A Comparative Efficacy to Analyse the Effect of Structured Therapy and Dual Task Training on Gait among Pediatric Population with Developmental Coordination Disorder-An Experimental Study

Dr. Aneri Patwari[1], Bharti Prajapati[2], Krupa Panchal[3]

[1]I/C Principal, Smt Shantagauri Rasiklal Shah (Rangwala) College Of Physiotherapy
[2,3]Smt Shantagauri Rasiklal Shah (Rangwala) College Of Physiotherapy

ABSTRACT:
Background: Developmental Coordination Disorder (DCD) is a neurodevelopmental disorder characterized by poor motor coordination, balance deficits, and gait abnormalities that interfere with daily activities and participation. Physiotherapy interventions such as structured therapy and dual-task training are commonly used to improve gait performance in children with DCD
Methodology: A 40 participates comparative experimental study will be conducted among children diagnosed with DCD. Participants will be randomly allocated into two groups. Group A will receive structured therapy focusing gait exercises, while Group B will receive dual-task training combining motor and cognitive tasks during walking asseses by DGI. Both groups will undergo intervention for a specified duration. Gait parameters will be assessed before and after treatment using standardized outcome measures.
Result: Both interventions are expected to improve gait performance; however, dual-task training may demonstrate greater improvements in gait speed, balance, stride length, and functional mobility due to enhanced cognitive-motor integration ($p<0.05$).
Conclusion: This study aims to determine the more effective intervention for improving gait in children with DCD. The findings may assist physiotherapists in selecting evidence-based rehabilitation strategies to enhance mobility and functional independence in the pediatric population.

Keywords: Developmental Coordination Disorder (DCD), structured therapy, dualtask training, gait, pediatric rehabilitation, physiotherapy.

INTRODUCTION:

There are two types of paediatric disorders: Acquired paediatric disorders, Congenital paediatric disorders 1. Acquired paediatric disorders are conditions developing after birth due to injury, infection, or environmental factors rather than genetic inheritance. Key examples include Acquired Cerebral Palsy (brain damage within 2–5 years of life), Traumatic Brain Injury (TBI), acquired limb deficiencies (trauma/infection), and acquired heart conditions.[1] 2. Congenital paediatric disorders According to the

WHO, congenital anomalies or birth defects affect one in every 33 infants every year worldwide and result in approximately 3.2 million birth defect-related disabilities every year. The prevalence of major congenital anomalies is 23.9 per 1,000 births for 2003-2007. 80% were live births. 2.5% of live births with congenital anomaly died in the first week of life. 2.0% were stillbirths or fetal deaths from 20 weeks gestation. 17.6% of all cases were terminations of pregnancy following prenatal diagnosis [1] Developmental disabilities are a diverse group of severe chronic conditions that are due to mental and/or physical impairments. People with developmental disabilities have problems with major life activities such as language, mobility, learning, self-help, and independent living."[2] Developmental disabilities (DD) includes conditions such as[: 3] Attention deficit hyperactivity disorder [(ADHD),] Autism, Intellectual disability, Learning difficulties (e.g. developmental coordination disorder (DCD) / dyspraxia, auditory processing disorder), Blindness, Cerebral palsy, Moderate to profound hearing loss, Seizures, Stuttering / stammering, Other developmental delay. It is a common and chronic disorder resulting in considerable consequences in daily life. Prevalence estimates of 5–6% are most frequently quoted in the literature [2,3] but ranges in reports between 1.4% and 19%, making it one of the more common childhood disorders [4]. At least 2% of all individuals with normal intelligence experience severe consequences of motor coordination difficulties in everyday living including academic performance, and a further 3% have a degree of functional impairment in activities of daily living (ADL) [5.] Children with DCD have been found to have smaller volumes of neuroanatomical structures, such as the cerebellum and basal ganglia, suggesting the possibility of delayed development of these areas in the brain [6]. In addition, magnetic resonance imaging (MRI) studies have linked the parietal lobe and parts of the frontal lobe as aetiological factors contributing to the diagnosis of DCD.[7] CAUSES WILL BE Motor control processes depend on the integrated functioning of the sensory, perceptual, cognitive and motor systems. It is, therefore, difficult to determine the location and nature of this neural deficiency.[8] The heterogenous presentation of DCD also makes it to challenging to identify the pathophysiology. It has been hypothesized and symptoms of DCD, including compromised manual dexterity. [9] In addition, current evidence reports a significantly higher risk in premature and/low birth weight children, those with delayed walking after 15 months and abnormalities in neurotransmission.[10]

According to the DSM-5, the diagnostic criteria for DCD includes the following[25]: In children, DCD may exhibit as delays in early development of sitting, crawling, walking; poor ability or difficulties with childhood activities such as running, jumping, hopping, catching, sports and swimming; slowness; frequent tripping and bruising; poor handwriting skills; difficulties with self care; difficulties with skills such as using cutlery or tying shoelaces; poor spatial understanding; difficulty following instructions; poor time management; and often losing objects.[11] Evidence from research and clinical practice indicates that DCD is not just a physical disorder, and there may be deficits in executive functions, behavioural organisation and emotional regulation that extend beyond the motor impairments and which are independent of diagnoses of co-morbidities.[12] In addition to the physical or motor impairments, developmental coordination disorder is associated with problems with memory, especially working memory.[13] This typically results in difficulty remembering instructions, difficulty organizing one's time and remembering deadlines, increased propensity to lose things or problems carrying out tasks which require remembering several steps in sequence (such as cooking). Whilst most of the general population experience these problems to some extent, they have a much more significant impact on the lives of dyspraxic people[14.] Measurement of DCD is by Developmental Coordination Disorder Questionnaire (DCD-Q)10[25] Physical therapy or occupational therapy can help those living with the condition. Physical therapy for children with developmental coordination disorder focuses on improving motor skills, coordination, and efficiency of movements. This is done through task-oriented activities and neuromotor training. Research suggests that early and individualized PT programs may result in fundamental improvements in motor skills and daily functioning.[15] Some people with the condition find it helpful to find alternative ways of carrying out tasks or organizing themselves, such as typing on a laptop instead of writing by hand, or using diaries and calendars to keep organized.[16] A review completed in 2017 by Cochrane of task-oriented interventions for DCD resulted in inconsistent findings and a call for further research and randomized controlled trials.[16] Among the common symptoms of DCD are motor impair ments such as deficits in posture, gait and upper limb control [17,18,19,20] as well as cognitive dysfunction such as reductions in inhibition and cognitive flexibility [17,21]. In addition, cognitive motor interference (CMI) is also common in neurodegenerative dis orders [17,24] These motor and cog nitive impairments have often been studied independently of eachother. The **Dynamic Gait Index (DGI)** measures dynamic balance, gait, and fall risk.[36,31] Though primarily designed for adults, it is increasingly used in pediatrics to assess conditions like cerebral palsy, fetal alcohol spectrum disorder, and developmental coordination disorder (DCD)[31]. However, researchofsimultaneousperformance of motor and cognitive tasks ("dual task," DT) has identified an interaction between them in healthy children, as well as youn ger and older adults [17,22,23] with more or less pronounced cognition–action trade-offs [22]. So, the aim of this study was to examine the effect of task-specific balance training in dual-task and single-task conditions on gait performance by DGI with DCD.

METHODOLOGY
STUDY DESIGN : Experimental study
SAMPLE SIZE: 40 participants
DURATION OF STUDY: 3 MONTHS
SAMPLING TECHNIQUE: Conventional sampling by lottery method
SOURCE OF DATA: KADI
TOOLS AND APPERATUS • Pen, • Pencil, • Paper • Laptop • Balance cushion • Ball • Blocks, swiss ball, balance board
SELECTION CRITERIA[26]
INCLUSION CRITERIA • Age: 7-10 years • Gender: Both male and female[38],[39] • Difficulty with fine motor task • Depth perception issues 28 • Challenges with rapid movements
EXCLUSION CRITERIA • Age below 6 years • Progressive neurological disorder Other severe concurrent illnesses unrelated to CP Recent history of major surgeries, diagnosis of the autism spectrum, attention deficit hyperactivity disorder, neurological or physical disor ders and prescription of any medication, occupational therapy treatment and lack of regular participation in physical activity
OUTCOME MEASURES 1. DYNAMIC GAIT INDEX
Randomization [37]: 20 participants in Experimental Group 1 received (dual task) and 20 participants in Experimental group 2 received (structural training)
Alpha :(α): Type 1 error rate Beta (β): Type 2 error rate d: Expected effective size, here taken the 0.8 g: Number of groups to compare Power (1 – β): 0.80 40-sample size- [40 Study Participants [EG1- 20 Participants, EG2- 20 Participants].

$$n \geq \left(1+\sqrt{g-1}\right)\frac{\left(Z_{1-\alpha/2}+Z_{1-\beta}\right)^2}{d^2}+\frac{Z_{1-\alpha/2}^2\sqrt{g-1}}{2\left(1+\sqrt{g-1}\right)}$$

INTERVENTION :

The duration was10 minutes of warm-up followed by 30 minutes of main activities and 5 minutes of cooling down.

In the single-task group, the child was instructed to keep balance while standing on one leg, maintain balance while walking. Indeed, children performed the designed balance program. The balance activities were selected which could be simply performed at home or school without any facilities or apparatus. These selected tasks were used by some previous studies (Cheldavi, Shakerian, Boshehri, & Zarghami, 2014; Fong, Guo, Cheng, et al., 2016; Fong, Guo, Liu, et al., 2016; Strang, Haworth, Hieronymus, Walsh, & Smart, 2011).[26,27,28,26]

The dual-task program was very similar to the single-task program with the exception that the participants in the dual-task group were required to perform cognitive tasks such as counting numbers, remembering a collection of letters, describing pictures or naming different

objects, or making discriminatory judgments while executing the designed balance program

These tasks were modified versions of tasks used by some previous studies (Plummer-D'Amato et al., 2012; Silsupadol, Siu, Shumway-Cook, & Woollacott, 2006).[29,30,31,26]

Balance exercise	Description	Repetitions/sets	Progression level
Double leg stance	Maintain balance with bare feet in different conditions	3 repetitions of 10 s	Level 1: stand on full feet, eyes closed Level 2: stand on toes, eyes open Level 3: stand on toes, eyes closed Level 4: stand on toes, eyes closed, keep an object in hands
Single leg stance (alternate feet)	Maintain balance in upright unilateral stance	3 repetitions of 10 s on each leg	level 1: hard surface, eyes open Level 2: hard surface, eyes closed Level 3: foam, eyes open Level 4: foam, eyes closed
Balance path	Walk in a straight line (4.5 m) with heels raised. Progress to heel-to-toe walk in a straight line (4.5 m)	3 trips (back and forth)	Level 1: linear path, gait Level 2: curved path, gait Level 3: linear path, heel-toe Level 4: curved path, heel-toe
Forward hop on marking sheets (alternate feet)	Double-leg hop or jump forward Progress to single-leg hop forward	3 sets of 10 repetitions on each leg	Level 1: jump on marking sheets Level 2: hop on Level 3: jump on marking sheets, keep an object in hand Level 4: hop on marking sheets, keep an object

TABLE 1: SINGLE/STRUCTURAL TASK TRAINING DESCRIPTION [26]

Balance task	Cognitive task (secondary tasks)	Focus (balance/cognitive task)
Stand on full feet, eyes closed	Count backward by 3	80/20 (emphasis on balance task)
Stand on full feet, eyes closed	Count backward by 3	20/80 (emphasis on cognitive task)
Stand on toes in double leg stance, eyes open	Name any words starting with letter A-K	80/20 (emphasis on balance task)
Stand on toes in double leg stance, eyes open	Name any words starting with letter L-X	20/80 (emphasis on cognitive task)
Walking in linear path, heel-toe	Remember words	80/20 (emphasis on balance task)
Walking in linear path, heel-toe	Remember words	20/80 (emphasis on cognitive task)
Walking in curved path, heel-toe	Visual imaginary task (tell the road direction from home to the lab)	80/20 (emphasis on balance task)
Walking in curved path, heel-toe	Visual imaginary task (tell the road direction from home to the lab)	20/80 (emphasis on cognitive task)

TABLE 2: DUAL TASK TRAINING [26]

Cognitive training	Progression level
Name things/words	Expression of simple words (animals, fruits, colors, clothes) Expression of difficult words (cities, provinces, provincial capital, names of men and women, flowers) Expression of words starting with a specific letter
Remembering things	Remembering the path from home to lab Remembering of certain names/numbers from the list Visual discrimination tasks: participants were shown the pictures before and after performing the balance tasks. They were asked to memorize the pictures and to respond if the pictures were the same. They were required to say "yes" if the pictures were the same, and "no" if they were different.
Counting numbers	Direct number counting Backward number counting Random number counting
N-Back task	Reverse 3-letter words or 3-digit numbers Reverse 4-letter words or 3-digit numbers Reverse the days of the week, months of the year and directions

TABLE 3: DUAL TASK TRAINING PROGRESSION [26]

FIGURE 1: PROCEDURE FOR DUAL TASK TRAINING

FIGURE 2 PROTOCOL FOR STRUCTURAL TRAINING

RESULT:

The present study was carried out to compare the effect of dual task training and structural training in developmental coordination disorder. 48 participants were included in the study but with the various reasons few were discontinued from the study and remaining 40 participants received their Treatment for 1 months (4 weeks) with age group distribution between 7-11 years diagnosed with the developmental coordination disorder questionnaire scale They were divided in to two groups: EG1 received dual task training exercise and EG2 received structural training exercise. Pre and post data was analysed by paired test and between the group data was anlysed by unpaired t test.

	PRE		POST	
	EG	CG	EG	CG
LEVEL SURFACE	1	1	2	3
SPEED	1	1	3	2
VERTICAL HEAD TURN	1	1	3	2
HORIZONTAL HEAD TURN	1	1	3	2
PIVOT TURN	1	1	3	2
OVER THE OBSTACLE	1	1	2	2
AROUND THE OBSTACLE	1	1	3	2
STAIRS	1	1	3	2

TABLE 4: COMPARISION OF EG1 & EG2 FOR DGI

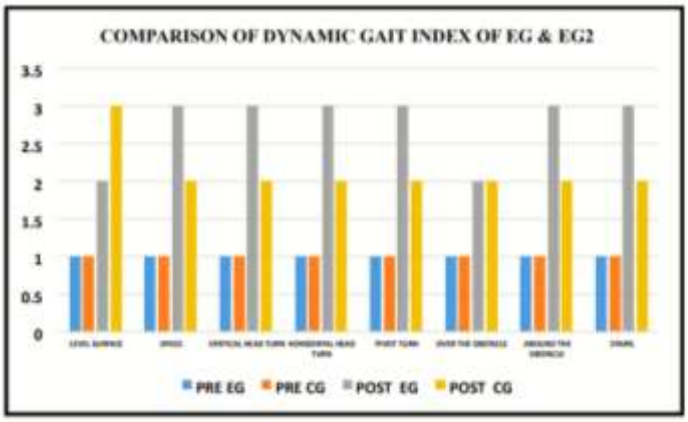

FIGURE 3: COMPARISION OF EG1 & EG2 FOR DGI

DISCUSSION:

The baseline characteristics showed that the P value was more than 0.05 in both the groups, which means homogeneity was maintained A paired T test was used to analyze the pre-post data within group, and an Independent T test was used to analyse the data between groups. In the EG, there is statistically significant difference in increasing the DGI ($p<0.05$)

Physiologically, children with DCD have reduced motor automaticity, meaning they require greater conscious attention to perform movements, making simultaneous cognitive and motor tasks more challenging. Dual task training promotes neuroplasticity, enhances sensory integration, improves postural control, and increases the efficiency of motor planning through repeated practice. Biomechanically, effective performance depends on maintaining the center of gravity within the base of support, coordinated muscle activation, and proper joint alignment. Children with DCD often exhibit poor balance, delayed muscle activation, inefficient gait, and increased movement variability.

In the EG2, there is statistically significant difference in increasing the DGI ($p<0.05$)

Biomechanically, structured training focuses on maintaining proper alignment, controlling the center of gravity within the base of support, improving joint stability, optimizing muscle activation, and producing smooth, coordinated movements. Regular structured training helps reduce movement variability, improve gait, balance, coordination, and functional performance, enabling children with DCD to perform daily activities more independently and efficiently

DCD group can complete dynamic dual-tasks under relatively simple task conditions. Simple tasks are defined as tasks that can be achieved automatically, e.g., locomotion. In contrast, a challenging task, such as locomotor obstacle negotiation (Wilmut and Barnett, 2017a,b), enlists greater anticipatory cognitive involvement, internal forward modeling and dynamic visual perception of the object (Patla and Vickers, 2003; Deconinck et al., 2010; da Silva et al., 2011; Higuchi, 2013). Internal forward modeling is a process known to be deficient in children with DCD (Adams et al., 2017; Wilson et al., 2020) and is likely to be reflected by greater performance costs. Similarly, a challenging cognitive task requires efficient cognitive control and may probe complex demands of inhibition, shifting or working memory (Hughes and Graham, 2002), areas of known deficit in DCD (Bernardi et al., 2018; Alesi et al., 2019; Sartori et al., 2020; Fogel et al., 2023), and is likely to demonstrate performance costs, i.e., errors or increased response time. Comparable pDTC between groups suggests that children with DCD can complete relatively simple motor and dual-tasks to the same level as their TD peers, a pattern also seen in motor planning research on DCD (Bhoyroo et al., 2018).[31-35]

LIMITATION:

This study is limited with children 7 to 11 year only 2. Only gait as an outcome has been taken 3. More number of females were there 4. No criteria for BMI was set

FUTURE SCOPE: Assement can be done at biomechanical, muscular or neurobehavioral analyses that would contribute to a better understanding of mechanisms underlying effects of dual-task balance. To confirm findings and valid results it is needed to investigate the underlying mechanisms.

CLINICAL IMPLICATION:

Disorder (DCD) to perform motor and cognitive tasks simultaneously. It enhances balance Dual task training improves the ability of children with Developmental Coordination, gait, coordination, attention, motor planning, and functional mobility while improving performance in daily activities such as walking, talking, and carrying objects. Regular dual task training also promotes motor learning, increases independence, and improves participation in school and community activities Structured training is an effective intervention for children with Developmental Coordination Disorder (DCD) as it improves motor coordination, balance, postural control, strength, and functional skills through repetitive, task-specific practice. It enhances motor learning, promotes independence in daily activities, reduces the risk of falls, and increases participation in school, sports, and social activities. Overall, structured training improves functional performance and quality of life in children with DCD.

CONCLUSION:

The present study concluded that both the groups improve Dynamic Gait Index at the end of 4 weeks by receiving the interventions in paediatrics who were diagnosed with developmental coordination disorder questionnary syndrome. But dual task training exercise adds an extra improvement in every component of DGI and structural training exercise program improves level surface component of DGI to a greater extent when compares with each other when given to paediatric having DCD

REFERENCES

1. Dolk H, Loane M, Garne E. The prevalence of congenital anomalies in Europe. Rare diseases epidemiology. 2010:349-64.
2. Zwicker JG, Missiuna C, Harris SR, Boyd LA. Developmental coordination disorder: a review and update. European journal of paediatric neurology. 2012 Nov 1;16(6):573-81.
3. Prowse T. The Social, Cognitive and Emotional Development of Children - Developmental Disabilities Course. Plus , 2021.
4. Prowse T. The Social, Cognitive and Emotional Development of Children - Developmental Disabilities Course. Plus , 2021.
5. Boyle CA, Boulet S, Schieve LA, Cohen RA, Blumberg SJ, Yeargin-Allsopp M, Visser S, Kogan MD. Trends in the prevalence of developmental disabilities in US children, 1997–2008. Pediatrics. 2011 Jun 1;127(6):1034-42.
6. Zablotsky B, Black LI, Maenner MJ, Schieve LA, Danielson ML, Bitsko RH, Blumberg SJ, Kogan MD, Boyle CA. Prevalence and trends of developmental disabilities among children in the United States: 2009–2017. Pediatrics. 2019 Oct 1;144(4).
7. Dewey D, Thompson DK, Kelly CE, Spittle AJ, Cheong JL, Doyle LW, Anderson PJ. Very preterm children at risk for developmental coordination disorder have brain alterations in motor areas. Acta Paediatrica. 2019 Sep;108(9):1649-60
8. Edwards J, Berube M, Erlandson K, Haug S, Johnstone H, Meagher, M, Sarkodee-Adoo S, Zwicker, J. Developmental Coordination Disorder in school-aged children born very preterm and/or at very low birth weight: A systematic review. Journal of Developmental and Behavioral Pediatrics Nov/Dec 2011; 32(9):678-687.
9. Fuelscher I, Caeyenberghs K, Enticott PG, Williams J, Lum J, Hyde C. Differential activation of brain areas in children with developmental coordination disorder during tasks of manual dexterity: an ALE meta-analysis. Neuroscience & Biobehavioral Reviews. 2018 Mar 1;86:77-84.
10. Faebo Larsen R, Hvas Mortensen L, Martinussen Torben, Nybo Andersen A. determinants of developmental coordination disorder in 7-year old children: a study of children in the Danish National Birth Cohort. Developmental Medicine & Child Neurology 2013;55(11);1016-1022.
11. What is Dyspraxia". *Dyspraxia Foundation*. Archived from the original on 21 May 2023. Retrieved 15 August 2022.
12. Green, D.; Payne, S. (2018). "Understanding Organisational Ability and Self-Regulation in Children with Developmental Coordination Disorder". *Current Developmental Disorders Reports*. **5** (1): 34–42. doi:10.1007/s40474-018-0129-2. PMC 5818572. PMID 2949759
13. Alloway TP, Rajendran G, Archibald LM (2009). "Working memory in children with developmental disorders" (PDF). *Journal of Learning Disabilities*. **42** (4): 372–82. doi:10.1177/0022219409335214. hdl:1893/863. PMID 19380495

14. Biggs V (2005). "3 A Survival Guide to School". *Caged in chaos: a dyspraxic guide to breaking free*. London; Philadelphia: Jessica Kingsley Publishers. ISBN 978-1-84310-347-9. OCLC 57316751
15. Offor, Nkechi; Ossom Williamson, Peace; Caçola, Priscila (2016). "Effectiveness of Interventions for Children With Developmental Coordination Disorder in Physical Therapy Contexts: A Systematic Literature Review and Meta-Analysis". *Journal of Motor Learning and Development*. **4** (2): 169–196. doi:10.1123/jmld.2015-0018. hdl:10106/26333. ISSN 2325-3193
16. Dyspraxia in adults". *National Health Service*. 18 October 2017.
17. Schott N. Dual-task performance in developmental coordination disorder (DCD): Understanding trade-offs and their implications for training. Current Developmental Disorders Reports. 2019 Jun 15;6(2):87-101.
18. Speedtsberg MB, Christensen SB, Andersen KK, Bencke J, Jensen BR, Curtis DJ. Impaired postural control in children with developmental coordination disorder is related to less efficient central as well as peripheral control. Gait Posture. 2017;51:1–6.
19. AdamsILJ, Lust JM, Wilson PH, Steenbergen B. Testing predic tive control of movement in children with DCD using converging operations. Br J Psychol. 2017;108(1):73–90.
20. Wilson PH, Smits-Engelsman B, Caeyenberghs K, Steenbergen B, Sugden D, Clark J, et al. Cognitive and neuroimaging findings in developmental coordination disorder: new insights from a sys tematic review of recent research. Dev Med Child Neurol
21. Wilmut K, Gentle J, Barnett AL. Gait symmetry in individuals with and without developmental coordination disorder. Res Dev Disabil. 2017;60:107–17.
22. Berger SE, Harbourne RT, Horger MN. Cognition–action trade offs reflect organization of attention in infancy. In: Benson JB, editor. Advances in child development and behavior, vol.
23. San Diego: Elsevier Academic Press; 2018. p. 45–86. 7. Li KZH, Bherer L, Mirelman A, Maidan I, Hausdorff JM. Cognitive involvement in balance, gait and dual-tasking in aging: a focused review from a neuroscience of aging perspective. Front Neurol. 2018;9:913. https://doi.org/10.3389/fneur.2018.00913 Published 2018 Oct 29.
24. McIsaac TL, Fritz NE, Quinn L, Muratori LM. Cognitive-motor interference in neurodegenerative disease: a narrative review and implications for clinical management. Front Psychol. 2018;9: 2061. https://doi.org/10.3389/fpsyg.2018.02061 Published 2018 Oct 29.
25. Caçola P, Lage G. Developmental Coordination Disorder (DCD): An overview of the condition and research evidence. Motriz: Revista de Educação Física. 2019;25:e101923.
26. Jahanbakhsh H, Sohrabi M, Saberi Kakhki A, Khodashenas E. The effect of task-specific balance training program in dual-task and single-task conditions on balance performance in children with developmental coordination disorder. Acta Gymnica. 2020 Jun 2;50(1):28-37.
27. Cheldavi, H., Shakerian, S., Boshehri, S. N. S., & Zarghami, M. (2014). The effects of balance training intervention on postural control of children with autism spectrum disorder: Role of sensory information. Research in Autism Spec rum Disorders, 8, 8–14.
28. Strang, A. J., Haworth, J., Hieronymus, M., Walsh, M., & Smart, L. J. (2011). Structural changes in postural sway lend insight into effects of balance training,vision, and support surface on postural control in a healthy population. European Journal of Applied Physiology, 111, 1485–1495.
29. European Journal of Applied Physiology, 111, 1485–1495

30. Plummer-D'Amato, P., Cohen, Z., Daee, N. A., Lawson, S. E., Lizotte, M. R., & Padilla, A. (2012). Effects of once weekly dual-task training in older adults: A pilot randomized controlled trial. Geriatrics & Gerontology International, 12, 622–629 12, 622–629
31. Silsupadol, P., Siu, K.-C., Shumway-Cook, A., & Woollacott, M. H. (2006). Training of balance under single-and dual task conditions in older adults with balance impairment.
32. Lubetzky-Vilnai A, Jirikowic TL, McCoy SW. Investigation of the Dynamic Gait Index in children: a pilot study. Pediatric Physical Therapy. 2011 Oct 1;23(3):268-73. 61.
33. Jahanbakhsh H, Sohrabi M, Saberi Kakhki A, Khodashenas E. The effect of taskspecific balance training program in dual-task and single-task conditions on balance performance in children with developmental coordination disorder. Acta Gymnica. 2020 Jun 2;50(1):28-37. 33. . Wild LB, de Lima DB, Balardin JB, Rizzi L, Giacobbo BL, Oliveira HB, de Lima Argimon II, Peyré-Tartaruga LA, Rieder CR, Bromberg E. Characterization of cognitive and motor performance during dual-tasking in healthy older adults and patients with Parkinson's disease. Journal of neurology. 2013 Feb;260(2):580-9.
34. Veldkamp R, Baert I, Kalron A, Tacchino A, D'hooge M, Vanzeir E, Van Geel F, Raats J, Goetschalckx M, Brichetto G, Shalmoni N. Structured cognitive-motor dual task training compared to single mobility training in persons with multiple sclerosis, a multicenter RCT. Journal of clinical medicine. 2019 Dec 10;8(12):2177.
35. Chandolkar GS, Sagar JH, Vardharajulu G. Effect of Structured Exercise Programme on Pulmonary Function and Physical Performance in Geriatric Population. EXECUTIVE EDITOR. 2020 Jan 1;11(01):233.
36. Dr Aneri Patwari, Fenny Patel, Riya Patel. A Comparative Efficacy To Analyse The Effect Of Multicomponent Exercise Versus Resisted Exercise On Gait Of Geriatric Individuals Having Frailty Syndrome- An Experimental Study. International Journal For Multidisciplinary Research E-ISSN: 2582-2160 Volume 8, Issue 3, May-June 2026.
37. Dr. Aneri Patwari, Pritesh Dalvi, Dhiren Pavar. A Comparative Efficacy Of Land Strength Exercise Programme Versus Proprioception Training On Postural Stability In Sedentary Obese Individual – An Experimental Study.
International Journal For Multidisciplinary Research E-ISSN: 2582-2160 Volume 8, Issue 3, May-June2026.
38. Dr Aneri Patwari, Dr. Loken Parmar. The Relationship between Cardiorespiratory Fitness and Lower Cross Syndrome among Sedentary Individuals- A Correlational Study International Journal of Medical Science and Advanced Clinical Research (IJMACR) Available Online at:www.ijmacr.com Volume – 8, Issue – 1, February - 2025, Page No. : 149 – 157
39. Dr. Rahil Snehal Patwari, Dr. Aneri Snehal Patwari. The Relationship Between Forced Vital Capacity as Cardiorespiratory Fitness and Upper Cross Syndrome among Sedentary Obese Individuals - A Correlational Study. International Journal For Multidisciplinary Research E-ISSN: 2582-2160. Volume 8, Issue 3, May-June 2026
    1. Physical Therapy, 86, 269–281.
    2. trum Disorders,