

Efficacy of Yogic Practices in Children with Down Syndrome: A Narrative Review

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ABSTRACT

Down syndrome is a genetic disorder in which an individual has an extra copy of chromosome 21 in each cell. It cannot be cured but can be managed with early intervention and alternative therapies. The present review aimed to review the existing literature on the efficacy of yogic practices in children with Down syndrome. Yoga has a holistic approach, and an early yogic intervention may be feasible in managing the symptoms of Down syndrome. The reviewed studies suggest that Yoga, through its various modalities like Asanas, Pranayamas, Kriyas, and relaxation techniques, positively influence the basic components such as balance, coordination, cardiorespiratory efficiency and also shows improvement in quality of life in children with Down syndrome.

Keywords: Cardiovascular fitness, Cognitive and motor development delay, Pranayama, Respiratory impairment, Yoga

INTRODUCTION

Down syndrome is a Chromosomal disorder, also known as Trisomy 21. About 95% cases have three copies of chromosome 21 in each cell and in 5% of cases; extra part of chromosome 21 is translocated to another chromosome. In 2% of cases, individuals have mosaic Down syndrome which is the combination of above two [1]. According to United Nations, between 1 in 1000 to 1 in 1100 live births worldwide. Each year approximately 3000 to 5000 children are born with Down syndrome [2].

The incidence of Down syndrome is closely linked to the mother's age. The likelihood of having an egg that contains an extra copy of chromosome 21 increases as a woman ages, older women are likely to give birth to an infant with Down syndrome than the younger women [3]. The presence of the extra chromosome shows delay in brain and body development [4]. The main diagnostic highlights of an individual with Down syndrome is an uncommon physical appearance, poor growth and developmental delay [5]. Usually some Down syndrome cases have to face neuro-developmental disorders, craniofacial problems, musculoskeletal impairment, autoimmune disorder, haematological disorders, obesity, cardiovascular and respiratory impairment [1]. Motor skill delay and cognitive skill developmental delay are also common in Down syndrome children [6]. Instead of walking by 12-14 months as most children do, children with Down syndrome learn to walk between 15-36 months. As cognitive development is also delayed most of the Down syndrome children function in the mild to moderate range of mental ability [6].

Early intervention and educational therapies are beneficial in improving outcomes of Down syndrome, like physical, speech and occupational therapies. Physical therapy includes activities and exercises that help to build up motor skills, increase muscle strength, improve posture and balance. Speech therapy can help Down syndrome children to improve their communication skills. Occupational therapies help to find out the ways to adjust everyday task and condition [7]. Yoga as one of the early intervention, can be helpful in the management of physiological and psychological dysfunction in Down syndrome children [8].

Yoga is an ancient Indian philosophy that emphasises achieving union of mind, body and soul. Apart from that, National Institute of Health (NIH) and National centre of Complementary and Alternative Medicine (NCCAM) recognised it as form of complementary and alternative medicine in the category of mind-body medicine [9].

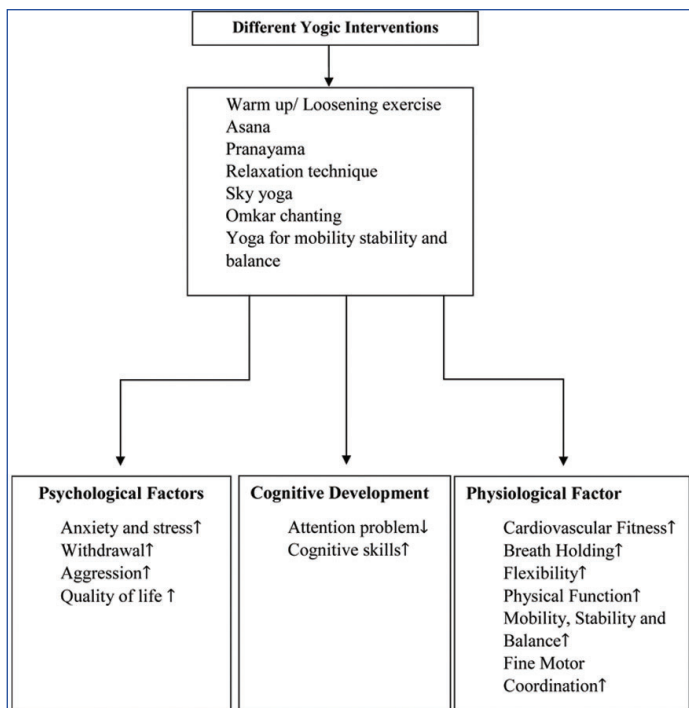
Research indicates that yoga can substantially benefit children with disabilities mainly those diagnosed with Autism Spectrum Disorder (ASD) and Attention Deficit Hyperactivity Disorder (ADHD). For children with ASD, yoga serves as a therapeutic intervention that helps balance the autonomic nervous system, promotes both physiological and psychological stability [10]. As ADHD children deals with inattention, hyperactivity, impulsivity and cognitive impairment in this condition yoga programs help them to reduce anxiety and stress, build energy and stamina therefore, yoga is efficient in the management of emotional and behavioural problems [11]. Yoga for differently abled children helps them to be focused and seated for long duration. It build strength, flexibility, balance and increase child's capacity to perceive and interact with others [11]. Despite numerous studies done on impact of yoga on children with ASD and ADHD [10-12], there is limited research available, addressing the efficacy of yoga in children with Down syndrome. As Down syndrome is a lifelong condition, early introduction of complementary therapies such as yoga may enhance physical and cognitive abilities.

Therefore, the present review aimed to provide an overview of research findings about the efficacy of yoga in Down syndrome and summarise the efficacy of yogic intervention for managing symptoms associated with Down syndrome.

Past Literature Findings

Down syndrome is a congenital disability. The condition is associated with physiological and psychological challenges [7]. Yoga, through its various modalities like Asanas, Pranayamas, Chanting, Kriyas, and Relaxation Techniques, affects all these basic components [Table/Fig-1].

As Researches indicate that early intervention improves outcomes for children with Down syndrome, as shown in [Table/Fig-2] [13-20]. The most dominant Yogic practices were Pranayama and breathing practices. They were included in the yogic interventions of four studies [13-16], which showed their efficacy in the relevance of pranayama in the management of increased cardiovascular fitness [13], reducing stress and anxiety, improving breath-holding time [14], fine motor coordination [15] and improved overall quality of life and participation in activities [16]. Pranayama also reduces odd behaviours, increases concentration and enhances sitting tolerance [16]. Physiological pathways include improvements in cardiovascular fitness, breath-holding capacity, flexibility, physical function, mobility, stability, balance, and fine motor coordination. Psychological



[Table/Fig-1]: Pathways through which different yoga modalities impact physiological, psychological, and cognitive aspects of Down syndrome [13-20].

pathways include reductions in anxiety, stress, withdrawal, and aggression, along with enhanced emotional regulation and overall quality of life. Cognitive pathways include improvements in attention, concentration, and general cognitive skills.

Motor Development and Balance

Regular practice of yoga improves Intelligence Quotient (IQ), concentration, attention span, and psychomotor coordination [21]. Asana, pranayama, bandhas and kriyas give a gentle massage to

the inner muscles and cleanse their impurities, which improve the overall performance of muscles and joints and therefore enhanced motor function abilities [22].

Two separate studies have examined the effects of yogic interventions on different physical parameters [13,17]. Out of these two studies, one study showed the effects of yogic intervention on flexibility assessed by the sit and reach test on 30 boys of age 12-18 years. The results show that children practising yoga showed significantly better flexibility compared to the aerobic exercise group [17]. In another study, cardiovascular fitness was assessed by Cooper's 12-minute run and walk test on 20 children aged 12-18 years with the intervention that included loosening exercise, pranayama and relaxation technique [Table/Fig-2] [13].

Yoga improved mobility, stability, and balance, likely due to emphasis on core strength, proprioceptive training, and postural control. However, the results are limited by an extremely small sample size and heterogeneity of the age group (4-21 years). The findings are also supported by another randomised control study conducted to assess the physical function of children with Down syndrome aged 3-5 years, and the findings showed that Yoga seems to be effective for improving physical function in young children with Down syndrome. Walking speed, Timed up and go, Timed one-legged stance, Five times sit to stand test, Two-minute walk test and Grip strength used to assess physical function of young Down syndrome children [18]. However, the detail of the Yoga intervention for both studies is not mentioned, which makes it difficult to understand the most suitable component of the yoga that may have resulted in the improvement.

A pilot study assessed flexibility and balance among Down syndrome adolescents [19]. The results indicated a significant difference in balance between groups after yoga, and no significant difference was found in flexibility. Selective asanas such as tadasana, ardhachakarasana, veerabhadrasana, and paschimottanasana can also be effective in increasing balance and physical function in Down syndrome.

S. No.	Study	Group size and Age	Type of study design	Type of intervention		Duration	Outcome measure	Changes in parameters	
				Experimental group	Control group			Experimental group	Control group
1.	Vishnu V [13]	n=20 Age=12-18 years	Quasi experimental design	Loosening exercise (5 min) Asana (30 min) Pranayam (15 min) And Relaxation Technique (10 min)	Non-structural Exercise session	16 weeks 3 days per week	Cooper 12-minute run or walk test	Cardiovascular fitness ↑↑	Cardiovascular fitness ↑
2.	Jayanthi R, and Valliammal GR [14]	n=26	Experimental (pre-post)	Prayer song, Pranayama practice Simple meditation, Chant and blessing Surya namaskar, Neuromuscular Breathing, SKY kapalopathy exercise, SKY makarasana part 1 and 2, Relaxation	Not mentioned	12 weeks 5 days per week	Respiratory exerciser kit, Standardised questionnaire for cognitive skills, Anxiety and stress	Cognitive skills ↑ Anxiety and stress level ↓ Breath holding ↑	Not mentioned
3.	Singh S and Singh JP [15]	n=5 Age=7-10 years	Experimental	Left nostril breathing, Right nostril breathing, Omkaar breathing in dhyana mudra	Not mentioned	8 weeks	Inserting pegs task	Fine motor coordination ↑	Not mentioned
4.	Tischler, D and O'Leary M [16]	n=2 Age= 6-10 years	Case Series	Yoga poses (seated, standing, supine and prone pose), seated breathing exercises	Not mentioned	10 weeks	PedsQL, CAPE	HRQOL ↑ Diversity ↑ Intensity ↑ With whom ↑ Where ↓ Enjoyment ↑	Not mentioned
5.	Vishnu V and Rani KU [17]	n=30 (Boys) Age=12-18 years	Experimental (pre-post)	Yoga practices	Non-structural Exercise session	12 weeks 6 days per week	Flexibility assessed by sit and reach test	Yoga Flexibility ↑↑↑ Aerobics flexibility ↑↑	Flexibility ↑

6.	Salem Y and Liu H [18]	n=24 Age-3-5 years	Randomised control study	Yoga exercise program	Routine program and activities	10 weeks	Walking Speed Timed up and go Timed one-legged stance Five minute sit to stand test Two minute walk test Grip strength	Physical Function ↑	No Changes
7.	Sangeetha P and Dhinu [19]	n=30 Age- 10-19 years	Pilot Study	Warming up, Tadasana, Padhastasana, Ardchhakrasana, Veerabadharasana, Sugsasana, Pachimottanasana, Badhakonasana	Regular Curricular activities	8 weeks	Sit and Reach test Stork stand test	Flexibility no significant changes Balance ↑	Not mentioned
8.	Perera WDS and Joniton S [20]	n=40 (males) 10-19 years	Experimental study	Yoga based intervention	No Practice	8 weeks	(CBCL 6-18) Questionnaire	Anxiety ↓ Withdrawal ↓ Aggression ↓ Attention problem ↓	No changes

[Table/Fig-2]: Illustrates how different yoga modalities including aerobic exercise, chanting, SKY yoga and relaxation techniques positively influence physical, psychological and cognitive domains in children with Down syndrome [13-20].

FMS: Functional movement screening, PST: Postural stability test, PED: Paediatric quality of life inventory, HRQOL: Health related quality of life, CAPE: Children assessment of participation and enjoyment

Yoga improved balance but did not yield significant gains in flexibility as contrary to the findings of another research [17]. The flexibility outcomes were inconsistent, may be because of the varied interventions used, suggesting that intensity, duration, and standardisation of practice may influence results.

The effects of various yogic interventions on motor skill development were assessed in one study. Inserting pegs task was used to assess fine motor coordination. The study highlighted that regular yoga practices can have the potential to slow down the symptoms of Down syndrome in children at an early stage of their life, and overall quality of life can improve [15]. However, with a very small size the results cannot be generalised.

Yogic practices improve adaptive behaviour and memory in children, which in turn improves the learning of new skills. Asanas help in improving locomotor skills and pranayama brings control over breath, which increases psychomotor coordination, thus yoga can be used as therapy to improve odd and problematic behaviour [23].

Cognitive and Psychological Outcomes

Regular yoga practice balances the Autonomic Nervous System (ANS) by decreasing sympathetic activity and increasing parasympathetic activity [24]. Yogic practices (asana, pranayama and meditation) are beneficial for cognitive and psychological function such as memory improvement and reduction of emotional tension, anxiety and irritability, because they involve active attention exercises [25]. A study observed improvements in cognitive skills and reductions in stress and anxiety, which was conducted on 26 children for 12-week duration. Simplified Kundalini Yoga (SKY) yoga (kapalathaty exercise and makarasana), surya namaskar, simple meditation, neuro-muscular breathing and pranayama exercises increased cognitive skills while reducing stress and anxiety levels [14].

One study assessed only psychological behaviour such as anxiety, withdrawal, aggression, and attention problems in 40 male Down syndrome adolescents [20]. After the yoga intervention of eight weeks, variables were assessed by using the Child Behavior Checklist (CBCL) questionnaire, in which findings indicated that yoga-based interventions decrease anxiety, withdrawal, attention problems and aggression. However, the study was limited by minimal intervention details and also the psychometric assessment (CBCL) is parental-reported, with a potential risk for observer bias.

Cardiovascular Fitness

In another study, cardiovascular fitness was assessed by Cooper 12 minutes run and walk test on 20 children aged 12-18 years with the intervention that included loosening exercise, pranayama and relaxation technique [13]. Results showed that the yogic practice group have better effect in increasing cardiovascular fitness of Down syndrome children. However, study is limited by the design and reliance on a single outcome measure used i.e., Cooper 12 minutes run or walk test to assess cardiovascular fitness. Another study, found that SKY Yoga and Pranayama improved breath-holding capacity in addition to improvements in other parameters (cognitive skills, anxiety and stress) [14].

Quality of Life and Social Participation

Quality of life and participation of children assessed in a case series that includes two cases of Down syndrome [16]. After the yogic intervention of 10 weeks that included yoga poses and seated breathing exercises, the quality of life improved in Down syndrome children. The study had four participants (02 with Down syndrome, two with ASD). Both the Down syndrome children showed an increase in CAPE scores except for the "Where" domain. However, with a small sample size (n=2), the findings cannot be generalised.

Evidence suggests that stress induces an imbalance in the autonomic nervous system with decreased Peripheral Nervous System (PNS) activity and increased Sympathetic Nervous System (SNS) activity [26]. Yoga practices help to restore balance and optimise autonomic functions [10]. Yoga practices result in decreased sympathetic activation and improved parasympathetic tone, promote body-mind equilibrium and enhance emotional self-regulation [27]. Yoga poses (asana) improve body awareness, concentration, and memory, and yogic breathing techniques (Pranayama) have a positive impact on the central nervous system, which are the vital skills for any child with developmental disabilities [6]. Deep breathing helps children with asthma and also ease in pulmonary hypertension, relieve nasal congestion and build the immune system [12,26]. Yoga poses (asana) helps in improving balance, strength, coordination, respiratory impairment, cardiovascular fitness and many other factors that affect Down syndrome children [11]. It has been suggested that a yoga programme could benefit children, especially those with psychomotor deficits; they reported that yoga postures promote body awareness, balance and laterality [28]. Breathing

practices (pranayama) and meditation improve the functioning of the central nervous system; have a positive effect on motor and cognitive skill development, concentration and memory [6]. Yoga can be counted as a feasible practice to overcome these challenges especially if yoga is introduced in early stages of childhood. In the present review, most of the studies show positive adaptation after yoga training.

Limitation

The present study was limited by the number of available studies and the methodological limitations. The total number of available studies was less, the included studies have a small sample size, and the intervention of some of the studies was not clearly described, which limited the generalisability of the findings.

CONCLUSION(S)

Yogic interventions offering a holistic approach, if started at an early age, shall help manage the symptoms associated with Down syndrome and improve the quality of life of such people. Despite promising findings, methodological limitations prevent firm conclusions. There is a need to prioritise and conduct more experimental studies with adequate sample sizes and a well-explained and constructed yoga protocol to ensure the efficacy and feasibility of Yoga for Down syndrome to address different components, such as balance, coordination, muscle strength, cardio-respiratory parameters.

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