

# Physical efficiency of 10-16 years old boys with hearing impairment

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## Abstract

**Purpose:** The aim of our investigation was to estimate on hand of the above the physical efficiency value of hearing impaired children and compare them with healthy counterparts.

**Material and methods:** The investigation covered a group of 63 boys, 27 with hearing impairment (HI) and 36 healthy (R), 10-16 years old. The investigated subjects were divided into 2 groups according to their age: 10-12 and 14-16 years old boys. For determination of cardio-respiratory system efficiency PWC<sub>170</sub> (Physical Working Capacity) test was performed. PWC<sub>170</sub> and VO<sub>2</sub>max indices were calculated using proper mathematical equations.

**Results:** The comparison of PWC<sub>170</sub> and VO<sub>2</sub>max indices shows no statistically significant differences between investigated groups. Boys from younger HI group obtained higher PWC<sub>170</sub> and VO<sub>2</sub>max values than boys from R group. In older groups, values of investigated indices were inverted in relation to younger groups. Boys from R group obtained higher values of investigated indices.

**Conclusions:** Results received shows some trend, which is probably connected with isolation and absence of cohesion between auditory organ rehabilitation and physical efficiency development. There is necessity of integration programs construction, which will influence on comprehensive and proper growth of hearing impaired children.

**Key words:** hearing impaired children, PWC<sub>170</sub>, VO<sub>2</sub>max, physical efficiency.

## Introduction

The estimation of children's cardio-respiratory system efficiency may be useful in children's growth controlling. As the most valuable index assessing cardio-respiratory efficiency the maximal oxygen uptake potential (VO<sub>2</sub>max) is accepted. Also, this index is commonly used in physical efficiency evaluation [1-3].

Many authors describe correlations between VO<sub>2</sub>max and various factors, for example: with body composition (especially with amount of active tissue – muscles) [4,5], specific influence of physical training [6], environmental contamination [7-9], life style etc. [8].

Physical efficiency of children from different inhabited areas, children of various physical activity status, and training different sport disciplines were widely investigated. However, there are few comparison studies between healthy children and those with hearing impairment [10,11]. The essence of rehabilitation processes, first of all, is reinstatement of normal functioning during usual day activities, while less attention is give for sport physical efficiency formation. The motor and physiological efficiency evaluation is fundamental in sport training planning.

The main purpose of our study was to measure cardio-respiratory efficiency and physiological performance level of children with hearing impairment, and then compare with a group of healthy children. This aim was realized based on VO<sub>2</sub>max and work capacity values calculated from PWC<sub>170</sub> test.

## Material and methods

The investigation covered a group of 27 boys with hearing impairment from "School for hard-of-hearing and deaf children" in Racibórz. As a reference group 36 healthy boys from

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Table 1. Somatic characteristics of investigated boys groups

Age group	10-12 years old boys		14-16 years old boys	
	Hearing-impaired children	Healthy children	Hearing-impaired children	Healthy children
Number of investigated persons	11	16	16	20
Age [years]	11.2±0.3	11.5±0.5	14.8±0.9	15±0.7
Body weight [kg]	40.3±4.2	39.9±7.3	56.9±17.8	65.5±12.7
Body height [cm]	146.1±2.9	145.4±4.7	166±10.3	173.3±6.6

\* statistically significant differences,  $p < 0.05$

Racibórz city were investigated. The investigated subjects were divided into 2 groups according to their age: 10-12 and 14-16 years old boys (Tab. 1).

For determination of cardio-respiratory system efficiency  $PWC_{170}$  test was performed on cycle ergometer 839E (Monark Exercise AB, Sweden), accordingly to method described by Halicka-Ambroziak [12]. The test was consist of two 5 minutes cycling periods with different loads (25 W and 50 W for younger, and 50 W and 75 W for older group). During the test heart rate was continuously monitored with Polar 810s (PolarElectro, Finland).  $PWC_{170}$  index was calculated using proper mathematical equation:

$$PWC_{170} = N_1 + (N_2 - N_1) \cdot \frac{170 - f_1}{f_2 - f_1}$$

where:

$N_1$  – load during first cycling period,  $N_2$  – load during second cycling period,  $f_1$  – mean heart rate in last minute of first cycling period,  $f_2$  – mean heart rate in last minute of second cycling period

For physical efficiency estimation maximum oxygen uptake ( $VO_{2max}$ ) was calculated using proper mathematical equation:

$$VO_{2max} = 1,7 \cdot PWC_{170} + 1240$$

Additionally,  $PWC_{170}$  and  $VO_{2max}$  indices were calculated per body weight in kilograms.

For calculation of statistically significant differences between groups the non-parametric U Mann-Whitney test was used (Statistica 6.0, StatSoft, USA). Values of  $p < 0.05$  were considered as statistically significant differences. Ethical approval was given by The Wrocław University School of Physical Education Research Ethics Committee. Additionally, parents of the boys gave consent for the investigation.

## Results

The comparison of  $PWC_{170}$  and  $VO_{2max}$  indices shows no statistically significant differences between investigated groups. Boys from younger with hearing impairment group obtained higher  $PWC_{170}$  and  $VO_{2max}$  values than boys from healthy group. On this basis we can assume, in this age group, that hearing-impaired boys are characterized by insignificantly bet-

Table 2. Comparison of investigated indices characterizing cardio-respiratory and physical efficiency of investigated 10-12 and 14-16 years old boys

Parameter	10-12 years old boys	
	Hearing-impaired children n=11	Healthy children n=16
$PWC_{170}$ [W]	95.1±41.4	75.9±34.4
$PWC_{170}$ [ $W \cdot kg^{-1}$ ]	2.3±1.1	1.9±0.6
$VO_{2max}$ [ $ml \cdot min^{-1}$ ]	1401.7±70.4	1369±59.4
$VO_{2max}$ [ $ml \cdot min^{-1} \cdot kg^{-1}$ ]	33.8±4.9	35.1±5.2
Parameter	14-16 years old boys	
	Hearing-impaired children n=16	Healthy children n=20
$PWC_{170}$ [W]	127.8±46.5	156.3±71.9
$PWC_{170}$ [ $W \cdot kg^{-1}$ ]	2.3±0.8	2.4±1.0
$VO_{2max}$ [ $ml \cdot min^{-1}$ ]	1457.3±79	1505.7±122.3
$VO_{2max}$ [ $ml \cdot min^{-1} \cdot kg^{-1}$ ]	27.1±4.2	26±3.5

\* statistically significant differences,  $p < 0.05$

ter cardio-respiratory efficiency and physical performance than healthy boys (Tab. 2).

In older groups, values of investigated indices were inversely related to younger groups. Boys from healthy group obtained higher values of investigated indices (Tab. 2). Differences in values of investigated indices were statistically insignificant in older group. However, these results indicated that 14-16 years old boys with hearing impairment have less efficient cardio-respiratory system and worse physical performance than healthy boys.

## Discussion

Hearing-impaired persons are frequently recognized as ill. Their handicap is not only seen as disability, but also as a complex morbid process. One can observe such behavior especially towards children, which are isolated from their healthy counterparts, particularly in physical effort sphere. Younger children with hearing impairment, similarly to children in their age, are characterized by enormous, spontaneous movement activity. They are simply curious about the world around them [13]. Therefore, there were no statistically significant differences in cardio-respiratory and physical efficiency between hearing impaired and healthy children.

In case of 14-16 years old boys, children with auditory sense damage obtained lower values of investigated indices describing cardio-respiratory and physical efficiency than their healthy counterparts. Probably, this can be induced by some kind of "shame" related with communication problems and natural isolation which occur when youth grow up. Persons with hearing impairment often have less possibility to participate in physical activities. Because of the communication improvement lessons are frequently emphasized in schools for hard-of-hearing and deaf children, slighter stress is laid on physical efficiency development. Specific society will be incommode and limit free

evolution, destroy creativeness, force strict moral system and often induce fear of "foreignness". Isolated lessons of physical education in schools for hard-of-hearing and deaf children may reduce individuality and physical efficiency of these children [14]. Therefore, there is necessity of integration programs construction, which will influence on comprehensive and proper growth of hearing-impaired children [15,16].

## Conclusions

1. There are no statistically significant differences in cardio-respiratory and physical efficiency, evaluated on the basis of  $PWC_{170}$  and  $VO_2\max$  indices, between 10-12 and 14-16 years old children with hearing impairment and their healthy counterparts.

2. Children with hearing impairment from 14-16 years old group are characterized by lower values describing cardio-respiratory and physical efficiency than healthy children. Nevertheless this are statistically insignificant differences, one may observe some trend, which is probably connected with isolation and absence of cohesion between auditory organ rehabilitation and physical efficiency development.

3. School program for hearing-impaired children should include integrated form of education, including physical education lessons.

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