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The test–retest reliability of 10 meter walk test in healthy young adults -A Cross sectional study

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Abstract: Background: *Walking speed (WS) is a valid, reliable, sensitive measure appropriate for assessing and monitoring functional status and overall health in a wide range of populations. These capabilities have led to its designation as the "6th vital sign". By synthesizing the available evidence on WS, article provides clinicians with a reference tool regarding this robust measure. The 10m walk test is the most feasible, short duration,and easiest test to be administered. Short-term test-retest reliability of the 10-meter fast walk test was evaluated in 31 ambulatory children with cerebral palsy and demonstrated good to excellent reliability of ICC 0.81 (95% confidence interval [CI] 0.65-0.90) across participants. At present there were no studies reporting the test retest reliability of 10m walk test in healthy Indian college students of age group 17-21 years. Hence this study is focused on test retest reliability of 10m walk test in healthy Indian college students.*

Objective: *To establish the test retest reliability of 10m walk test in healthy Indian college students.*

Methodology: *A Cross sectional study was conducted with150 students of age group between 17-21 years through convenient sampling .Demonstrations about the test measures were done and each participantswere instructed to walk at a comfortable (normal pace) and fast pace (as fast as they could safely without running) for 10 meter a quiet even uncarpeted corridor. Only the middle 6 m, however, was timed to eliminate the effects of acceleration and deceleration. Start and stop of test's performance time coincided with the toes of the leading foot crossing the 2-m mark and the 8-m mark, respectively. From these data, the speed was calculated by dividing the middle 6 m by the time (in seconds) required to walk the 6 m. Data analysis was done using the SPSS software (version 20.0). Results are considered to be significant at $p < 0.05$ and CI of 95%. An intra-class correlation coefficient for test – retest reliability was used for the study. Bland–Altman limits of agreement analysis for assessing the agreement between two test scores were taken. Standard error of measurement (SEM) was used to calculate the variability in measurements of same tester and Small real difference (Minimum detectable change) was also calculated*

Results: *The test retest reliability for normal pace was r = 0.984(0.979-0.988) and for fasting pace r = 0.972(0.964-0.978).Standard error of measurement (SEM) for normal pace was 0.3235 and for fasting pace = 0.3612. The calculated value of Small real difference (SRD) or Minimum detectable change (MDC) for normal pace = 0.8967 and for fasting pace =0.8756 in 10 MWT.*

Conclusion*:It is concluded that 10 m walk test is the reliable measure to assess the walking speed and it moderately reflects overall physical functional performance.*

Key words*: 10 meter walk test, Walking speed , Physical performance*

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I. Introduction

Walking is a complex functional activity with multifarious variables that contributes or influences the walking speed. These variables include individual health status, motor control, muscle performance and musculoskeletal condition, sensory and perceptual function, endurance, cognitive status, motivation and mental health and the environmental constraints[1]. Despite the walking speed (WS) influenced by several variables, it is a valid, reliable, sensitive measure appropriate for assessing and monitoring functional status and overall health in a wide range of populations. These capabilities have led to its designation as the "6th vital sign"[2].Walking speed being a important component of gait , it is commonly used as an objective measure of functional mobility in both clinical and research settings. Its importance lies not only in its implications for community ambulation but also in relationship with various health outcomes which reflects both physiological and functional changes [3].

Mobility and functional independence are frequent goals of rehabilitation, and increasingly paired down versions of self-report, performance mobility, and functional measures which should be investigated to produce brief insightful outcome measures in context with WS [4]. Walk tests, in which the distance covered over a period of time is documented, have been used since 1970s as a part in quantification of functional capacity [5]. In the field of rehabilitation and physical therapy practices antecedent (prior) to these functional walk tests , cycle ergometry was considered as gold standard test in evaluation of exercise capacity and physical fitness[6]. At present due to the simplicity, interpretability and its representation in health outcomes, a wide variety of walk tests exist (eg ; 2-, 5-, 6-, 9- and 12-minute walk tests) [5] with time as the major variant. The recommendations provided for most of these timed walking tests are not withstanding due to fact that many individuals have difficulty to walk for a long period of time [7] and there may be barriers for implementation of these tests which are associated with ability of the patient, acceptability, time, and resource restraints[8]. By synthesizing the available evidence on WS, it is evident that the walk tests with greater time such as 12 MWT might be time consuming to the evaluator and it may also be exhaustive and tiring for the participants or subjects particularly with health ailments[5]. Inspite of the WS being one of the indicator for functional performance, several standardised assessments and physical performance tests are still required for the appropriate prediction of physical function and health related events [2]. Hence the shorter walk test such as 10 MWT might be the potential measure to assess the WS as a part of evaluating the physical performance of the individual within a shorter duration of time. The 10m walk test is the most feasible, short duration and easiest test to be administered. On detailed literature review , the studies elucidate that there were good test- retest reliability of 10 MWT (individuals with traumatic brain injury, joint pain and fracture, neuro muscular conditions, parkinsons disease, cerebral palsy, Spinal cord injury and stroke)[9,10,11,12,13]. Apart from these diseased population, the 10 MWT has a greater part in normal individuals such as evaluation of functional performance, physical fitness and other health indicators etc. Though there is a strong relationship between age, walking speed and functional performance [14] with the available evidences, still there is a dearth or meagreness that the test – retest reliability of 10 MWT has not been documented over the 17to 21 year age span of healthy young adults particularly in Indian context. Therefore the purpose of this study was to determine the test- retest reliability of 10 MWT in healthy young adults of age group 17- 21 years.

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II. Methods

Participants:

In a cross-sectional study, we evaluated 150 healthy subjects (75males and 75 females) of age span 17-21 years through a non-probability sampling method. They were recruited from 5 campuses of Alva's education foundation, Mangalore, Karnataka, India. Inclusion required that participants were fluent in English [15] and able to follow verbal commands. Individuals with cardio-respiratory, neurological, musculoskeletal disorders, arthritis, recent fractures of lower extremity, impaired co-ordination, impaired balance and other systemic illness which affects the gait were excluded from the study [5, 6].

Procedure:

Basic demographic characteristics (sex, age, gender) and anthropometrics (height, weight and BMI) were obtained from the participants before the test performance. Body weight was assessed with a beam scale (to the nearest 0.1 kg precision) and the height with a stadiometer (0.1cm precision) with subjects standing barefoot in light clothing. BMI was calculated as weight/height (kg/m2)[6]. Following the documentation of subject characteristics, demonstrations about the test measures were done and each participantswere instructed to walk at a comfortable (normal pace) and fast pace (as fast as they could safely without running) for 10 meter a quiet even uncarpeted corridor. Only the middle 6 m, however, was timed to eliminate the effects of acceleration and deceleration. Start and stop of test's performance time coincided with the toes of the leading foot crossing the 2-m mark and the 8-m mark, respectively. From these data, the speed was calculated by dividing the middle 6 m by the time (in seconds) required to walk the 6 m[16]. The test performance was carried out on 4 different days and the test – retest reliability was determined by comparing the 4 measurements documented by single physical therapy practitioner (test 1, test 2,test 3 and test 4)

The study was approved by the institutional review boards of Alvas college of Physiotherapy and research centre, Alvas Education Foundation, Moodbidri, Mangalore. Informed consent was obtained from all participants before the commencement of the study .

Statistical analysis

Data analysis was done using the SPSS software (version 20.0). Results are considered to be significant at $p < 0.05$ and CI of 95%. An intra-class correlation coefficient for test – retest reliability was used for the study. Bland–Altman limits of agreement analysis for assessing the agreement between two test scores were taken. Standard error of measurement (SEM) was used to calculate the variability in measurements of same tester and Small real difference (Minimum detectable change) was also calculated.The ICC values ranges from 0 to 1; 1= perfect reliability, 0.90 to 0.99 = very high correlation; 0.70 to 0.89 = high correlation; 0.50 to 0.69 = moderate correlation; 0.26 to 0.49 = low correlation and 0.00 to 0.25 =little, if any, reliability (17). Agreement was determined by the Bland-Altman method in which the individual differences were plotted against the individual mean scores. Significance level was set at 5%(18). The standard error of measurement (SEM=Average SD x √1-ICC) was used to determine the measurement error. The SEM was then converted into the Minimal Detectable Change (MDC), which expresses the minimal magnitude of change that likely reflects true change rather than measurement error. The MDC95% was estimated from the SEM and calculated as 1.96 √2 × SEM(19).

III. Results

The present study used 150 participants with average age for male 19±1.42 and female 19±1.42years .The demographic and anthropometric data of 150 samples are shown in table1.And the test retest reliability of 10 MWT for normal and fasting pace is given in table2. Agreement determined by the Bland-Altman method in which the individual differences were plotted against the individual mean scores of 10 MWT for normal and fasting pace are shown in figure 1&2. The Bland-Altman chart is a scatter plot with the difference of the two measurements for each sample on the vertical axis and the average of the two measurements on the horizontal axis. A reasonable agreement betweenthe measures with most of the values fall within M ± 2SD($p<0.05$) indicates high reliability. Standard error of measurement (SEM) for normal pace was 0.3235 and for fasting pace =0.3612. It is a measure of absolute reliability ,if small the SEM the more reliable the measurements(20).The calculated value of Small real difference (Minimum detectable change) SRD (MDC) for normal pace =0.8967 and for fasting pace =0.8756 in 10 MWT. The correlation between the 10MWT and other anthropometric measures are shown in table 3.

Table 1:Descriptive statistics of participants (N=150)

Subject characteristics	MALE		FEMALE	
	Mean	Std. Deviation	Mean	Std. Deviation
Age	19.00	1.42	19.00	1.42
Height	170.59	7.119	157.56	5.85
weight	61.44	10.02	50.01	7.20
BMI	21.08	3.06	20.17	2.95
Leg length	92.18	5.60	87.60	4.88
Day1 Norm	3.84	.42	4.32	.434
Day2 N	3.80	.44	4.3	.42
Day3 N	3.86	.42	4.28	.44
Day4 N	3.81	.42	4.27	.43
Day1fastpace	2.86	.37	3.11	.35
Day2fastpace	2.88	.374	3.05	.341
Day3fastpace	2.86	.36	3.02	.34
Day4fastpace	2.86	.37	3.01	.318

Table 2 : Test- retest reliability (Intra class correlation coefficient N=150)

Measure	Intra class Correlation	95% Confidence Interval(upper- lower limits)	
(Normal pace)	.984	.979	.988
(Fasting pace)	.972	.964	.978
Male(Normal pace)	.981	.973	.987
Female(Normal pace)	.978	.968	.985
Male(Fasting pace)	.978	.968	.985
Female (Fasting pace)	.960	.943	.973

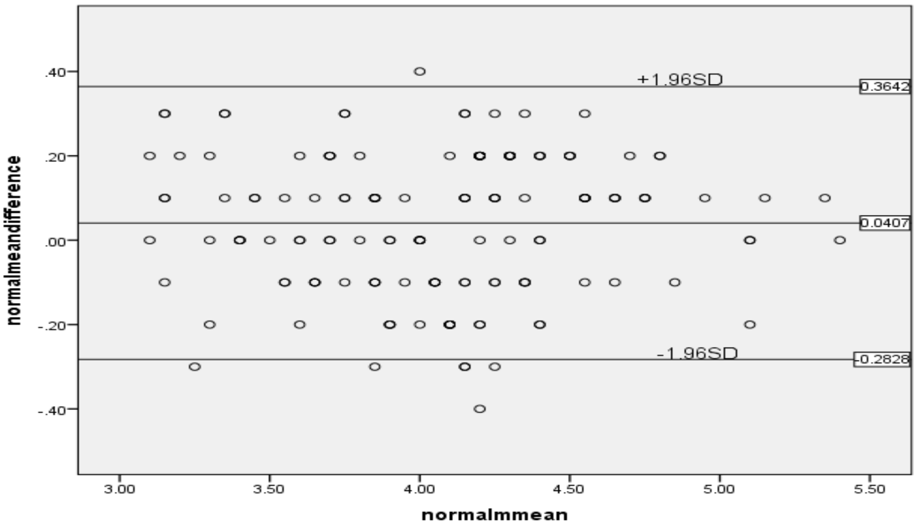

Figure 1:Bland Altman agreement plot (Normal)

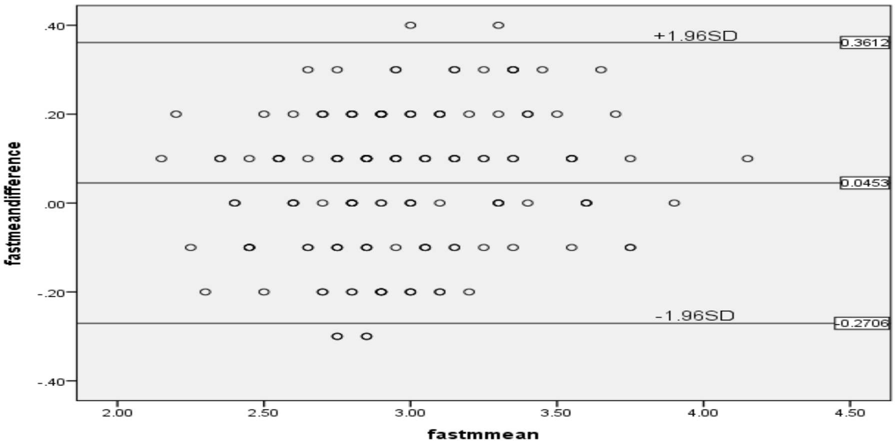

Figure 2:Bland Altman agreement plot (Fasting)

Table 3: Correlation statistics of 10MWT (N=150)

	Age	Height	weight	BMI	Day1 Norm	Day1fastpace
Age	1	-.006 .945	.165* .044	.201* .013	.084 .304	-.099 .229
Height		1	.606** .000	-.004 .960	-.403** .000	-.256** .002
weight			1	.789** .000	-.215** .008	-.118 .150
BMI				1	.025 .760	.035 .668
Day1 Norm					1	.496** .000
Day1fastpace						1

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

IV. Discussion

The main aim of this study was to determine the test- retest reliability of 10 MWT in healthy young adults of age group 17- 21 years. The results of the study showed ICC value for test retest reliability of 10MWT was greater than 0.95 for both male and female with normal and fasting pace indicating a very high correlation between the measures. The ICC value and a very small SEM value indicates that 10MWT could be reliable for the purpose in 17-21 years young adult population.[12,13,14]

Patricia Thompson in his study conducted on cerebral palsy had shown the potential applicability of the 10mFWT with ICC of about 0.81[12]. Despite the ICC values of this study is quite similar to the test retest reliability of our study, this small difference might be due to the fact that there is negative impact of having a different assessor at retest for nine of the cerebral palsy children. It has been previously demonstrated that the correlation coefficients calculatedfor the intra- and interrater reliability of 10 MWT among Spinal cord injury patients were excellent with ICC of about 0.98 which has the strong agreement with our study[1].

Since this study projects both the normal pace and the fast pace walking , there may also have adverse effect that the reliability estimates on the 10mFWT has provided with assessors positive feedback which reinforces the walk speed that a participant chose when performing the 10mFWT practice test. In contrast there is no such reinforcement in case of normal walking pace in 10MWT**.**

Walking being a fundamental quality of both normal and impaired gait, and many gaitparameters are velocity-dependent [21,22,23,24]. Walking speed may determine the degree of independence in thecommunity and the ability to participate in society and may be a good quantitative measure which may have an impact on health related quality of life in both normal and disabled population. In this study it is clear that the healthy young adults aged 17-21 years can walk at an average speed of3.8 m (male) and 4.3m (female) in normal pace and for fast pace it is about 2.8m(male) and 3.1m(female) for every 10 meter.

The 10-meter walk is adequate for the capture of kinematics, kinetics, and dynamic electromyography and the measurement of walking speed over such short distances is frequently used as an outcome measure in clinical practice to estimate the individual's capacity to function in the community [25,26,27] and to address walking endurance during rehabilitation.

Together, the findings from this study have clearly demonstrated that 10 meter walk test is a highly reliable tool and it can be considered as one of the valid indicator for evaluating the functional performance, physical fitness and other health related fitness.

The limitations of this study is that, a non- probability convenience sample of age specific population (healthy young adults aged 17-21 years)was used. A population with age variant might yield different completion rates, reliability coefficients, and relationships between distances walked.

V. Conclusion

The test–retest reliability of the 10 MWT were found to be excellent in healthy Indian young adults of age group 17- 21 years. The 10 MWT is time bound, require less space and does not require any specialist training for test administration. Future research will involve the collection of normative data , reliability and validity for the 10 MWT across the various age-span and that data will then be used as a benchmark for evaluating the various health related fitness and physical performance for healthy Indian population.

Disclosure:
The author has no conflicts of interest.

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