphic skills of children with hearing impairment. It was found that children with cochlear implants demonstrated greater detail in their drawings, but their overall performance on graphic tasks was lower compared to hearing children. Although the level of detail in their drawings was higher, graphomotor skills as an overall process remained at a lower level in this group of children. Research by Karasu and Girgin (2007) showed that students with hearing impairment achieved average results in tasks related to writing skills. Their study also revealed a significant correlation between the degree of hearing loss, duration of hearing aid use, and writing skills, but not between the child's age and writing skills. Further studies have shown that children with hearing impairment perform worse than hearing children in assessments of fine motor skills and visualmotor integration. This suggests that children with hearing impairment have greater difficulties in coordinating eye-hand movements, which is crucial for the successful development of graphomotor skills. Children with hearing impairment who use cochlear implants include more detail in their drawings compared to hearing children, yet their overall graphomotor efficiency is still lower (Metref, Sahraoui & Baziz, 2024). These findings indicate that, despite certain advantages in specific tasks, children with hearing impairment face challenges in the overall development of graphomotor skills. The general trend in research is that children with hearing impairment, even with technological advancements such as cochlear implants, continue to experience difficulties in developing graphomotor skills. The greatest difficulties relate to coordination, bilateral motor skills, and other fine motor tasks.

On the other hand, studies also suggest that age and the length of hearing aid use are positively correlated with the development of motor skills, which can help compensate for some difficulties and lead to progress in graphomotor development.

The present study has several limitations that should be considered when interpreting the findings. First, the sample size was relatively small which reduces the generalizability of the results. Additionally, the use of a single assessment instrument focusing on selected graphomotor variables may not fully capture the complexity of graphomotor development.

CONCLUSION

The results of this study showed a significant difference in graphomotor skills between participants with hearing impairment and hearing participants, in favor of the hearing group. On the subtests "hand-fist-palm," "figure copying," and the assessments of general and fine motor skills, which all relate to graphomotor abilities, participants with hearing impairment achieved notably lower scores, especially on the "fine motor skills" subtest, indicating that

Research in Education and Rehabilitation 2026; 9(1): 1-11 **DOI**: **10.51558/2744-1555.2026.9.1.1**

their fine motor skills were less developed compared to hearing participants. The degree of hearing impairment affects the graphomotor skills of children with hearing impairment, while educational conditions and gender did not show any influence on these skills. Age also impacts the graphomotor skills of children with hearing impairment, suggesting that graphomotor skills develop with age and experience. These results enable a better understanding of the specific needs of children with hearing impairment and highlight the importance of individualized education, considering the individual characteristics of each child. To improve graphomotor abilities, it is important to recognize the specific needs of students with hearing impairment in the area of graphomotorics and to develop strategies that will facilitate their effective inclusion in educational activities, the application of individualized teaching approaches, and the encouragement of hearing aid use. Furthermore, it is necessary to conduct continuous assessment and monitoring of the development of motor skills in general.

REFERENCES

Barišić, I., Sansović, I., Knežević, J., & Pavelić, J. (2004). *Genetički uzroci oštećenja sluha. Paediatria Croatica, 48*, 123–130. https://www.researchgate.net/publication/228479065

Bradarić-Jončić, S., & Mohr, R. (2010). *Uvod u problematiku oštećenja sluha. Edukacijsko-rehabilitacijski fakultet*. https://hrcak.srce.hr/80986

Carlson, A. G., Rowe, E., & Curby, T. W. (2013). Disentangling fine motor skills' relations to academic achievement: The relative contributions of visual-spatial integration and visual-motor coordination. *The Journal of Genetic Psychology*, 174(5-6), 514–533. https://doi.org/10.1080/00221325.2012.717122

Dulčić, A., & Kondić, Lj. (2002). *Djeca oštećena sluha*. Alinea.

Gkouvatzi, A. N., Mantis, K., & Kambas, A. (2010). Comparative study of motor performance of deaf and hard of hearing students in reaction time, visual-motor control, and upper limb speed and dexterity abilities. *International Journal of Special Education*. https://www.researchgate.net/publication/288065145

Huremović, A., & Islamović, H. (2019). Some characteristics of deaf and hard of hearing children's text rewriting activities. *Research in Education and Rehabilitation*, 2(1), 52–58. https://rer.ba/index.php/rer/article/view/62/49

Huremović, A., Islamović, H., & Numanović Senyüz, E. (2019). Vrste grešaka u pisanju gluhe i nagluhe djece. In Proceedings of the X International Scientific-Professional Conference "*Unapređenje kvalitete života djece i mladih*" (pp. 549–560). Istanbul, Turkey.

Huremović, A., Nikolić, M., Beha, A., Šarić, E., Radžo Alibegović, Dž., & Mehmedinović, S. (2025). *Višestruke teškoće*. OFF-SET Tuzla.

Ivanović, L., Medenica, V., Potić, S., & Eminović, F. (2011). Procena konstruktivne praksije kod dece sa oštećenjem sluha. *Engrami*. https://scindeks.ceon.rs/article.aspx?artid=0351-26651103019I

Research in Education and Rehabilitation 2026; 9(1): 1-11 **DOI**: **10.51558/2744-1555.2026.9.1.1**

Kamel, R. M., Mehrem, E. S., Mounir, S. M., Essa, M. M., Fergany, L. A., & Elbedewy, M. A. (2021). Sensorineural hearing loss imprint on fine motor skills: A pediatric and adolescent innovative study. *NeuroRehabilitation*, 48(3), 285–292. https://doi.org/10.3233/NRE-201589

Karasu, H. P., & Girgin, U. (2007). Assessment of writing skills of hearing-impaired students who attend mainstream classes. *Anadolu University Journal of Social Sciences*, 7, 467–488.

Metref, O., Sahraoui, N., & Baziz, N. (2024). Graphic skills of deaf children with cochlear implants: A study of drawing development. *Journal for ReAttach Therapy and Developmental Diversities*, 7(6), 161–170. https://doi.org/10.53555/jrtdd.v7i6.3166

Smits-Engelsman, B. C., Niemeijer, A. S., & van Galen, G. P. (2001). Fine motor deficiencies in children diagnosed as DCD based on poor grapho-motor ability. *Human Movement Science*, 20(1-2), 161–182. https://doi.org/10.1016/s0167-9457(01)00033-1

Vidranski, T., Tomac, M., & Farkaš, L. (2015). Motoričke vještine djece s kohlearnim implantatom. *Hrvatska revija za rehabilitacijska istraživanja*, 51(1), 1–9.

Veiskarami, P., Roozbahani, M., Saedi, S., & Ghadampour, E. (2022). Comparing fine and gross motor development in normal hearing children, rehabilitated, and non-rehabilitated hearing-impaired children. *Auditory and Vestibular Research*, 31(3), 208-217. https://doi.org/10.18502/avr.v31i3.9871

World Health Organization. (2008). Grades of hearing impairment. https://iris.who.int/items/9c4fdcae-28fc-41c0-bfa1-48e11708dfba