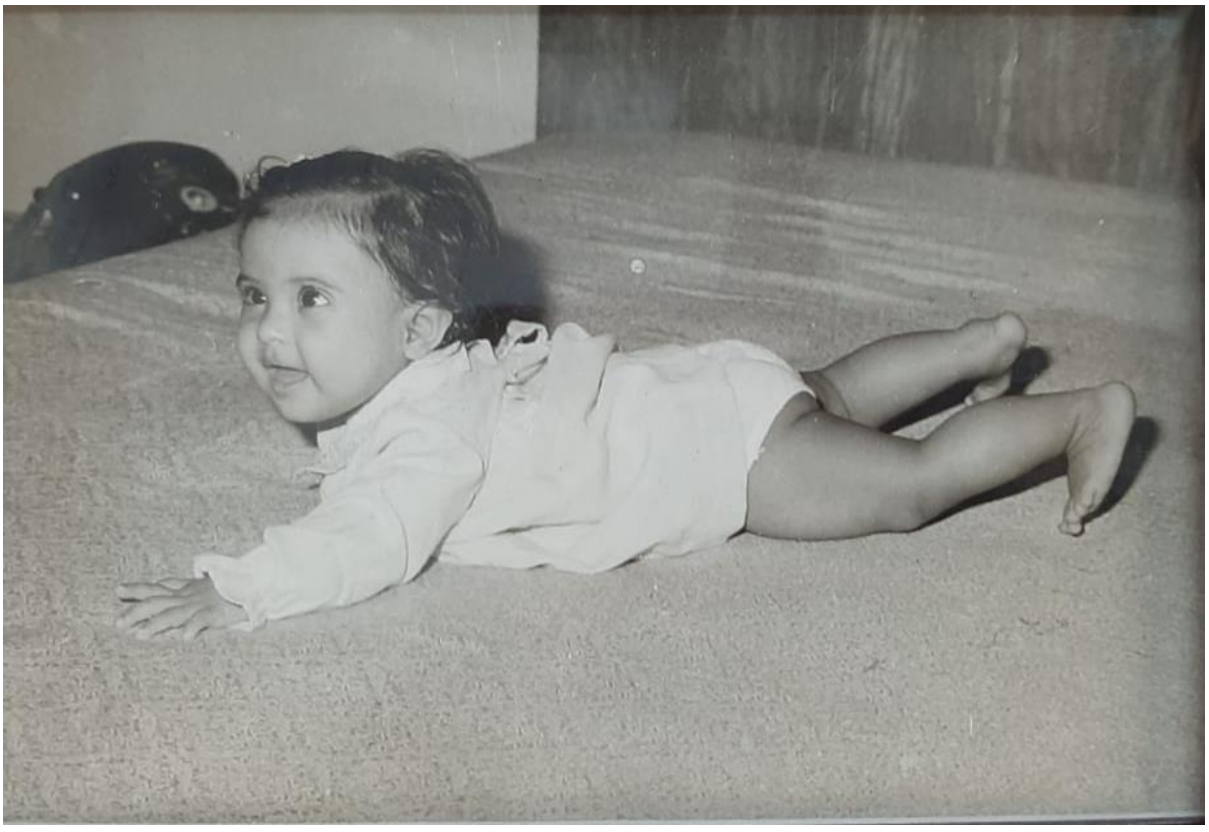
THERAPEUTIC APPROACHES FOR DEVELOPMENTAL DELAY IN TODDLERS WITH DOWN SYNDROME (Trisomy 21)

PHYSIOTHERAPY FOR EARLY MOTOR DEVELOPMENT



DOWN SYNDROME
FEDERATION OF INDIA
40 years of empowering families

PREFACE

Children with Down syndrome have the potential for the development of correct posture, balance reactions, movements and skills. Sometimes this potential remains relatively untapped resulting in unusual, inefficient or even detrimental patterns of movement. Therapeutic intervention in the early stage of motor development in a toddler with Down syndrome is crucial.

Motor development is important throughout a child's early life, because physical development is tied to other developmental areas. Physiotherapy being an integral part of early intervention for a child with Down syndrome, it is important for the caregivers to understand the stepwise physiotherapy approaches at each stage of the child's development.

I sincerely hope that this book would fill the gap in understanding the difference in therapeutic management for children with Down syndrome as compared to other special needs, and would provide useful guidance to the caregivers. This book includes comprehensive physiotherapy approaches for delayed milestones in children with Down syndrome and the importance of physiotherapy in adulthood for persons with down syndrome.

ACKNOWLEDGMENTS

Should this publication achieve its aim of making a positive contribution to the development of children with Down syndrome, it will only be due to the inspiration of Dr. Surekha Ramachandran (President of DSFI), who is the author's mentor as an early intervention therapist, and Mrs. Chitra Shah (director of Sathya special schools, Pondicherry), who has been instrumental in authorizing this book.

ABOUT AUTHOR

The author of this book, Srilakshmi R is a graduate from college of physiotherapy, Sri Ramachandra medical university, Chennai, experienced in the field of neuro rehabilitation, geriatric care and pediatric management. She is working with the Down Syndrome Federation of India as an early intervention therapist and has been part of the DSFI team's awareness and consultation camps conducted every year all over the country. She has also published a paper on aquatic therapy on children with Down syndrome.

DOWN SYNDROME FEDERATION OF INDIA (DSFI)

DSFI is an organization that offers support to individuals with Down syndrome and their families through various Down syndrome institutions across India.

Dr. Surekha Ramachandran is the chairperson and founder of Down Syndrome Federation of India.

Down Syndrome Federation of India bears the unique distinction of being the only center of its kind in South India. And not just this, a lot of research programs, specialized outpatient services and early intervention programs are also conducted and coordinated here.

DSFI organizes health camps across the country in order to assess and assist persons with Down syndrome and their families. These camps have therapist, specialists and counselors who examine the child and provide the necessary inputs to help the children lead better and more fulfilling lives.

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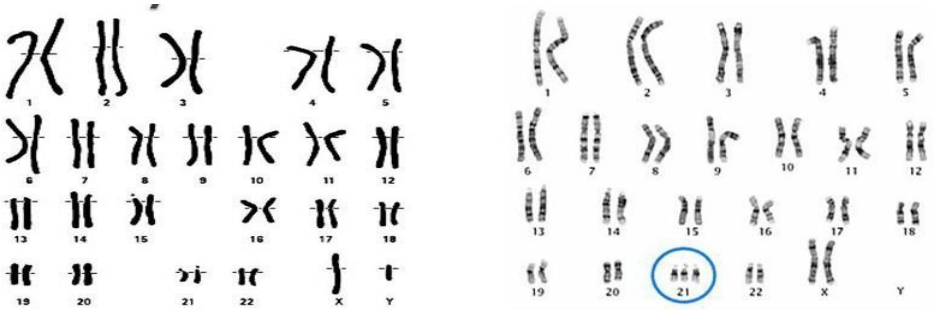
CONTENT

ALL ABOUT DOWN SYNDROME

WHAT IS DOWN SYNDROME?

Down syndrome is not a disease. It's a genetic disorder/condition in which a child is born with an extra copy of their 21st chromosome caused by abnormal cell division. So, child is born with 47chromosomes instead of the usual 46 chromosomes.



On the left is what a normal person would look like and on the right is what a person with down syndrome would look like.

This extra genetic material causes the physical and mental **developmental delays.** A child born with Down syndrome can have a variety of medical problems. About 40% of children with Down syndrome have heart problems. This can range from a very small hole (conservatively managed) between two heart chambers to a very large hole (surgically managed).

TYPES OF DOWN SYNDROME – Trisomy 21 (95%), Translocation (3%) & Mosaicism (1%).

HOW TO KNOW ABOUT DOWN SYNDROME?

It can be detected during pregnancy by

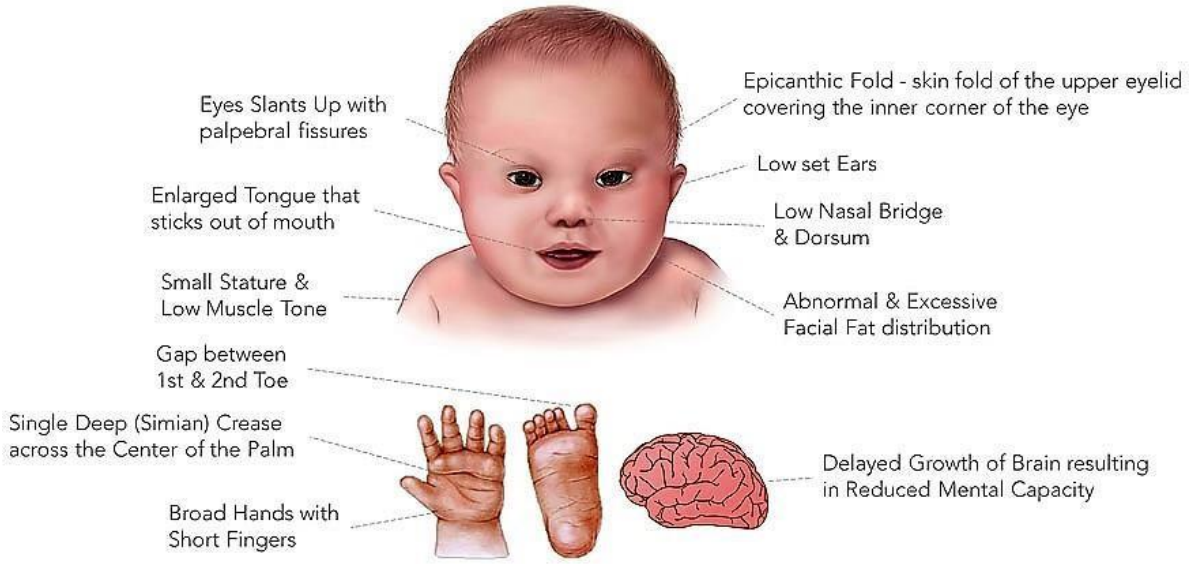
Screening test can only tell if your baby is at increased risk of Down syndrome and cannot be sure. Screening test for Down syndrome should occur before the 20th week of pregnancy.

1. Blood (serum) screening
2. Ultrasound screening

Diagnostic test identifies Down syndrome

1. Chorionic villus sampling (CVS)
2. Amniocentesis

If not after the tests, usually at birth by baby's physical characteristics



MYTHS & REALITY ABOUT CHILD WITH DOWN SYNDROME:

S.NO	MYTH	REALITY
I	Down syndrome is a rare genetic disorder	Down syndrome is the most commonly occurring genetic condition. India alone records around 32,000 cases every year.
Ii	Children with Down syndrome must be placed in segregated special education programs.	Children with Down syndrome have been included in regular academic classrooms in schools across the country. They are fully included in the regular classrooms for all subjects with the right kind of professional guidance. The current trend of educational for all is for full inclusion in the social and educational life of the community. Increasingly, individuals with Down syndrome graduate from high school with regular diplomas, participate in post-secondary academic and collage experiences and, in some cases, receive college degrees.
Iii	People with Down syndrome cannot read or write.	People with Down syndrome are capable of learning and many people with Down syndrome are visual learners so for them reading can be a particular strength.
Iv	People with Down syndrome are always sick.	Though people with Down syndrome are at an increased risk for certain medical conditions such as congenital heart defects, respiratory and hearing problems, and thyroid conditions, advances in health care and treatment of these conditions have allowed for most individuals with Down syndrome to lead healthy lives.
V	People with Down syndrome have a short life span	Life expectancy for individuals with Down syndrome has increased dramatically in recent years, with the average life expectancy approaching that of peers without Down syndrome.
Vi	People with Down syndrome have severe cognitive delays.	People with Down syndrome have cognitive delays that are mild to moderate. Children with Down syndrome fully participate in public and private educational programs. Educators and researchers are still discovering the full educational potential of people with Down syndrome.

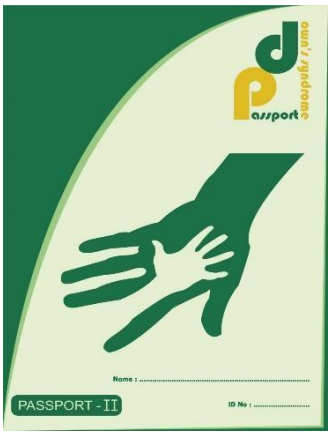
Vii	Children with Down syndrome cannot participate in sports.	Children with Down syndrome can definitely participate in sports and should not be stopped from taking part in sports or team activities. Some of them have won medals in the chosen sports
Viii	Adults with Down syndrome are same as children with Down syndrome	Adults with Down syndrome are not children, and should not be considered children. They enjoy activities and companionship with other adults, and have similar needs and feelings as their typical peers.
Ix	People with Down syndrome are always happy.	People with Down syndrome have feelings just like everyone else in the population. They experience the full range of emotions. They respond to positive expressions of friendship and are hurt and upset by inconsiderate behavior.
X	Most people with Down syndrome are institutionalized.	Today people with Down syndrome live at home with their families and are active participants in the educational, vocational, social, recreational activities of the regular education system and take part in sports, camping, music, art programs and all the other activities of their communities. People with Down syndrome are valued members of their families and their communities, contributing to society in a variety of ways.
xi	Adults with Down syndrome are unemployable.	Businesses are seeking adults with Down syndrome for a variety of positions. They are being employed in small and medium-sized offices: by banks, corporations, nursing homes, hotels and restaurants. They work in the music and entertainment industry, in clerical positions, childcare, the sports field and in the computer industry to name a few.

KNOWING YOUR CHILD WITH DOWN SYNDROME

- It's a child first and then a child with Down syndrome
- A baby with Down syndrome has the same needs as all babies and will develop by being cared for interacted with in the same way all babies do.
- Mother being the first and closest care taker of the baby with Down syndrome, nursing care and feeding should be given priority in the first two month, as it is the first stage of eye contact and communication.
- Communication is the key to any relationship. A child who cannot communicate cannot have their needs addressed in a timely manner. It is vital that parents establish strong communication skills in their children. Some children and young adults with Down syndrome may experience behavioral problems because of ineffective communication.
- If your child has Down syndrome, it will not stop them from achieving developmental milestones. Many people with the condition can still learn physical, mental and social skills that most other people acquire, they just do it at a slower/different pace.
- Children with Down syndrome make gestures to identify objects. If parents identify what that object is and give it a verbal label, then children with Down syndrome are likely to enter that word into spoken vocabulary within the next year as a typically developing child. This makes it even more crucial for parents to assign a word for the gesture. If these opportunities are missed, the child's vocabulary development will be delayed. Translating gestures immediately after they occur allows the child to make the connection between the verbal label and the object of interest more easily. As with typically developing children, even in children with Down syndrome, repetition helps a child enter a word into their vocabulary.
- Most children with Down syndrome do everything their siblings/peers do.
- Children with Down syndrome can think and reason. Their cognitive abilities may be a little delayed but people with Down syndrome can participate, communicate in educational programs and interact well. An extra help from teachers, therapists help them in discovering their fullest potential.
- Be ready to celebrate your child's little achievements and not worry about what they can't.
- Giving a choice is very important for a child with Down syndrome as it lets them think and allow them to perform their daily routine as childhood is a time for growth both physically and mentally. This will help them to grow up as confident and independent adults.
- Never doubt the ability of your child with Down syndrome.
- When children with Down syndrome receive consistent, responsive care and attention from parents and care givers, they are able to establish a sense of trust in the world. This sense of being loved and feeling safe is essential to stimulate areas of development, including physical development. When they feel safe and secure, children use their brain, muscles, and sense to explore the world around them.
- Children/persons with Down syndrome are individuals who have their likes and dislikes which has to be respected.

DOWN SYNDROME PASSPORT – available on the DSFI website

This Down syndrome passport has been developed to ensure continuity of care for children with Down syndrome. This passport can contain information about how to communicate best, knowing their health state, some likes or dislikes of the child. If a document contains all this information and goes with the child, then all care providers will be aware of the information.



EARLY INTERVENTION

WHAT IS EARLY INTERVENTION?

Early intervention is the service and support that are available to babies and children with development delays and disabilities and their families. Early intervention starts from birth to 3 years of age because neural plasticity is greater at this stage.

WHY EARLY INTERVENTION?

Developmental delays and disabilities may require tailored intervention and full-time care in order to maximize function and opportunities. It's important to establish proper intervention strategies early in life. Early intervention for infants and children with Down syndrome can make a difference in realizing their potential and improving their quality of life.

WHO IS PART OF EARLY INTERVENTION?

Early intervention includes physiotherapist, speech therapist and special educators. Early intervention starts with physiotherapy sessions for a child with Down syndrome. When the child is able to maintain sitting posture, speech and special educator's sessions can be started. Special educator's sessions are basically school readiness programs.

IMPORTANCE OF PHYSIOTHERAPY

- Physiotherapy is a critical service, not because it will accelerate a child's rate of development, but because it will improve a child's long-term functional outcome.
- Physical development refers to children's abilities to use and control their bodies.
- Goal is to minimize the development of abnormal compensatory movement patterns that children with Down syndrome are prone to develop.
- Helps motor development progress through a sequence. Repetition and practice of different movements, are building and maintaining connections between brain cells.
- Gross-motor skills involve the mastery of large muscle movements, as well as the building of strength in muscle groups like arms, legs and core (abdomen &spine). Examples of such skills for infants and toddlers include reaching, rolling, crawling and climbing
- Fine-motor skills involve smaller, more precise movements, particularly movements of the hands and fingers, such as grasping. Skill mastery and development are also the result of brain growth and development.
- In children who have Down syndrome the ligaments which stabilize the joints tend to be particularly lax and this, combined with low tone, results in an unusual wide range of movement.
- There are four critical areas in a child's physical development which needs to be improved in children with Down syndrome. They are:

(i) Extremity (arms &legs) strength
(ii) Postural strength
(iii) Postural alignment
(iv) Normalized gait pattern

- When these four critical areas are addressed, the child can develop a body with a solid foundation. This will support exercise and fitness throughout their life span.
- Typically, children develop these four critical milestones naturally, but a child with Down syndrome is prone to develop compensations, therefore, developing physical problems as they grow.
- Physical development/motor development prepare the infants and toddlers for activities that support language development, cognitive (thinking skills) development, emotional development and social skills and other areas of learning.
- Each Child develops at a different pace. What we do is make sure that they are developing and continue to develop at their pace. Goals are more child centric and child specific.
- All the 3 types of Down syndrome have the same physical developmental issues and the physiotherapy approach is the same for all.
- All the exercises that are prescribed in this booklet will be active-assisted movements progressing to active movements. We do not recommend and passive movements for children with Down syndrome, as these children are capable of contracting their muscles unlike children with disorders like Cerebral Palsy and Muscular Dystrophy. They should be allowed to do Active-assisted movements so

that they can achieve all the developmental milestones that a typically growing child does - from neck control to walking.

FEEDING

- Breast feeding is recommended for all babies, but it may be especially beneficial for those with Down syndrome as antibodies in breast milk help build immunity (Children with Down syndrome are at a higher risk of respiratory infections) and it is more easily digested (they are also prone to bowel problems such as constipation).
- Physical process (repeated sucking) involved in breast feeding strengthens jaw, tongue and facial muscles, which helps with future speech and language development.
- Babies with Down syndrome should be introduced to solids at the same time and in the same way as other babies. It may take them a bit longer to co-ordinate the actions needed for eating solids. Remember they are good visual learners, so make meal time a family time.
- Food will be a fascination for your child. So, food offers not only nutritional value, but also tactile and fine motor movements.
- Introduce your child to finger foods (small cubes of foods, sprouts, dried foods etc.) as you would any other child offering different textures and flavours.
- Give them the choice and let them touch and play with different types of food.

GASTROINTESTINAL ISSUES

- The gastrointestinal (GI) system includes all the parts of your body—from mouth to anus—that are involved in the digestion of food.
- Approximately 3% of infants with Down syndrome are born with imperforate anus, 2-5% with Hirschsprung disease, 5% with duodenal obstruction and 1% with tracheoesophageal fistula. This is are easily identified when a physician examines a baby for the first time and can be corrected with a simple surgery.
- 1-5% people with Down syndrome have reflux – medically known as gastro esophageal reflux disorder (GERD) which has significant improvement with medication therapies.
- People with Down syndrome can be constipated for all the same reason that people without Down syndrome become constipated – poor diet and lack of exercise among many reasons. However, people with Down syndrome are also prone to conditions that can result in constipation:
  - **i.** Hyperthyroidism
  - **ii.** Hirschsprung disease
  - **iii.** Celiac disease
  - **iv.** Behavioral concerns
- Celiac disease can range from mild to severe and the symptoms can also vary. The treatment is dietary and involves eliminating all barley, rye and wheat from a person's diet.

PHYSIOTHERAPY APPROACH – GENERAL BODY AWARNESS & JOINT COMPRESSION EXERCISE

GENERAL BODY AWARENESS

- In the early months the tactile (touch), proprioceptive (awareness of where body is in space or position sense) and vestibular (orientation in space without vision) system contribute the greatest percentage of input for the infant.
- Tactile stimulation is a valuable tool in helping to increase body awareness and tone. It will help the child to relate touch and position and begin to make them aware of their body parts. In the early months a baby will take objects to his mouth (this is called mouthing). This provides sensory stimulation, and the body should be positioned so that they can explore their hands and feet with mouth as well.
- Proprioception input, together with integration of tactile and vestibular information, provides the child with awareness of the position of their body in space and of movement and it increases tone. This input involves any kind of activity which gives gentle compression or distraction to the joints.

JOINT COMPRESSION EXERCISE

- Physiotherapy session for toddlers with Down syndrome should start with joint compression exercise.
- It is done for the weight bearing joints in our body – shoulder joint, elbow joint, wrist joint, hip joint, knee joint and ankle joint.

METHOD

I. Child lying on the back on exercise mattress or firm surface. Hold the arm and leg away from the body in sagittal plane (90 degree away from body facing the celling).
II. Place your one hand below the joint (for support) to be compressed and other hand above the joint (to move).
III. Move the hand above the joint downward giving a compressive force to the joint.
IV. Hold the joint compression for 2 minutes and release the joint and repeat the same for 10 counts, twice a day recommend in all joints mentioned above.

fig 1a

fig 2a

fig 3a

joint compression exercise shoulder-fig 1 a, elbow-fig 2a, wrist-fig 3a

fig 4a

fig 5a

fig 6a

joint compression exercise hip-fig 4a, knee-fig 5a, ankle-fig6a

PHYSIOTHERAPY APPROACH– NECK CONTROL AND ROLLING OVER

NECK CONTROL

- Development of neck control is the starting point for movement control of the body
- Reason for no neck control can be delayed maturation of nervous system, hypotonia of the muscles of the head and trunk, dislike of lying on tummy, lack of handling or lack of drive.
- Head movement and neck control are key factors in the baby's development and unnecessary delay in this area will cause more delayed development.

METHOD

i. TUMMY TIME – Position your baby on the stomach often during the day on a mat/floor as shown in fig 1b. This position encourages movement of head, resulting in strengthening neck and gradually extends to the spine (back muscles), arms and hips. Use a rattle toy and encourage head movement in semicircular and upward directions, while lying on the stomach.

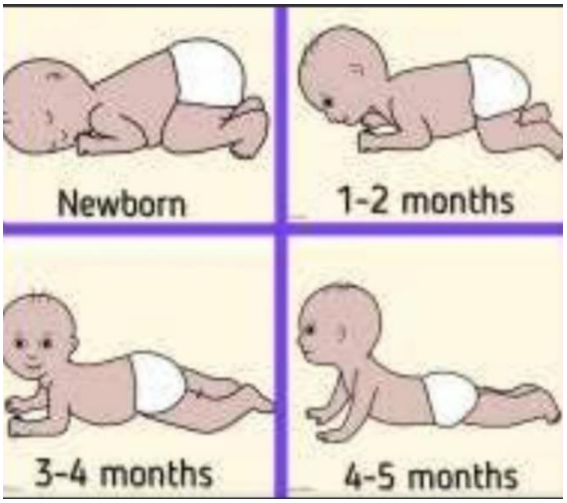


fig 1b

tummy time-fig 1b

ii. BOLSTER / ROLLED TOWEL EXERCISE – Use a rolled nappy or towel, under the armpits such that the chest is raised up. Care taker sits behind and place your leg below the child's knee crease (popliteal fossa), so that the lower part of child's body is stabilized and bring the child's head to the midline placing your hand under baby's chin to hold the head up as shown in the fig 2b and move the head right and left in a semicircle and then move head upward.


fig 2b

neck control exercise semicircular movement-fig 2b

As head control develops (partial neck control achieved) support can be removed from the chin and you can see, child starts stretching both hands and tries to bear the weight as shown in fig 3b. Use rattle toy to encourage head movement from right to left and in a semicircle and then upward.



fig 3b

neck control exercise with partial control-fig 3b

ROLLING OVER

- Your baby will not roll until semi/partial neck control is achieved. Ability to rotate trunk is also a pre-requisite for rolling.

METHOD

i. Position your child on the back.
ii. Bend child's one knee – opposite to the side of rolling.
iii. Stretch child's shoulder above the head – on the side of rolling (so the child can roll over easily).
iv. Gently give a mild push on the bend knee sideways to facilitate rolling and hold the position and wait till your child lifts off his shoulder and starts rotating the trunk to roll and come to tummy position (on stomach).

v. When rolling the child from his stomach to back the same method is used. Bend the knee up under and push it towards the opposite shoulder, keeping it as close to the body as possible.
vi. Repeat the same on the other side. Rolling should be encouraged on both sides.
vii. Repeat the movement on either side for 6 counts, twice a day recommended.



fig 1c fig 2c fig 3c

rolling over exercise-fig 1c starting of rolling, fig 2c partially rolled, fig 3c rolled on tummy

RELATED ACTIVITY

- Gross motor activity – Holding, grasping and reaching out activity can be encouraged while working with this milestone.

PHYSIOTHERAPY APPROACH – HIP RAISING & SITTING

HIP RAISING

- Hip lifts tone the back (spinal erector) muscles, which boosts core strength for improved power and performance in every activity we do.
- Hip raising is a very important exercise for a child with Down syndrome as it plays a crucial role in all locomotive movements – walking, running, crawling, jumping, hopping, marching, climbing, galloping, sliding, leaping & skipping.
- It is advisable to continue hip raising exercise till your child walks independently.

METHOD

i. Place the child on the back (supine lying) with both knees bend.
ii. Place your leg gently on child's ankle to stabilize the foot and hold the knee in bend position.

iii. Stimulate the hip (anywhere from the sides to the spine (PSIS) behind, such that the child raises the hip.

iv. Initially, child will only lift their hip and lower it but as you keep doing the exercise, child will raise and hold the hip in raised position for few counts and then release. Start with 20 counts and later progress it to 200 counts, twice a day recommended.

v. Child should be actively raising the hip and holding it for few counts and not you passively lifting the hip. The child has to actively contract the muscles (which will happen with repeated practice), lift the hip and hold the position all through the count, only then it will be beneficial for them.

fig 1d

fig 1d side view

hip raising exercise starting-fig 1d

fig 2d

hip raising holding up-fig 2d

SITTING

- When the child attains complete neck control, child may be positioned in sitting for longer periods. This position is useful for the facilitation and strengthening of back extension and the development of postural control.
- Sitting is not a static state – limb and trunk movements are to be encouraged while your child is in the sitting position.
- The more the time a child spends in different sitting positions (side sitting, long sitting, cross sitting and high sitting – sitting posture recommended in Down syndrome child), better will be the sitting balance and child will soon be able to sit

up independently and perform activities in sitting as it requires a lot of coordinated muscle contraction and stability which happens on repetition of the movements.

METHOD

i. SIDE SITTING – Place your child in sitting with both knees bent to one side and arms stretched on the other side, keeping child's elbow straight with your hand and hold the position for 200 counts, twice a day recommended. Repeat the same switching the side.

fig 1e

side sitting exercise-fig 1e

ii. LONG SITTING – Place child in sitting with legs stretched straight and arms by the side, keeping child's elbow straight with your hand and hold the position for 200 counts, twice a day recommended.

fig 2e

long sitting exercise-fig 2e

iii. CROSS SITTING – Place your child in sitting with legs crossed and arms stretched in front, keeping child's elbow straight with your hand and hold the position for 200 counts, twice a day recommended.

fig 3e

cross sitting exercise-fig 3e

iv. LYING TO SITTING – Place your child in side lying in front of you. Bend child's hip & knee. Place your hand on child's upper back (between the shoulder blades) and gently assist child's sitting up position.

fig 4e

lying to sitting exercise starting position-fig 4e

fig 5e

lying to sitting exercise finished position-fig 5e

v. PICKING UP/PULL UP – Place your child lying on the back and put your leg on the child's knee to stabilize the legs and gently pull, holding child's arm above the elbow (not wrist), as to come up to sitting. Don't just pull child up but give a little pull (i.e. "take the slack"), wait till you can feel the response of child's muscle contracting, then gently help the child into sitting position. You will notice the use of trunk rotation.

fig 6e

pull up exercise starting position-fig 6e

fig 7e

pull up exercise finished position-fig 7e

vi. WALL CONER SITTING – Make the child sit on floor in a wall corner, legs crossed and in long sitting. Initially for 5 minutes

fig 8e

wall corner sitting position-fig 8e

SITTING POSITION TO BE AVOIDED – W sitting can tighten and shorten the muscles of the legs which can cause 'pigeon-toed' walking. Causes long term postural problems & back pain

w sitting-fig 9e

SITTING BALANCE

Stage I: Cup your hand around the child's shoulders and sway from side to side. Initially only a gentle swaying movement is attempted. As child improves the swaying can be increased gradually until child's opposite buttock lifts off the mat.

Stage II: Hold child's hip and knee (knee bend in crook sitting) and slowly tip the child sideways and then forwards and backwards. When tipped to one side, child will bring their head and trunk to the midline and when tipped backwards, will bring their trunk and head forward in an attempt to right themselves in sitting position.

RELATED ACTIVITY

- As child's sitting balance improves, you make them sit on a low stool and encourage them to reach out to the side. This also elicit good active trunk rotation.
- Both gross motor and fine motor activities can be encouraged in sitting position.

PHYSIOTHERAPY APPROACH – OROMOTOR EXERCISES

OROMOTOR

- Oro-motor skills refers to the movements of the muscles of the face – mouth, jaw, tongue and lips
- Oro-motor skills plays a large role in the child's development and are essential in speech and feeding process.

METHOD - should be performed with hold and release technique for 5 seconds

STAGE I

i. Facial muscle activation
ii. Tongue push and pull exercise
iii. Lip retraction and protrusion

STAGE II – At this stage, make the child do the exercises in front of a mirror for visual feedback.

i. Active facial movements
ii. Tongue movements – up and Down and sideways
iii. Clockwise and anticlockwise circular movements of tongue
iv. Moving air from one cheek to another
v. Lip retraction and protrusion
vi. Side to side movements of jaw

PHYSIOTHERAPY APPROACH – CRAWLING / CROSS CRAWL

- Crawling is important for brain development (cognition, problem solving) as well as for vestibular/balance system, sensory system, strengthen bone and muscles and coordination of movements.
- Criss-cross movement of child's hands and knees through the body support causes Criss-crossing of information in the brain. That is, crawling helps develop their band of nerves that allow the hemispheres of child's brain to communicate with each other.
- It lays a strong foundation for more advanced forms of mobility.

FIRST SIGN OF CRAWLING

- Doing mini push ups
- Doing a 'swimming' movement on their tummy or rocking back and forth.

THREE STAGES OF CRAWLING

i. Balance in static position – child learns to balance on all four limbs.
ii. Shifting weight – child learns to move body weight backwards & forwards and side to side and on alternative arms and legs whilst maintaining balance.
iii. Crawling – child learns to move on all four limbs.

DIFFERENT STYLES OF CRAWLING

i. Classic crawl – moving one arm and opposite leg together.
ii. Backward crawl – most children with Down syndrome start with moving backward, remember any motion is good.
iii. Commando crawl – lying on their tummy but using arms to move forward.
iv. Scoot – dragging their bottom across the floor.
v. Crab crawl – propelling forward with one knee bent and the other extended.

METHOD

i. Probing – Place your child on your lap such that the child's chest and lower part of the body is fully supported on your lap. Stretch child's arm with elbow straight and in locked position (push child's elbow bone forward to lock the elbow) and allow the child to weight bear on their hands. Hold the position for 200 counts, twice a day recommended. This position prepares the child for crawling movement as it helps in strengthening the muscles of upper limb to move forward in crawling.
Child's elbow should not be bend or hyperextended (during the hold) as it may prevent development of muscular control around the elbow.

fig 1f

fig 2f

probing exercise hand position-fig 1f, leg position-fig 2f

ii. Crawling position – Place your child on tummy (prone lying). Place your leg on child's calf (below knee crease-popliteal fossa) and pull the child's hip up and backward to bring on knees and another care taker (sitting in front of the child), bring the child up to weight bear on their hand with elbow straight and in locked position. Hold the position for 200 counts, twice a day recommended.

fig 2f

crawling position exercise-fig 2f

iii. Crawling movement – Bring the child to crawling position. With two-person (care taker) support move the child's arm and legs alternatively forward. This will help the child to learn the coordinated alternative movements of arms and legs in moving forward in crawling.

fig 3f

crawling movement (right arm & left leg)-fig 3f

fig 4f

crawling movement (left arm & right leg)-fig 4f

iv. Crawling movement using a sling – Pass a sling under child's belly and hold either side and encourage the child to move forward by placing a toy in front

fig 5f

crawling movement using a sling-fig 5f

RELATED ACTIVITY

- Place a toy just out of reach to encourage them to stretch forward in creeping and crawling position.
- Bring the child to probing position as mentioned above and try walking the child along on their hand (arm walking). This can be done as play activity but this helps in increasing upper arm strength, needed for moving the body forward in crisscross crawling movement.
- Bring the child in crawling position and gently rock backward and forward or from side to side. This encourages stability in the position and also allows your child to feel the weight through their arms and legs. They will the do this often before attempting to crawl.
- Encourage the child to crawl forward by placing a bright object or toy nearby so that child can crawl towards it.
- Making the child sit in vajrasana pose/thunderbolt pose is very beneficial for a child with Down syndrome as it strengthens the pelvic muscles, increasing blood flow to the stomach – aiding in digestion and relieving or preventing constipation.

PHYSIOTHERAPY APPROACH – SIT TO STAND

- This phase is to prepare the child for self-standing. Children with Down syndrome show greater postural sway during sit to stand than typical children.

METHOD

i. Kneeling – Make the child sit on knees and place your leg on the child's calf to stabilize child's lower part of the body. Support the child's trunk and hold the position for 200 counts, twice a day recommended.

fig 1g

kneeling exercise-fig 1g

ii. Half kneeling – Make the child sit on knees and place your leg on the child's calf to stabilize child's lower part of the body. Gently pull one hip out, so that child weight is on the foot (hip and knee bend in right angles – 90*). You may place your hand over child's hip or the upright knee if child needs extra stabilization for balance. Hold the position for 200 counts, twice a day recommended.
Repeat the same on the other side.

fig 2g

fig 3g

half kneeling exercise position on right knee-fig 2g , position on left knee-fig 3g

iii. Sit to stand – Make the child sit in squatting position in front of you. Place your hand in child's hip and stimulate at the waist, so that the child pulls up to standing. Repeat this movement for 10 counts, twice a day recommended.

fig 3g

sit to stand starting position-fig 3g

fig 4g

sit to stand end position-fig 4g

RELATED ACTIVITY

- To encourage self-standing, make the child to sit near a low stable object (e.g., couch or coffee table), so that the child can hold on to. Place a toy on the table in such a way that the child will have to stand to reach it.

PHYSIOTHERAPY APPROACH – STANDING

- If your child is able to stand independently, this is a valuable time for developing a good basis for walking, so give them plenty of time to practice.

METHOD

i. Initiate standing – Place your one hand over the child's knees and other hand behind the bottom (gluteal region), to help the child up to standing position. Hold the position for 200 counts, twice a day recommended.

ii. Standing against the wall – Make the child stand in the wall corner with knees straight, locked in neutral position with your hand and maintain a normal base of support (usually children with Down syndrome stand with a wide base of support). Hold the position for 5 minutes.
Progression – when your child can stand for 5 minutes without buckling of knees, make the child stand against the wall (not corner) without support for 5 minutes and gradually increase the time, twice a day recommended.

iii. Standing balance – Make your child stand with a ball at the back against the wall. This will help in reducing the base of support against wall and challenge balance in standing. Hold the position for 5 minutes, twice a day recommended.

fig 1h

standing balance with a ball-fig 1h

iv. Standing balance with forward movement – Make your child stand with a ball at the back against the wall and encourage the child to reach forward by showing a toy to disturb their balance while standing. Repeating this will enable them to improve their standing balance further.

fig 2h

standing balance with forward movement-fig 2h

v. Bending – Child standing with back facing you, lock the child's knee in neutral position with your one hand and bend the child at the pelvis forward (bending forward from standing) and encourage the child to come up to standing by showing toy or with voice. This strengthens the core muscles.

fig 3h

bending exercise starting position-fig 3h

fig 4h

bending exercise finishing position-fig 4h

RELATED ACTIVITY

- Weight bearing through their legs by bouncing up and down on your lap – suggested that this builds up the supportive reflex and conditions your child to taking weight on the soles of their feet.
- Weight transfer sideways and forwards are prerequisite for walking and thus an important step in the progression.

PHYSIOTHERAPY APPROACH – WALKING

- Child's first independent steps are always a long-awaited milestone for a parent. Remember that it is the quality of movement that is important and "the first steps" will happen in their own good times.

METHOD

i. Knee rotation – This exercise helps to correct the lower limb alignment before encouraging walking. Child in standing position, first care taker sits behind and cup the child's knee in front such that the thumb is on the lateral border of the knee and fingers on the patella. Second caretaker sits in front and supports the child's waist (to stabilize the upper body) and stabilize child's ankle between your web space of big toe and 2nd toe. Rotate child's knee outward such that the care takers thumb moves behind to popliteal fossa and fingers to the lateral border of the knee.

fig 1i

knee rotation exercise locking position-fig 1i

ii. Side stepping – Child standing against a low stable object (e.g., couch or coffee table). Encourage your child to take a sideway step by lifting the right leg and place it few inches closer to child's left leg. Child will then shift left leg further to the left in an effort to regain initial "comfortable" base. Repeat the same in the opposite direction.

iii. Knee walking – Child in kneeling position, first caretaker kneels and hold the child's bend knee from behind (to assist the movement) and second caretaker supports the child at the armpit in front. Move the child in knee walking forward.

fig 2i

knee walking exercise-fig 2i

iv. Walking forward with support – It is advisable and recommendable to use traditional wooden walker ideal for your child's height. Initially assist the child in moving the wooden walker by gently pushing the walker forward, walking by your child's side.

Once the child gains more control, will move the walker forward without assistance from you. On reaching this stage, use a small sandbag tied near the front wheel of the walker to increase the complexity of the movement as a progressive phase.

fig 3i

traditional wooden walker-fig 3i

GAIT (WALKING PATTERN) CORRECTION TECHNIQUES

i) Figure of eight walking – Draw a huge 8 on the floor and make the child walk with in the 8. Infinity walking method also called "figure eight walking" stimulates the movement, sight, hearing, thinking and speaking senses.

What are the developmental benefits associated with the Infinity Walk?

- Improves communication between the two hemispheres of one's brain as well as both sides of his/her body.
- Increased complete and automatic coordination of the body.
- Improves the ability to control both eyes together as well as one's capacity to visually track an object or person.

What are the functional benefits associated with the Infinity Walk?

- Prepares the brain for learning.
- Improves concentration and the ability to reason efficiently.
- Improves coordination for sports involving a ball or other moving object.


fig 4i

figure of eight walking method-fig 4i

ii) Walking with in a narrow path – Mark parallel line on the floor and place a large mirror in front for visual feedback, ask the child to walk with in the parallel lines as it will help in reducing the wide gait pattern usually seen in child with Down syndrome.


fig 5i

Walking with in narrow path-fig 5i

RELATED ACTIVITY

- To encourage independent walking – make the child stand with back to the wall support and play games like "clap hands" which may be used to encourage your child to stand without support of the wall. Once the child can do this, then move a short distance away, so that your child actually has to take steps to reach you or object you are holding.
- When child can take independent steps, give light objects (progress to able to carry) to carry while walking

PHYSIOTHERAPY APPROACH – IMPORTANCE OF JUMPING

- Jumping is a significant gross motor skill.
- Jumping may not seem like an important development milestone for children, but it's one of the activities that children need for better gross motor strength, proprioception, motor planning, balance and core muscle development.
- Without this development, child's lower level of brain (cerebellum) used for balance, coordination, attention and rhythm could become under developed which could lead to delay in learning, sensory behavior or attention and focus issues in the classroom.
- When a child begins to jump - the joints, muscles and ligaments in their hips, knees, ankle and feet will become stronger for better proprioception.

BENEFITS OF JUMPING

i. Muscle strength – requires a lot of strength and power, thus contributing to develop muscles that are important for all gross motor movement.
ii. Bone strength – jumping puts a good kind of stress on bones, the kind that helps them grow and harden.
iii. Balance – jumping employs a new level of balance for the child
iv. Motor planning & sequencing – skill that allows us to plan & execute our movements in order to safely navigate our environment. Child uses motor planning, to judge distance, evaluate how much power is required to jump and land. Plan the movement and execute the jump in proper sequence.
v. Social interaction – gives child the confidence to participate in all activities, games and sports that involve valuable social skills

HOW NOT TO INITIATE JUMPING IN KID'S WITH DOWN SYNDROME

- Using a trampoline to encourage / initiate jumping is absolutely not advisable.
- Trampoline may promote stunted growth in children.
- Prone to neck injury – Craniocervical instability (atlantoaxial instability and occipital axial instability) is a concern in children with Down syndrome.
- High risk of injury – sprains & fractures.

HOW TO INITIATE JUMPING IN KID'S WITH DOWN SYNDROME

i. Hold your child's hands and jump along with your child, upward thrust you create while holding their hand will encourage them to do it. Initially child will only lift the heel off the ground and toes still on the ground. Ask your child to look at your leg while jumping, to observe your foot off the ground while jumping. With regular practice, child will gain confidence and start jumping with both feet off the ground.

ii. Make your child stand on a foot stool and encourage to jump down.

iii. Introduce hurdle (small bowl) jumping – Initially place hurdle in a linear pattern and then progress to zigzag pattern.

iv. Introduce games involve jumping, skipping and running.

PHYSIOTHERAPY APPROACH – AQUATIC THERAPY / HYDROTHERAPY

- Aquatic therapy is physical therapy that takes place in a pool or any other aquatic environment under the supervision of a trained health care professional.
- Aquatic therapy is a supplement to regular physiotherapy
- Like other physiotherapy approaches, the aim of aquatic therapy is to enhance the ability to perform daily activities.
- Aquatic therapy also known as water therapy, aquatic rehabilitation, aqua therapy, pool therapy, therapeutic aquatic exercises or hydrotherapy.
- Properties of water such as buoyancy, hydrostatic pressure and fluid resistance when utilized with aquatic exercises have shown to have a positive impact on range of motion, strength, proprioception, core stability and gait.
- Aquatic therapy programs incorporate many of the same activities of physiotherapy that would be used for regular therapy, such as stretching, resistive exercise, aerobic exercise and endurance and motor skills. It also incorporates adjustment to water, functional independence, control of movement in the water, rotation, swimming and respiratory activities.
- Pediatric aquatic therapy program was designed based on the Halliwick concept, which combines play, fun, self-help skills and impairment related goals.

BENEFITS OF WATER'S NATURAL PROPERTIES

i. Buoyancy – allows for flotation (weight reduction) and decreases the compressive force (effect of gravity) on joints and muscles, resulting in a more fluid active movement for children.
ii. Viscosity or resistance – can be used for muscle strengthening and increasing trunk stabilization.
iii. Turbulence and wave propagation – let the therapist gently manipulate the child through the desired movements.
iv. Hydrostatic pressure – improve tolerance to multisensory stimuli and increase circulation due to the effects of hydrostatic pressure.

WHAT DOES AQUATIC THERAPY FOR CHILDREN WITH DOWN SYNDROME INVOLVE?

i. Balance exercises
ii. Proprioceptive exercises
iii. Strengthening exercises
iv. Core stability exercises
v. Mobility – assisting with gait and locomotion
vi. Cardiovascular endurance
vii. Weight reduction
viii. Relaxation exercises
ix. Respiratory muscles are forced to work harder in the water, allowing for a natural strengthening that benefits the child long after the therapy sessions has ended.

WHAT ARE THE ADVANTAGES OF AQUATIC THERAPY FOR CHILDREN WITH DOWN SYNDROME?

i. Faster milestone development
ii. Improve gross motor skills
iii. A fun and engaging environment
iv. Relaxing
v. Safe
vi. Improve fitness
vii. Confidence with social interactions and play

CRITERIA FOR STARTING AQUATIC SESSIONS

- Complete neck control
- No cardiac issues

Children with Downs syndrome generally show apathy and lack of motivation towards physical exercises. In this regard, it has been observed that young adults with Down syndrome engage more easily in fun physical activities carried out in a stimulating environment. Therefore, this fun filled and motivating training programs impart better results in persons with Downs syndrome than the conventional rehabilitation procedures.

PAPER PUBLISHED ON AQUATIC THERAPY FOR DOWN SYNDROME TODDLERS

(Complete paper available online)

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Research Article

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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UNDERSTANDING AGING - ADOLESCENCE TO ADULTHOOD IN PERSONS WITH DOWN SYNDROME

AGEING AND DOWN SYNDROME

- Changes in body function and structure secondary to aging have the potential to lead to activity limitation and participation restriction for this population.

CHANGES IN BODY STRUCTURE AND FUNCTION ASSOCIATED WITH AGING IN DOWN SYNDROME

- As individuals with Down syndrome age, they are more susceptible to age-related physical and neurological or psychiatric conditions than the general population.
- Physical conditions related to thyroid dysfunction, cardiovascular disorders, obesity and musculoskeletal disorders.
- Neurological or psychiatric conditions like Alzheimer diseases and depression.
- Thyroid dysfunction – Adults with Down syndrome are at risk for developing both hyperthyroid and hypothyroid conditions as they age, with hypothyroid being more common. By adulthood approximately 40% of all people with Down syndrome will develop hypothyroidism. Untreated hypothyroidism can often lead to symptoms that mimic a decline in cognitive skills, therefore individuals may be misdiagnosed as having Alzheimer's
- Symptoms of hypothyroid in individuals with Down syndrome are:
  i. Decreased energy
  ii. Decreased motivation

iii. Weight gain
iv. Constipation
v. Bradycardia – lower heart rate
vi. Dry skin

- Cardiovascular disorders – Mitral valve prolapse is reported to occur in 46% to 57% of adults with Down syndrome. Mitral valve prolapse can occur even in adults with Down syndrome who have no previous history of cardiac pathology.
- Early signs of mitral valve prolapse are:
  i. Fatigue
  ii. Irritability
  iii. Weight gain
  iv. Dyspnea with physical activity
  v. Bilateral crackle that does not clear with a cough, and a third heart sound
- Lower cardiovascular capacity in adults may be secondary to a lower lean body muscle mass, lower muscle strength, thyroid disorders, hypotonic muscle tone, higher incidences of obesity or an impaired sympathetic response (lower peak heartrate and blood lactate concentration) to exercise.
- Obesity – Adults with Down syndrome have also reported high rates of obesity. Some studies have suggested that adults with Down syndrome tend to lead a sedentary lifestyle, which results in increased rate of obesity. Lower resting metabolic rate was a cause of increased rate of obesity in individuals with Down syndrome. Lower metabolic rate in children with Down syndrome may predispose them to obesity as adults. When the presence of thyroid disease was controlled, the resting metabolic rate in adults with Down syndrome was similar to that in the general population.
- Musculoskeletal disorders – Because of premature aging, adults with Down syndrome might experience musculoskeletal disorders usually associated with elderly individuals earlier than the general population.
  i. Juvenile arthritis like arthropathy develops in approximately 1% to 2% of adolescents with Down syndrome.
  ii. Mid- cervical arthritis
  iii. Hip dysplasia with dislocations – progressive hip instability after skeletal maturity in individuals with Down syndrome, which led to a decrease in ambulation skills.
  iv. Foot pronation may lead to an increased incidence of pedal arthritis in adults with Down syndrome.
  v. Osteoporosis – may be secondary to decreased physical activity, early menopause, thyroid disease.

EXERCISES IN YOUNG ADULTS WITH DOWN SYNDROME

- Physical exercises are safe for individuals with Down syndrome.
- Exercise program should be taking into account the specific physiological needs of persons with Down syndrome.
- Exercises have a clear benefit for individuals with Down syndrome both in terms of cardiovascular and neuromuscular responses.
- Basic function and vocational performance are positively affected by exercises.
- Regular exercise facilities the release of nitrate oxide, causing vasodilation of blood vessels and thereby enhancing blood flow.
- Regular aerobic exercises, reduce cardio metabolic risk profile of persons with Down syndrome.
- Exercise training on muscle strength – use a combination of cardiovascular and strength exercise.
- Because of the physiological impairments related to Down syndrome such as low oxygen respiratory exchange ratio of oxygen, longer training duration should be used to improve aerobic fitness in individuals with Down syndrome.
- Individuals with Down syndrome often have mild to moderate obesity so, frequency and duration of physical exercise intervention should be increased to improve their body composition compared with the general population.
- Individuals with Down syndrome can benefit from activities such as weight bearing exercises, treadmill walking and balance exercises.

REASON WHY EXERCISES ARE IMPORTANT FOR YOUNG ADULTS WITH DOWNSYNDROME

- Aerobic capacity (VO2 peak) in youth and adults with Downs syndrome is reduced in comparison to their neurotypical peers.
- Studies suggest that, adolescents with Down syndrome generally do not show improvement in muscular strength beyond the age of 14 years. Adolescents with Down syndrome exhibit weak knee extensor strength compared to typical children and adolescents.
- Metabolic function, limiting exercise performance in youth with Down syndrome.
- Physical activity is lowered and sedentary behavior is higher in older youths with Down syndrome when compared to younger ones.
- Prevalence of overweight and obesity are substantially higher in individuals with Down syndrome compared to their age matched typical peers

PHYSIOTHERAPY APPROACH FOR YOUNG ADULTS WITH DOWNS SYNDROME

- Physical fitness – ability of body system to work together efficiently to allow you to be healthy and perform activities of daily living.
- Physical fitness – cardiovascular fitness, muscle strength & endurance and body composition.
- Intervention in physical fitness is aerobic training, balance training and progressive resistance training.
- Strength training is a safe and important component of exercise prescription in young adults with Down syndrome.
- Physical activity – simple skeletal muscle movements of the body that uses energy.
- Physical activity should be age-appropriate, enjoyable and offer variety.
- Physical activity may be influenced by a person's health status, functional profile, participation in life activities and contextual factors – either within the person or in the environment.
- Acute health problems might present barriers to physical activity for youth with Down syndrome. However, when medical issues are efficiently overcome, physical activity may be facilitated.
- Physical activity promotion must be multi-factorial – it should be adapted to the physiological, cognitive and psycho-social profiles of youth with Down syndrome, and should also take into consideration environmental modifications.
- Engaging in regular physical activity has been shown to improve both cardiorespiratory fitness and muscle strength in persons with Down syndrome. These improvements help to maintain functional ability and independence.

HOW TO PROMOTE PHYSICAL ACTIVITY IN YOUTH WITH DOWNS SYNDROME

i. Wide range of recreational activities including swimming, bowling, dancing, skating, bicycling and team sports.
ii. Chose an activity that they will enjoy or want to do
iii. Encourage childhood games that are traditional and active such as hopscotch, hide & seek or obstacle courses.
iv. Use simple ways to get them to be more physically active in daily life such as walking to nearby shops, taking the stairs instead of lift or walking the family dog.
v. Running, jumping and dancing are great physical activities to build their fitness and there are no-cost considerations.
vi. Give them lots of positive and encouraging feedbacks.

CONCLUSION

Physiotherapist may offer interventional services to children with Down syndrome, who aim to improvise their motor and fine motor skills and create a platform to enhance their development with better quality and longevity. But it is not just the therapist who performs the intervention 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. Regular practice at home is essential for improvement and family participation is the key.

Individuals with Down syndrome face many challenges as they age, including a number of age-related conditions that could lead to activity limitation and participation restriction. Exercise programs appear to have the potential to positively affect the overall health of adults with Down syndrome, thereby increasing the quality of life and years of healthy life for these individuals.

So, I emphasize the importance of consistent exercise, good healthy diet habits, community involvement and regular health examinations throughout their life. This will help these children and their families to increase the years and quality of their life.