

# Comparative Study on Aquatic Therapy vs. Exercise for Toddlers with Trisomy 21 (Down's Syndrome)

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## ABSTRACT

**Background:** Down's syndrome (DS) is a common genetic disorder which has the incidence is about 23000/yr live births in India. In comparison to normal children, Down's syndrome Children have weak hip abductors and knee extensors. Maintaining a state of equilibrium is limited or compromised in children with mild to moderate levels of motor impairment. Swimming is one of the best ways to maintain and improve the motor fitness in low IQ level individuals with Down's syndrome. This study is to analyze the aquatic therapy session in comparison with the regular physiotherapy session with assistance of physiotherapist. The comparison is gauged using various observations.

**Materials and methods:** This is a single center study and children with Down's syndrome aged 6 months to 4 years, confirmed by Karyotyping or genetic analysis will be selected for data collection. The criterion for subject selection is children with Down's syndrome having complete neck control without medical issues. This study is to see the difference in outcome of treatment methods used. Study group and the control group receive the same set of physiotherapy exercise for 5 days a week except that the study group gets aquatic sessions in addition to exercise for 2 days a week. A questionnaire is used for assessment to know the physical development of the child before the study at 0 week and 6 weeks later.

**Results:** Our study results revealed most of the parameters studied on the Down's syndrome children namely sitting, creeping, standing, crawling, pushing, moving, walking and kicking improved significantly ( $p < 0.01$ ) on Down's Syndrome children who underwent both exercise and aqua therapy when compared to children who did only exercise.

**Conclusion:** Combination of water and land exercise is an effective strategy to improve daily activities in Down syndrome children. It was noted that combination of exercise and aqua therapy showed significant improvement in many motor parameters in Down's syndrome children.

**Keywords:** Down's syndrome; Balneotherapy; Hydrotherapy

## INTRODUCTION

Down's syndrome (DS) is the most common chromosomal disorder, with an incidence of about 23000/yr live births in India [1]. It is known to be associated with low IQ and congenital malformations, especially of the cardiac system. Down's syndrome is also characterized by dysfunction/disease in several other organs. Short stature is a cardinal feature of Down's syndrome. The growth retardation of children with Down's syndrome commences prenatally [2].

It is a genetically linked syndrome caused by chromosomal abnormality by the presence of an additional chromosome 21 and there could be perceptual impairments along with cardiovascular symptoms. Orthopaedic, neuromuscular, visual and cognitive impairments are notable [3]. Down's syndrome causes developmental ailments in children that result in loss of gross motor and fine motor skills. Studies have proved that Down's syndrome affected individuals have inadequacy in hand-eye coordination, muscle strength, balance and maintaining

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equilibrium, laterality, visual motor coordination and reaction time [4].

Children with Down's syndrome have been noted to have hypotonia and decreased strength of hip adductors and knee extensors when compared with normal children [5]. Learning and coordination of motor skills becomes diminished in Down's syndrome children due to the low endurance and muscle strength. The hips, feet and shoulder movements are poorly coordinated and induce strain on the ligaments (which are longer than usual) and joints on the long run [6]. The upper and lower limbs are shorter than the trunk length in Down's syndrome children and this explains why their gross motor skills are restricted. For instance, shorter legs compromise climbing skills; balancing skills such as sitting and standing are more difficult; and a child falls further before their hands could reach the ground to balance and protect them from falling [7].

These children also have poor posture control. This loss of body balance can be well explained by their impaired muscle tone, lack of neuromuscular coordination, poor proprioception in the muscles and ligaments, slow visual feedback and delayed reflexes [8]. Thus the Down's syndrome children have overstated body movements as the outcome of the destabilized stimulus. [9]. Children with mild to moderate motor impairment have limited abilities to maintain a state of equilibrium [10].

The role of aqua therapy in improvising the equilibrium mechanisms is commendable. The circulatory system, respiratory system and immune system are enhanced in the aquatic environment and the endurance improves. A swimming medium has properties that allow the body to work differently than on land. Water also decreases muscle spasticity, enhances strength and stamina and imparts motivation to the kids which can assist in the developmental growth in a wide range of disabilities [11].

The buoyancy of water supports the body, and enables people with disabilities to perform a wide range of movements than they could do on land. It is also noted in case of individuals with severe learning difficulties, whose physical ability is limited [12]. Swimming is recognized as probably the best way of maintaining or improving the motor fitness of low IQ level individuals, and in consequence, of individuals with Down's syndrome [13].

Aquatic therapy is also known as pool therapy, hydrotherapy or balneotherapy. Exercise in warm water is a popular pain relief treatment for many other painful neurologic or musculoskeletal conditions [14]. The warmth of water enhances blood flow and dissipates algogenic chemicals that relax the muscles. The buoyancy of water blocks nociception that stimulates the thermal and mechanoreceptors which in turn influence the spinal segmental mechanisms. Peripheral edema is reduced by the hydrostatic effect of water and there is pain relief due to the dampening of sympathetic nervous system [15].

The child must be given early stimulation preferably before 3 years of age because neural plasticity is greater at this stage. This is an empowering intervention that aims to assist and stimulate the disabled child's postures and thereby supports in the maturation and the development of the child's motor and cognitive skills [16]. Exercises may be targeted for the child's development based on the stage of the child. The earlier the interventions, the greater

the chances to minimize, prevent or limit the developmental modifications [17].

Physiotherapists may offer interventional services to the Down's syndrome children who aim to improvise their motor and fine motor skills and create a platform to enhance their development with better quality and longevity [18]. But these staff cannot always perform the interventions on the child; the parents and the family play an important role in helping the child to acquire motor abilities and it is essential for them to understand that these marked changes occur within the first three years of life [19].

This study is to analyze the aquatic therapy session in comparison with the regular physiotherapy session with assistance of physiotherapist. The comparison is gauged using various observations.

## METHODS

This study is a single center study. Children (6 months to 4 years) with Down's syndrome, confirmed by Karyotyping or genetic analysis will be selected for data collection for this study. The demographic data of the Down's syndrome children, both sexes will be collected from the clinic from their medical history. The data will be stored in MS excel format with restricted access. The study is that it's a comparison study of aquatic therapy along with regular physiotherapy vs regular physiotherapy exercises of trisomy 21 toddlers.

The criterion for subject selection is children with Down's syndrome having complete neck control with no medical issues. This study is to see the difference in outcome of the treatment methods used. Study group and the control group receive the same set of physiotherapy exercise for 5 days a week except that the study group gets aquatic sessions in addition to exercise for 2 days a week.

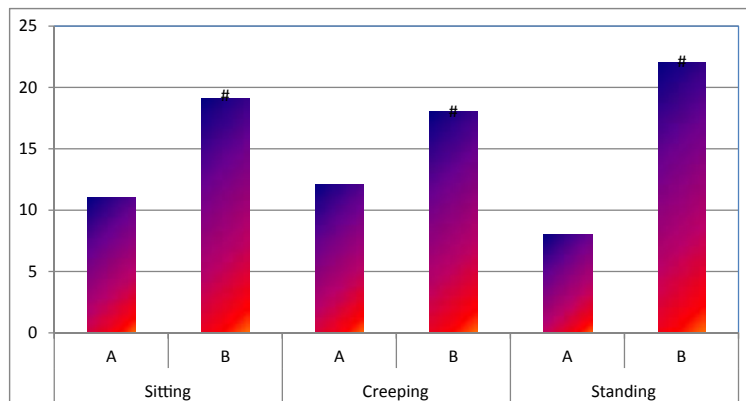
A questionnaire is used for assessment to know the physical development of the child before the study at 0 week and 6 weeks later. All the statistical analysis is to be done by using the SPSS Version 18.0. Normality of the variables under analysis was determined using Kolmogorov-Smirnov's normality test ( $p > 0.05$ ). The student's t-test for dependent data was employed to measure between effects and quality of life variables. All data were analysed using Statistical Package for SPSS v 16. The significance threshold was set to be at  $p < 0.05$ .

## RESULTS

All the three positions sitting, creeping and standing improved significantly on children who underwent both exercise and aqua therapy (Figure 1). Thus it is noted that the aqua therapy provided good improvement on the muscles related to movement of sitting, creeping and standing.

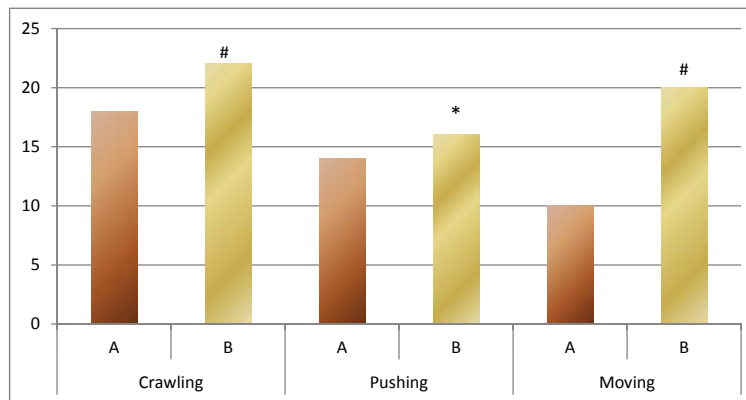
All the three positions crawling, pushing and moving improved significantly on children who underwent both exercise and aqua therapy (Figure 2). Thus it is noted that the aqua therapy provided good improvement on the muscles related to crawling and pushing along with every movement of the children.

All the two positions walking and kicking improved significantly on children who underwent both exercise and aqua therapy (Figure 3). Thus it is noted that the aqua therapy provided additional improvement on the muscles related to jumping and walking.



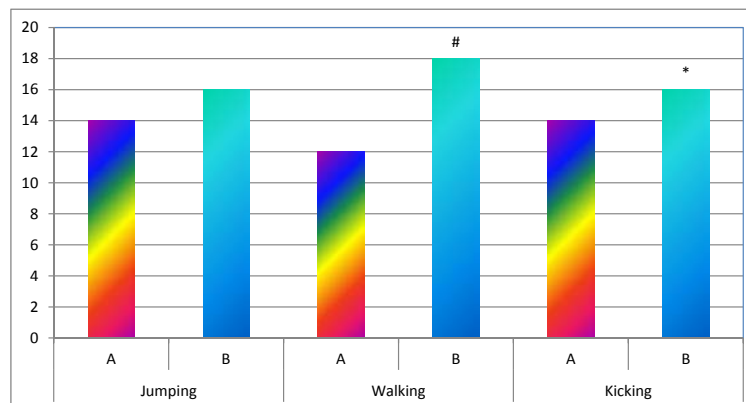
Note: A - Exercise therapy, B - Exercise therapy+Aqua therapy  
 # P<0.01 which is significant

Figure 1: Overall improvement in parameters - sitting, creeping & standing - response vs parameters



Note: A - Exercise therapy, B - Exercise therapy+Aqua therapy  
 #P<0.01, \*P<0.1which is significant

Figure 2: Overall improvement in parameters - crawling, pushing and moving



A - Exercise Therapy, B - Exercise Therapy+Aqua therapy  
 #P<0.01, \*P<0.1which is significant

Figure 3: Overall improvement in Parameters - Jumping, Walking & Kicking

## DISCUSSION

Over the past decade, increasing attention has been focused on the importance of physical fitness in the promotion of health in children with Down's syndrome.

The main health-related physical fitness is very necessary and it is dependent on the function of respiratory, cardiovascular, and skeletal muscle systems [20]. Children with Down's syndrome typically have decreased cardio-respiratory endurance, muscle strength, balance, coordination, and motor skills. These impairments limit children with disabilities from participating with

their peers in community-based sports and physical activities, and put them at risk for developing secondary health problems [21].

Preliminary research suggests that aerobic exercise programs can improve cardio-respiratory endurance in Down's syndrome children and adolescents. Children who start aerobic exercise programs are at high risk for overuse syndromes as a result of muscular weakness, poor joint alignment, and contractures mainly for Down's syndrome children [22].

The potentiality of aquatic therapy to improve posture in Down's syndrome children results from the impact the water environment

throws on the human body than on land. This improves physical activity in the Down's syndrome children and youth while at rest and exercise [23].

Children with Down's syndrome generally show apathy and lack of motivation towards physical exercise. In this regard, it has been observed that adults with Down's syndrome engage more easily in fun physical activities carried out in a stimulating environment [24]. Therefore, these fun filled and motivating training programmes impart better results in Down's syndrome cases than the conventional rehabilitation procedures.

In the present study most of the parameters which determine the child movement was observed and the same was collected in questionnaire format. The various parameters like Sitting, Creeping, Standing, Crawling, Pushing, Moving, Jumping, Walking and kicking was observed. Except jumping almost all the parameters improved in children who underwent aquatic therapy, with more significant improvement in pushing and kicking.

Aquatic exercise is a fun-filled alternative to land-based exercise for children with intellectual disabilities [25]. In spite of this, research on the effects of these types of training programs in children with Down's syndrome is scarce. This is one of the many studies to report whether water-based training is an effective intervention in improving the health-related physical fitness and quality of life of children with Down's syndrome, in India.

The results obtained in this study suggest that this kind of therapy yields most of the desired responses. This improvement could be related to the inclusion criteria applied in this study. It can be speculated that health related physical fitness improved significantly in Down's syndrome children with aquatic therapy and the scope for these programmes must be improved and supported [26].

The proposed aquatic intervention showed improvement in the aerobic performance of the children. In this regard, it has been put forward that the scope for improvement of aerobic fitness in people with Down's syndrome might be limited, although increases in their submaximal exercise capacity can be expected [27]. This hypothesis is in line with the slight improvement in the aerobic test observed once the intervention ended. Nevertheless, scientific evidence has confirmed that children with Down's syndrome can achieve significant gains in their aerobic capacity, principally after participating in well-structured training programmes specifically designed for this study [28].

The water-based exercise programme has a positive impact on children with Down's syndrome. It is reported that an aquatic exercise and nutrition intervention lead to significant changes on the body fat percentage and BMR (Basic Metabolic Rate) in a group of adults with Down's syndrome [29]. It seems that the combination of water and land exercise could be an effective strategy for Down's syndrome children, to achieve this goal of improvement in motor parameters. Parameters like sitting, standing, balance and postural stability of the body are gained with the children who underwent aquatic exercises constantly. As the final outcome it was noted that exercise along with the aqua therapy was helpful in children with Down's syndrome in gaining improvement in many motor parameters.

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