

A Study to Determine the Value of 2 Minute Walk Test in Children with Down Syndrome in Bangalore.

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Abstract

Introduction: Down syndrome (DS) is a genetic disorder characterized by several clinical symptoms that affect systems like cardiovascular, cognitive, orthopaedic, neurological, hormonal, and visual perceptual impairments. The most common form of physical activity is walking and this forms the basis for performing a functional walk test that helps in assessing functional capacity, exercise tolerance and mobility, thus determining treatment effectiveness, and quantifying the prognosis of individuals with DS. However, patients with severe disability and cognitive impairment find long distance tests to be too fatiguing, hard to understand, difficult to perform, time consuming and intolerable. Psychometric properties of 2MWT indicates that it could be a more feasible clinically sub-maximal exercise test for persons with poor concentration span or endurance due to its short duration. There is a dearth of evidence on 2MWT in children with DS and the reference values are currently unavailable, hence the need of the study is to determine the value for 2MWT in Bangalore residential children with DS.

Objectives: To estimate the average value of 2 -Minute Walk Test (2-MWT) in children with Down syndrome in Bangalore.

Methods: A cross sectional research study design was chosen to assess the 2MWT in 65 subjects with Down syndrome which were recruited based on the convenience sampling. Assuming desired total width of the confidence interval (W) to be 13 and standard deviation (SD) of the variable sample to be 27, and 95% of confidence level (CL), minimum sample size required was estimated to be 65. Statistical package for social science (SPSS) version 23 and Microsoft Excel 2007 was used for primary data entry and plot a chart. To test the normality of distribution the Shapiro Wilk test was used. The significance was found to be >0.05 .

Results: Distance walked by children with DS in 2MWT was median (IQR) distance of 99.36 meters (91.44-112.85). Distance covered by males was greater than females with DS. However, on comparing the values with the normative data, it was found that there is significant difference ($p<0.0001$) between the healthy children and the children with Down's syndrome.

Conclusion: This study has revealed that in 2MWT males walked median range of 106 meters and females walked 96 meters of 2MWD. This data can help the therapist implement the use of 2MWT as an important outcome measure in children with DS to assess the functional ability and planning of rehabilitation protocol.

Keywords: 2-minute walk test, Down syndrome, Functional capacity, Children.

Introduction

Down Syndrome (DS) is attributed to a chromosomal abnormality (trisomy 21 - wherein there is the presence of an extra chromosome 21 in all the cells of the body) and is the most common genetic form of mental retardation [1]. This syndrome is often characterized by several clinical symptoms that indicate cardiovascular, cognitive, orthopedic, neurological, hormonal, and visual perceptual impairments. Other common characteristics are hypotonia, ligament laxity, reduced strength, joint laxity, and lack of coordination in walking, reduction in balance ability, altered gait dynamics, and reduction in aerobic capacity. [2]

Muscle weakness and hypotonia impair midline movements of the upper extremities and alter the gait to a large extent; this is characterized by decreased single-limb support time, increased hip flexion posture, shorter step length, and increased knee flexion during foot contact. The dynamics of altered gait can also impose a high energetic cost. All these factors may limit work performance in day-to-day activities, collectively as well as individually. [2,3]

Children with DS are known to have a higher prevalence of heart defects and circulatory abnormalities, lower maximal heart rate and are at a greater risk of developing the restrictive pulmonary disease. These children may demonstrate reduced participation in physical activities,

there by affecting their physical fitness and functional capabilities [3,4].

Additionally, they may develop a sedentary lifestyle which could lead to obesity [1]. Owing to all the above-mentioned reasons, an increase in morbidity and/or hospital admissions is seen, particularly in young children with DS. Submaximal walk tests are generally found to be practical and inexpensive exercise tests, which are easy to administer and require minimal equipment. As these are sub-maximal exercise tests, they reflect the patient's capability to undertake day to day activities [5]. Walking is the most common physical activity undertaken by children with DS. Difficulty in walking can thus, negatively impact their overall status due to reduced physical activity levels. This formed the basis to perform functional walk tests that help in assessment of the functional capacity, exercise tolerance and mobility, thus determining treatment effectiveness, and quantifying the prognosis of individuals with DS [6]. The duration of walk tests described in the literature ranges from 2-12 minutes.

According to previous studies, 6 minute walk test (6MWT) is a reliable tool for assessment in adults with DS [2]. However, some individuals with severe disability and cognitive impairment, find 6-min walk test (6MWT) and 12-min walk test (12MWT) to be too fatiguing, hard to understand, difficult to perform, time-consuming and intolerable even with the allowable standing rests [7,8]. These facts have led to the use and recommendation of shorter duration walk test-most notably the two-minute walk test (2MWT). 2MWT has been found to be a valid, reliable and feasible exercise performance test to determine the limitations in walking endurance for children and youth [9]. Psychometric properties of 2MWT also indicate that it may be a more feasible clinically sub-maximal exercise test for subjects

with poor concentration span or endurance due to its short duration [5]. Moreover, distance covered in 2 minutes is highly correlated with the distance covered over 6 minutes [7]. Normative and reference values are required if patient performance on a test is to be interpreted accurately. Reference values for the 2MWT in children and adolescents is published by Bohannon 2017 for American males and females [9]. However, there is a lacuna in literature and reliable data on 2MWT in Indian children with DS is scarce.

India is a vast country with unique cultural, social, geographical, ethnic and climatic differences. The morphological characteristics and sexual maturation of Indian children vary according to regional variations of this country, which ultimately affects physical growth and development [6]. Various regions in India vary in nutritional and socio-cultural statuses, which can influence the child's aerobic power and cardiopulmonary response to exercise. Hence, regional differences also need to be taken into consideration while assessing Indian children, rather than taking ethnic differences into consideration alone [10]. Additionally, it is crucial to determine values for the Indian population for the following reasons [6]. Exercise capacity of Indians differs from those of other races. Indians have differences in built, genetic and environmental variances, food habits, etc. when compared to Caucasians.

Due to these reasons, the scarcity of evidence on 2MWT in children with DS in India appears even more glaring. Since we cannot extrapolate and contextualize something as pertinent as normative values in vulnerable groups and because the reference values are not available, this study was designed with the aim of determining the value for 2MWT in children with DS who are residents of Bangalore, an urban city in South India. The objective of

this study is to determine the values of 2MWT in children with DS in Bangalore.

Materials and Methods

A cross sectional research study design was chosen to assess the 2MWT in subjects with Down syndrome. The study included 65 subjects with Down syndrome of age group 6 - 11 years and who were ambulatory with or without assistive devices. Study was approved by the institutional ethics and research committee vide Ethical Approval No. MEU-PT/EC/03/2018. The subjects were recruited based on the convenience sampling. Subjects who were non-ambulatory were excluded from the study. The sample size was estimated according to study by Richard W. Bohannon et al; the present study sample size was calculated. Assuming desired total width of the confidence interval (W) to be 13 and standard deviation (SD) of the variable sample to be 27, and 95% of confidence level (CL), minimum sample size required was estimated to be 65 [9].

Procedure For Data Collection

Meetings were held with administration bodies of recreational centres and special schools from different areas of Bangalore, for recruitment of participants and explaining the nature of the study. Consents were taken for recruiting the participants. Potential participants' parents were contacted and explained using a participant information sheet about the study. All potential concerns and doubts were answered; following which participant's parents who agreed to allow their child to participate were enrolled in the study after obtaining written informed consent. The preferred walking course was 50 foot (15.2 m) out-and-back course on the wide, flat, open, straight and hard surface. A cone clearly marked the turn-around points. The start and end lines were marked with brightly colored tape. A cone was placed near the

beginning of the course length of the walkway and the number of turns the participant made was recorded.

Preparation: After the consent was obtained, the participant’s demographic data was taken. Participants were made to sit in a chair before the test. During this time, blood pressure and pulse rate and oxygen saturation were measured. Participants were allowed to use their usual walking aids during the test (walker, cane etc.). A light meal before tests early morning or early afternoon was permitted. However, they were advised not to engage in vigorous exercise within 2 hours of beginning the test. Required repeated testing was conducted about the same time of the day to minimize within day variability.

During testing: Distance travelled during the walk test was recorded using markings on the floor behind the participant’s heel where participant stopped, and distance was measured from the last lap to the tape. Familiar person or practitioner was allowed to walk one step behind the subject.

Instructions: Below given instruction was given to participants:

“The purpose of this test is to find out how far you can walk in two minutes. You will start from this point and follow the corridor/path to the cone. You should pivot briskly around the cone like this (demonstrate to the subject how to go around the cone briskly) and continue back the other way without stopping. You will walk back and forth between the two cones. Walk as fast as you can until I ask you to stop. Do not worry if you slow down or rest, but if you stop, you should start walking again as soon as you feel ready to do so.”

“When the two minutes are up, I will say “STOP.” I want you to stop where you are. Do you have any questions? Are you ready? Please begin when I say “GO.”

At the completion of the 2MWT: Blood pressure, pulse rate, oxygen saturation, and distance walked were recorded.

“The test took approximately 4-10 minutes to administer including instructions and practice. Note that participants took the 2MWT as part of the entire NIH Toolbox battery under the Motor Domain [11]”.

For the purpose of comparing the values with normal population, from the cited study, “A study to establish the reference values for two-minute walk distance in school going children” the mean (158.26) and SD (16.02) was considered.

Statistical Analysis

Data analysis was performed using the statistical package for social science (SPSS) version 23 and Microsoft Excel 2007 for primary data entry and plot a chart. Descriptive statistics were obtained for demographic data. The average value of the normative data was compared with mean (158.26) and SD (16.02) of the study, A study to establish the reference values for two-minute walk-test in school going children. The normality of distribution was assessed using the Shapiro-Wilk test. Shapiro Wilk’s significance was found to be >0.05; hence, non-parametric tests are used for analysis. Data was found to be non-normal. Hence, the median and inter-quartile ranges (as measures of central tendency and dispersion) have been reported.

Vitals N= 65	Median	
	Pre-test	Post-test
Heart rate of participant (bpm)	94.00	96.00
Systolic blood pressure of participant (mmHg)	100.00	107.00
Diastolic blood pressure of participant (mmHg)	68.00	67.00
SpO2 of participant (%)	97.00	98.00

Table 1: Vitals: Pre and Post Test

Results

The total samples included were 65 children. For the purpose of analysis age, height, weight, and BMI are

considered as demographic characteristics. The median age of the participants was 10 years, with height being 1.21 meter and weight 24 kg and median BMI was 16.76. However, on comparing the values with the normative data, it was found that there is significant difference ($p < 0.0001$) between the healthy children and the children with Down's syndrome. The table 1 describes all vitals taken pre and post-tests, pre-test values were taken while enrolling the participants and post-test was recorded immediately after test completion where we found heart rate and systolic blood pressure significantly ($P < 0.05$) increased post-test. The range of distance walked by 65 children with Down syndrome while 2MWT, where median (IQR) distance walked, was 99.36 meters (91.44-112.85). It was found that the distance walked by males (median=106.68) was farther than females (median=96.01). The figure 1 shows the comparison of the mean distance walked by the normal children compared to children with Down's Syndrome.

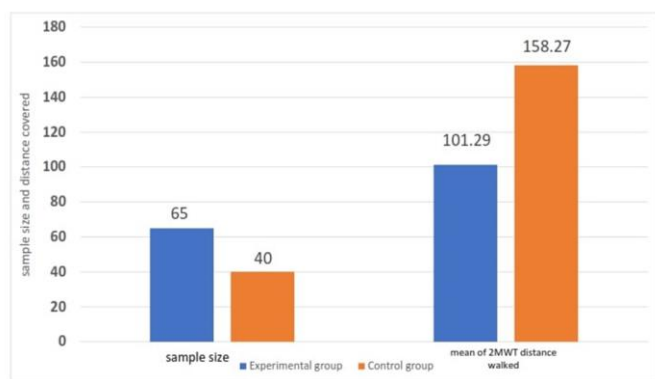


Figure 1: Comparison of 2MWT distance between Down's population with normal comparable group

Discussion

The results of our study showed that 2MWT distance, 2-minute walk distance covered by DS children of Bangalore was median (IQR) 99.36 meters (91.44-112.85). 2MWT requires less time and can be more likely completed by males and females rather than the 6MWT [7]. It was also observed that the test was more feasible

clinically for an individual with poor concentration span or endurance as stated by other researchers [12]. Even though it is known that complex test is not feasible for ID children, 2MWT is not used as extensively in this population due to lack of norms. Herein, our purpose of the study was to determine the 2MWT value in DS children aged 6 to 11 years.

Variables like resting HR, resting oxygen saturation, and resting blood pressure, post- test HR and saturation and blood pressure were analyzed, in order to understand the influence of these parameters on 2MWD. There was no significant correlation with distance walked and the variables. These results were concurrent with the results published by Bohannon et al. in 2014 for 2MWT normative values in the American population, Casanova et al. in 2011 for 6MWD reference value and Jessyca P R Selman et al. in 2013 for 2MWT reference equation in a Brazilian population [7].

Changes observed in pre and post 2MWT vital parameters like HR and BP can be taken as an indicator of a cardiopulmonary system of an individual being stressed during the testing. These findings do not deny the fact that other systems of the body are not being challenged. However, there was no outcome measure used in this study to determine that and confirm the effect on them.

According to these findings, we can conclude that 2MWT has a major role in evaluating the functional capacity and exercise tolerance of a child.

There was a trend observed in 2MWD with relation to the age of children with DS, there was no maximum difference observed between two strata (6-8 and 9-11 years). According to these findings, we can say that 2MWT doesn't seem sensitive to identify the change in age. Similar findings were observed in the study done by T Krishna et al. in 2015 [6].

The completion rate of 2MWT among our study participants was observed to be 100%. Single participant aged 6 years was excluded from the study due to failure in start the test. The completion rate less than 100% was reported by a study done by Lammers et al; the participants of this study aged between 4-11-year-old children. Similar findings were reported by Geiger et al. where the completion rate was found to be greater than 82.5% for males and females aged 3-18 years. Our participants, therefore, were able to complete 2MWT better.

It was observed during testing that the majority of children got the understanding of the test after practice tests; the reason for this can be attributed to their learning effects. This was also reported by other studies done by Casanova C, et al. 2011, Chetta. A et al. in 2006 and I wamma. A. M, et al. in 2009. The learning effect may be caused by an improvement in coordination, overcoming anxiety and familiarization to the test.

Communication with an intellectually disabled child can be challenging, an objective test is better to determine the functional level of the child can offer a solution. In theory, the 2MWT could have been fit for use in a DS population. The act of walking is familiar to all as opposed to other activities like cycling, stepping, treadmill, running, which are commonly used for testing. Therefore, reconsidering the methodology of 2MWT to improve feasibility for administration in DS children might prove to be worthwhile. Some studies concerning field-testing in intellectually disabled persons have paired participants with a partner while testing [13].

Modification should give serious consideration because children with DS have lack of motivation, necessary knowledge, and ability regarding pacing techniques. In a review of measuring cardiovascular endurance of person

with ID, Lavay et al. put light on considering proper test familiarization in this type of population [13].

The median distance covered by participants with DS was 99.36 meters with the IQR of 91.44-112.85 meters in our study. Bohannon et al. in 2017 reported 122-209 meters of a mean covered distance of 2MWT in males and females with the age of 3 to 17 years without DS in the USA. The comparatively modest 2MWD found in the overall participants may be associated with research suggesting that children with Down syndrome are comparatively less active and have lower fitness levels than peers without DS [14].

A possible explanation for comparatively low walk distance can include reduced aerobic capacity. Gait characteristics of an individual with DS can also be a contributing factor for higher energy expenditure while walking [15].

These findings also put light on the importance of promoting an increased level of physical activities to combat the multitude of health-related concerns associated with a sedentary lifestyle and low physical fitness in DS children [16].

There are certain limitations, which should be recognized while interpreting the results of this study. Larger sample size would have provided with values that are more representative. The sample was limited to residents of an urban city with good developmental indicators. Discretion is advised when using these values to assess children in different parts of the country. The findings of this study, thus, cannot be generalized to DS children in other parts of India and other countries.

We tried to incorporate some of the aspects of positive behavior reinforcement, by using standardized encouragement during all tests. Practice tests may not always be practical in certain settings due to logistical constraints. Also, the use of volunteer to walk behind the

child is not a suggested approach by 2MWT guidelines, even though this approach has been used in 6MWT literature [17] and among participants with ID when performing cardiovascular fitness tests [18].

Conclusion

This study has revealed that in 2MWT, median (IQR) 2-minute walk distance walked by Bangalore children with DS aged 6-11 year was 99.36 meters (91.44-112.85) where males walked median range of 106 meters and females walked 96 meters of 2MWD. This data can help the therapist to use 2MWT as an important outcome scale in children with DS to assess the functional ability and planning of rehabilitation protocol.

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