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# Speed of Movement of Deaf Children and Children with Impaired Hearing

*by*

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*The goal of this research was a comparative assessment of speed of movement (dotting test) within two groups of children with hearing disorders. One group included schoolchildren from the Educational Centre for Deaf Children, the other, children from integration school who share some classes with their healthy peers. The control group included primary school children with normal hearing. Additionally, speed of movement was assessed in relation to gender and age. The survey involved 470 children between the age of 7 and 15, of whom: 72 from the Educational Centre for Deaf Children, 47 from the integration school, and 395 primary school children who formed the control group. Hearing impairment of children from special schools rated from 50 to 100 dB.*

***Key words:*** *psychomotor fitness, deaf children, children with impaired hearing, speed of movement*

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## Introduction

One of the basic characteristics of central nervous system development includes psychomotor fitness. The opinions on physical and motor development of children and teenagers with impaired hearing are varied. Some of them maintain that children with hearing impairment show equal, or even higher physical development than their healthy peers. Others claim that the level of selected morphological features in deaf children is lower in relation to healthy children with normal hearing (9, 10, 16).

Myklebust (14) claims that serious hearing impairment causes disturbances in functional abilities of the organism as a whole. Maszczak (13), who carried out an evaluation of the level of physical development of the entire population of Polish deaf children, observed the occurrence of a secular trend in body height, which also concerns healthy children. Deaf girls and boys are generally taller than their healthy peers, nevertheless, they have lower body weight. Malina and Gorzycki (11), as well as Wala (19) obtained similar results. Motor fitness of deaf children corresponds to average efficacy of normally hearing children. Highly developed abilities include agility and endurance, while the development of strength is impaired.

## Material and Methods

The aim of the study was the evaluation of speed of movement; one of many elements of psychomotor fitness in children with partly or fully impaired auditory functions.

Children with impaired hearing were from two special schools: the Educational Center for Deaf Children, and the Special School for Children with Impaired Hearing. The control group consisted of children with normal hearing. The tests were conducted on 470 children aged 7 – 15. They were divided into three groups:

I- Schoolchildren from the Educational Center for Deaf Children (72 children)
II- Schoolchildren from the Special School for Children with Impaired Hearing (47 children)
III- Healthy schoolchildren from a primary school (395 children)

Hearing impairment of children from special schools rated from 50 to 100 dB.

The children were divided into four sub-groups in accordance with age:

| | |
|---|---|
| A – 7-9 years old | (group I – 15; II – 9; III – 96 children) |
| B – 9-11 years old | (group I – 20; II – 14; III – 100 children) |
| C – 11-13 years old | (group I – 19; II – 7; III – 95 children) |

D – 13-15 years old (group I – 18; II – 17; III – 104 children)

None of the tested children indicated any deviation in cognitive functions. The dotting test was performed with a pencil on a "A" size sheet of squared paper with 24x18 squares of 1 $cm^2$ each. The subjects were to dot as many neighbouring squares as possible within one minute. Each square was to contain only one dot. None of the squares could be omitted.

The results were analyzed by means of analysis of variance in a factorial system and Scheffe's multiple comparison test.

## Results

The subjects performed the test twice – with a right and left hand. "Right" was used for the dominant hand, "left" for the non-dominant hand. In both stages of the test, the children with hearing impairment obtained worse results than their healthy peers, whereas, among special school subjects, children from the integration school dotted more squares than those from the Educational Centre. Average values of the number of dots performed with the right hand rated from 103.19 ± 28.56 for the schoolchildren from the Educational Centre to 126.02 ± 37.25 for the healthy schoolchildren from the control group, and with the left hand from 83.85 ± 28.21 to 103.19 ± 25.61 respectively. (tab. 1, 2)

**Table 1**

*Comparison of mean values in the number of dots in the dotting test performed by the tested groups with age subgroup consideration (Right Hand)*

| | I | II | III | Statistically Significant Differences $p \leq 0,05$ |
|---|---|---|---|---|
| A | 71,38±18,87 | 70,33±24,77 | 91,55±15,86 | I/III |
| B | 89,35±32,09 | 88,21±24,90 | 105,58±25,51 | I/III |
| C | 108,18±19,46 | 131,12±24,11 | 139,37±31,54 | I/III |
| D | 120,09±33,68 | 148,23±30,61 | 158,07±28,60 | I/III |
| Total | 103,19±28,56 | 113,27±41,45 | 126,02±37,25 | I/III |

I -schoolchildren from the Educational Centre for Deaf Children

II -schoolchildren from special school (integration school)

III- reference group

A, B, C, D - age subgroups

**Table 2**

*Comparison of mean values in the number of dots in the dotting test performed by the tested groups with age subgroup consideration (Left Hand)*

| | I | II | III | Statistically Significant Differences $p \leq 0,05$ |
|---|---|---|---|---|
| A | 54,84±11,76 | 61,55±17,50 | 79,77±12,00 | I/III |
| B | 63,45±20,57 | 76,35±22,31 | 90,50± \20,03 | I/III |
| C | 89,68±21,17 | 106,75±20,21 | 109,25±18,72 | I/III |
| D | 106,50±31,29 | 118,52±34,85 | 125,64±20,20 | I/III |
| Total | 83,85±28,21 | 93,58±34,69 | 103,18±25,61 | I/III |

The analysis of results obtained by each age sub-group show a relation between the speed of movement and the age of the tested children. Schoolchildren from sub-group A were slowest, while those from sub-group D quickest. Significant statistical differences between the sub-groups were obtained (tab. 3 and 4).

**Table 3**

*Comparison of mean values in the number of dots in the dotting test between the tested age subgroups (Right Hand)*

| | A | B | C | D | Statistically Significant Differences $p \leq 0,05$ |
|---|---|---|---|---|---|
| I | 71,38 ±18,87 | 89,35 ±32,09 | 108,18 ±19,46 | 120,09 ±33,68 | B/C A/D |
| II | 70,33 ±24,77 | 88,21 ±24,90 | 131,12 ±24,11 | 148,23 ±30,61 | B/C A/D |
| III | 91,55 ±15,86 | 105,58 ±25,51 | 139,37 ±31,54 | 158,07 ±28,60 | B/C A/D |

**Table 4**

*Comparison of mean values in the number of dots in the dotting testbetween the tested age subgroups (Left Hand)*

| | A | B | C | D | Statistically Significant Differences $p \leq 0,05$ |
|---|---|---|---|---|---|
| I | 54,84 ±11,76 | 63,45 ±20,57 | 89,68 ±21,17 | 106,50 ±31,29 | B/C A/D |
| II | 61,55 ±17,50 | 76,35 ±22,31 | 106,75 ±20,21 | 118,52 ±34,85 | B/C A/D |
| III | 79,77 ±12,oo | 90,50 ±20,03 | 109,25 ±18,72 | 125,64 ±20,20 | B/C A/D |

The biggest difference in number of dots performed with the right hand by the youngest and the oldest subgroups occurred among integration school children, and the smallest one between relevant sub-groups from the Educational Centre. During the left hand performance, the variation in number of dots between the youngest and oldest subgroups was smaller than in the first stage of the test, nevertheless such subgroups from the Educational Centre showed greater diversity than respective sub-groups from the control group. It should be pointed out, however, that those differences were not as distinct as during the right hand performance. Variation in these results in terms of sex of the subjects did not reveal considerable differences as far as the children with hearing disorders were concerned. Only boys from the Educational Centre obtained slightly better results in the left hand performance than girls. There was a bigger difference between boys and girls from the control group. Girls performed the task faster than boys in both stages (tab. 5, 6).

**Table 5**

*Comparison of mean values in the number of dots in the dotting test with gender consideration (Right Hand)*

| | I | II | III | Statistically Significant Differences $p \leq 0,05$ |
|---|---|---|---|---|
| Girls | 100,90 ± 28,19 | 113,61 ± 44,48 | 138,17 ± 34,62 | I/III |
| Boys | 105,22 ± 29,14 | 113,06 ± 40,30 | 118,07 ±37,39 | I/III |

**Table 6**

*Comparison of mean values in the number of dotsin the dotting test with gender consideration (Left Hand)*

| | I | II | III | Statistically Significant Differences $p \leq 0,05$ |
|---|---|---|---|---|
| Girls | 81,09 ± 26,82 | 92,16 ± 34,55 | 112,52 ± 26,31 | I/III |
| Boys | 86,30 ± 29,56 | 94,43 ± 35,33 | 97,07 ±23,67 | I/III |

## Discussion

Neurophysiologic methods of research in motor development of children are essential for evaluation of nervous system maturity and for recognition of a wide variety of dysfunctions, e.g. writing or reading difficulties, lack of self-control, etc (4). Muscle coordination patterns are perfected till the age of seven and optimization of processes related to the speed of movements is observed at the age of eleven (2). The research confirmed that the speed of movement showed a developmental tendency. The youngest children dotted the smallest number of squares, and the results improved with age. Dynamics of changes, however, were not the same in all tested groups. The children with hearing disorders obtained worse results than their normally hearing peers. The obtained results confirmed observations made by other authors (5, 15, 20). One of the reasons for this phenomenon can be longer synaptic retardation due to hearing deprivation (8). Moreover, children with impaired hearing show worse tactile perception than those with normal hearing (18). This is quite important because apart from cortico-spinal and cortico-bulbar tracts, also skin mechanoreceptors are responsible for perception of limb position and control of movement correctness (3). Children with impaired hearing proved not only to work slower than their normally hearing peers, but also to have difficulties with visual-motor coordination examined by reaction times and coordination as well as precision of hand movements (1, 17).

In conclusion, it should be stated that deafness does not considerably influence psychomotor development. It only prolongs full development, as the tested features follow the same patterns in all children and only its dynamics vary. Since dysfunctions of hand movements can be the reason for writing difficulties, this feature should be recognized in early childhood and adequate revalidating treatment should be administered.

## Conclusions

The obtained results allow for the following conclusions:

1. Speed of movement in the tested age bracket is a developmental trait not related to the sex of tested subjects.
2. The environment in which children live and learn can affect development of psychomotor fitness, evaluated by speed of movement.
3. Early recognition of hearing disorders, quick introduction of compensatory therapy (among others, hearing aid, internal prosthesis) and working out an adequate revalidation programme for children with impaired hearing can positively influence their psychomotor development.

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