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Physical therapy and health-social benefits of controlled physical activities in disability children

Fizjoterapia i korzyści zdrowotno-społeczne kontrolowanej aktywności fizycznej w niepełnosprawności u dzieci

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Abstract

Aim of the study: The aim of the study was to analyse anthropometric indicators, e.g. quiescent heart rate, quiescent respiratory rate and heart rate burden, in children with mental, hearing, visual disabilities participated in intervention programs of controlled physical activities. **Material and methods:** 180 children: 90 males, 90 females, aged 8-15 years, were divided in experimental and control samples according researched disabilities. Intervention method was realised in 10 months period. 3 times in 10 months of intervention program was provided an investigation, followed by data analysis. Relations of dependent variables to probands' sex, to experiment and its exact phases were evaluated using repeated measures ANOVA, software Statgraphics Centurion. **Results:** A tendency for a decrease in quiescent heart rate and quiescent respiratory rate was found among both boys and girls from all experimental groups, whereas for the controls this value either stayed at baseline level or even increased. In the case of heart rate burden, the values significantly decreased for the experimental groups and increased for the control group members. **Conclusions:** The presented evaluation of the positive changes shows that the hypothesis has been verified in all three aspects. Significant positive changes were approved in the monitored indicators through the intervention programs of controlled physical activities in children with mental, hearing or visual disabilities. The results verified the specific prevention and treatment benefits of controlled physical activities in the child disability context in the important age period of 8-15 years.

Key words: physical development in childhood, disability child, motor learning, control movement, anthropometric data

Streszczenie

Cel badań: Celem niniejszego badania było przeanalizowanie wskaźników antropometrycznych, np. tętna spoczynkowego, spoczynkowej częstości oddechów i obciążenia tętna u dzieci niepełnosprawnych umysłowo, dzieci z upośledzeniem wzroku i dzieci z upośledzeniem słuchu, które uczestniczyły w programach interwencyjnych, podejmując kontrolowaną aktywność fizyczną. **Materiały i metody:** Uczestnicy badań: 180 dzieci – 90 chłopców i 90 dziewczynek w wieku 8-15 lat – zostali podzieleni na grupy badane i grupy kontrolne zgodnie z badanymi niepełnosprawnościami. Metoda interwencyjna była realizowana w ciągu 10 miesięcy. Badania wraz z analizą danych prowadzono trzykrotnie podczas 10 miesięcy trwania programu interwencyjnego. Związki zależnych zmiennych z płcią probantów, z eksperymentem i jego dokładnymi etapami zostały ocenione z użyciem środków ANOVA i oprogramowania Statgraphics Centurion. **Wyniki:** Zaobserwowano tendencję spadkową w przypadku tętna spoczynkowego i spoczynkowej częstości oddechów wśród chłopców i dziewczynek ze wszystkich grup badanych, podczas gdy w przypadku grup kontrolnych niniejsza wartość pozostała na poziomie wyjściowym lub nawet wzrosła. Jeśli chodzi o obciążenie tętna, wartości znacznie spadły w przypadku grup badanych, a wzrosły w przypadku grup kontrolnych. **Wnioski:** Prezentowana ocena pozytywnych zmian wskazuje, że hipoteza została zweryfikowana we wszystkich trzech aspektach. Znaczące pozytywne zmiany nastąpiły w przypadku wskaźników monitorowanych w programach interwencyjnych, w ramach których dzieci upośledzone umysłowo, dzieci z upośledzeniem słuchu i dzieci z upośledzeniem wzroku podejmowały kontrolowaną aktywność fizyczną. Wyniki pozwoliły zweryfikować poszczególne korzyści profilaktyczne i lecznicze wynikające z podejmowania kontrolowanej aktywności fizycznej przez dzieci upośledzone w wieku 8-15 lat.

Słowa kluczowe: rozwój fizyczny w dzieciństwie, dziecko upośledzone, nauczanie motoryczne, ruch kontrolowany, dane antropometryczne

Introduction

The term "controlled physical activities" is the designation of system in recreational physical activities carried out to achieve health-social benefits through professionally guided motor learning. It presents an intentional process achieving health objectives with the significant socialization effect. Gorny cites examples where the application of controlled physical activities in persons with hearing and vision disability led to positive shifts in the ability to differentiate sizes, shapes,

colors, to estimate distances, to keep movement direction [1]. Mansell pointed out, that a possibility to participate actively in controlled physical activities is an important element of integration for persons with mental and hearing disability, as it is closely linked with their social development [2].

The current trend in the rehabilitative care for disability children in EU is presented of a civil model, which emphasizes active social participation of disability people and the necessity of scientific and research work in physiotherapy. EU needs quality research data to know and assess possibilities of disability person development [3]. Health benefits of physical activity for children with disability should be addressed more often by physicians [4]. Physicians' competences should include recommending of physical activity age-appropriate and in a load level according the disability to aim health benefits [5]. A prerequisite for success in rehabilitation work in the area of the controlled physical activities is successful management in the process of motor learning. In disability children is from this point of view very important physiotherapists competences of stimulation, activation, communication [6, 7].

Disability children are usually reluctance to move. Therefore they have often problems with poor physical condition, resulting in further health complications, including poor posture [4]. Educational challenge in disability children aged 8-15 years is to forse a positive attitude to movement [8]. Negatively in this issue shows hypokinesis, resulting in the so-called "hypokinetic syndrome", which is reflected of impulsivity, irritability, decreased ability to concentrate and increased psychosomatic restlessness and aggression. Hypokinetic syndrome in children aged 8-15 years presents a non-physiological phenomenon, which is postmodern lifestyle induced of prolonged sitting – at school, at home, on computers, TV, mobile phones and tablets, as well as in transport, etc. [9, 10]. We should try to deep possibilities of hypokinesis compensation through right choice of exercises in disability children [11].

For example application of the walk is generally known in the context of healthy lifestyle. It belongs to the natural movement of human activities, which should be learn in disability children as a fundamental movement patterns, e.g. walking, running, jumping, and climbing hand over hand. Dancing is a way how to express emotions, contains a strong effect of catharsis. A rational approach is suppressed while dancing, while it presents an expression of positive experience, spontaneity and openness to the motor learning. At the same time dancing has an important psycho-hygienic effect for disability children. Also outdoor games support and extend active interaction among children, nature, and adults [12]. In UK there are organized outdoor game activities, dedicated to therapeutic use and comprehensive rehabilitation of disability persons, of professionals [13].

Regularly performed yoga exercises lead to experiencing of a healthy, adequately trained body and enhance commitment and self-efficacy [14]. For this reason, yoga is recommended like an effective system of physical, breathing, relaxation and concentration exercises in disability children [15]. Motion stimuli consist of simple movements in all parts of the body (including fingers, face, tongue) based on movement and breathing synchronizing. Also floatsation allows a wide range of using in disability children. It allows a fun way how to remove fears of the water environment, a confident and independent movement in water, to develop and master swimming skills, to experience relaxation in water environment and to reduce muscle tensions in children with spasticity. Mansell developed simple instruments, which are made of hollow balls of various sizes and colours, placed in textile networks, which can be variously shaped according to needs, for example, a rolling device for creating an abutment of head [2].

The aim of the study was to analyse anthropometric indicators in children with mental, hearing, visual disabilities participated in intervention programs of controlled physical activities.

It was established the basic hypothesis H1: On the base of controlled physical activities intervention programs application, in children with mental hearing, visual disabilities, occurs in experimental samples to the positive significant changes compared to the control samples in the monitoring anthropometric indicators, e.g. in the quiescent heart rate H1a), in the quiescent respiratory rate (H1b) and in the heart rate burden (H1c).

Material and methods

Characteristics of samples

Using the method of stratified random selection, experimental and control samples were created (tab. 1). Experimental investigation was attended by 180 children with surveyed kinds of disabilities (90 boys, 90 girls) in the age range 8-15 years, with an average of 12.4 years. There were 100 probands (50 boys, 50 girls) with mental disability (mild, moderate), in average age 12.2; 40 probands (20 boys, 20 girls) with hearing disability, in average age 12.8; 40 probands with visual disability (20 boys, 20 girls) in average age of 12.3. All individuals of experimental and the control samples lived in the South Bohemia region (CZ), were educated in the same school institutions. The list of diagnoses is presented in table 2.

Table 1. Basic overview of research files and the number of probands participating in the experimental investigation (n = 180; 90 boys, 90 girls; age 8-15 years)

Samples	Mental disability		Hearing disability		Visual disability		Together
	boys	girls	boys	girls	boys	girls	
Experimental	25	25	10	10	10	10	90
Control	25	25	10	10	10	10	90
Together	50	50	20	20	20	20	180

Table 2. Characteristics of specific diagnoses in probands of experimental investigations (n = 180; 90 boys, 90 girls; age 8-15 years)

Type of disability	Diagnoses	∑ Probands
Mental disability	light	51
	moderate	49
Hearing disability	complete deafness	16
	medium hearing loss	24
Visual disability	amblyopia	10
	hypermetropia	14
	strabismus	01
	astigmatism	12
	glaucoma	05
	aniridia	04
	myopia gravis	04
	nystagmus	03

Procedure

Experimental investigation was carried out in the South Bohemia region of Czech Republic for children with mental, hearing and visual disabilities. First, through method of stratified random selection, probands were selected in experimental and control samples according the type of disability. Investigation of the examined parameters was carried out in experimental and control files 3 times in 10 months, always before the start of the intervention program, then after 5 months, and thereafter 10 months, after the intervention program complete. Investigations were conducted always at the same time of the day, in the same conditions. Resulting data were statistically analysed and modified.

Methods

Anthropometric diagnostics:

1. *Investigation of quiescent heart rate* [16]: Carried at rest, in lying position of proband, using POLAR 51 M for 5 minutes.
2. *Investigation of quiescent respiratory rate* [17]: Carried at rest, in lying position, with investigator's palm on proband´s sternum for 1 min.
3. *Investigation of heart rate* burden [18]: Test "shuttle run 4 × 10" performed with POLAR M51, sensing heart rate. Probands on command ran off track to 10 meters away, orbiting. First the test was clearly demonstrated. Probands with visual disability completed test using the guide line and signalising equipment [19].

Statistics [20]

Statistical data processing was carried out under the direction of Ing. Martin Hill, DrSc., an expert in the field of statistics, working in the Institute of Endocrinology and Charles University in Prague. Relations of dependent variables to sex, experiment and its phases were evaluated by repeated measures ANOVA included factors of Subject (explaining inter-individual variability), factor Phases of the experiment (within-subject factor) and factors Sex and Experiment (between subject factors). Furthermore, the model included the interaction Sex × Experiment, Sex × Phase of experiment, Experiment × Phase of experiment and Sex × Experiment × Phase of experiment. The dependent variables with asymmetrical distribution of a non-constant variance were tested before ANOVA model transformed towards symmetry and homoscedasticity through Box-Cox transformation [21]. Optimal transformation parameter was found using linear regression on the maximum conformity of the theoretical of Gaussian distribution with quantiles of the actual distribution of the transformed data [22]. To the statistical analysis was used the software Statgraphics Centurion, version XVI from Statpoint Inc. (Warrenton, Virginia, USA).

Intervention

Intervention programs (IP) were conducted in experimental samples separately for ES1 – children with mental disability, for ES2 – children with hearing disability, for ES3 – children with visual disability. Intervention programs for all species investigated disabilities lasted 10 months. They consisted of 3 three-month training cycles of controlled physical activities, specifically didactic moderated according a disability type. The tenth months of IP was divided into three ten-day blocks in which the investigations were conducted. The three-month cycles were chosen because they are effective in motor learning process [23]. Content of intervention programs was emerged from the experience gained during the stay in the UK, West Midlands region [24], it was coordinated gradually and consequently from walk to the dance activities, yogic exercises and floatsation. Controlled physical activities were implemented to avoid of any confrontational tension in participants. The medium was maintained, controlled motion, in which can be easily choose frequency and can be achieved best skills development. During the practicing the current physical fitness of probands was accepted. For practicing school facilities and institutions surrounding areas (parks, playgrounds) were used, with that the children were well aware of. Regularly once per week an appropriate intervention unit in the afternoon, in a time period of 90 minutes, was provided. In addition, a care was taken to ensure that each intervention unit of the controlled physical activities carried out at least 1-2 hours after the main meal of children. Each intervention unit was designed with the subsequent overlap into the following 6 days of week (i.e. to the next intervention training unit) in form of motivational tasks. So it was ensured repeating, needed for the development of musculoskeletal engrams. Intervention programs did not differ in terms of the timeline, content, goals, but only in terms of the current situation of the child and type of disability.

1. Walk – 3 coherent training units in each cycle of IP
Motor learning focused on developing of aerobic fitness, corresponding with current possibilities. It was alternated and developed various combinations of simple walking (forward, backward, sideways, with turnovers), walk dance with accompaniment of music combined with imagination and creative elements (e.g. walking on the "moss"), according to the possibilities of children with a combination of hops and during (e.g. galloping horse, Indian run). In children with visual disability walk has been a significant part of orientation training (walking up stairs, down the stairs, changing direction, etc.). In the 2nd and 3rd cycle was rehearsed walking with poles (Nordic Walking) and normal tourist walking. In both cases, the training focused on outdoor walking (street, park, forest and road) in combination with outdoor games using natural environment – practicing walk in pairs, walk in a group, walk up/down the hill.

2. Dancing – 3 coherent training units in each cycle of IP
Motor learning was mainly focused on the progressive development of skills and right posture. Dancing is an important part of self-expression and social contact. It is valued for the possibility of spontaneous motor release and catharsis [25]. During dancing practicing the ability to concentrate and remember is strongly supported. There were chosen skills appropriate current possibilities of participants. Initially, the movement was developed through learning dance games using chants and rhymes, clapping and movement improvisation (e.g. the dance in the "the ball" – the idea that I have in hand a brush and can paint space in which I stand – above, around). An important part of motor learning presented methods of demonstration and method of kinestheses, i.e. helping by instructor to stay in a position. In the 2nd and 3rd cycle simple dance in a circle and couple dance were trained. For children with hearing disability practicing of dance and rhythmic exercises were supported by different perceptions (vibration perceived from the floor, agreed rhythmic signals, etc.).

3. Yoga Exercise – 4 coherent training units in each cycle of IP
Motor learning focused on the gradual development of flexibility, strength and right posture. The training program was based on the acquisition of simple exercises in slow rhythm, in synchronising with breathing, with an emphasis on the balance development. There was also an important part of IP imagination and play. The idea of "trees", "animal", "Sun" was using to perform of exercises motivation and memorization. In the 2nd and 3rd cycle yoga sets (e.g. Sun salutations) were mastered, which improve mobility of the body and positively affect on the activity of glands, muscle sensory and spatial orientation. Daily practicing of several yoga set rounds corrects poor posture, reduces back pain, stress and digestive problems [26]. It was an effort to master the set smoothly in accordance with breathing. Imagination with the idea of body part, warming up of the sun, helped in a given positions.

4. Floatation – 2 coherent training units in each cycle of IP
Motor learning in controlled physical activities was mainly focused on the development and release of capabilities "floating in the wate", using a small pool with warmer water. In the intervention units were used walk in water, game, spraying and dipping into the water to get rid of the feeling of fear of the water. The basic principle of access for instructors presented the approach of Halliwick method: "I'm here to help you," emphasized of gesture. Various tools using for floating developed a pleasant feeling of "floating", "passage", "drift" and various combinations with help of instructors, without steam. It was used for "flow" effect, known from sports psychology, awakening feelings of joy, satisfaction, peace and happiness during physical activities and bringing desire to repeat, to return in motion experiences. Such intervention training units were part of the 2nd and 3rd cycle and there were at least due to limited availability.

Results

Results of anthropometric investigation

Results of anthropometric investigations are given for clear presenting of data divided into three subsections, which are arranged in a given type of examination results in a sequence of mental disability, hearing disability and visual disability.

Quiscent heart rate in probands with mental disability

In the beginning of the experimental investigation, the average of quiescent heart rate in probands with mental disability was analysed in the range of 83-122 beats/min, with no significant differences between ES1 and CS1. As it is shown in table 3 and figure 1 during experimental investigation average heart rate in probands ES1 decreased to an average value of 86 beats/min, representing a significant difference between the 1st and 3rd examinations ($F = 136.87$; $p = 0.001$). Probands of CS1 value remained quiescent heart rate without significant changes (fig. 1).

Statistical analysis of the quiescent heart rate values in the samples of boys and girls with mental disability was found that boys and girls ES1 were recorded analogous positive values of decreasing when difference between the initial and final investigation was significant, i.e. boys $F = 316.49$; $p = 0.001$ and girls: $F = 134.94$; $p = 0.001$.

Table 3. Statistical results of changes in quiescent heart rate in probands with mental disability in the course of the experiment (n = 100; ES1 = 25 boys, 25 girls; CS1 = 25 boys, 25 girls)

Source	F-ratio	p-value
Sex (A):	6.29	0.013
Experiment (B):	136.87	0
Phases (C):	47.39	0
Subject:	14.67	0
A × B:	10.02	0.0018
A × C:	0.98	0.3762
B × C:	88.78	0
A × B × C:	0.21	0.8134

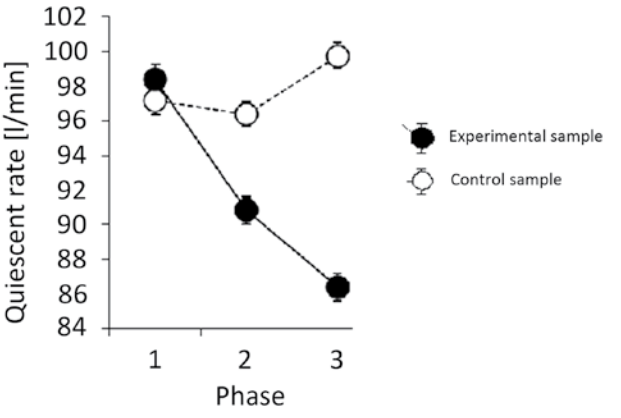

Fig. 1. Development of quiescent heart rate in probands with mental disability in the course of the experimental investigation: comparison of ES1 and CS1 broken down by phase (n = 100; ES1 = 25 boys, 25 girls; CS1 = 25 boys, 25 girls)

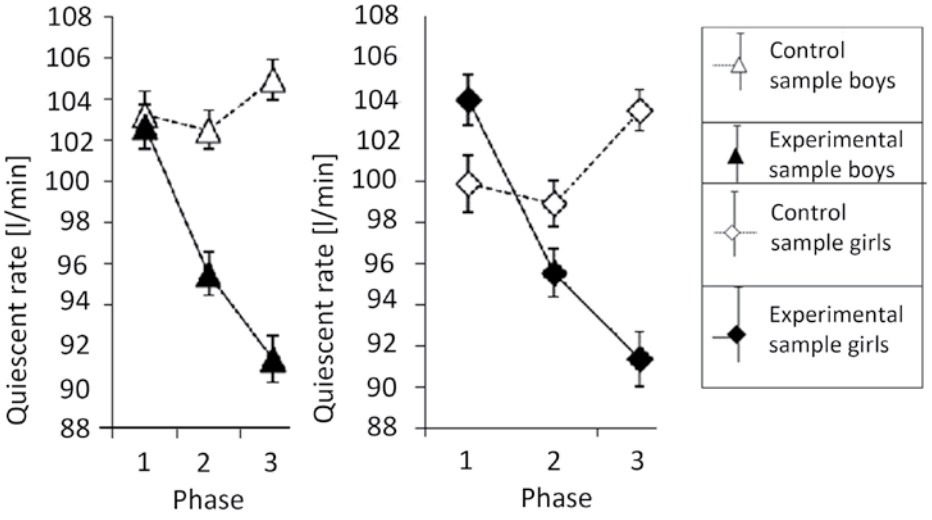

Fig. 2. Development of quiescent heart rate in probands with mental disability in the course of the experimental investigation: comparison of ES1 and CS1, broken down by sex and phase (n = 100; ES1 = 25 boys, 25 girls; CS1 = 25 boys, 25 girls)

In CS1, the analysis of the values of quiescent heart rate of both boys and girls did not show a significant difference in the second investigation. In the third investigation of CS1,both sexes displayed a negative tendency in quiescent heart rate value (fig. 2), with F = 26.54; p = 0.001 for CS1 boys, and F = 20.42; p = 0.001 for girls.

Quiscent heart rate in probands with hearing disability

In the beginning of the experimental investigation, the mean of quiescent heart rate in probands with hearing disability in amount of 87.5 beats/min, without any significant differences between ES2 and CS2. As shown in table 4 and figure 3, during the experimental investigation decreased average quiescent heart rate in probands ES2 to an average of 84 beats/min, which is a positive significant difference between the 1st and 3rd examination (F = 15.53; p = 0.001). Probands of CS2 value remained quiescent heart rate in all three phases of experimental investigation with no significant changes. For groups of boys ES2 and CS2 were detected in the first examination analogous to the average value of quiescent heart rate without significant differences: 84.5 beats/min. U girls ES2 and CS2 were analysed also the same as the initial value of quiescent heart rate on 89 beats/min, i.e. about 4.5 rates higher than average in boys.

As seen in figure 4, the quiescent heart rate values decreased during the experimental investigation only in the ES probands, from 85 beats/min in the first investigation to 82 beats/min in the 3rd investigation in boys, and in girls from 89 beats/min to 86 beats/min in the third examination. For boys and girls from the experimental group ES2 a significant positive difference was confirmed between the initial and final testing, (boys: F = 316.49; p = 0.001, and girls: F = 134.94; p = 0.001).

For groups of boys and girls of the CS2 values were quiescent heart rate in the 2nd and 3rd examination without significant changes.

Table 4. Statistical results of changes in quiescent heart rate in probands with hearing disability during the experimental investigation (n = 40; ES2 = 10 boys, 10 girls; CS2 = 10 boys, 10 girls)

Source	F-ratio	p-value
Sex (A):	174.5	0
Experiment (B):	8.26	0.0054
Phases (C):	15.53	0
Subject:	133.45	0
A × B:	9.58	0.0028
A × C:	2.22	0.1158
B × C:	12.57	0
A × B × C:	0.6	0.5498

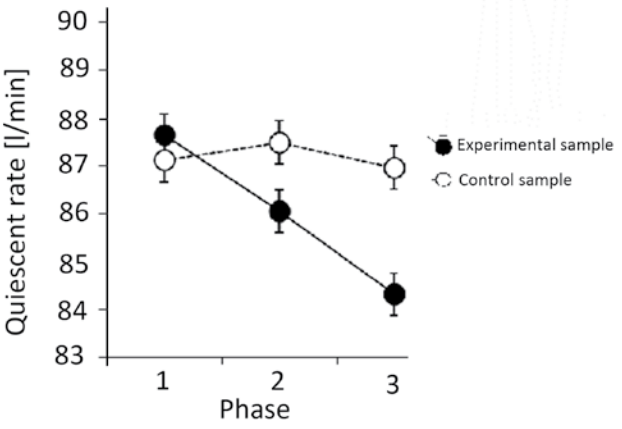

Fig. 3. Development of quiescent heart rate in probands with hearing disability during the experimental investigation: comparison of ES2 and CS2 broken down by phase (n = 40; ES2 = 10 boys, 10 girls; CS2 = 10 boys, 10 girls)

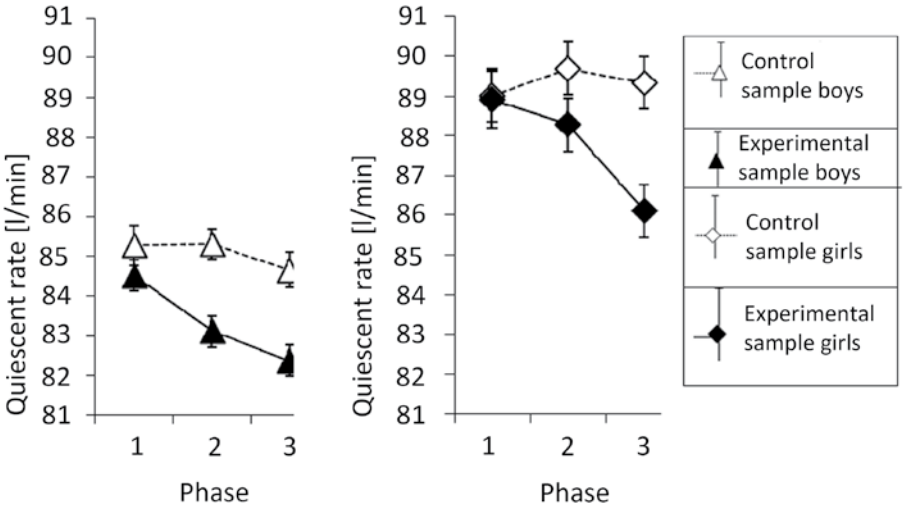

Fig. 4. Development of quiescent heart rate in probands with hearing disability during the experimental investigation: comparison of ES2 and CS2, broken down by sex and phase (n = 40; ES2 = 10 boys, 10 girls; CS2 = 10 boys, 10 girls)

Quiescent heart rate in probands with visual disability

Already at the beginning of the experimental investigation in probands with visual disability was found significant disparity between ES3 and CS3, and in the average of quiescent heart rate (F = 33.3; p = 0.001).

As is apparent from table 5 and figure 5, in the course of experimental investigation decreased average of the heart rate only in probands of ES3 of 87 beats/min to 80 beats/min, and thus to achieving a positive significant difference between the 1st and 3rd examinations (F = 406.73; p = 0.001). Probands of CS3 value remained quiescent heart rate in all three phases of experimental investigation with no significant changes. A significant change has been achieved, in particular in the group of boys ES3 (91 beats/min to 79 beats/min), F = 134.94; p = 0.001.

Table 5. Statistical results of changes in quiescent heart rate in probands with visual disability during the experimental investigation (n = 40; ES3 = 10 boys, 10 girls; CS3 = 10 boys, 10 girls)

Source	F-ratio	p-value
Sex (A):	33.3	0
Experiment (B):	295.77	0
Phases (C):	21.98	0
Subject:	31.57	0
A × B:	31.19	0
A × C:	8.88	0.0004
B × C:	30.48	0
A × B × C:	9.67	0.0002

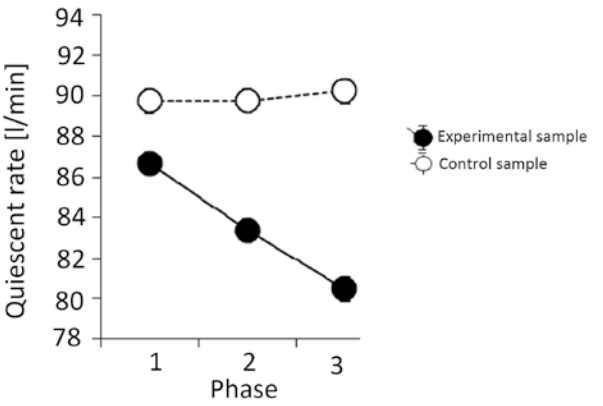

Fig. 5. Development of quiescent heart rate in probands with visual disability during the experimental investigation: comparison of ES3 and CS3 broken down by phase (n = 40; ES3 = 10 boys, 10 girls; CS3 = 10 boys, 10 girls)

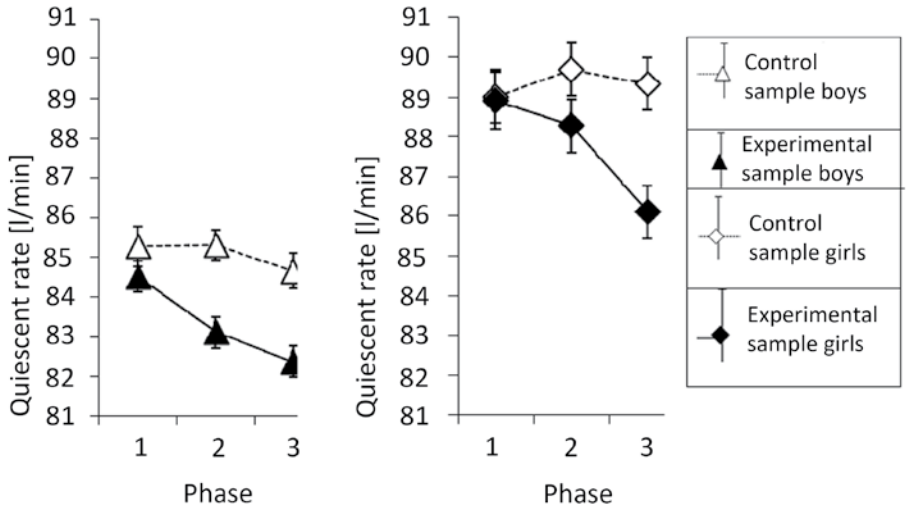

Fig. 6. Development of quiescent heart rate in probands with visual disability during the experimental investigation: comparison of ES3 and CS3 broken down by phase (n = 40; ES3 = 10 boys, 10 girls; CS3 = 10 boys, 10 girls)

In the group of girls ES3 positive decrease in mean quiescent was analysed in the heart rate of 86 beats/min to 82.5 beats/min (F = 316.49; p = 0.001). For the groups of boys and girls in CS3, the mean quiescent heart rate in the second test was found on the same level as in the 1st test, with a slight non-significant increase in the 3rd test (see fig. 6).

Quiescent respiratory rate in probands with mental disability
Analysis of the results evaluated with quiescent respiratory rate clearly demonstrated the positive reduction in respiratory rate from the analyzed average value of 22 breaths/min to 19.75 breaths/min at ES1. Significant difference between the 1st and 3rd examinations in ES1 was achieved (F = 84.16; p = 0.001) (tab. 6, fig. 7).

Table 6. Development of quiescent respiratory rate values in probands with mental disability in the course of experimental investigation (n = 100; ES1 = 25 boys, 25 girls; CS1 = 25 boys, 25 girls)

Source	F-ratio	p-value
Sex (A):	109.13	0
Experiment (B):	398.32	0
Phases (C):	58.75	0
Subject:	43.54	0
A × B:	18.2	0
A × C:	0.06	0.9395
B × C:	84.16	0
A × B × C:	1.01	0.365

In contrast, in CS1 were analysed statistically significant differences in measured values of quiescent respiratory rate in the various stages of an experimental investigation. The difference between ES1 and CS1 in the final examination after completion of the third ten-month intervention program was significant (F = 398.32; p = 0.001).
Quiescent respiratory rate in probands with hearing disability

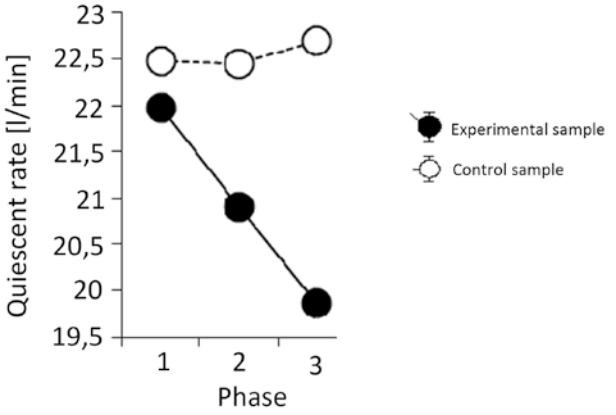

Fig. 7. Development of quiescent respiratory rate values in probands with mental disability in the course of the experimental investigation: comparison of ES1 and CS1 broken down by phases (n = 100; ES1 = 25 boys, 25 girls; CS1 = 25 boys, 25 girls)

Also, the results of quiescent respiratory rate in probands with hearing disability showed a significant decrease in respiratory frequency in ES2 between the 2nd and 3rd investigations (F = 219.33; p = 0.001) (fig. 8) with no difference between the first and second examinations.

In CS probands, there were no significant differences in measured values in any comparison of the various phases of experimental investigation.

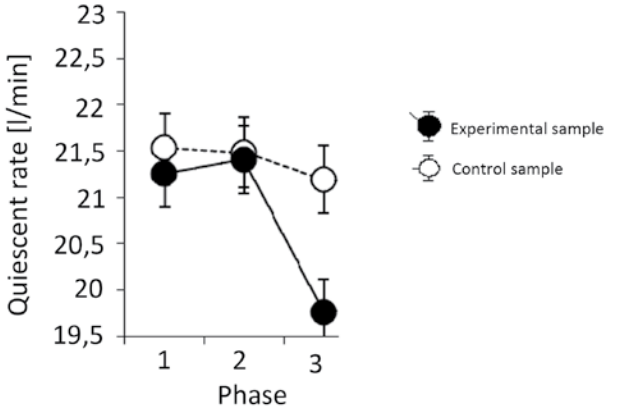

Fig. 8. Development of quiescent respiratory rate values in probands with hearing disability during the experimental investigation: comparison of ES2 and CS2, broken down by phase (n = 40; ES2 = 10 boys, 10 girls; CS2 = 10 boys, 10 girls)

Quiescent respiratory rate in probands with visual disability
For probands with visual disability was observed similar results in the course of experimental investigation as in the probands with mental disability. Analysis of test results of quiescent respiratory rate values again clearly demonstrate the positive reduction in respiratory rate in the sample ES3 compared to quiescent respiratory rate in the CS3. Statistical analysis of the measured values of the quiescent respiratory rate found significant difference between the 1st and 3rd investigations in ES3 (F = 84.16; p = 0.001) (tab. 7, fig. 9). In contrast in CS3, there were found no significant differences in the measured values. The difference between ES3 and CS3 after 10 months of the experiment was statistically significant (F = 219.33; p = 0.001).

Table 7. Development of quiescent respiratory rate values in probands with visual disability during the experimental investigation (n = 40; ES3 = 10 boys, 10 girls; CS3 = 10 boys, 10 girls)

Source	F-ratio	p-value
Sex (A):	6.23	0.0149
Experiment (B):	328.78	0
Phases (C):	62.37	0
Subject:	6.83	0
A × B:	1.71	0.1947
A × C:	1.61	0.207
B × C:	70.18	0
A × B × C:	0.86	0.4279

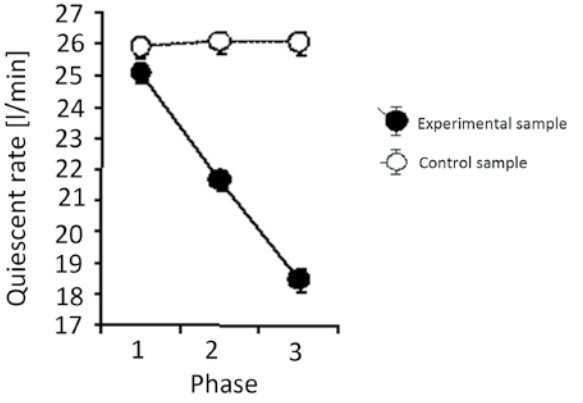

Fig. 9. Development of quiescent respiratory rate values in probands with visual disability during the experimental investigation: comparison of ES3 and CS3 broken down by phase (n = 40; ES3 = 10 boys, 10 girls; CS3 = 10 boys, 10 girls)

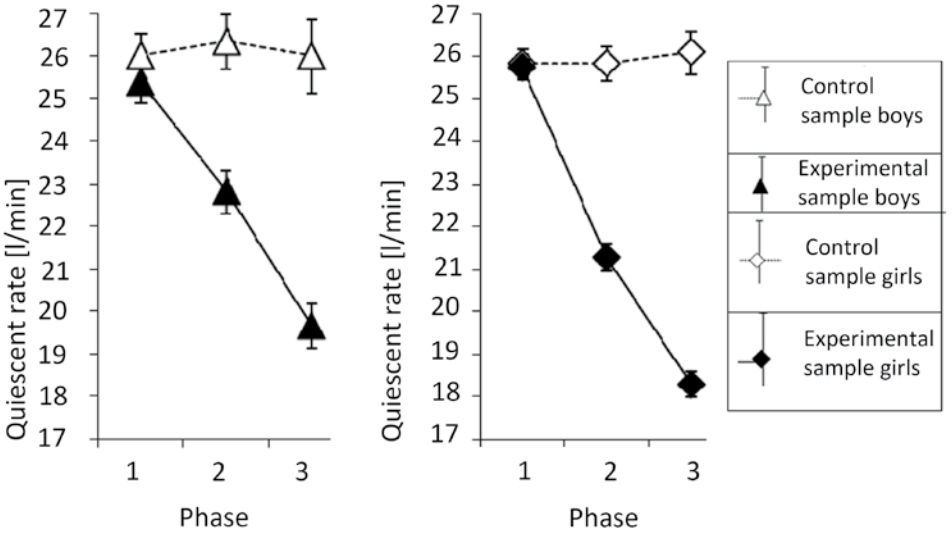

Fig. 10. Development of quiescent respiratory rate values in probands with visual disability during the experimental investigation: comparison of ES3 and CS3, broken down by sex and phase (n = 40; ES3 = 10 boys, 10 girls; CS3 = 10 boys, 10 girls)

An obvious course of successful reduction in respiratory rate is also evident from the results of analysing differences in sex. In groups of boys and girls ES3 there was a significant decrease in respiratory rate (boys F = 142.07; p = 0.001; girls F = 385.87; p = 0.001), while groups of boys and girls of the CS3 to significant shifts occurred (tab. 7, fig. 10).

Heart rate burden in probands with mental disability

At the beginning of the experimental investigation, the average of heart rate burden in probands with mental disability in the range 183-184 beats/min, with a significant difference between ES1 and CS1 (F = 64.27; p = 0.001). As is apparent from table 8 and figure 11, during the experimental investigation decreased average of heart rate burden during exercise in probands ES1 to an average value of 179 beats/min, representing a positive significant difference between the 1st and 3rd examinations (F = 328.06; p = 0.001).

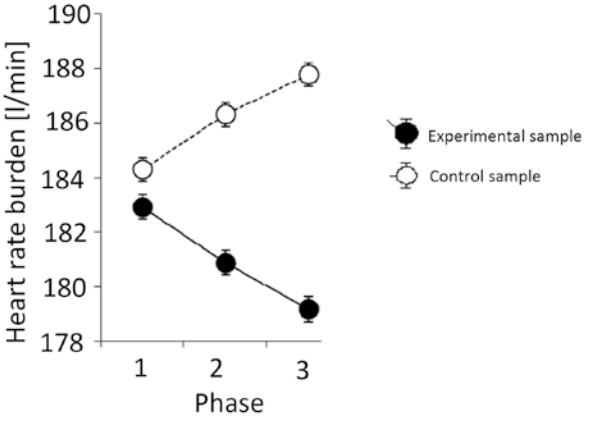

Fig. 11. Development of heart rate burden values during exercise in volunteers with mental disability in the course of an experimental investigation: comparison of ES1 and CS1 broken down by phase (n = 100; ES1 = 25 boys, 25 girls; CS1 = 25 boys, 25 girls)

Table 8. Development of heart rate burden values during exercise in volunteers with mental disability in the course of experimental investigation (n = 100; ES1 = 25 boys, 25 girls; CS1 = 25 boys, 25 girls)

Source	F-ratio	p-value
Sex (A):	21.85	0
Experiment (B):	328.06	0
Phases (C):	0	0.9957
Subject:	14.47	0
A × B:	41.21	0
A × C:	0.72	0.4884
B × C:	64.27	0
A × B × C:	1.2	0.3033

In probands of CS1 the value of heart rate burden during exercise in the next stages of testing went up to the final significant difference between boys CS1 to 188 beats/min (F = 64.01; p = 0.001) in girls CS1 even to the level of 198 beats/min (F = 62.52; p = 0.001) (fig. 12).

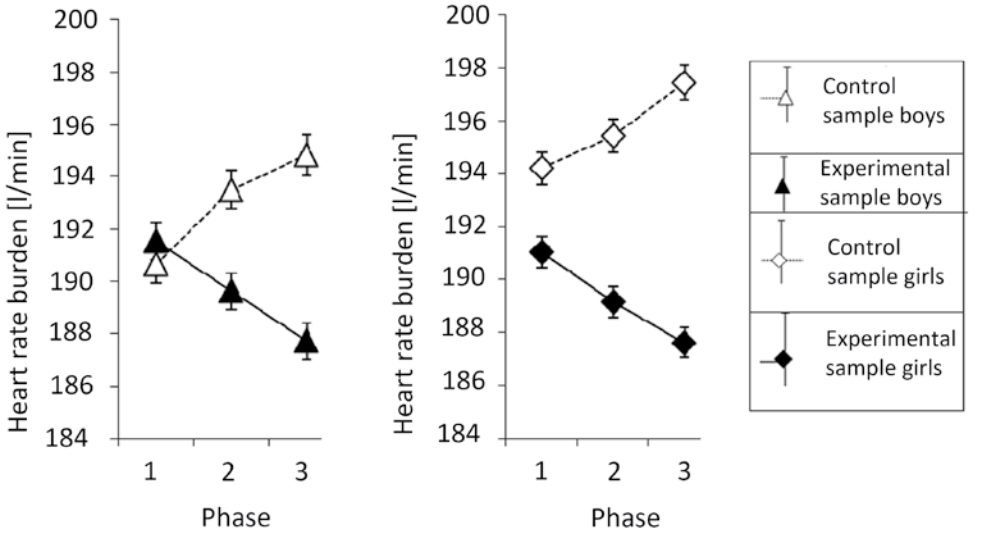

Fig. 12. Development of heart rate burden values during exercise in volunteers with mental disability in the course of an experimental investigation: comparison of ES1 and CS, broken down by sex and phase (n = 100; ES1 = 25 boys, 25 girls; CS1 = 25 boys, 25 girls)

Heart rate burden in probands with hearing disability

For probands with hearing disability was initially average of the heart rate burden in the range 183-185 beats/min, with a significant difference between ES2 and CS2 in the third phase (F = 25.97; p = 0.001). As it is apparent from table 9 and figure 13, during the investigation average of the heart rate burden during the intervention program decreased in probands of ES2 to average value of 181 beats/min, which is a positive significant difference between the 1st and 3rd investigations (F = 25.97; p = 0.001), while the value of CS2 3rd investigation increased to 185 beats/min. For probands with hearing disability CS2 value of heart rate burden during intervention increased with a significant difference between boys ES2 and boys CS2 (189 beats/min), girls CS2 heart rate burden increased slightly with non-significant difference to the value of 183 beats/min (see fig. 14).

Table 9. Development of heart rate burden values during exercise in probands with hearing disability during the experimental investigation (n = 40; ES2 = 10 boys, 10 girls; CS2 = 10 boys, 10 girls)

Source	F-ratio	p-value
Sex (A):	52.61	0
Experiment (B):	2.77	0.1006
Phases (C):	0.8	0.4532
Subject:	118.95	0
A × B:	1.56	0.2155
A × C:	0.29	0.7485
B × C:	25.97	0
A × B × C:	0.93	0.3982

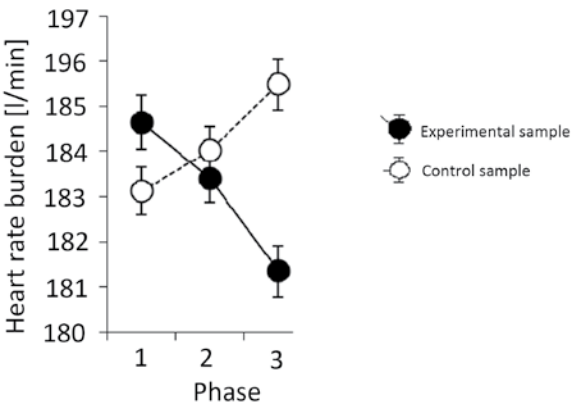

Fig. 13. Development of heart rate burden values during exercise in probands with hearing disability during the experimental investigation: comparison of ES2 and CS2 broken down by phase (n = 40; ES2 = 10 boys, 10 girls; CS2 = 10 boys, 10 girls)

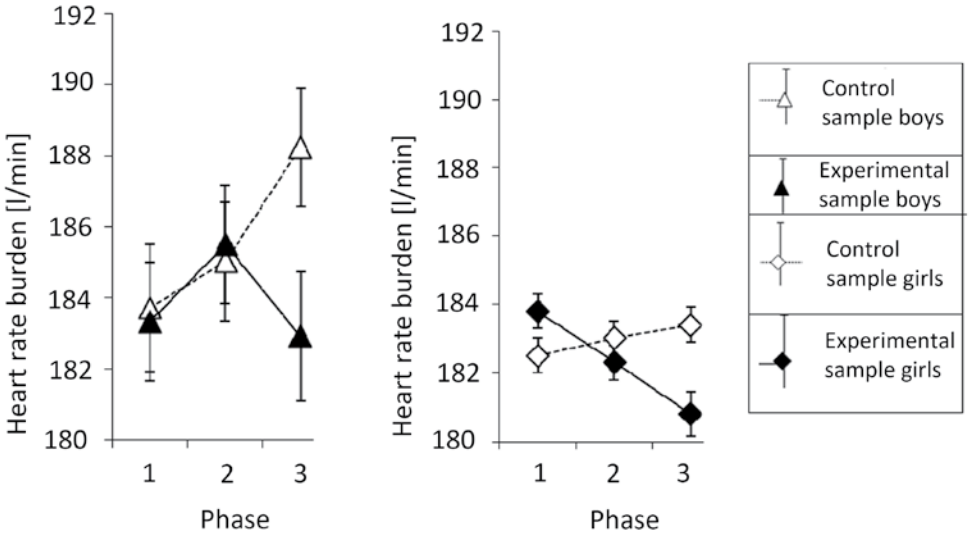

Fig. 14. Development of heart rate burden values during exercise in probands with hearing disability during the experimental investigation: comparison of ES2 and CS2, broken down by sex and phase (n = 40; ES2 = 10 boys, 10 girls; CS2 = 10 boys, 10 girls)

Heart rate burden in probands with visual disability

For probands with visual disability was initially experimental investigations average of heart rate burden in the range of 172-175 beats/min, with a significant difference between ES3 and CS3 (F = 23.45; p = 0.001). As it is apparent from table 10 and figure 15, during the experimental investigation average of the heart rate burden had surprisingly decreasing of probands ES3, neither in probands CS3. In contrast in the second investigation heart rate burden increased on 176-177 beats/min in both groups.

Table 10. Development of heart rate burden values during exercise in probands with visual disability during the experimental investigation (n = 40; ES3 = 10 boys, 10 girls; CS3 = 10 boys, 10 girls)

Source	F-ratio	p-value
Sex (A):	23.45	0
Experiment (B):	0.57	0.4516
Phases (C):	4.83	0.0108
Subject:	6.94	0
A × B:	4.46	0.0382
A × C:	1.81	0.1706
B × C:	0.4	0.6696
A × B × C:	1.39	0.2545

In the 3rd investigation occurred in ES3 to reduce heart rate burden to 174 beats/min, which may involve forming with the training effect, while in CS3 the heart rate burden value stand on 177 beats/min. This final difference between ES and CS is significant (F = 12.27; p = 0.001).

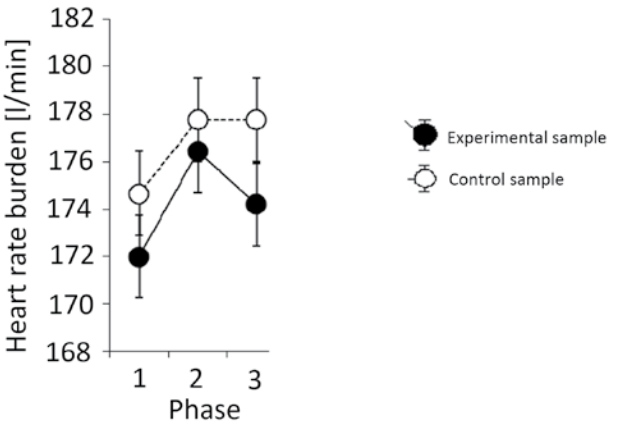

Fig. 15. Development of heart rate burden values during exercise in volunteers with visual disability during the experimental investigation: comparison of ES3 and CS3, broken down by the phase of investigation (n = 40; ES3 = 10 boys, 10 girls; CS3 = 10 boys, 10 girls)

Discussion

Discussion of the quiescent heart rate investigation results

Due to the fact that there was found a significant improvement in experimental samples of all kinds researched disabilities, can be discussed in accordance with interpretations [16] a beneficial effect of intervention programs implemented probands in the age group 8-15 years on functional development of the cardiovascular system. Apparently there was positively reflected fitness training of indoor and outdoor walk, as well as dance training activities and, last but not least, the popularity of various balance, relaxation and breathing exercises (dance games, yoga exercises, physical activities in water – floatsation).

Discussion of the examination quiescent respiratory rate results

Analysis of the quiescent respiratory rate results showed a positive effect of controlled physical activities evaluated with under the intervention programs for participants with mental, hearing and visual disabilities. We are particularly pleased with the significantly outcomes of probands with mental disability ES1, when the regulation of quiet breathing from the average of 22 breaths/min decreased to 19.75 breaths/min. Also in probands with hearing disability analysed results of quiescent respiratory rate showed a significant decrease in respiratory rate in ES2, especially between the second and third investigation. Probands with hearing disability appeared to be the most nervous and unsure of all three examined samples of probands, so it is necessary to take a longer period of time to achieve the desired changes, and also to ensure calm before testing.

A similar course of results, which was found in probands with mental disability, was found in probands with visual disability. Analyse of the quiescent respiratory rate results demonstrates clearly the positive reduction in respiratory rate in the experimental sample, suggesting the acquisition of diaphragmatic breathing. It is necessary to add, that in control groups CS1, CS2, CS3 were no significant differences in the measured values of quiescent respiratory rate detected. This affirmed the importance of controlled physical activities programs managed in children with mental, hearing and vision disabilities, especially in the context of a successful intervention effect of applied yoga exercises as well as walking and dancing. These findings are consistent with educational preferences of [27] in a sense of relaxing guided motoric concept.

Discussion of the heart rate burden results

The results again document the positive effect of the intervention program with a positive functional effect on a young growing organism. Positive functional changes as a result of physical training effect in adolescents are analysed by many authors, but only in the context of intact population. In the Czech Republic it is mainly [23, 28, 29], etc., abroad then [30, 31], etc. It would be important to continue research and on a larger scale to analyse functional changes under the influence of training in children with disabilities.

For probands with visual disability is required to assess changes in heart rate burden otherwise than in probands with mental and hearing disabilities. Under an influence of visual disability in the performance of the first investigation (shuttle run) probands were running slowly under the influence of uncertainties of the visual disability. During the intervention program of controlled physical activities they improve fitness and spatial orientation, and thus in the second investigation they run faster with greater passion and naturally higher heart rate burden. In the third investigation after 10 months of the intervention program probably towards the training effect and thereby reduce the heart rate burden during exercise and they run in the same speed as in the second investigation.

Conclusions

In conclusion it can be stated that the research objectives have been met. Through selected research methods managed to determine the changes observed indicators for the population of children obtained data to analyze the statistical procedure and evaluate them. On the basis of demonstrated positive changes the hypothesis was verified in all three aspects.

The current lifestyle of children is accompanied by hypokinesia, which is further enhanced in the case of a child with a disability. As evidenced by the results of the intervention effect for all three types Disabilities to reverse this negative condition by using well maintained motor learning in the context of controlled physical activities. Research has shown that children are examined types Disabilities can achieve positive effects on anthropometric indicators. Learning outcomes can be beneficial for rehabilitation of children with disability issues in reducing symptoms fearful behavior and increased exposure independent behaviour. Suggestions for further scientific study of the issue could be deeper research cooperation with foreign colleagues, in addition to any comparison of physical parameters (height, weight) of children with Disabilities species examined in the context of a scientific analysis of the impact of various aspects of the environment.

References
Piśmiennictwo

[1] Górny M., Estetika pohybu dětí se zrakovým postižením. Univerzita Palackého v Olomouci, Olomouc 2013.
[2] Mansell J., Beadele-Brown J., Active support: enabling and empowering people with intellectual disabilities. Jessica Kingsley Publishers, London 2010.
[3] Barnes C., Mercer G., Exploring disability. The Policy, Cambridge 2010.
[4] Bolach E., Buliński P.E., Ocena sprawności motorycznej dzieci w wieku przedszkolnym. Rozprawy Naukowe AWF we Wrocławiu, 2012, 39, 120-125.
[5] Hazwood K., Getchell N., Life span motor development. Human Kinetics, Champaign 2005.
[6] Kornatovská Z., Zdravotně – sociální benefity adekvátních pohybových aktivit u dětí s mentální, sluchovou a zrakovou disabilitou. In: Sborník příspěvků 1. České národní konference aplikovaných pohybových aktivit. Univerzita Palackého v Olomouci, Olomouc 2011.
[7] Kurkova P., Válková H., Scheetz N., Factors impacting participation of European elite deaf athletes in sport. J. Sports Sci., 2011, 29 (6), 607-618.
[8] Davis R.W., Teaching disability sport: a guide for physical educators. Human Kinetics, Champaign 2011.
[9] Harada T., Krejčí M. et al., Education to healthy life style with the accent to sleep habits – intervention programs. Acta Salus Vitae, 2013, 1 (1), 13-27.
[10] Marcus B.H., Forsyth L.H., Psychologie aktivního způsobu života. Portál, Praha 2010.
[11] DePauw K.P., Gavron S.J., Disability sport. Human Kinetics, Champaign 2005.
[12] Jirásak I., Filosofická kinantropologie: setkání filosofie, těla a pohybu. Univerzita Palackého v Olomouci, Olomouc 2005.
[13] Kudláček M., Morgulec-Adamowicz N., Verellen J., European Standards in Adapted Physical Activity. Univerzita Palackého v Olomouci, Olomouc 2010.

[14] Krejčí M., Setkání s jógou: jóga jako prostředek rozvoje zdraví dětí na 1. stupni ZŠ. EM Grafika, České Budějovice 2003.
[15] Maheshwaranenda P.S., Yoga mit Kinder. Urania, Stuttgart 2005.
[16] Benson R., Connolly D., Trénink podle srdeční frekvence: jak zvýšit kondici, vytrvalost, laktátový práh, výkon. Grada Publishing, Praha 2012.
[17] Hanzlová J., Hemza J., Základy anatomie soustavy dýchací, srdečně cévní, lymfatického systému, kůže a jejich derivátů III. Masarykova Univerzita, Brno 2007.
[18] Měkota K., Kovář K. et al., Unifittest (6-60): příručka pro manuální a počítačové hodnocení základní motorické výkonnosti a vybraných charakteristik tělesné stavby mládeže a dospělých v České Republice. Univerzita Karlova, Praha 2002.
[19] Belšan P., Perič T., K účasti zrakově postižených ve sportu. In: Sport v České Republice na začátku nového tisíciletí. Univerzita Palackého v Olomouci, Olomouc 2001.
[20] Meloun M., Hill M., Militký J., Vrbíková J., Stanická S., Skrha J., New methodology of influential point detection in regression model building for the prediction of metabolic clearance rate of glucose. Clin. Chem. Lab. Med., 2004, 42 (3), 311-322.
[21] Meloun M., Hill M., Militký J., Kupka K., Transformation in the PC-aided biochemical data analysis. Clin. Chem. Lab. Med., 2000, 38 (6), 553-559.
[22] Meloun M., Militký J., Hill M., Brereton R.G., Crucial problems in regression modelling and their solutions. Analyst., 2002, 127 (4), 433-450.
[23] Dovalil J. et al., Výkon a trénink ve sportu. Olympia, Praha 2009.
[24] Kornatovská Z., Jůda J., Vytvoření webových stránek s nabídkou řízených pohybových aktivit pro děti s disabilitou v Jihočeském regionu. Aplikované pohybové aktivity v teorii a praxi, 2014, 5 (1).
[25] Dinold M., Zanin K., Miteinanders: Kreative Arbeitsweise für behinderte und nichtbehinderte Menschen mit den Mitteln Körpererfahrung, spontanem Spiel, Tanz und Theater. Hpt-Breitschopf, Wien 1996.
[26] Maheshwaranenda P.S., Yoga in Daily Life – The System. University Verlag, Wien 2001.
[27] Nadeau M., Relaxační hry s dětmi. Portál, Praha 2011.
[28] Dvořáková H., Didaktika tělesné výchovy nejmenších dětí a dětí s hendikepy. Univerzita Karlova, Praha 2000.
[29] Máček M., Radvanský J., Fyziologie a klinické aspekty pohybové aktivity. Galén, Praha 2011.
[30] Galladhue D.L., Donnely F.C., Developmental Physical Education for all Children. Human Kinetics, Champaign 2007.
[31] Gasparini W., Talleu C., Sport and discrimination in Europe. Council for Europe Publishing, Strasbourgh 2010.

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