

Quantify One Minute Walk Test and its Relation with Physiological Cost Index (PCI) in Children among Little Disease

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ABSTRACT

Background and Objectives: Little disease means it is non progressive neurological disorder which mainly affects human locomotor systems. The aims of the study was to find out test - retest reliability of 1 minute walk test in little disease and to find out the correlation between 1 minute walk test and physiological cost index (PCI).

Study Design: Pre and post test experimental study and correlation study.

Subjects: Sixty little disease children consisting of forty four male and sixteen females.

Materials and Methods: Total 60 subjects with age group 7-12 years were included. A signed informed consent has been taken from the children's parents before participation of the study. Reliability of one minute walk test was measured by measuring the distance covered by the children in one minute. After 30 min rest distance covered in one minute was measured again. PCI was calculated by taking the heart rate which was measured by using fingertip oxymeter.

Results and Discussion: Descriptive statistical analysis has been carried out in the present study. One minute walk test showed 0.86 good test retest reliability and correlation between one minute and PCI showed moderate negative correlation ($r = -.321$, $p = 0.012$).

Conclusion: The results showed good test-retest reliability of one minute walk test and significant moderate negative correlation between one minute walk test and physiological cost index.

Keywords: Little disease, physiological cost index, walk test

INTRODUCTION

An abnormality of motor function (the ability to move and control movements) that is acquired at an early age, usually less than 1 year, and is due to a brain lesion that is nonprogressive little disease, formerly known as "Cerebral Paralysis," was first identified by English surgeon William little in 1860. ^[1]

Two 25 year studies of the changing epidemiology of cerebral palsy have shown a startling rise in the incidence of cerebral palsy amongst low and very low birth weight infants. ^[2] Prevalence of cerebral palsy is the number of cases present during a specified time, is usually calculated as age specific prevalence rate 5. A reasonable estimate of the prevalence of cerebral palsy at school age is 2 per

1000 live birth in this industrialized nations. ^[3]

Etiological factors underlying little disease are usually grouped into prenatal, prenatal, postnatal categories. ^[4] Prenatal factors are hereditary or genetic conditions; prenatal infections including viral, bacterial, and parasitic infections.

Fetal anoxia is caused by haemorrhage from premature separation of placenta or maldevelopment of the placenta, Rh incompatibility including erythroblastosis fetalis, haemolytic anaemia, and hyperbilirubinemia; metabolic disorder such as maternal diabetes and toxemia of pregnancy and developmental deficits which include maldevelopment of brain, vascular and skeletal structures. Prenatal factors includes rupture of blood

vessels or compression of brain during prolonged or difficult labour, and asphyxia caused by drug sedation, distress of labor, premature separation of placenta, and placenta previa or related to prematurity.

Postnatal factors leading to CP include vascular accidents and intracranial haemorrhage, head trauma, brain infections including bacterial or viral encephalopathy, toxic conditions such as lead poisoning, anoxia from drowning or cardiac arrest, seizures, and tumours.^[5]

All types of LD are characterized by abnormal muscle tone, reflexes, or motor development and coordination. There can be joint and bone deformities and contractures. The classical symptoms are spasticity, spasms, other involuntary movements, unsteady gait, problems with balance, and/or soft tissue findings consisting largely of decreased muscle mass. Scissor walking and toe walking are common among people with little disease who are able to walk, but taken on the whole, LD symptomatology is very diverse.^[6]

Little disease is by far the most common type, occurring in 70% to 80% of all cases. Moreover, spastic CP accompanies one of the other types in 30% of all cases. People with this type are hypertonic and have a neuromuscular condition stemming from damage to the corticospinal tract or the motor cortex that affects the nervous system's ability to receive gamma amino butyric acid in the area affected by the disability.^[7]

For although the "gold standard" assessment of exercise tolerance in children can be measured in a laboratory using a treadmill, the necessary equipment is expensive and may not be readily accessible. To facilitate assessment in children, the tests should be non-threatening, inexpensive, and easy to administer.^[8] The validated field tests of exercise tolerance can be used in children and adolescents with cerebral palsy. Maximal aerobic power is "walking". Walk test has become increasingly popular as an outcome measure for testing patient with a disability and have recently been used to assess the outcome measure of strengthening regimes in children and adults with little disease.^[9]

AIMS AND OBJECTIVES

1. To find out test-retest of one minute walk test in cerebral palsy.
2. To find out correlation between one minute walk test and physiological cost index among children with little disease.

MATERIALS AND METHODS

Sample Selection

Population:

Children diagnosed with spastic cerebral palsy.

Sample Size: Total 60 patients.

Sampling Design:

Simple random sampling test.

Research Design:

One group pre and post, experimental design.

Study Carried out

Physiotherapy Centre, NIMHANS, Bangalore.

Duration

Total duration over six month's stipulated period

Inclusion Criteria

1. Subjects who have age between four-twelve years of Age of either sex.
2. Subjects who are able to ambulate more than ten minutes without assistance of person.
3. Subjects who are able to walk with or without assistive device.
4. Subjects who have GMFCS level is 4 and 5 who are able to walk with assistive device

Exclusion Criteria

1. Subject with current ill health e.g. fever, jaundice, typhoid fever etc.
2. Subject with Any lower limb surgery or botulin toxin injection within previous
3. Twelve months.
4. Uncooperative subject.

Materials

1. Fingertip pulse oxymeter. Wrist watch.
2. Measuring tape.

Outcome: Distance covered in one minute Physiological cost index.

Intervention

Children who are diagnosed as little disease by a neurologist were given a written/informed consent. Children were being selected randomly based on inclusion and exclusion criteria. Reliability of one minute walk test was checked by duration covered in one minute by the children. Its correlation with physiological cost index was taken.

Physiological cost index was measured by $PCI = (\text{heart rate when walking}) - (\text{heart rate at rest}) / (\text{walking speed})$. Heart rate was checked by using fingertip oxymeter. Time taken in one minute by children to walk the distance

covered was measured by using wristwatch. Distance covered in one minute was measured by using measuring tape. Children were allowed to wear their splints and use their walking aids as appropriate. A minimum of five minute rest was given before starting the test. Ten meter walkway was selected and the children were made to stand at the starting point. Pulse rate was measured by a pulse meter before starting the test.

Instruction was given to the child to start walking straight as fast as possible for one minute. After one minute heart rate was measured. After thirty minute again distance covered in one minute was measured for test-retest reliability.

RESULT

A reliability and correlation study with sixty children with little disease is undertaken to study the reliability of one minute walk test and its correlation of physiological cost Index. The statistical analysis which was computed through SPSS version 18.



Figure 1: Material used



Figure 2: One minute walk test

Descriptive analysis was performed to find out mean, standard deviation, minimum and maximum values of 1st reading, 2nd reading and physiological cost index (PCI)

Relationship of distance covered in one minute walk test and physiological cost index was analyzed by using Karl

Table 1: Age distribution of children

Age in years	Number	Percentage (%)
7	29	48.30
8	15	25.0
9	13	21.70
10	2	3.30
11	1	1.70
Total	60	100.00

Table 2: Gender Distribution of Children

Gender	Number
Male	44
Female	16
Total	60

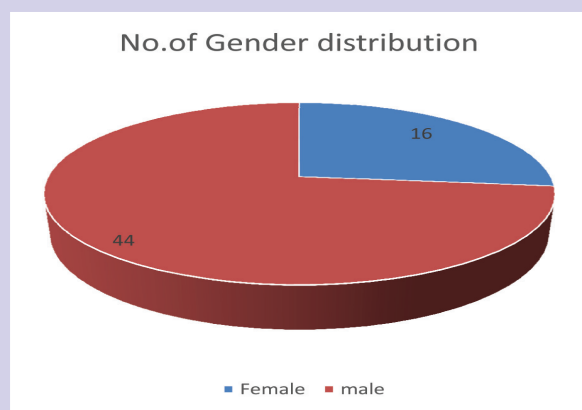


Figure 3: Pie - chart Gender distribution in children which states that there were 44 male and 16 female children

Table 3: Descriptive statistics of outcome measures studied

Parameters	Min-Max	Mean \pm SD
Distance covered in one minute	24.0-30.0	26.37 \pm 1.52
Distance covered in one minute (after 30 minutes)	24.0-30.0	27.03 \pm 1.50
Physiological cost Index	1.13-2.65	1.87 \pm 0.26



Figure 4: Mean difference of distance covered in one minute- 1st reading which shows mean difference of distance covered in one minute. 2nd reading shows mean difference of distance covered in one minute after thirty minute rest

Table 4: Reliability analysis of outcome measures- Distance covered in one minute

Variable	1st Measurement	2nd Measurement	Intraclass Correlation	Significance
One minute walk test	26.36±1.51	27.03±1.49	.861	<.0001

This table which shows that mean difference of 1st and 2nd reading. ICC Score of one minute walk test is 0.86 which indicates good test retest reliability.

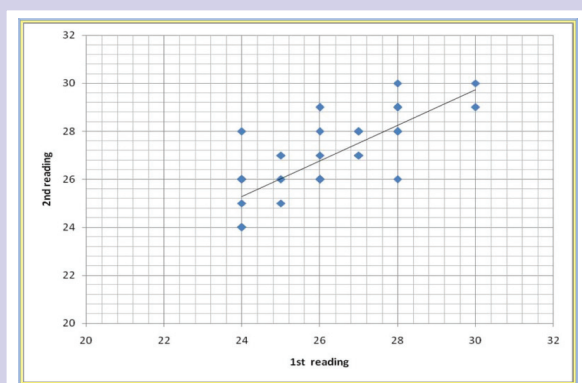


Figure 5: Reliability analysis between 1st measurement and 2nd measurement

Table 5: Pearson correlation of Physiological Cost Index with Distance covered in one minute

1MWT	PCI	Correlation coefficient	P value
26.36±1.51	1.87±.26	-0.321	< 0.012

This table shows $r = -0.321$, $p < 0.012$ which indicates that there is significant moderately negative correlation between one minute walk test and physiological cost index.

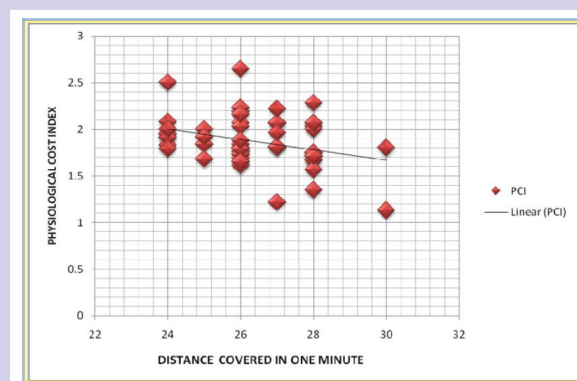


Figure 6: Pearson correlation of distance covered in one minute and physiological cost index by scatter plots

Test-retest reliability of one minute walk test in children in cerebral palsy was analyzed by intra class correlation coefficient.

DISCUSSION

The purpose of my study was test-retest reliability of one minute walk test in children with cerebral palsy and its correlation with distance covered in one minute and physiological cost index in children with spastic cerebral palsy.

A reliability study of 60 children with spastic cerebral palsy was undertaken to test reliability of one minute. In this distance covered in one minute was measured. After 30 min rest, again distance covered in one minute was measured.

Field testing is widely used to estimate aerobic capacity in children and adolescents because it is imperial to obtain laboratory measurements for larger group of people. In Children, who are able to walk independently, the most functional way to assess their maximal aerobic power is "walking".

The various field tests 6 minute walk test, 10 meter fast walk test, in children and adult with cerebral palsy have been used. In previous studies, Intra class correlation coefficient of 6 minute walk test, shuttle run test, 10 meter fast walk test were 0.98, 0.97, 0.81, in children with cerebral palsy.

One minute walk test was introduced as potential measure of functional ability and walking endurance in children with ambulatory cerebral palsy. In the one minute walk test, children were made to walk for one minute, which is comparatively lesser than other field tests like 6 minute walk test, shuttle run test.

However one minute protocol described here is more subject to variability than six minute protocol. This is

perhaps not surprising as distance walked over longer time period, causing more exertion and demands on the cardiovascular system, is likely to result in a more stable value. So the aim of this study was to quantify the reliability of one minute walk test in children with little disease.

This study demonstrated very good test-retest reliability for fast one minute walk test in children with little disease. The one minute walk test was having high reliability in this study because subjects did not include a practice walk prior to the test; also adequate rest period was given between two trials.

This might be a reason for reduced distance covered by them. The subjects reached their maximum walking speed in 1 minute itself. Hence, 1 minute walk test will better discriminate functional ability than 6 minute walk test within this population.

Motor system involvement in cerebral palsy may result in varied manifestation such as spasticity, incoordination, and loss of selective control, spasticity of antagonist muscles, paresis, and involuntary movement, all of which hamper normal walking. Apart from obvious gait abnormalities, another deterring effect of motor system involvement is abnormally high energy consumption while walking.^[9]

Energy efficiency during exercise and walk tests is measured by O_2 cost, Physiological cost index and Baseline above beat index. But O_2 cost method requires gas analyser which is more expensive. Many investigators have used the PCI as a measure of energy expenditure in the clinical and research arena. Energy expenditure is also less in one minute walk test compared to six minute walk test, 12 minute walk test, 10 meter fast walk test.^[13]

Physiological cost index is a simple, functional and non-invasive method and found to be valid and reliable to measure the physiological cost of walking.^[10]

Bowen et al 54 established an average correlation coefficient ($r = 0.503$ to 0.196) between O_2 cost and PCI values in 5 children with little disease. Another study noted that any gait deviation results in excessive energy consumption but did not mention which pattern of aberrant gait the most energy is consuming.

Identifying the gait aberration that results in the highest energy consumption can help the clinician to decide the priorities of treatment aimed at improving the ambulatory capacity of children with little disease. Among the children with CP, children with a crouch gait demonstrated highest PCI values. In this study PCI is correlated with one minute walk test.^[11]

Result showed that there was a significant moderate negative correlation between the distance covered in one minute and physiological cost index. ($r^2 = -0.321$, $P = 0.012$) in children with bilateral cerebral palsy. This finding was in accordance with the majority of the investigations that have been performed on disabled subjects and children that have shown that both energy expenditure and PCI increases with physical disability.^[12]

In this study, PCI value was also increased in spastic cerebral palsy. This could be because the added effort of lifting the walker and placing it forwards with each step. (Similarly children who were given rigid ankle foot orthosis showed an increase in the values of PCI. The evidence based study to evaluate the efficiency of PCI in ambulatory little disease and concluded that it is a reliable outcome measure of gait efficiency in children with little disease.

CONCLUSION

This result of the study showed that good test-retest reliability of one minute walk test and moderate negative correlation between distance covered in one minute physiological cost index. Hence, experimental hypothesis is accepted which states that, One minute walk test have quantify the test retest reliability of one minute walk test among children with little disease. The present study which shown that significant relation between one minute walk test and physiological cost index among little disease.

CONFLICT OF INTEREST :

The authors declared no conflict of interest.

FUNDING : None

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