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Down Syndrome: Goals for Improvement

Connecting through Bharatanatyam

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Abstract: Down Syndrome is the most common generic cause for intellectual disability. This paper reviews different medical issues faced by individuals with Down Syndrome and goals for improvement. Based on the goals a study is conducted to review functionality and how Bharatanatyam can help improve. There have been vast improvements in managing medical conditions with Dance leading to high rate of survival. These improvements impact on quality of life for individuals with Down Syndrome. Study of how Bharatanatyam can provide benefits to individuals with Down Syndrome is covered in this paper.

Index Terms – Down Syndrome, Bharatanatyam

I. INTRODUCTION

This paper focuses on different issues faced by individuals with Down Syndrome and how Dance can help to improve leading day-to-day life activities. Considering different goals for improvement formed the foundation of the study. Identifying different aspects of Dance, specifically Bharatanatyam was considered in this study.

II. MEDICAL ISSUES RELATED TO DOWN SYNDROME

Down Syndrome (DS) is the most common chromosomal abnormality in humans and most easily recognised condition causing both physical and intellectual disability (Connolly et al., 1993). The chromosome abnormality affects physical and psychological development of the individual, such as cognitive ability, gross and fine motor, language, etc. This occurs in every 600-800 live births, and is not related to race, nationality, religion or socioeconomic status (Farias & Teixeira-Machado, 2016).

When considering physical conditions, there are many medical conditions that people with DS frequently experience that includes Learning difficulties, Poor cardiac health, Thyroid dysfunction, Diabetes, Obesity, Digestive problems, Low bone density, Hearing and Vision loss. Common symptoms of Down Syndrome vary from person to persons and in different range. Because of poor muscle tone, a child with down syndrome may be slow to turn over, sit, stand, and walk. Though the kids with down syndrome take longer to achieve these milestones, they can successfully manage them.

Physical symptoms include decreased or poor muscle tone, short neck, with excess skin at the back, small head, ears and mouth, flattened facial muscles and nose, eyes slightly upward slanting, short and wide hands and fingers, extra space between first and second toes (Bull & the Committee on Genetics, 2011). These kids also have cognitive impairment and delay in thinking and learning (Farias & Teixeira-Machado, 2016). Behavioural patterns such as short attention, poor judgement, slow learning, delayed language and speech development are seen in individuals with Down Syndrome. Individuals with Down syndrome have problems in learning the phonological form of words during vocabulary acquisition, given their apparent problems in verbal short term memory (Jarrod & Baddeley, 2001). People with Down Syndrome have great diversity in terms of personality, intelligence, appearance, humour, learning styles, compassion, compliance and attitude (Vicari, 2006). Several studies have demonstrated a general decline in IQs in children with Down syndrome from infancy to late childhood (Connolly et al., 1993).

They have emotions and attitude and are creative and imaginative. People with Down Syndrome have feelings just like everyone else in the population. Similar to all, they respond to positive expressions of friendship and are hurt and get upset by inconsiderable behaviour. They also like to be independent with varying degree of support and attempt to develop strong academic and social skills. Children with Down Syndrome are highly sociable and have great people skills (Cebula et al., 2010). In addition to social ability, there are several relative strengths such as socioemotional ability, and self-care ability are seen in individuals with DS. A total of 79% community people and 85% teachers reported that children with Down syndrome are more affectionate than others (Jiar et al., n.d.).

Individuals with Down Syndrome learn at a slower pace, but they always continue to learn. It is associated with impairments in language (Martin et al., 2009), cognition (Cebula et al., 2010), learning and memory (Jarrold & Baddeley, 2001). They are capable and like to participate in all aspects of community events, such as education, recreation, employment, social and family life. The initial reports document the development of children with Down syndrome as similar to that of typically developing children but occurring at a much slower rate and reducing as they age.

III. BRAIN STRUCTURE AND FUNCTIONALITY

At birth, many Down Syndrome brains have smaller dendritic arborization and fewer synapses¹, likely to contribute to the reduced functional brain connectivity found in many newborns with Down Syndrome. Examining the brains of adults with DS, MRI studies have demonstrated that the size of the cerebellum, hippocampus, and cortex is significantly smaller than in the neurotypical case, while basal ganglia are similar in size and ventricles are enlarged (Karmiloff-Smith et al., 2016). By 15 weeks of pregnancy, brains of DS children are significantly smaller than those of other babies, with a shrunken cortex and cerebellar volume about 80 percent of normal. The frontal cortex is disproportionately reduced in volume and during visual recognition tasks there is evidence of differences between typically developing infants and those with Down's syndrome in frontal and parietal site brain activity (Cebula et al., 2010). Knowledge of any underlying neuropathology and of differences in neurological processing in children with Down's syndrome is still remarkably limited, but differences such as these may well be implicated in the difficulties seen in socio-cognitive development (Farias & Teixeira-Machado, 2016). There is also some evidence that children and adults with Down's syndrome experience difficulties with some 'executive functions' goal-directed behaviours which are linked to the development of frontal areas of the brain. For example, difficulties with set shifting, verbal short-term memory and dual-task processing have all been reported.

Reasons for specific behaviours is that the individuals with Down Syndrome are born with underdeveloped brain. In recent years the role of attention in children's learning has received increasing research interest and the possibility that training in infancy may improve children's attention. In addition, the evidence suggests that individuals with Down syndrome do have relatively poor verbal short-term memory abilities (Jarrold & Baddeley, 2001). There is already some evidence in the literature that children with Down syndrome demonstrate impairments in perceptual-motor coupling. When children with Down syndrome perform motor tasks, they have difficulty in properly adjusting both the spatial and temporal aspects of their grasp as a function of object size or task goal.

IV. GOALS FOR IMPROVEMENT

Based on the above issues faced by individuals with Down syndrome, following goals were identified to help improve and cope with daily activities.

- Goal 1: Coordination and motor skills
- Goal 2: Balance, strength, and flexibility
- Goal 3: Body alignment and awareness
- Goal 4: Social skills and confidence
- Goal 5: Spatial awareness
- Goal 6: Focus and following instructions
- Goal 7: Speed and agility
- Goal 8: Expression, emotion, and creativity

¹ The brain cells communicate through connections known as Synapses and in individuals with Down Syndrome the brain cells have only about 60% of the usual number of Synapses

Table below matches the issues faced by the individuals with Down syndrome and their goals identified to help manage. These goals were considered the foundation for the study and different Bharatanatyam techniques were considered to help improve.

Issues	Difficulties	Goals	Bharatanatyam Techniques
Hypotonia (low muscle tone)	Delay in gross motor skills and fine motor skills Due to Hypotonia and hyper flexibility, there is increased risk of joint dislocation and delayed motor skills	Goal 1: Coordination and motor skills	Movements with feet, hands, eyes coordination Hand gestures
Postural stability	Movement and balance, Body coordination in dynamic position changes is difficult due to muscle and joint sensory structures. The enlarged joint mobility may contribute to the lack of postural stability.	Goal 2: Balance, strength, and flexibility	Different foot positions for balance Yoga poses and Karanas
Impaired Neurological development	Slow to develop movement skills, Body awareness and space awareness	Goal 3: Body alignment and awareness Goal 5: Spatial awareness Goal 6: Focus and following instructions	Movements in Bharatanatyam Directional movements – diagonal, lines, circular etc. Teaching strategies – various visual ways of teaching
Cerebellum is smaller and less dense	Motor control and motor learning disorders Balance Posture Reflex motor acts	Goal 1: Coordination and motor skills Goal 2: Balance, strength, and flexibility Goal 3: Body alignment and awareness	Spins, Leaps, Jumps Different poses for posture stability
Corpus Callosum is thinner	Disrupted efficiency of bimanual movement	Goal 1: Coordination and motor skills Goal 2: Balance, strength, and flexibility Goal 3: Body alignment and awareness Goal 7: Speed and agility	Moving in different speeds Alignment techniques Stamina building and strength
Smaller frontal lobe	Goal oriented functioning Concentration Judgement and reasoning Emotional expression Creativity Speech and language production Memory	Goal 4: Social skills and confidence Goal 6: Focus and following instructions Goal 8: Expression, emotion, and creativity	Group dancing Different methods for attention Creative dance Expression and emotions
Facial muscles	Tight facial muscles	Goal 8: Expression, emotion, and creativity	Abhinaya -facial expression

Goal 1: Coordination and motor skills

Brain structure and function influences the development of coordination and motor abilities (Thomas, n.d.). Significant change in size of cerebellum leads to psychomotor dysfunctions among these individuals. Smaller frontal lobe volumes cause problems with voluntary activities, cognitive deficits, and gait quality, especially in adult life. Corpus callosum² size is also reduced in children with DS and is associated with mental retardation, problems with coordination, and atypical laterality.

² The corpus callosum is the major neural pathway that connects homologous cortical areas of the two cerebral hemispheres. Other studies suggest that the corpus callosum integrates information across cerebral hemispheres and thus serves an excitatory function in interhemispheric communication.

Compared with typically developing children, individuals with Down Syndrome have delayed gross and fine motor skills (McGuire et al., 2019, Connolly et al., 1993). They require more time to learn these skills and the complexities. Motor function in individuals with Down syndrome is characterized by hypotonia and hyper flexibility, which results in an increased risk of joint dislocation and retarded motor skills (Albin, 2016). People with Down syndrome have more joint mobility than the average (Biederman & Freedman, 2007).

The walking development of infants with Down syndrome has frequently been compared to typically developing infants to aid understanding of motor delay. Several kinematic differences between individuals with and without Down syndrome have been noted which may contribute to the delayed development of walking in children with Down syndrome. It was also noted less ability to control anti-gravity movements of the lower extremity and difficulties in adjusting head position in space in individuals with Down syndrome. Pelvic and hip instability, particularly excessive degrees of thigh abduction have also been documented. This may limit stepping ability since the position of the hip is important for load reduction at the end of stance and for swing initiation.

Though the individuals can't be cured from Down syndrome, movement patterns can be improved and help reach some of their motor skills. As children with Down Syndrome also have decreased pulmonary function and physical fitness compared with peers who are typically developing (Lewis & Fragala-Pinkham, 2005).

Goal 2: Balance, strength, and flexibility

Cerebellum hypoplasia is responsible for muscle hypotonia, problems with movement fluency and axial control (axial truncal muscle), body balance, coordination, and speech disorders. Previous research also found that individuals with Down syndrome have significantly lower scores in running speed, balance, strength, and visual motor control than did the group without Down syndrome (Connolly et al., 1993). Connolly (1993) also continued saying that balance problems in children with Down syndrome do not result from hypotonia, but rather from defects within higher-level postural control mechanisms. These individuals with Down Syndrome have great difficulty with both static and dynamic balance. In particular, these individuals walking, running,

Goal 3: Body alignment and awareness

Children with Down Syndrome have also decreased postural control. Muscles to hold them up is weak. Regarding early postural control, cross-sectional studies have shown that head righting, protective reactions, and other responses are also impaired. In addition, previous longitudinal studies have demonstrated that the acquisition of motor skills, especially midline behaviours and vertical postures, is often delayed (Cardoso et al., 2015). Children with Down Syndrome learn to sit with a posterior pelvic tilt, trunk rounded and the head resting back on the shoulders.

Hypotonia, decreased muscle tone, and muscle weakness are theorized to impair upper extremity midline movements and gait, noted by shorter step lengths, increased knee flexion at foot contact, decreased single-limb support, and increased hip flexion posture that can contribute to the higher energy cost of gait in persons with this disorder (Lewis & Fragala-Pinkham, 2005). Hypotonia has a negative effect on the proprioceptive feedback from muscle and joint sensory structures and can have a detrimental effect on the efficiency of co-contractions and postural reactions. Together with the failure of co-contraction, it can have a negative impact on joint stability. People with Down syndrome have hyper flexibility, more joint mobility than the average. This joint laxity is found in several parts of the body due to the abnormal collagen found in Down syndrome. The enlarged joint mobility may contribute to the lack of posture control.

Goal 4: Social skills and confidence

Individuals with DS have multiple medical conditions and cognitive impairment (Bull & the Committee on Genetics, 2011). The main disability associated with Down Syndrome is a cognitive deficit which is thought to influence children's ability to perceive process and make use of relevant information to solve problems and engage in appropriate behaviour (Carr, 1985). Intellectual disability faced by individuals with DS has limitations resulting in problems with reasoning, learning or problem-solving as well as communication and social skills difficulties (Shukla et al., 2015). In comparison to other disorders most children and adults with Down syndrome continue to develop good social skills and appropriate social behaviour, though a significant minority may develop difficult behaviours, particularly those with the greatest delays in speech and language development.

Behavioural problems such as stubbornness, impulsivity and temper tantrums may be more common in children with Down syndrome. Many children process information by talking out loud to themselves as a way of understanding. One of the relative strengths is the social skills. Social functioning is relatively less delayed in individuals with DS when compared to other areas of development. As babies they look at faces and smile only a week later than other typically developed individuals. Infants with Down syndrome enjoy communicating and make good use of non-verbal skills including babbling and gesture in social situations.

For individuals with Down Syndrome, engaging and understanding their emotions and feelings may not be easy as typically developed individuals. This may or may not be more impaired by the cognitive ability. These interpersonal understandings are affected by both biological and environmental factors. The researcher believes that environmentally based intervention program has a good realistic possibility for improvement. Most children and adults with Down syndrome continue to develop good social skills and appropriate social behaviour, though a significant minority may develop difficult behaviours, particularly those with the greatest delays in speech and language development.

Goal 5: Spatial awareness

The Down syndrome behavioural pattern includes relative strengths in areas of visual spatial processing, compared with verbal processing (Deakin, n.d.). Visio spatial processing tends to be strong and even observed to be comparable to typically developing children. In particular, visual memory and visual-motor integration appear to be areas of relative strength (Vicari, 2006). Evidence and previous research suggest that children with Down Syndrome have good skills in this area and are able to better learn through visual information. Performance of young adults with Down syndrome shows dramatic improvement with practice even in tasks that are very simple and seem to offer little room for improvement.

Participants in previous studies were encouraged to perform various tasks during practice showed significantly larger improvements in their performance and indices of finger coordination as compared to those who practised only the main task. This shows vast improvement that can be achieved with practice and continuous effort.

Goal 6: Focus and following instructions

Instructional strategies for children with severe developmental delays often include interactive modeling techniques with instructors delivering physical and verbal guidance and social responses such as "Good job!" or "Good girl!" meant as rewards for appropriate student behaviour (Biederman & Freedman, 2007). Studies employing various comparison groups, including typically developing children matched on chronological age, mental age, or language level, children with Down syndrome display substantial difficulties with respect to various aspects of social understanding and associated socio-cognitive skills (Guralnick et al., 2011).

It is also common for individuals with Down syndrome to experience decreased levels of social participation that can lead to a lower quality of life (McGuire et al., 2019). Therefore, physical activity for individuals with Down syndrome is very important, however, it is sometimes a challenge due to potential limitations such as low fitness capacity; balance and coordination issues; extreme range of motion limitations; and trouble reaching their age-predicated maximal heart rate.

Many individuals with Down syndrome experience both cognitive and social difficulties; thus, a system of rewards should be set in place for behavior modification when working with individuals who have Down syndrome (McGuire et al., 2019). When compared to children without Down syndrome, children with Down syndrome have been found to have more behavioral issues such as attention-deficit, non-compliance, and social withdrawal.

Children with Down syndrome have been found to demonstrate difficulties with working memory and verbal instructions. One well-established fact concerning cognitive and language development in individuals with Down syndrome is that working memory is particularly poor, with auditory working memory worse than visual working memory (Frances et al., 2001). Working memory serves the functions of control, regulation, and active maintenance of information and is critical in daily complex cognitive activities. Thus, there is a strong need to find effective and practical interventions targeted at improving working memory in individuals with Down syndrome. These individuals are noted as having short term memory, specifically verbal short-term memory³. Further research has also shown that the individuals' visuo-spatial short-term memory is relatively unimpaired, in contrast to their verbal short-term memory (Jarrold & Baddeley, 2001). One obvious reason for verbal short term memory could be their hearing difficulties (Bull & the Committee on Genetics, 2011).

Goal 7: Speed and agility

There is lack of research done in speed and agility in individuals with Down Syndrome. This goal focuses on strength and endurance to hold the position and strong lower body. Speed and power are areas that needs attention and can be transferred to real life (Lewis & Fragala-Pinkham, 2005). Individuals with Down syndrome who were between 7 and 14 years of age scored consistently low on agility and balance tasks when compared with typically developed children. (Connolly et al., 1993).

Goal 8: Expression, emotion, and creativity

Language delays are common characteristic for kids with Down Syndrome. But social functioning has been considered as a feature and strength in kids with Down Syndrome (Guralnick et al., 2011). The perceptions of parents, and teachers of children with Down syndrome are consistent with this sociable profile and with social development as a relative strength. Cognitive and social strength and weakness impacts the development of a child.

With their immediately identifiable features, these kids may experience exclusion at school or other social events. Understanding and explaining the immediate friends is important to make sure kids don't get treated differently. In general, it has been found that young children with Down's syndrome use pointing and requesting gestures competently to communicate with others (Cebula et al., 2010). Continuous effort to get kids with Down syndrome to interact in a social manner helps to participate in community-based activities. Other developmental characteristics common to children with Down syndrome, such as unusual difficulties in expressive language, may further place these children at risk for significant peer competence problems (Guralnick et al., 2011). Tasks using photo matching or puppet paradigms to explore emotion recognition have been noted that in comparison with typically developing children of a similar level of cognitive ability, some children with Down syndrome may experience difficulties in recognising some of the core facial expressions of emotion such as fear, surprise, and anger (Cebula et al., 2010). Studies of empathic responses also reveal with children with Down syndrome showing equivalent, or higher, levels of pro-social empathetic behaviours than typically developing children of similar cognitive and linguistic ability (Cebula et al., 2010).

³ Verbal short-term memory refers to the ability to maintain verbal items such as words or digits,

One example of differences in social attention seen at the very earliest stages of development is in mutual gaze with caregivers (looking into each other's eyes). This is initially slow to emerge in children with Down's syndrome, although by later in the first year, as typically developing infants focus on the wider social and physical world around them and mutual gaze begins to decline, it continues to be maintained at high levels (Cebula et al., 2010). Based on care giver, teacher and parent interactions and parenting style, children have adapted to different development. Mother's and siblings have also started developing different ways to interact to adopt to better social interaction. Children's interpersonal skills is associated with significant speech and language difficulties and over 95% reported that individuals immediately outside the family experienced difficulties understanding in their child's speech (Cebula et al., 2010).

IV. RESULTS AND DISCUSSION

This study reviewed medical conditions faced by individuals with Down Syndrome. These issues were studied in detail and different goals for improvement were considered. These goals form the foundation of this study. Understanding Bharatanatyam techniques and how different strategies can be used was the outcome of this study.

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