

Aerobic Exercises as Physical Activity and Recreation for People with Down syndrome

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Abstract: Down syndrome (DS) is caused by trisomy of chromosome 21 and is the most common genetic cause of intellectual disability in the human population. Physical activity is one of the many daily activities that the healthy population engages in, and it must be enabled and adapted to the needs of the population with Down's syndrome, because it is crucial for their growth and development. In terms of formal and informal acceptance of this group of people in everyday life, the characteristics of the population with Down's syndrome caused a more spherical adaptation of society to their needs. In this paper, I highlight the importance of aerobic exercises for people with Down's syndrome and how much physical recreation can have a positive feedback on the psychophysical health of that population. We based the integration of aerobic exercises into the inclusive teaching of Elementary Schools in the area of the city of Bijeljina, and the program itself is conditioned and designed in such a way that it can be carried out independently of inclusive classes and can serve as classic recreation, but primarily for younger people with Down syndrome.

Keywords - down syndrome, aerobic exercises, recreation, elementary school

1. INTRODUCTION

Physical activity is an important habit that should be developed and maintained throughout life. Improvements in general health, such as physical fitness, bone metabolism, improved cardiovascular and respiratory muscle function, and control/prevention of obesity and coronary artery disease, are all good benefits of FA in people with intellectual disability (ID). Benefits for social and psychological well-being include increased self-esteem, self-competence, self-efficacy, and positive self-perception. Furthermore, a significant body of research has found a link between regular physical activity and brain growth, particularly in the area of the prefrontal cortex (Chapman et al., 2013). There are several possible explanations for this relationship: Regular athletic exercise programs improve cognitive performance by increasing neurotrophin production, synaptogenesis, and angiogenesis, as well as improving information processing speed, working memory, planning, and behavioral control techniques. (Morres et al., 2019).

Researchers and practitioners have sought to design sport intervention (PSI) programs that aim to achieve the aforementioned beneficial outcomes for atypical populations, such as people with ID, based on evidence from these studies (Seron et al., 2015).

Understanding the difference between FA and adaptive physical activity (AFA) is critical to understanding the health benefits of FA for people with ID. "Any physical action performed by skeletal muscle that requires energy expenditure" is how FA is defined. This includes free time activities such as various exercises, all aimed at developing basic motor skills (walking, catching, sprinting, throwing and so on). Although the World Health Organization advises at least 60 minutes of moderate-to-vigorous aerobic FA per day for children aged 5 to 17 and 150 minutes of moderate-intensity aerobic FA per week for people aged 18 to 64, many people with ID do not meet these guidelines (Sobol et al., 2016).

With the exception of well-known examples of FA in people with disabilities (eg Special Olympics), a significant gap has been identified between Special Olympics programs and non-competitive sports programs. It is necessary to create and implement intervention actions and educational methods to improve daily fitness levels and encourage people with ID to exercise regularly at home and in educational settings. Increased clinical disorders and health consequences such as increased bone mass accumulation, type II diabetes and functional motor impairments are associated with an inactive lifestyle. The main goal is, in addition to accepting individual differences, to promote greater access to active lifestyles and sports for people with intellectual disabilities. This includes physiotherapy, occupational therapy, motor rehabilitation, pediatrics, (Khalili & Elkins, 2009; Obrusnikova et al., 2022).

Sports intervention programs, on the other hand, can be considered a subtype of AFA because they emphasize sports components. Swimming, martial arts, cycling, movement and dance, as well as strength, agility and balance challenges are all covered in PSIs.

In people with ID, they are increasingly used in combination with traditional physiotherapy or medical therapies. The type of PSI is determined by the particularities of the given handicap. Water sports, for example, are recommended for children with autism spectrum disorders, while cycling, movement and dance, strength and agility, and balance training are the most popular PSI for people with Down syndrome. (P. h. Boer & Moss, 2016).

PSIs, on the other hand, have proven particularly effective in promoting socialization by creating an inclusive environment that accommodates individual variation. Sport provides a natural environment for social interactions and complex behaviors and offers an appropriate framework for cooperation. These positive effects are, however, compromised by the high levels of inactivity reported in a subset of the population with ID. The literature describes lower rates of engagement in FA, community sports, and exercise programs compared to typically developing (TD) populations. This disparity exists for a variety of reasons. Physical impairments

and difficulties with motor skills such as walking, running, jumping, standing or maintaining body control are often observed. Furthermore, environmental barriers and a lack of sufficient motivational resources hinder program compliance. (P.-H. Boer & de Beer, 2019). Family overprotection of children, concerns about clinical characteristics, as well as family financial situations and transportation availability, also reduce or limit participation in sports activities of people with intellectual disabilities.

2. PERSONS WITH DOWN SYNDROME

Down's syndrome, one of the most common conditionally speaking genetic anomalies or disorders, affects an increasing number of young people. Any conception can lead to this syndrome, however mothers older than 35 have a higher chance of giving birth to children with Down syndrome (Presson et al., 2013). People with Down syndrome have an extra chromosome within the chromosome pair 21, unlike normal people, who have 46. In other words, the individual has 47 chromosomes as opposed to 46. Notable features include a flattened face, small head and short neck, flat nose bridge, small mouth and mandible, generally a protruding tongue, extra skin on the back of the head, eyelids that tilt upwards, small ears or ears that are unusually shaped. Muscular hypotonia, found in 80% of newborns and infants with Down syndrome, is characterized by low muscle tone. These people have what are known as Brushfield spots, which are small white spots on the iris (Moyer et al., 2021). Another difficulty with these children is intellectual disability, which varies from case to case and can cause mild, moderate or severe intellectual problems. Congenital heart defects are present in half of all newborns with Down syndrome. Without endangering the mother or fetus, genetic anomalies, such as trisomy 21, can be found in the early stages of pregnancy. Diagnostic techniques, such as prenatal karyotype testing from chorionic villi or fetal cells from amniotic fluid, can reliably identify whether the fetus is affected and the type of Down syndrome. Screening tests can be performed to show the risk of pregnancy with Down syndrome (Palomaki et al., 2020).

2.1 Characteristics of people with Down syndrome

Clinical signs of people with Down syndrome:

- characteristic physical characteristics;
- changes in physical and intellectual development;
- malformations of some organs (heart malformations are the most common);
- low muscle tone;
- lower waist and weight than other children.

Babies with Down syndrome show the following signs:

- flattened facial features;
- brachycephalic head;
- round and flat face;
- small ears of atypical shape;
- shorter and wider hands;
- shorter neck;
- protruding tongue;
- eyes tilted upwards;
- muscle weakness.

A baby born with Down syndrome may have a normal birth weight, but its development will be slower than that of a normal baby. Motor development is even slower than intellectual development.

Mental manifestations of Down syndrome can also occur, such as:

- impulsive behavior;
- poor judgment;
- attention deficit;
- slower learning skills.

Patients with trisomy 21 show calmness, obedience, affection, love of society, music and are generally happy. The average life expectancy is now approximately 65 years after a significant increase in previous years. This syndrome is present in about seven million people worldwide. Early intervention is necessary in every single case of developmental delay. The sooner physical and cognitive recovery therapy begins, the more likely success is. In order to create an appropriate motor development plan and intervention in the first phase, a thorough assessment of the child's abilities is required (Esbensen et al., 2017). Among the therapies used are occupational therapy, behavioral therapy, speech therapy and physical therapy. In addition to these, which are generally considered "traditional" approaches, people with Down syndrome benefit from art therapy (Art therapy), animal therapy (such as

hippotherapy with horses and onotherapy with donkeys) or water-based movement exercises (hydrotherapy). The therapist and family must also enforce sensory stimulation and fine motor development(Daunhauer & Fidler, 2011).

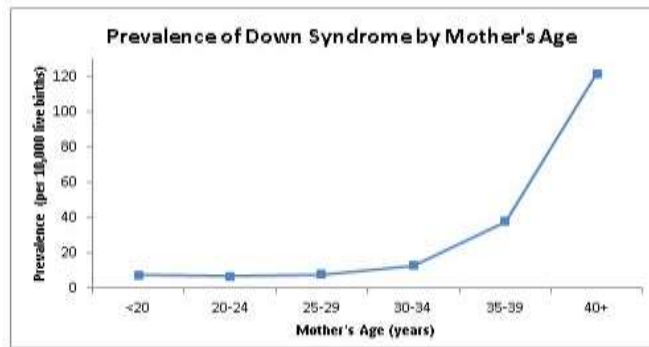


Figure 1. Prevalence of DS, in correlation with maternal age.

Source:(Heinke et al., 2021)

One of the characteristics of this disease is that, unlike other types of developmental delay, people with Down syndrome show social abilities. Therefore, it is crucial that the therapeutic approach emphasizes the growth of the child's verbal and non-verbal independence, as well as the development of his unique artistic abilities. As for any other person, the family is extremely important in the life of a child diagnosed with Down syndrome. The key is that parents don't feel guilty, abandoned, or blamed for their children's behavior. Children are healthy if their parents are. Caring for young people with special needs requires strength and coordination. In order to regain their inner balance, parents occasionally need a life separate from the life of the child. Therapies and exercises of the child should be continued at home with the help and encouragement of the parents. Only if parents use corrections in their interaction with their children can the quality and effectiveness of the intervention be affected(Ruiz-González et al., 2019). However, there is also the risk that they focus too much on the child's problems and challenges or on therapy and recovery, which makes them forget that the young child is first and foremost their own child and needs to play. The family "sets the tone" in the social environment during the life of a child with Down's syndrome: a child who is accepted in the family, cared for, and whose parents do not lock him in the house, do not hide or use derogatory language or terms related to the disease will grow up and be accepted in society.

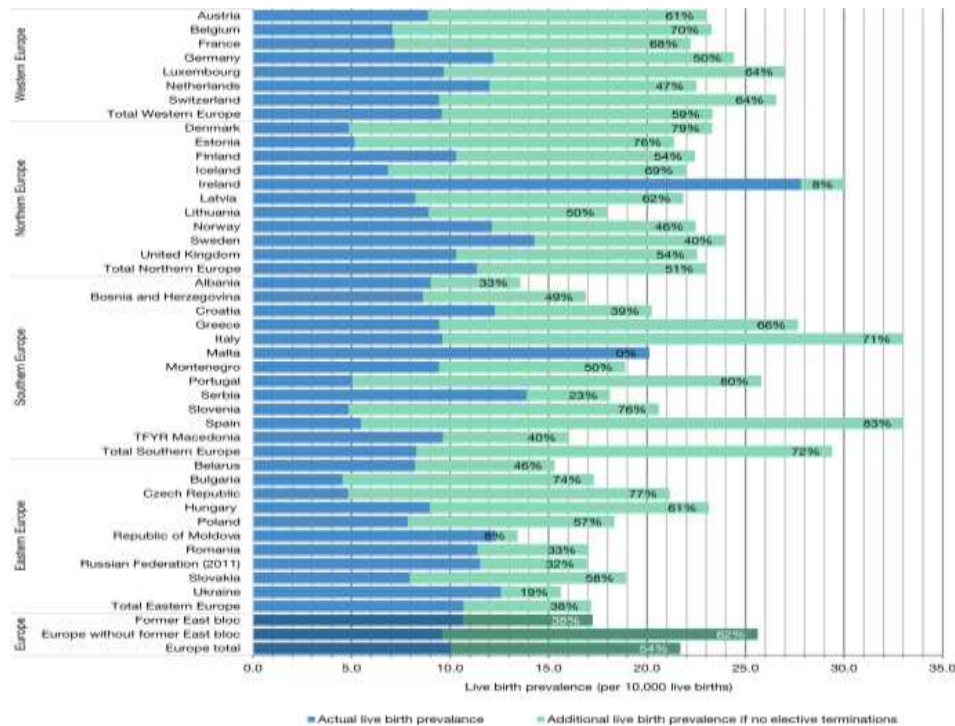


Figure 2. Estimate of the number of people with DS in Europe.

Source:(de Graaf et al., 2021)

2.2 Sport and people with Down syndrome

Because of their generosity and enthusiasm, children with Down syndrome are often called "children of the sun." People with Down syndrome, like other people, have a natural need for mobility and a dynamic life. Even their motor behavior is subject to certain problems characterized by functional limitations.

Sport is certainly one of the informal educations available to people with this condition. Since independence is a difficult goal for people with intellectual disabilities, the passion and persistence that these people show every day in training has helped to form many sports champions. Through athletics, people with Down syndrome can develop their independence and learn to independently manage their daily routines. Like everyone else, people with intellectual disabilities such as Down syndrome or other cognitive impairments need to be physically active.

Each person with Down syndrome is unique and has their own talents. These individuals can actually learn well enough to contribute to society and enjoy their own lives. There is no way to stop this hereditary condition before or during pregnancy. Every year, an increasing number of children with Down syndrome enroll in regular schools and participate in social activities with their siblings and friends.(Pitetti et al., 2013). Although learning is more difficult for children with Down syndrome, going to school with other children their age helps them learn how to take care of themselves, communicate with others, and thus their cognitive development can be most easily monitored.

Due to advances in medicine, it has been established that people with Down syndrome have certain abilities that are moderate, but can be further developed into constant work. By using different tactics and methods of working with them, I can have a fulfilling life. The latest data lead us to the conclusion that today we can be more positive than ever about the future of children with Down syndrome. Many people might think that a person with certain limitations cannot play sports, but fortunately adapted sports offer chances for socialization, exploration and acceptance of human performance, even for individuals with special abilities(Cabeza-Ruiz et al., 2019).

For people with Down's syndrome, unfortunately, there are not too many programs that can encourage them to be physically active, but there are still a few existing ones, which is a good basis for creating new ones in the future. Certain organizations deal with the integration of people with Down syndrome in sports activities, and one of the most famous is certainly the organization "Sports union for athletes with Down Syndrome", also known as SU-DS. The organization was created by agreement between the existing associations with the aim of easier organization and holding of international competitions. In 2012, in Terceira in the Portuguese Azores, a decision was made to establish the SU-DS alliance. In addition to already existing individual associations for sports in which competitions and programs for people with Down syndrome are organized, in order to raise it to a higher level, it was necessary to centralize everything and that is the key reason why the SU-DS was founded. The federations retained their autonomy as an international sports federation, and in this way SU-DS was the easiest to adapt to changes and develop in accordance with recommendations.(Shields et al., 2013).

The International Paralympic Committee is the global umbrella organization in the field of sports management for people with disabilities. Considering the numerous benefits that each individual has (with an emphasis on individuals from the population with Down's syndrome) as a result of engaging in physical activity in a recreational form, this organization enabled the implementation of already existing competitions at the international level. Within the first few years of its establishment, there were no major competitions, until 2016, when they gathered in Florence, Italy, in the form of all the sports registered until then in the newly formed association (athletics, basketball, futsal, gymnastics, judo, alpine skiing, etc.).

The latest "Trisome games" were supposed to be organized in 2020 in Antalya, Turkey, but they were canceled due to the newly created situation caused by the COVID-19 virus pandemic. (Sports Union for Athletes with Down syndrome, 2012)

Swimming is also one of the activities that people with Down's syndrome particularly like, as it is a very healthy activity, so it is preferable to carry out programs in the water mainly for rehabilitation reasons. In swimming for people with Down syndrome, we have almost all the disciplines as in the normal population, but we also have disciplines such as walking through the water with and without assistance, as well as just swimming with and without assistance. Table tennis is also played in the form of standardized rules, but for people with Down syndrome it is most often played in pairs. As table tennis in itself is a sport that requires a lot of speed and dexterity, it is not very popular among the population with Down syndrome.

Athletics is also one of the sports in which people with Down syndrome are integrated. Within the "Queen of Sports" we also have almost all already known disciplines, while others are included which are determined by the degree of intellectual disorder, such as walking with help, throwing a tennis ball into the distance, etc. Aerobic exercises are offered today as one of the generally known activities in the world, but still new in the form of including people with Down syndrome in it. For that population, aerobic exercises could be an ideal activity in the form of prevention of future deformities and health problems, as well as rehabilitation for already existing ones.(Diaz, 2020; Naczka et al., 2021).

2.3 Areobic exercises

The term "aerobics" originally appeared in its original form in 1968 in the book of the same name by the American physiologist and physician Dr. Kenneth H. Cooper (Cooper, 2018). The root of the word indicates that it refers to a training program that guarantees the effective growth and maintenance of what is known as functional ability, especially the aerobic capacity dimension. The Greek term *aer*, from which the English word *aerobics* is derived, literally translates as "life of certain action" in the presence of oxygen. J. Sorensen and J. Fonda presented modern aerobics as a completely new type of exercise at the turn of the 1980s. The mentioned physical activity in that period of time spread rapidly, first in America, and then in the rest of the world. It has continually evolved into newer forms and different types, all of which have the word "aerobics" in their name to make it clear that their primary purpose is to build and maintain the body's fundamental functional ability. (Kagan & Morse, 1988).

Some of the aerobic exercises:

- High Impact- aerobic exercises of high intensity; the name itself suggests the type of exercise being performed; it is a high-intensity workout with music that has a tempo between 145 and 160 beats per minute (BPM), which affects the speed at which the legs lift off the ground during all types of jumping, and running.
- Low impact – aerobic exercises of low intensity; in contrast to high impact aerobics, it is done at a lower intensity and with slower music, along with all the elements of aerobics that do not include the simultaneous separation of both legs from the ground with synchronized hand work.
- Hi/Lo – aerobic exercises of mixed intensity; a mix of steps and exercises that are defined as high and low impact
- Step - aerobic exercises on a bench; it consists of climbing, descending, going around, jumping and going over the bench
- AQUA – aerobic exercises in water; it consists of all elements of aerobics that are based on the weight of one's own body with the resistance of water, where the water also brings a therapeutic effect
- Slide – aerobic exercises on a sliding surface; consists of sliding on a rubber plastic surface from curb to curb. In addition to suitable tennis shoes, it is necessary to have covers on them to facilitate the implementation of skating itself
- New body – a form of aerobic exercises performed with low-intensity steps in the form of a simple choreography; exercises for the upper body are performed in a certain sequence with the help of an external load (most often dumbbells), and there is also a form of this aerobic exercise that is done on a step bench (New body step).
- Dance - dance aerobic exercises; common name for all types of aerobics that use music and the basic movements of a dance (hip-hop, jazz, funky, Latin, etc.)

2.4 Health benefits for people with Down syndrome and aerobic exercise

People with Down syndrome have a high incidence of metabolic syndrome, which is associated with increased cardiometabolic risk profiles (diabetes mellitus, poor insulin sensitivity and high insulin resistance, obesity, atherosclerosis, high-density lipoprotein cholesterol, hypertension and poor aerobic capacity). Moreover, high oxidative stress is associated with increased insulin resistance, poor insulin sensitivity, atherosclerosis, and hypertension. Oxidative stress impairs β -cell function, which reduces insulin production by interfering with glucose-stimulated insulin secretion, thus creating a state of hyperglycemia, which ultimately leads to the development of diabetes mellitus (Kinnear et al., 2018). Abnormal lipid metabolism is associated with premature risk of developing atherosclerosis in people with disabilities. Regular aerobic exercise has the added benefit of early utilization of lipids, protecting muscle and liver glycogen stores, which affects carbohydrate conservation. (Sobey et al., 2015). More ATP is produced when lipids are used as an energy source compared to breaking down carbohydrates. Through the process of lipolysis, lipids are catabolized. The greater the reduction in fat storage, which reduces body fat, the more lipids are needed. People with Down syndrome who exercise frequently have a lower percentage of body fat.

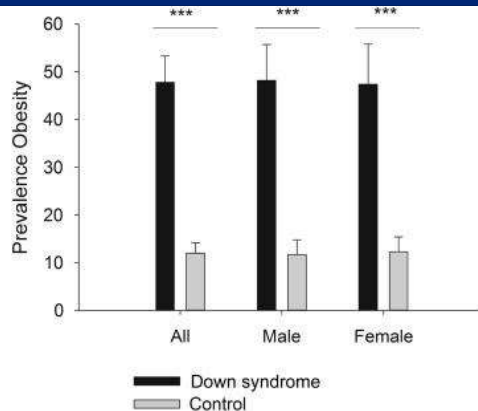


Figure 5. Prevalence of obesity in Down syndrome

Source:(Basil et al., 2016)

Regular endurance training and physical activity reduce arterial cell damage and lipid peroxidation, which limits the pathogenesis of atheroma. In addition, regular activity affects the formation of nitric oxide, which dilates blood vessels and improves blood flow. These results demonstrate the value of consistent aerobic exercise in reducing the cardiometabolic risk profile in people with disabilities.

2.5 Recreational activity plan for people with Down syndrome in elementary school

Children with Down syndrome are included in inclusive education in primary schools. In addition to children with Down Syndrome, other children with developmental disabilities can also be included in the process of aerobic exercise. It is important that schools have their own sports halls, so that space for performing aerobic exercises is easily accessible. It is desirable to include in inclusive teaching, from the aspect of sports activities, i.e. recreation, areal exercises that would follow a certain adapted program, which would be significantly longer compared to the duration of the school year, so that there would be a constant continuity of exercise. It is extremely important to divide the participants into two groups, a more advanced and a less advanced group in accordance with the already discussed categorizations of comorbidity of intellectual ability of people with Down syndrome. As a result of the division, two homogenized groups would be created,

The primary goal of developing an annual aerobic exercise program for people with Down syndrome is to derive the most significant health benefits from the exercises that will be performed with them. Therefore, as already indicated, due to lack of physical activity, most individuals in today's society have a number of comorbid health conditions. Due to their way of thinking (inability to appreciate the importance of exercise) and genetic susceptibility to some disturbances caused by intellectual disabilities, this is especially noticeable in people with Down syndrome.

We are of the opinion that the annual cycle, which lasts nine months, should be divided into three parts, the first of which is the introductory phase, i.e. the phase of multilateral preparation in which adapted work is done with people with Down syndrome to introduce them to any physical activity and acquire a certain level.

The second phase involves tangible instruction that takes the form of gradually learning the steps and finally, choreographing a dance or some other form of aerobic exercise. Towards the end of the cycle, the third and final phase is final, and focuses mainly on gathering what has already been learned. The movements of the second part and their integration into a purposeful choreography, as well as their improvement.

Table 1. Annual cycle of aerobic exercise activities for people with Down's syndrome

	Annual cycle of activities									
Places	9	X	XI	XII	I	II	III	IV	V	VI
Phases	3	Preparation phase			Specific preparation phase			Stage of competitive preparation		

As a result, the optimal functioning of the program would be 37 weeks and 74 training days per year (9 months instead of 12). The ideal way to engage the necessary psychophysical efforts of the participants of the proposed program, so that the effects of exercise are as good as possible, is to design exercises in the format of two hours a week.

Given that the population of people with Down's syndrome is predominantly obese, and thus has classic posture abnormalities, the early phase of the exercise cycle places great emphasis on posture and reducing adipose tissue (kyphosis, scoliosis, lordosis). Initially, the activities mainly consisted of various sports runs and games that were suitable for the abilities of the participants.

It should be noted that each exercise must be demonstrated because the response of the participants was much more confident and engaged after such a demonstration. For example, walking on tiptoes with hands in hand is demonstrated as "picking apples", and running around the hall while jumping is compared to "skipping a pond", try to explain thematically and present the exercise to the participants with the aim of easier adoption and understanding. Compared to most children under the age of 12, who until that age learn things based on visual cues, our participants use visualization, which is far more effective, to answer the tasks set, which is common for this type of intellectual disability.

Conclusion

The aim of the paper is to provide a list of specialized aerobic exercise programs for young people with Down syndrome. The paper deals in more detail with the development and comorbidities of Down's syndrome as a type of handicap that requires socialization and other functional life requirements, as well as the overall effects of physical activity on such persons and the additional benefits that aerobic exercise provides. However, it has been repeatedly shown that the health status of these people depends on their level of physical activity, which is still quite low compared to the rest of the population. Their participation in competitions or other sporting events raises public awareness of their importance and the benefits that the Down syndrome community derives from them. Physical education professors, as educated individuals whose profession is partly related to this issue, must become more involved.

It is critical to continue to develop as many structured types of exercise as possible for people with Down syndrome, as several studies have shown that physical activity benefits the demographics mentioned above.

Most of these principles are accepted in larger cities, but more needs to be done to educate people in smaller towns about the value of encouraging people with Down syndrome to be physically active and to make available more programs to help with integration.

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