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Study regarding the role played by exercise in developing the lung capacity in teenagers with Down syndrome

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Abstract

This research aims to study the respiratory modifications that happen after exercising in teenagers with Down syndrome (DS). The research is based on the pathophysiological theoretical notions regarding DS and theoretical–methodical notions of exercise. The study was conducted over 6 months, in the gym of the Faculty of Movement, Sports, and Health Sciences, on 20 subjects. Exercising was used as an instrument to reach several objectives, such as team work, motor skill learning and the re-education of respiration. To reach these objectives, exercising was used as individual and team play, and to identify the modifications in the studied parameters, several methods were used: a social skill questionnaire and the monitoring of pulse and respiratory rate before and after exercising. The results of the study have demonstrated an improvement in the respiratory parameters, a consolidation of the motor skills and a development of the social skills.

Keywords: Down syndrome, physical exercise, lung capacity.

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1. Introduction

There are more than 50 traits that are characteristic of the Down syndrome (DS). The symptoms of every child vary with the number and severity.

A constant consequence of this trisomy 21 is muscle hypotonia, accompanied by ligament hyperlaxity. A series of classical symptoms described for trisomy 21 are secondary to hypotonia and hyperlaxity.

Because of mouth-face hypotonia and the large size of the tonsils, the subjects have respiratory disorders, such as dyspnea or sleep apnea.

Due to these modifications, during and after the effort the subjects have breathing trouble, such as dyspnea. In addition, breathing trouble during the physical effort is due to abdominal muscle hypotonia, which prevents the subjects from reaching the necessary range for the abdominal respiration.

Children with DS are at the risk of restrictive pulmonary disease with weak cough, concomitantly to a decrease in the volume of lungs because of the generalized trunk and extremity weakness (Tecklin, 2015).

Respiratory problems are the primary cause of morbidity and hospital admission particularly in the young children with DS. There is an increased prevalence of sleep-related upper airway obstruction and lower airway disease (Hilton, Fitzgerald & Cooper, 1999).

A deficiency of the pulmonary system to oxygenate the mixed venous blood or remove the carbon dioxide from this blood may contribute to a high incidence of respiratory infections, reduced effectiveness of cough and diminished lung volume (Tecklin, 2015).

Physical exercise is an important *morphogenetic factor*, especially for the musculoskeletal system elements. The 'bones and periosteum', 'joints and muscles' and 'tendons and fascias' have such an obvious functional structure that has the significance of a graphical representation of the mechanical forces exerted on them by the static and dynamic actions. Thus, studies in this field have shown that physical exercise determines a continuous renewal of the fundamental element of bone structure, the osteocyte, in the sense of an adjustment, destruction or reconstruction concordant with the mechanical action, which explains its effects on the growth of the bone in length and width, or the deformations during the growth periods.

By stimulating the muscles, *one improves both their physiological properties and their physical qualities.* Thus, one can influence the contraction volume and power, muscle endurance, elasticity and strength, at the same time affecting the tendons, fascias and aponeuroses.

Physical exercises perfect the basic motor skills through the intervention of certain neuromotor factors that ease the transmission of the nervous impulse and the complete use of energy substances.

Also, by creating the need for an increased intake of energising substances, physical exercise accelerates the respiratory and cardiovascular functions and the intestinal absorption, nutrition and excretion.

Considering that the nervous system is educable, especially through a better psych-neuromotor control, it can be said that physical exercise plays, at any age, a strong *educational role*.

Motor characteristics of people with DS include hypotonia and ligament hyperlaxity, difficulties with regard to coordination, using their own body, regulating the strength of their own body, slowness in movements, deficient static and dynamic balance.

A study about the quality of life of youth with DS (Xanthopoulos et al., 2017) exerted that caregivers reported a lower quality of life in youth with DS compared with youth without DS with the exception

of emotional functioning. Obesity influences most domains of weight-related quality of life in youth with and without DS; therefore, providers should address weight concerns in youth with obesity even in the presence of DS.

Children with DS experience communication difficulties, however, little is known about their pragmatic profile, particularly during early school years. Smith, Næss and Jarrold (2017) study a group of 29, eight year old children with DS and discovered a profile of relative strengths and weaknesses that was found in the children with DS (Smith, Naess & Jarrold, 2017); the area of nonverbal communication was significantly stronger, while the area of understanding context was significantly poorer, relative to the other areas of pragmatics assessed in these children. Relationships between areas of pragmatics and other linguistic areas, as well as aspects of vocabulary and social functioning, were observed.

Basil *et al.* (2016) evaluated 303 individuals, 47.8% of whom were obese (body mass index ≥95th percentile for age and sex). This was significantly higher than the general pediatric population, which had a 12.1% obesity rate. Body mass index *z*-scores did not change markedly over time. The majority of children with DS also had obstructive sleep apnea syndrome (74.0% of the 177 children who had polysomnography studies). Their results indicate that children with DS are at a substantial risk for obesity and obstructive sleep apnea syndrome. These findings support the need for more aggressive weight management in early childhood and throughout the lifespan. Children with DS clinically show a diminished activity limit at all ages due to muscle weakness and respiratory problems.

Children with DS are more sedentary and less physically active; they are at the increased danger of secondary health conditions, including type II diabetes, cardiovascular disease and osteoporosis (Rimmer, Heller, Wang & Valerio, 2004). Especially strength in lower-extremity muscles in children with DS and individuals with mental retardation has a central significance to their general health and daily activity of their performance ability (Croce, Pitetti & Horvat, 1996). Cardiovascular exercise programs and physical activity programs to keep children physically active have been shown to improve peak oxygen consumption and maximum workload (Dodd & Shields, 2005). Intervention to improve the strength and coordination and to decrease the wear and tear on the weight-bearing joint structures should be implemented as preventive practice. Training includes endurance training, which involves a large group of muscles working at moderate intensity for a more extended period, and strength training which involves a small group of muscles working for a short period with three sets for eight repetitions. Strength training was shown to be equally as effective as endurance training on exercise capacity and health quality (Spruit, Gosselink & Trooster, 2002).

2. Methodology

The research *hypotheses* were as follows:

i. The application of a physical exercise program dosed on respiratory times will determine the improvement in the type of respiration and respiration rate.
ii. If the exercises included in the program will be centred on motor and sensory deficits of the DS children, one will observe an improvement in their social skills.

2.1. Materials and Methods

The study was conducted with the help of the DS Association of Bacau, in the gymnastics room of the 'Vasile Alecsandri' University, on 20 children and teenagers with DS. The study observed a series of parameters such as weight, height, body–mass index, respiratory rate, heart rate and blood pressure.

The tests applied to assess the subjects were: respiratory rate, heart rate, blood pressure, portage scale–motor area, and the adaptive behavior assessment scale (Bildt et al., 2005).

The program applied to the research subjects consists of the following:

The rehabilitation program proposed comprised three phases:

i. the warm-up (5–10 minutes)
ii. the actual exercises/the track (20–30 minutes)
iii. the cool-down (10–15 minutes)

The warm-up:

- ✓ *head and upper limb exercises*: active mobilizations in the motion planes and axes
- ✓ *trunk exercises*: holding their hands on their trunk, the subjects rotate their trunk, incline it, and flex it moving their arms toward the floor
- ✓ *lower limb exercises*: squats and lateral/forward/backward lunges

The actual exercises/the track:

- ✓ *throwing and catching the ball*: throwing and catching the ball using both hands, throwing and catching the ball using one hand. Passing the ball from one subject to another through rolling or kicking it. Throwing the ball through a circle using both hands
- ✓ ball jumping, throwing the ball up in the air and catching it, throwing the ball up in the air and clapping
- ✓ *applicative track*: jumping from one circle to another, passing between poles, bench crawl, going through circles and rolling
- ✓ *applicative track*: jumping from one circle to another, passing between poles, climbing a Swedish ladder, walking on a bench, going through circles and rolling
- ✓ *balance exercises*: balance board, balance tape, standing on one leg, standing on tiptoes and standing on heels

The cool-down

- ✓ *parachute exercises'*: the children hold on the 'parachute' and spin around it, walking on heels, walking on tiptoes and walking on the inside part of the foot or on the outside part of the foot.

All exercises were performed on respiratory times as follows: during the warm-up part, the motion of opening the thoracic cage was accompanied by inspiration and the one of blocking it, by expiration. During the applicative track, the subjects were constantly stimulated and encouraged to breathe correctly, thus avoiding the specific apnea that occurs during effort.

Also, during the cool-down part, the subjects performed simple exercises, with a minimum demand and with ample breathing, each respiratory time being combined with a favouring motion.

3. Results

Although DS is among the chronic disorders that limit one's physical activity, a certain type of exercise is allowed, adapted and personalized to the person's characteristics. The DS subjects are able to participate in most physical activities. They can benefit from certain aspects of physical exercises from a point of view of both the influence of the functional parameters and the social aspect of exercising.

Because of their joint hypermobility and laxity, the DS subjects cannot perform drills that increase joint mobility.

The results recorded during the physical exercises program combined with respiratory exercises were graphically represented, so that the progress of the measured parameters would be highlighted. The interpretation of the results showed an improvement in the respiratory rate not just during the rest, but also during the effort. A re-education of the subjects' respiration during the time spent in the gymnasium, as well as the indications to perform certain respiratory exercises with their parents have

determined an improvement in the respiratory rate, a drop in the frequency of sleep apnea moments and an improvement of the cardiac function. The well organized and dosed physical exercise, combined with elements that are necessary for the development of strength, coordination, attention and social skills, has determined progress also in this regard. The improvement of social skills was observed in most subjects, referred to by the family and highlighted by a questionnaire to which the subjects' parents or tutors have answered.

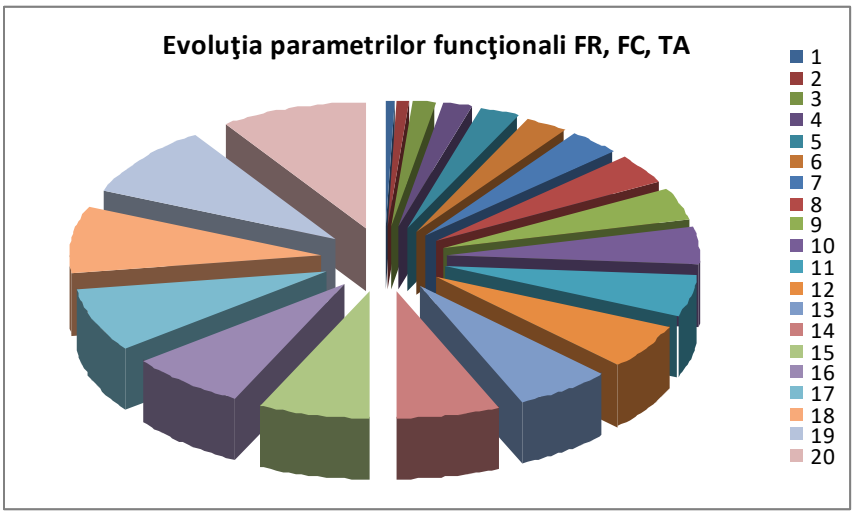

Figure 1. Graphical representation of the progress of the functional parameters in the 20 subjects

An analysis of the graphical representation of the progress of the functional parameters in the 20 subjects shows that there was a good recovery of the functional parameters after the effort, which translates in a good adaption to effort in the subjects.

The data in Table 1 represent the measurements conducted 5 months since the beginning of the physical exercise program with these subjects. The initial values were different, and the return to normal values after the effort was achieved with difficulty.

Table 1. The progress of the subjects' functional parameters (before and after effort)

No.	Gender	Age (years)	Height	Weight (kg)	BMI	BMI/degree	Resp. rate before	Resp. rate after effort	Heart rate before effort	Heart rate right after effort	Heart rate 2 min after the effort	Blood pressure
1	F	26	168	61.7	22	Normal	16	20	83	105	92	118/75
2	F	19	167.8	57.9	20.5	Normal	17	20	81	103	87	116/60
3	F	22	145	40	19	Normal	17	19	96	122	100	118/66
4	F	12	155	39	16.2	Normal	17	19	79	90	82	90/47
5	F	22	165.3	70.8	26	Overweight	16	18	96	106	98	113/71
6	F	15	151.5	48.7	21.5	Normal	17	20	59	75	69	101/53
7	F	24	156.5	40	16.5	Underweight	16	19	78	90	85	89/60
8	F	17	172	53	17.9	Normal	17	19	70	92	82	116/67
9	F	18	162	70.3	27	Overweight	17	20	91	100	91	108/70
10	F	15	147.5	47	21.6	Normal	18	21	89	120	100	121/61
11	B	18	166.8	78.7	28.5	Obesity	16	18	75	95	84	110/70
12	B	24	160	80	31	Obesity	17	19	81	92	88	112/64
13	B	15	159	47.5	19	Normal	16	18	94	110	96	109/61
14	B	16	165	69.2	25.5	Overweight	16	18	76	108	85	130/56
15	B	22	157	72.7	29.4	Obesity	16	19	92	115	92	128/109
16	B	18	172	53	18	Normal	17	19	80	117	78	104/60
17	B	24	151.5	74	32	Obesity	16	18	90	106	95	100/82
18	B	25	165.5	61.5	22.4	Normal	17	20	67	89	82	106/62
19	B	19	164	57.9	21.5	Normal	17	21	82	87	85	106/81
20	B	23	148.5	59.5	27	Overweight	16	19	70	125	83	77/68

4. Conclusions

At the end of the study, based on the results recorded during the final assessment, one can say that the physical exercise program has improved the mobility, strength, balance and coordination with regard to the motor area; respiratory and heart rate with regard to functionally; attention, memory and social skills.

Muscle strengthening determines a decrease in joint laxity, an increase in joint stability, a better balance and a coordination of movements that is adequate for the demand. The stimulation of the persons with DS to perform physical activities can lead to the improvement of their health, self-esteem, behavior and social skills. It also can constitute a support for their families.

Because this study comprised people between the ages of 12 and 25, it can be said that the subjects up to 16 years old recorded a faster learning of the exercises, while the subjects over 17 needed more time to learn them. This study did not try to improve the motor skills in particular, but to improve the cardio-respiratory parameters, the psychological aspect, the relational aspect and the motivational factors that can be always stimulated and influenced no matter the subjects' age.

The duration of the study (6 months) has allowed the reach of the set goals and maintenance of the results.

Ethical considerations

Ethical approval was obtained from the Ethics Commission. Informed consent was received from the caregivers.

References

Basil, J. S., Santoro, S. L., Martin, L. J., Healy, K. W., Chini, B. A. & Saal, H. M. (2016). Retrospective study of obesity in children with Down syndrome. *Journal of Pediatrics*, *173*, 143–148. ISSN: 0022-3476. doi: 10.1016/j.jpeds.2016.02.046

Bildt *et al.* (2005). The psychometric properties of the vineland adaptive behavior scales in children and adolescents with mental retardation. *Journal of Autism and Developmental Disorders, 35*, 53. doi: 10.1007/s10803-004-1033-7

Croce, R. V., Pitetti, K. H. & Horvat, M. (1996). Peak torque, average power, and hamstrings/quadriceps ratios in nondisabled adults and adults with mental retardation. *Archives of Physical Medicine and Rehabilitation, 77*, 369–372.

Dodd, K. J. & Shields, N. (2005). A systematic review of the outcomes of cardiovascular exercise programs for people with Down syndrome. *Archives of Physical Medicine and Rehabilitation, 86* (10), 2051–2058.

Hilton, J. M., Fitzgerald, D. A. & Cooper, D. M. (1999). Respiratory morbidity of hospitalized children with Trisomy 21**.** *Journal of Paediatrics and Child Health, 35*(4), 383–386.

Rimmer, J. H., Heller, T., Wang, E. & Valerio, I. (2004). Improvements in physical fitness in adults with Down syndrome. *American Journal of Mental Retardation, 109*, 165–174.

Smith, E., Næss, K.-A. B. & Jarrold, C. (2017). Assessing pragmatic communication in children with Down syndrome. *Journal of Communication Disorders, 68*, 10–23. ISSN: 0021-9924. doi: 10.1016/ j.jcomdis.2017.06.003

Spruit, M., Gosselink, R. & Trooster, T. (2002). Resistance vs endurance training in patients with COPD and peripheral muscle weakness. *European Respiratory Journal, 19*(2002), 1072–1107.

Tecklin, J. S. (2015). Intellectual disabilities: focus on Down syndrome. In D. B. Bertoti & M. B. Schreiner (Eds.), *Pediatricphysical therapy* (5th ed., pp. 379–402). London, UK: Lippincott Williams & Wilkins, Wolters Kluwer Business.

Xanthopoulos, M. S., Walega, R., Xiao, R., Prasad, D., Pipan, M. M., Zemel, B. S., . . . Kelly, A. (2017). Caregiver-reported quality of life in youth with Down syndrome. *Journal of Pediatrics, 189*, 98–104.e1. ISSN: 0022-3476. doi: 10.1016/j.jpeds.2017.06.073