



ASSESSMENT OF FINGER DEXTERITY UNDER A DUAL-TASK CONDITION IN ADOLESCENTS WITH DOWN'S SYNDROME AND NORMAL ADOLESCENTS

Physiotherapy

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ABSTRACT

Dual-task assessment in Down's syndrome will help us find their ability to perform in situations demanding dual-tasking, which will help us design a dual-task training protocol specific to the individual's needs, which may show significant neuroplastic changes. The purpose of the study was to assess and determine the difference in cognitive-motor and motor-motor dual-task finger dexterity, using the Nine Hole Peg Test, between adolescents with Down's syndrome and normal adolescents. It was a comparative study consisting of 22 Down's and 22 normal individuals. Mean cognitive-motor 9HPT and motor-motor 9HPT scores in Down's were 45.18 and 41.11 respectively; the same in normal were 17.95 and 17.45. Individuals with Down's syndrome have significant but trainable deficit in dual-task finger dexterity.

KEYWORDS

Down's syndrome, Dexterity, Nine Hole Peg Test, Dual-task

INTRODUCTION

Down's syndrome is a chromosomal disorder resulting in 47 chromosomes instead of 46. Commonly called trisomy 21, Down's syndrome results from faulty cell division affecting the 21st pair of chromosomes, either owing to a nondisjunction (95%), translocation (3%-4%), or least commonly, a mosaic presentation (1%).^[1] It is the most common chromosomal disorder occurring with a frequency of 1:800 to 1:1000 newborns. The origin of the extra chromosome 21 is either maternal or paternal. In most cases, the extra chromosome is from the mother. It occurs more often in offspring of mothers conceiving at older age.

Patients with Down's syndrome have mental and physical retardation, flat facial profile, an upward slant of eyes and epicanthic folds. The nose is small with flat nasal bridge. Mouth shows a narrow short palate with small teeth and furrowed protruding tongue. There is significant hypotonia which usually improves by late childhood. Skull appears small and brachycephalic with flat occiput. Ears are small and dysplastic. Clinodactyly (hypoplasia of middle phalanx of fifth finger) and simian crease are usual.^[2] Levels of cognitive impairment in children with Down's syndrome vary from profoundly (below 35% IQ) to mildly impaired (50-69% IQ), with a mild to moderate (35-50% IQ) impairment being most common. They have attention deficits and difficulties in information processing.^[2]

Dexterity is an important component in the comprehensive assessment of upper extremity function. It is defined as "The fine voluntary movements used to manipulate small objects during a specific task, as measured by the time to complete the task."^[3] Gross motor dexterity involves coordination of arm and hand while fine motor dexterity involves wrist and fingers.^[4] For optimum performance of activities of daily living, work, school, play and leisure, dexterity is essential.^[3]

The Nine Hole Peg Test is widely used as a quick measure of finger dexterity by occupational therapists due to its inexpensive construction cost and short administration time.^[5]

Dual task is defined as concurrent performance of two tasks that can be performed independently and have distinct and separate goals. Ability to divide one's attention between two or more concurrent tasks is an important aspect of functional movement during ADLs. Classic dual task paradigm:

1. Measure performance of each task in isolation (single task) e.g. gait alone
2. Measure performance of each task while performing both the tasks concurrently (dual task) e.g. gait while buttoning a shirt.

Dual task pairings are as follows:

1. Cognitive-Cognitive
2. Motor-Motor
3. Cognitive-Motor^[6,7]

Dual task performance is measured by:

- a. Absolute measures: single task and dual task parameters (e.g. gait speed, Nine Hole Peg Test time)
- b. Relative measures: Dual task effect (cost/benefit)^[6]
DTE (%) = $\pm (\text{dual task} - \text{single task}) \times 100 / \text{single task}$

MATERIALS AND METHODS: It was a comparative study assessing dual-task performance of a study group of 22 Down's and a control group of 22 healthy individuals in the age group of 13-19 years. Inclusion criteria for study group was individuals in the age group of 13-19 years, with mild to moderate MR (35% -70% IQ) and able to follow instructions properly. Exclusion criteria was Severe MR (IQ-below 35%), unable to follow instructions and severe musculoskeletal or neurological complications. Inclusion criteria for control group was normal healthy individuals in the age group of 13-19 years.

PROCEDURE: The study was to assess finger dexterity using the cardboard Nine Hole Peg Test (9HPT)^[10] under a cognitive-motor dual-task condition and motor-motor dual-task condition in two groups aged 13-19 years-one consisting of individuals with Down's syndrome and another consisting of healthy controls. 22 adolescents with Down's syndrome (15 males and 7 females), who matched the inclusion criteria were selected from a special school in Nigdi, Pune. 22 normal adolescents (6 males and 16 females) were selected according to the inclusion criteria from a school and colleges situated in Talegaon Dabhade. After explaining the purpose and procedure of the study to the subject and parent, informed consent and child assent form was taken prior to the assessment. Subjects were assessed on three consecutive days. On day one, subject performed the Nine hole Peg Test. On day two, subject performed the Nine Hole Peg Test with a cognitive task (cognitive-motor 9HPT). On day three, subject performed the Nine Hole Peg Test with a motor task (motor-motor 9HPT). In the cognitive-motor 9HPT, subject performed 9HPT while repeating a set of 3 words, told at the beginning of the test (word recall task). In the motor-motor 9HPT, subject performed 9HPT with foot tapping (right foot when performing with right hand and left foot when performing with left hand).

Administration method of 9HPT: Both the dominant and non-dominant hands are tested twice. The patient is seated at a table with the dish on the same side as the hand being tested. The other hand can hold the edge of the board to provide stability. On a start command, the stopwatch is started, the patient picks up the nine pegs one at a time, as quickly as possible, puts them in the nine holes, and, once they are in the holes, removes them again as quickly as possible, one at a time,

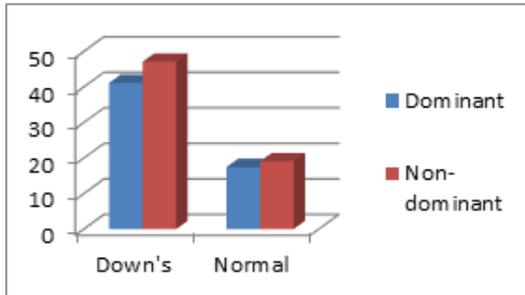
replacing them into the shallow dish. The total time to complete the task is recorded in seconds Two consecutive trials with dominant hand are immediately followed by two consecutive trails with non-dominant hand.

RESULTS:

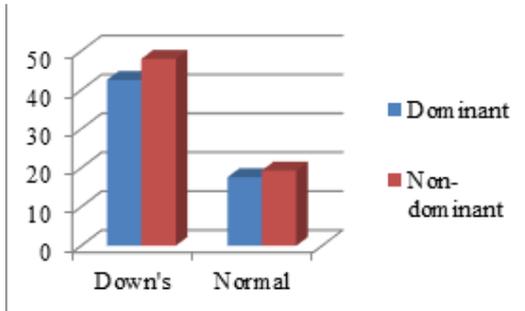
There was a statistically significant difference in both cognitive-motor dual-task 9HPT and motor-motor dual task 9HPT scores in individuals with Down's syndrome and normal individuals, with p-value <0.0001. Mean values of dual task 9HPT scores of both the groups are as follows:

Table 1: Means of cognitive-motor and motor-motor 9HPT

	C9HPT		M9HPT	
	Dom	Non-Dom	Dom	Non-Dom
Down's	45.18	47.66	41.11	47.09
Normal	17.95	19.29	17.45	19.06



Graph 1: Cognitive-motor 9HPT



Graph 2: Motor-motor 9HPT

DISCUSSION:

The present study aimed at finding out if there is a significant difference in dual-task finger dexterity between healthy controls and people with Down's syndrome in the age group of 13-19 years. Results showed a significant but trainable difference in dual-task finger dexterity between both the groups. Individuals with Down's syndrome have attention deficits and difficulties in information processing, sequential verbal processing, social-cognitive skills, auditory memory and motor planning.^[2]

Due to small size of hands and feet (10-30% reduction in metacarpal and phalangeal length), absent palmaris longus and supernumerary forearm flexors^[2], dexterity has been found to be deficient in adolescents with Down's syndrome.

The results of the present study are consistent with the findings of Horvat M. et al (2013)^[7] who studied the influence of dual task condition on spatial and temporal parameters of gait in young adults with and without Down's syndrome. It was concluded that movements are less efficient and functional in individuals with Down's syndrome when an additional task is encountered while walking.

Spatial parameters indicated that step length, step width, stride length and stride width revealed significant group and condition interactions (p<0.01). Temporal parameters yielded significance in velocity and single length support time (p<0.01).

Lanfranchi S. et al (2011)^[8] studied about the working memory in people with Down's syndrome. Two distinct deficits were found in individuals with DS: impairment in verbal tasks and further impairment in all dual task conditions.

Docter et al^[9] assessed performance of children with Down's syndrome aged from 4.11 to 13.7 on the Bruininks Oseretsky Test of Motor Proficiency. The total point score presented with a mean of 15.5 in the 20 subjects in the study. Comparison of the total score of children with Down's syndrome with normal children when matched for age and sex showed a significant difference between their respective scores. The researchers concluded that BOTMP-SF is not an adequate tool to measure motor skills of children with Down's syndrome and recommended the use or development of other tests.

Smith et al^[4] conducted normative and validation studies of the 9HPT with children aged 5 to 10. Correlations of -80 and -74 between scores of the 9HPT and Purdue Pegboard Test at all tested ages indicated adequate concurrent validity and a significant difference in test scores between regular and special education groups provided further evidence of construct validity.

Mathiowetz et al^[5] established standardized procedures and normative data for the 9HPT in the age group of 20-94 years. This study served as a reference for 9HPT scores in healthy controls.

Dubuisson N et al^[10] validated the affordable cardboard 9-HPT launched by the 'ThinkHand' campaign at ECTRIMS 2016 in UK. The study demonstrated that the cardboard version is equivalent to plastic version with almost same mean scores for both versions.

Dighe A.D., Dhote S., Palekar T., Pande A., Yengde P., Singh G. et al^[11] assessed manual dexterity using Bruininks Oseretsky Test of motor Proficiency (2nd Edition) in children, aged 5-15 years. The study concluded that male and female children showed similar performance on fine motor point score. Also a majority of children from all the age groups were in average category.

CONCLUSION:

The present study concluded that Down's syndrome individuals have significant deficit in dual-task performance, but if trained properly in a dual-task training protocol they can perform close to normal in dual task conditions.

LIMITATIONS: 1. Sample size was less.

- 2. The individuals were not age and gender-matched
- 3. Individuals with Down's syndrome were selected from only one special school

SCOPE:

- 1. Sample size can be increased.
- 2. The study should be carried out with age and gender-matched individuals
- 3. The study can be further extended to study effect of a dual-task training protocol in Down's syndrome.

CLINICAL IMPLICATION: It is imperative to include upper limb and lower limb dual-task training in treatment protocol of trainable Down's syndrome children and adolescents

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