

CHANGES IN PSYCHOMOTOR REACTIONS AND HEMODYNAMIC PARAMETERS DURING A SIX MINUTE WALKING TEST FOR MEN WITH HEARING IMPAIRMENTS

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ABSTRACT

Background. Lately scientists abroad and in Lithuania have been interested in the peculiarities of motor learning and control. As the recent research shows, psychomotor parameters of persons with disabilities receive much attention from the community. However, we could find only a few scientific papers dealing with the psychomotor peculiarities of the disabled people, deaf people among. *Research aim* was to evaluate psychomotor reactions and hemodynamic indices of persons with hearing impairments, athletes and male persons who did not go in for sports.

Methods. Twenty two young persons with hearing impairments took part in the study. Among them there were deaf players from the national basketball team (age 23.80 ± 2.6 years), (45.5%, $n = 10$). Persons with hearing impairments who did not go in for sports were in the control group (age 21.75 ± 1.8 years), (54.5%, $n = 12$). Research was carried out in the Lithuanian Sports University (LSU) using the analyser of dynamic parameters DPA – 1 for human hand and leg movements in the laboratory of motor control.

Results. Simple and complex reaction time was statistically different only after physical exercise between athletes with hearing impairments and those who did not go in for sports ($p < 0.05$). Simple psychomotor reaction time of athletes with inborn and acquired hearing impairments before and after exercise was not statistically significantly different. There were no significant changes in simple and complex reaction time and hemodynamic parameters (double product) of athletes with inborn hearing impairment after the 6-minute walking test.

Conclusion. Simple and complex reaction time in athletes with hearing impairment and those who did not go in for sports was statistically different ($p < .05$) only after physical strain in sportsmen. Having tested simple psychomotor time reaction in deaf persons since birth and those with the acquired hearing impairment before and after exercise we found that there was no significant difference ($p > .05$) between them, but the complex reaction time in subjects with acquired hearing impairment before and after exercise was shorter than in persons who were deaf since birth. However, the difference was also not significant ($p > .05$). There were also no significant changes in simple and complex reaction time and hemodynamic parameters (double product) in athletes who were deaf since birth after the 6 min walking test.

Keywords: hearing impairment, psychomotor parameters, reaction time.

INTRODUCTION

Different specialists and scientists of biomedicine, psychology, sports scientists, and educators are interested in people's motor skills and their peculiarities. Voluntary movements are studied analysing the peculiarities

of psychomotor skills (Mickevičienė, Motiejūnaitė, Skurvydas, Darbutas, & Karanauskienė, 2008).

Deaf people are often forgotten as this disability is not so seen externally. According the data of the World Health Organization (WHO), in 2012

about 360 million of people had various hearing impairments – from medium to the absolute loss of hearing. Even 30 % of people from the whole population have different hearing problems, thus the topic of psychomotor reaction and motor skills is absolutely relevant.

Research aim was to evaluate psychomotor reactions and hemodynamic indices of persons with hearing impairments, athletes and male persons who did not go in for sports.

METHODS

Research methods applied were:

- A questionnaire survey
- 6 min walking test
- Measuring psychomotor reaction (reaction time, time to target, average speed, time to maximum speed, average asymmetry from the path line and the path of movement), using the analyser of dynamic parameters for hand and leg movements (DPA-1)
- Recording hemodynamic indexes (heart rate and blood pressure)

Twenty two young persons with hearing impairments took part in the study. There were deaf national basketball team players in the research group (age 23.80 ± 2.6 years), (45.5%, $n = 10$), persons with hearing impairments who did not go in for sports were in the control group (age 21.75 ± 1.8), (54.5%, $n = 12$). Research was carried out in the Lithuanian Sports University (LSU) using the analyser of dynamic parameters DPA – 1 (p. No. 5251; 2005 08 25) for human hand and leg movements in the laboratory of motor control.

Research procedures. Initially the heart rate and blood pressure were recorded. Then the subjects had to accomplish two tasks: simple and complex. The simple task demanded reacting to a visual signal as fast as possible and moving the handle of the device. After explaining the task it was allowed to carry out three tests, the results of which were not recorded. Then twenty times in turn the task was carried out and the reaction time (RT) of the right hand was recorded (ms). The complex task was carried out immediately after the simple task. The person had to respond to the target which appeared the screen and push the handle of the device as soon as possible in such way that the circle of the handle symbol would reach the target and stop with the precise trajectory as fast as possible. The target appeared in the same place. The end of the movement was recorded when the centre

of the handle symbol stopped in the circle of the target and stayed there no shorter than 0.03 s. After explaining the task it was allowed to accomplish three tests, the results were not recorded. The task was performed twenty times in turn in five series and the reaction time (RT – T) (ms) of the right hand was recorded. After the evaluation of psychomotor reaction, BP (blood pressure) and heart rate were measured after a six min walking test. After the test, when BP and the heart rate were measured, the psychomotor reaction was evaluated (complex and simple tasks).

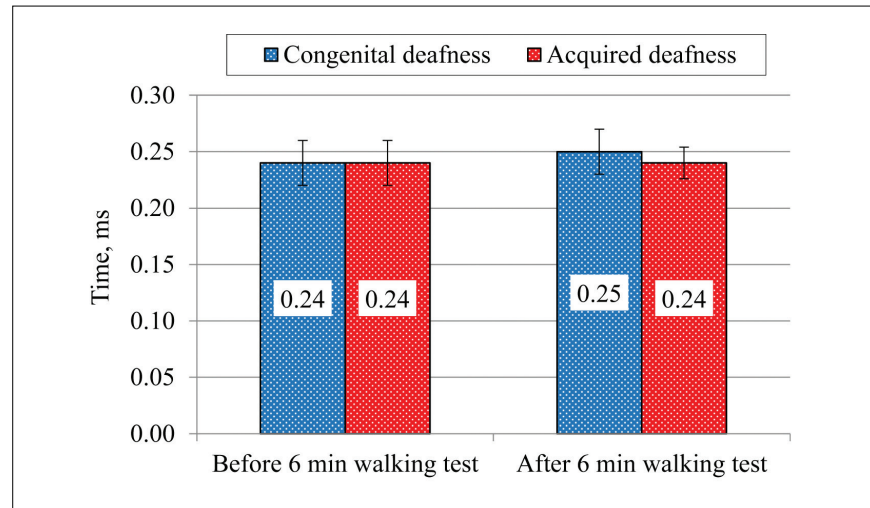
Statistical analysis. The statistical analysis of the survey data was performed using SPSS 17.0 programme and Excel 2007 programme. Quantitative data are presented as arithmetic means (M) with standard deviation (SD). Mann–Whitney *U* test was used for the comparison of mean values of non-parametric variables of two independent samples, Friedman test was used for the comparison of mean values of non-parametric variables of more than two independent samples. Spearman's correlation coefficient (*r*) was used to estimate the strength of the relationships of parameters. If $0 - |r| \leq .3$, the values are weakly dependent, if $.3 < |r| \leq .8$ – moderately dependent, if $.8 < |r| \leq 1$ – strongly dependent. The correlation coefficient is positive when one value increases and the other value decreases. When the significance level is set at $p < .05$, the difference in parameters in the groups was considered statistically significant. The results are given in charts and tables.

RESULTS

During the analysis, simple psychomotor reaction time before and after six min walking test was evaluated. For athletes with congenital and acquired deafness, simple reaction time before six min walking test was 0.24 ± 0.02 ms, after the test for those with congenital deafness it was 0.24 ± 0.01 ms. Comparing the results statistically significant differences were not received ($p > .05$) (Figure 1).

The investigation evaluated the DPA – 1 measurement data of the average values of all five series and compared them for athletes with different nature of deafness. The maximum speed before and after six min walking test for athletes with inborn deafness was higher, but after the test – lower and less asymmetry of the path of movement ($p < .05$). The average values of the other measurements did not differ significantly ($p > .05$) (Table 1).

Figure 1. Simple reaction time before and after 6 min walking test for the participants in the group depending on the nature of deafness



Note. $p > .05$.

Table 1. DPA – 1 measurements depending on the nature of deafness

Measurements	Evaluation	Congenital deafness (n = 5)	Acquired deafness (n = 5)	Total (n = 10)	p^*
Reaction time (ms)	Before test	0.27 ± 0.03	0.25 ± 0.01	0.26 ± 0.03	> .05
	After test	0.24 ± 0.04	0.20 ± 0.02	0.22 ± 0.03	> .05
Time to target (ms)	Before test	0.66 ± 0.08	0.69 ± 0.08	0.68 ± 0.08	> .05
	After test	0.62 ± 0.07	0.63 ± 0.03	0.62 ± 0.05	> .05
Average speed (mm/s)	Before test	279.73 ± 32.7	255.24 ± 11.6	267.46 ± 26.2	> .05
	After test	292.95 ± 43.9	272.86 ± 11.9	282.91 ± 32.1	> .05
Maximum speed (mm/s)	Before test	795.73 ± 261.76	611.55 ± 92.6	703.64 ± 209.0	< .05
	After test	857.67 ± 56.3	622.30 ± 75.8	739.99 ± 272.7	< .05
Time to maximum speed (ms)	Before test	0.19 ± 0.04	0.22 ± 0.02	0.21 ± 0.03	> .05
	After test	0.19 ± 0.04	0.21 ± 0.03	0.20 ± 0.04	> .05
The average asymmetry from the path of movement (mm)	Before test	-12.41 ± 2.8	-14.07 ± 21.4	-13.24 ± 2.3	> .05
	After test	-10.62 ± 2.0	-14.11 ± 1.3	-12.37 ± 2.4	< .05
Path of movement (mm)	Before test	170.49 ± 5.5	165.68 ± 2.7	168.08 ± 4.8	> .05
	After test	170.21 ± 6.4	164.86 ± 2.0	167.54 ± 5.3	< .05

Note. * – Mann–Whitney U test.

During the investigation we evaluated hemodynamic indicators and psychomotor reactions. To do that we performed correlation analysis between the changes of dual characteristics and DPA – 1 measurements that took place after six min walking test for athletes. In general the moderate positive statistically significant link was found between the change in the dual characteristics and average complex reaction time ($r = .588$, $p < .05$) and athletes with congenital deafness showed a strong positive statistically significant relationship

between the parameters ($r = .900$, $p < .05$). This means that if the average speed of performing the task is higher, even more after six min walking test the systolic blood pressure and heart rate increase. Statistically significant changes were not observed between other indicators of psychomotor reactions and hemodynamic indicators ($p > .05$) (Table 2).

Analysing the correlation of the dual change and the average reaction time, a very strong statistically significant correlation was found ($r = .9$, $p < .05$). This shows that when systolic

blood pressure increases, the average reaction time increases as well (Figure 2).

Simple reaction of athletes before six min walking test lasted 0.24 ± 0.02 ms, for those who did not go in for sports – 0.26 ± 0.03 ms ($p > .05$). After six min walking test this reaction time of the athletes was 0.25 ± 0.03 ms, of those who did not go in for sports – 0.30 ± 0.02 ms. After the test the simple reaction time and the control group time statistically significantly differed ($p < .05$) (Figure 3).

Comparing the athletes and non-athletes with hearing impairment and their complex reaction time before six minutes walking test there was no significant difference ($p > .05$) while complex reaction time was longer of those who do not do sports. After six minutes walking test in tested and control groups, complex reaction time was statistically and significantly different ($p < .05$) complex reaction time of athletes was 0.22 ± 0.06 ms and those who do not go in for sport – 0.30 ± 0.01 ms (Figure 4).

Measurements	The change in the dual system (<i>r/p</i>)		
	Congenital deafness	Acquired deafness	Total
Simple reaction time (ms)	-.564 / .322	-.410 / .493	-.418 / .230
Complex reaction time (ms)	-.051 / .935	-.200 / .747	-.258 / .471
Time to target (ms)	-.100 / .837	-.667 / .219	-.207 / .565
Average speed (mm/s)	.200 / .747	.900 / .037	.588 / .047
Maximum speed (mm/s)	.400 / .505	.600 / .285	.382 / .276
Time to maximum speed (ms)	-.359 / .553	-.738 / .155	-.483 / .157
The average asymmetry from the path of movement (mm)	-.700 / .188	-.500 / .391	-.515 / .128
Path of movement (mm)	.400 / .505	.200 / .747	.236 / .511

Table 2. Links between the changes in the hemodynamic indicators and simple and complex reaction time depending on the nature of deafness

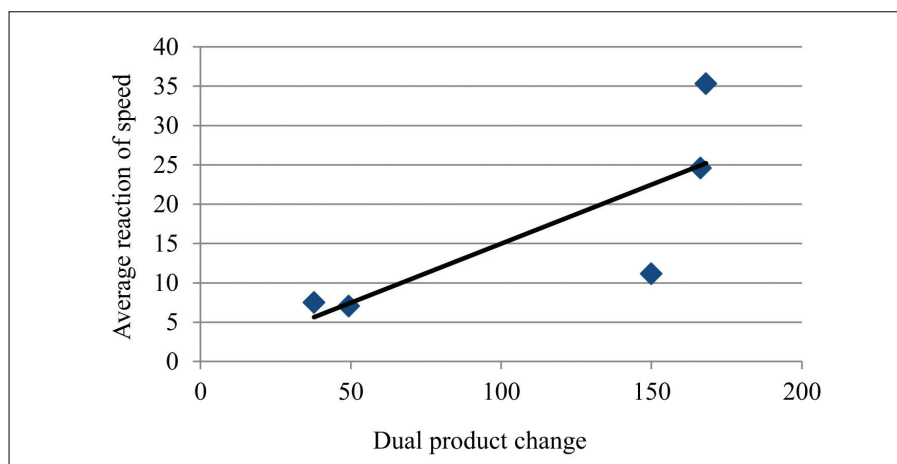


Figure 2. Links between the changes of the average reaction time and dual product for athletes with acquired deafness

Note. $r = .900, p < .05$.

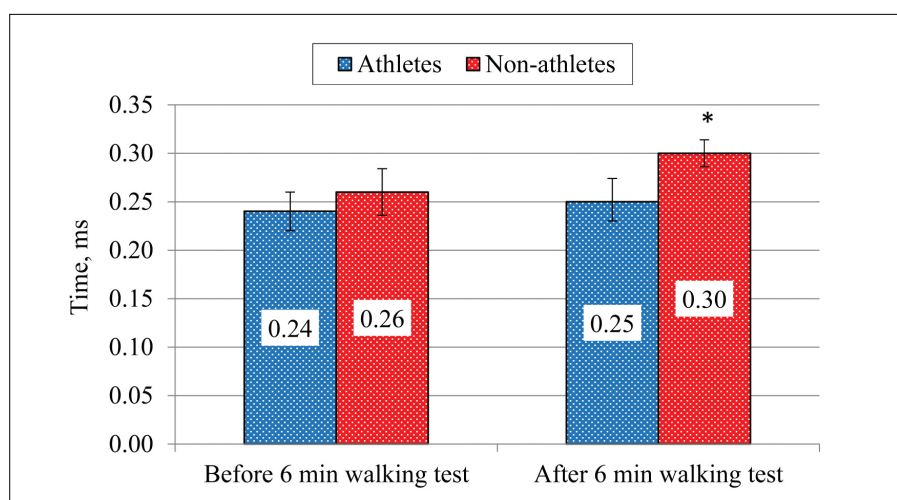
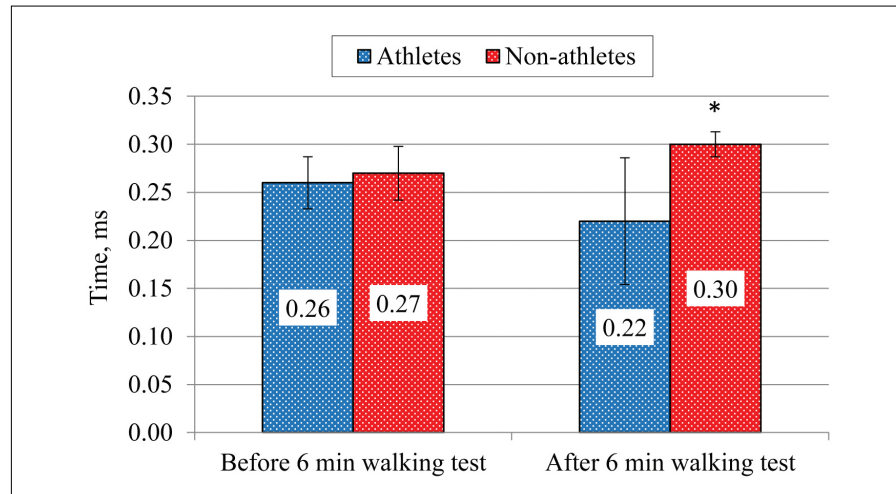


Figure 3. Simple reaction time of the research and control groups

Note. * – $p < .05$, Mann–Whitney *U* test.

Figure 4. The complex reaction time of tested and control groups



Note. * – $p < 0.05$, Mann–Whitney U test.

DISCUSSION

After the analysis of psychomotor reaction time for athletes with inborn and acquired hearing impairments before and after physical exercise between groups, no statistically significant difference was observed, while the complex reaction time for those with acquired impairment before and after physical exercise was shorter, however it did not differ significantly ($p > .05$).

Hartman et al. (2011) study coincides with our investigation of psychomotor reaction, because the latter explains that deaf basketball players have better motor skills than those who do not go in for sport. We realised that sportsmen with congenital and acquired deafness the simple reaction before six minutes walking test lasted 0.24 ± 0.02 ms and after test with inborn deafness lasted 0.24 ± 0.01 ms. Comparing the results there was no statistically significant difference ($p > .05$). Our received results confirm Hick's law, which states that reaction time is directly proportional to the difficulty of the task (Jensen, 1998). However, there are other studies where authors state that the results of reaction time do not differ significantly taking into account the complexity of the task (Yin-Chen Shen & Franz, 2005). Wilson et al. (1997) investigated the deaf people's memory and found that they have better spatial memory than people who hear and that perhaps could have an impact on the results of the psychomotor reaction investigation. Alejandra et al. (2003) state that deaf people have a better peripheral vision and therefore the reaction may be better than people who hear have. However, our study confirms the opinion of others that the reaction time men who do not go in for sport with hearing impairment is worse than among athletes (Dummer et al., 1996).

Gurkan (2013) proved that the balance of the national men's basketball team and members of the sedentary individuals significantly are different. Statistically significant difference was found evaluating the balance of basketball players and inactive, carried out by hearing impairment having athletes. So it can be claimed that the sport effect for static and dynamic balance is positive.

Analysing deaf people the most common question is whether the hearing loss cause changes of the rest sense. Because of the lack audible informatikon deaf individuals must use visual senses and get informatikon from the environment. There were researches and it was demonstrated that visual senses of deaf people do not change (Brozinsky & Bavelier, 2004). The results of our study which present the results of a simple and complex reaction coincide with Bavelier (2006) and scientific works of other authors. It was found that vision senses of deaf people become better of there are moving stimuli of peripheral vision, particularly when complex attention focus is needed.

Stevens and Neville (2006) found that individuals with total loss of hearing notice static and moving peripheral stimuli faster than people who hear, while other studies suggest that deaf people have bigger field of vision than those who hear (Codina et al., 2011). Also our study confirms Lavie's (2005) "the theory of load" for deaf individuals, because deaf people can keep attention up to a certain stimulus complexity, perhaps due to this the complex reaction time was slower of those deaf men who do not go in for sport. It is stated that psychomotor reaction depends on tiredness. After a good rest it is faster and a person is tired the reaction is slower. Emotional status also is important. Psychomotor reaction time of hands and legs is also different (Skernevičius et

al., 2004). During the investigation we estimated hemodynamic indicators and psychomotor reactions. We did an analysis of the correlation between the dual characteristics of the product changes and DPA – 1 measurement changes, which were estimated after six minutes walking test done by sportmen. In general the moderate positive statistically significant link between the change in the dual of the product change and medium complex reaction speed change ($r = 0.588$, $p < .05$) and athletes with congenital deafness received a strong positive statistically significant link among these parameters ($r = 0.900$, $p < .05$). This means that after six minutes walking test tested people with more increased systolic blood pressure and rapid heart rate, they reflect a greater average speed of performing the task. Among the other measurement indicators of psychomotor reactions and changes hemodynamic indicators there were no statistically significant links ($p > .05$). Skernevičius et al. (2004) paid significant attention to good athletes of different sports and young people who do not do sports and did not notice that this

speed of sportmen is reliably bigger but there are authors who claim that physical exercises and sports trainings affect psychomotor reaction.

CONCLUSIONS

1. Simple and complex reaction time was only statistically significantly different after physical exercise sample ($p < .05$) of sportmen and those who do not do sport with hearing impairment athletes time was shorter.

2. After examination of simple and complex psychomotor reaction times of athletes with congenital and acquired hearing impairment before and after physical strain test, there was no statistically significant difference.

3. There was absence of simple and complex reaction time and hemodynamic indicators (dual product) change of athletes with congenital hearing impairment practising six minutes walking test. Statistical difference was observed only in a complex reaction of average speed record of sportmen with acquired hearing impairment.

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