Evolution of cardio-respiratory parameters in adapted aquatics program for people with disabilities

Constantin Pehoiu a*, Gabriela-Monica Moacă b, Felix-Mihail Stănescu c, *

a, b “Valahia” University of Târgoviște, Faculty of Humanities, Str. Lt. Stancu Ion, no. 35, Târgoviște, Dâmbovița County, Romania
b Association “Eu Pot”, str. Vlad Ţepeş, no. 4, Târgoviște, Dâmbovița County, Romania

Abstract

This study was possible due to a partnership between the Department of Physical Education and Sports of Humanities Sciences Faculty of Valahia University from Targoviste and the Association „ Eu Pot!” that consists of monitoring the evolution of cardio-respiratory parameters of children with disabilities, since December 2013 to May 2014. Adapted physical activity in this programe was conducted over a period of 6 months, personalized and individualised for each subject. By evaluating the main functions of organism, we have followed the evolution of the relationship between adapted physical activity and health for all 12 children, gathering good results for the entire lot during 6 months, results decribed below.

Keywords: disabilities; adapted physical activity; heart rate; vital capacity.

1. Introduction

Disability is the loss or limitation of opportunities to take part in the normal life in the community on an equal level with others due to physical or social barriers. Children with special needs may have physical disabilities (physical), mental or intellectual: Autism, Down Syndrome, low intelligence quotient deficiencies associated. This may be due by genetic errors, problems during pregnancy, birth or health problems due by social conditions of living

* Corresponding author.
E-mail address: cpehoiu@yahoo.com
Motor learning, sport specific, means agonistic behavior, tactical thinking, ingenuity and creativity. Learning is a complex motor actions that unifies learning and teaching intelligent motor. It follows that learning in tangible activities includes learning gestural, motor and perceptual-motor and smart and creative forms of learning (Epuran, Holdevici, 1993).

Down Syndrome is a frequent diagnosis, accounting for about 33% of people with intellectual disabilities and is a chromosomal aberration by triple pair 21. It manifests itself by affecting the physical, mental and learning process. However, each child has their own level of impairment, psycho-motor level to be assessed and correctly classified. Psycho-motor development of children with Down Syndrome is very much family and social environment which includes (Lauteslager, 2004).

Autism is a disorder of personality characterized by disruption of both the inside and his own relationship with the world around. It is a complex disorder that appears in the first 3 years of life due to neurological dysfunction that hinders social interaction and communication skills. Children with autism have difficulties in verbal and non-verbal communication, social interactions and leisure activities. Recent studies show that the large number of vaccinations (over 20) of children up to 2 years, may lead to autism. (Todea-Gross, 2012).

A.D.H.D. is a behavioral disorder manifested by children unable to concentrate on one task. It is a medical problem that starts in childhood and, if not discovered and treated properly, can expand over time, affecting adult life. ADHD has 3 main symptoms:
- lack of attention, most common symptom, which is added during time, inability to concentrate, ordering of activities and major memory problems;
- impulsiveness- adults suffering from ADHD can not dedicate socio-emotional relationships of long duration;
- hyperactivity, is keenly felt in children; recent studies have shown that 60% of children with ADHD suffer from this condition and in adulthood (Sanz & Reina, 2012).

Paraparesis is muscle weakness in the arms and legs which are characterized by ataxia, abolition of reflexes and deep impaired sensibility. These neurological signs are associated with a dysmorphic syndrome, often represented by increased planting vault and rarely by kyphoscoliosis.

Spastic hemiplegia is suppression or drastically reduced voluntary movements in one of the two halves of the body due to unilateral brain damage (Moțet, 2011).

Double congenital thoraco-lumbar scoliosis is a rare malformation that occurs in one in 20,000 births. Children may be unable to breathe and even paralyzed teenager.

2. Theoretical foundation and related literature

„Swimming adapted stimulates venous return and is beneficial for people with reduced mobility in the lower body.” (Gómez J. M., Miguel R. P., Fernández-Rio J., 2000). It can be prescribed in patients immobilized in wheelchairs, but also those who spend most of their time in the static position, regardless of the reasons. Physiotherapy assessment at a swimming school for children revealed that „to 18.51% of the subjects it was possible to observe an excellent cardiac adaptation to effort, very good at 46.29% and 27.7% other good one, while only 7.4% of the target group was observed moderate or poor adaptation.” (Sanchez Perez S., Jimeno Serrano F. J., Palacios V. S., 2000). „Regular physical activity contributes to the prevention of the most serious chronic diseases encountered today and is associated with a reduced risk of premature death” (Warburton, 2006). We have enough scientific evidence about the existence of a linear relationship between the amount of physical activity performed and health. Recent research indicates that blood pressure was significantly reduced after exercise body. „The effects of post-exercise blood pressure can take up to 22 hours and can occur decreases in systolic and diastolic blood pressure 3 to 5 mmHg” (Festschrift & Fagard, 2006).

3. Purpose

The target of this study was the monitoring of cardio-respiratory (blood pressure, heart rate, oxygen saturation, vital capacity) group, with 12 children with disabilities, during December 2013-May 2014. The evaluation of the main functions of the body (cardiovascular and respiratory) to follow the evolution of the relationship between
physical activity and health adjusted.

4. Objectives

For this activity were determined following steps:
- establishment of target group;
- pre-participatory evaluation (questionnaire);
- initial assessment (monitoring parameter);
- adapted physical activity planning;
- observing the evolution of physiological parameters recorded during the sessions (recording heart rate clock);
- comparing the cardiovascular system response to exercise with progressively increasing workload;
- final assessment (monitoring parameter);
- activity analysis and results.

5. Hypothesis

If we exercise the body under the influence of hydrostatic pressure, with a rate of one session per week, 90 minutes (with a volume progression in intensity between 130 and 200 beats per minute), then be favored both developing cardiovascular system and respiratory, leading to decreased heart rate and blood pressure at rest and increased vital capacity and oxygen saturation of peripheral blood.

6. Subjects, the place and period

The study included 12 children (4 female and 8 male) aged between 7 and 19 years, with serious diagnoses or sharp, intellectual disabilities (3 children with Down Syndrome, 2 with Autism, 1 with ADHD) and physical (1 with tetraparesis, 1 with paraparesis, spastic hemiplegia, 2 with one double thoraco-lumbar scoliosis, 1 with stern blocked) and associated pathologies (ventricular septal defect operated dyslalia, bilateral valgus foot surgery, severe mental deficiency). After the area of origin, 10 of them are urban, 2 rural. Everyone in the lot are the secondary school students (9) and high school (the other 3), 7 of them enrolled in special units, the other 5 in the process of inclusion in regular schools.

Activity was deployed at municipal swimming pool in Targoviste, for a period of 6 months (5 December 2013 29 May 2014).

7. Methods and Means

Earlier work has developed a questionnaire that was applied subjects (December 2013) to know their situation at the time and may be assigned, and the data were entered in the form type comprising: name, age, sex, occupation, area of origin, primary diagnosis and comorbidities (associated disease). Data were entered in the form type, centralized and processed.

During the sessions were used specific swimming materials and aquagym (rafts, palm and feet swimming, mask snorkel tube type, pullbuoy, stick figures and floating circles, balls, etc. .), the response to exercise was measured using heart rate watches, and the two assessments: initial (December 2013) and final (May 2014), the children were tested, using spirometer (measuring vital capacity) and pulse oximetry (measurement of oxygen saturation of peripheral blood).

Adapted swimming sessions were grouped into 3 macrocycles: one of adjustment, following accumulation and final transformation of the physical qualities of the subjects. The period of accommodation focused on acquiring basic aquatic skills such as floating, breathing and propulsion, for adjustments aimed at neuro-muscular and joint and muscle hypertrophy among patients in this study.

The second part of the program aimed to develop extensive and mixed aerobic resistance, the amount of work
being characterized by a large number of exercises and repetitions, a mild to moderate intensity exercise, following the occurrence of adaptations in the cardiovascular and respiratory mainframe systems.

In the last part of this study, adapted swimming sessions increased in intensity, breaks between exercises or games being shorter and higher execution speed (strength and anaerobic lactic, anaerobic mixed zone) by tracking games, relay races and speed, but the amount of effort has low, being made in lower numbers than in previous macrocycle, all of which one are intended to make aerobic and resistance physical strength, acquired in the first two parts, as to improve the patients cardio respiratory function unit.

The planned program has been structured:

| December | January | February | March | April | May |
|----------|---------|----------|-------|-------|-----|
| accommodation | accumulation | transformation |       |       |     |
| 1 2 3 4 5 6 | 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 |       |       |       |     |

8. Results

In Table 2 (initial assessment) and 3 (final evaluation) we introduced each of the 12 subjects of the questionnaire data, to which we added measurements of biological constants: vital capacity, oxygen saturation, blood pressure and heart rate.

| no | name/ surname | diagnostic | age (yrs) | hight (cm) | weight (kg) | C.V. (l) | Saturation in O2 (%) | TA (mmHg) | HR (bpm) |
|----|---------------|------------|-----------|------------|-------------|----------|----------------------|-----------|---------|
| 1  | P.D. | Down syndrome, Ventricular septal defect surgery | 16 | 153 | 62 | 1.94 | 98 | 150/90 | 88 |
| 2  | L.G. | Stern blocked | 7 | 126 | 21 | 1.28 | 78 | 130/70 | 105 |
| 3  | S.D. | Spastic tetraparesis, Severe mental deficiency Psycho-affective disorders, Dyslalia | 16 | 163 | 40 | 2.32 | 99 | 130/80 | 78 |
| 4  | T.I. | Autism | 10 | 133 | 31 | 0.67 | 97 | 105/96 | 135 |
| 5  | I.B. | Spastic paraparesis, Thoraco-lumbar scoliosis, Foot operated bilateral valus | 14 | 150 | 43 | 1.99 | 99 | 100/70 | 93 |
| 6  | A.D. | Autism | 13 | 169 | 70 | 2.95 | 99 | 110/70 | 86 |
| 7  | C.L. | Down Syndrom | 18 | 138 | 45 | 1.95 | 99 | 102/76 | 81 |
| 8  | B.M. | A.D.H.D. | 9 | 139 | 28 | 2.02 | 99 | 108/89 | 93 |
| 9  | V.A. | Down Syndrom | 9 | 122 | 26 | 1.47 | 97 | 100/54 | 88 |
| 10 | G.R. | Left hemiplegia spastic weakness | 18 | 171 | 65 | 5.08 | 97 | 130/110 | 85 |
| 11 | U.A. | Psycho-motor deficiency disorders static and walking, Moderate mental retardation with learning disabilities | 19 | 169 | 60 | 3.10 | 99 | 110/68 | 91 |
Table no. 3- Final assessment (29.05.2014)

| no | name/ surname | diagnostic                                                                 | age (years) | height (cm) | weight (kg) | C.V. (l) | Saturation in O₂ (%) | TA (mmHg) | HR (bpm) |
|----|---------------|------------------------------------------------------------------------------|-------------|-------------|-------------|-----------|------------------------|-----------|----------|
| 1  | P.D.          | Down Syndrome, Ventricular septal defect surgery                             | 16          | 153         | 60          | 2,22      | 98                     | 122/70    | 88       |
| 2  | L.G.          | Stern blocked                                                               | 7           | 128         | 22          | 2,96      | 96                     | 90/57     | 86       |
| 3  | S.D.          | Spastic tetraparesis, Severe mental deficiency, Psycho-affective disorders, Dyslalia | 16          | 165         | 40          | 3,80      | 99                     | 125/81    | 90       |
| 4  | T.I.          | Autism                                                                      | 10          | 140         | 33          | 0,91      | 81                     | 122/74    | 105      |
| 5  | I.B.          | Spastic paraparesis, Thoraco-lumbar scoliosis, Foot operated bilateral valu | 14          | 156         | 45          | 2,80      | 99                     | 120/82    | 89       |
| 6  | A.D.          | Autism                                                                      | 14          | 171         | 71          | 3,10      | 98                     | 108/66    | 73       |
| 7  | C.L.          | Down Syndrom                                                                | 18          | 138         | 45          | 2,20      | 99                     | 89/53     | 66       |
| 8  | B.M.          | A.D.H.D.                                                                    | 9           | 141         | 30          | 2,17      | 99                     | 107/75    | 82       |
| 9  | V.A.          | Down Syndrom                                                                | 9           | 124         | 26          | 2,42      | 98                     | 112/75    | 82       |
| 10 | G.R.          | Left hemiplegia spastic weakness                                            | 18          | 171         | 60          | 5,80      | 99                     | 127/82    | 92       |
| 11 | U.A.          | Psycho-motor deficiency disorders static and walking, Moderate mental retardation with learning disabilities | 19          | 170         | 61          | 4,04      | 98                     | 121/65    | 63       |
| 12 | N.D.          | Double thoraco-lumbar scoliosis                                            | 17          | 158         | 54          | 3,13      | 99                     | 139/88    | 82       |

9. Discussion

**Vital Capacity.** At the final evaluation we found all 12 subjects vital capacity improvement in variable percentages. A significant increase values were LG (130%) S.D. (65%), V.A. (65%), I.B. (40%), T.I. (35%), U.A. (30%), while A.D. and B.M have improved C.V. only with 6%.
**Heart Rate** in subjects in the study had the following evolution:
- at 1 subject was unchanged (P.D.);
- S.D. and G.R. has been an increase in the 12 and 7 units;
- 6 of the subjects had a decrease in H.R. with values ranging between 6 and 19 units;
- at T.I. the decrease was significant, 30 units.

**Blood Pressure.** In 7 of the subjects blood pressure decreased, most conclusive result had PD 150/90 mmHg at the reached final assessment of 122/70 mmHg.

5 of the children had increases in blood pressure, VA an increase from 100/54 mmHg at baseline to 112/75 in the final evaluation.

**Table 4.** Evolution of blood pressure

| No | Name & surname | Blood Pressure (mm Hg) 05.12.2013 | Blood Pressure (mm Hg) 29.05.2014 |
|----|----------------|-------------------------------------|-------------------------------------|
| 1  | P.D.           | 150/90                              | 122/70                              |
| 2  | L.G.           | 130/70                              | 90/57                               |
| 3  | S.D.           | 130/80                              | 125/81                              |
| 4  | T.I.           | 105/96                              | 122/74                              |
| 5  | I.B.           | 100/70                              | 120/82                              |
| 6  | A.D.           | 110/70                              | 108/66                              |
| 7  | C.L.           | 102/76                              | 89/53                               |
Peripheral Blood Oxygen Saturation

- 5 of the subjects did not change the saturation of the final assessment from baseline (PD-98%, SD, IB, IC, BM-99%);
- 3 children, decreased the final evaluation (TI down from 97-81%, AD and UA at 99-98%);
- 4 of the subjects had increases in the amount of oxygen, of which the most important ND, and from 52-99%.

![Fig. 3. Evolution of Oxygen Saturation (%)](image)

10. Conclusions

Comparing the results of two medical assessment (December 2013 and May 2014) were found:
- improving cardiovascular parameters (BP normalization and decreased heart rate at rest) and peripheral circulation (expressed by maintaining or increasing oxygen saturation indicators);
- increase vital capacity (average 20-30%).

Therefore, an adapted swimming program applied to a group of people with disabilities, place over a period of 6 months, to maximal and submaximal exercise intensities, with a progressive increase in workload, significantly improved the cardiovascular and respiratory system of children.

This research is the result of the activity of authors, held on 5 December 2013 to 29 May 2014.

No conflict of interest.

The study had approval of parents or guardians of children with special needs.

Reference

Todea-Gross, C. (2012). *Vaccinurile: Prevenție sau Boală*. București: Editura Christiana.
Radu, I.D. & Ulici, Gh. (2003). *Evaluarea și educarea psihomotricității copiilor cu dificultăți psihomotorii de integrare*. București: Editura Fundației Humanitas.
Lauteslager, E. M. Peter. (2004). *Copiii cu Sindrom Down – Dezvoltare motorie și intervenție*. București: Centrul Educațional Teora cu sprijinul Lios Club Olanda.
Moțet, D. (2001). Psihopedagogia recuperării handicapurilor neuromotorii. București: Editura Fundației Humanitas.

Neagoe, M. (2003). Dizabilitate și sănătate, Modele ale dizabilității. București: Editura Semne.

Radu, I.D. & Ulici, Gh. (2003). Evaluarea și educarea psihomotricității copiilor cu dificultăți psihomotorii de integrare. Editura Fundației Humanitas, București.

Rios, M. (2007). Actividad física adaptada. Barcelona: Paidotribo.

Sanz, M., & Reina R. (2012). Actividades físicas y deportes adaptados para personas con discapacidad. Barcelona: Paidotribo.

Tuero M. & al. (1995). Efectos positivos de la actividad física en el medio acuatico. Barcelona: Paidotribo.

Warburton, D.E. R. & al. (2006). Health benefits of physical activity: the evidence. Ottawa, ON: CMAJ.

Juan Medina Gómez, Raúl Prieto Miguel, Javier Fernández-Río, „La natación adaptada como medio de integración para una persona con movilidad reducida”, http://www.efdeportes.com/, Revista Digital - Buenos Aires - Año 5 - N° 28 - Diciembre de 2000.

Sofia Sanchez Perez, Francisco Javier Jimeno Serrano, Víctor Salinas Palacios, „Valoración fisioterápica en una escuela infantil de natación”, http://www.efdeportes.com/, Revista Digital - Buenos Aires - Año 5 - N° 20 – Abril 2000.