

ASSESSMENT OF PHYSICAL WORK CAPACITY AMONG CHILDREN WITH DOWN SYNDROME

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ABSTRACT

Background: People with DS seem to have a lower physical fitness than their peers without disabilities. **Purpose:** The aim of this study was to compare between children with down syndrome and typically developing children regarding the physical work capacity through 6-minute walking test. **Subjects and Methods:** Thirty children, aged from 8 to 12 years of both sexes were participated in this study. They were selected from the public schools and special needs schools of Al-Fayoum government. They were assigned into two groups; group A which included typically developing children; n=15 and group B which included down syndrome children n=15. Assessments of physical work capacity via Six Minute Walk Test were performed. **Results:** There was a significant increase in distance in the normal children compared with that of children with down syndrome ($p > 0.05$). **Conclusion:** Physical work capacity of children with down syndrome is lower than typically developing children.

INTRODUCTION

Down syndrome (DS) is caused by the presence of the whole or part of an extra copy of chromosome 21. The disorder can be diagnosed in utero by screening or karyotyping, or early after birth by muscle hypotonia (poor muscle tone) and other symptoms and confirmed by karyotype analysis of a blood sample. Global estimation of the incidence of Down syndrome is 1 in 1,000 to 1 in 1,200 live births (**Irving et al., 2008**).

Recent biomedical and molecular studies have suggested that the chromosomal anomaly in Down syndrome determines several alterations in protein expression patterns which result in particular biochemical, physiological, anatomical, and behavioral characteristics such as imbalance of the oxidative metabolism (Roat et al., 2007), impaired nervous system, musculoskeletal disorders, congenital problems of the heart, narrowed airways, reduced dynamic lung function, obesity, poor sinus drainage, immunological abnormalities, premature ageing, poor sleep quality and high risk of psychopathologies, dementia and behavioral problems (Coppus et al., 2006).

Many people with Down syndrome have poor strength, poor muscle mass, and high body fat percentage and so are disposed to cardiovascular health problems (Andriolo et al., 2010).

The evidence supports the importance of the assessing and monitoring physical fitness component during childhood and adolescence. It is thus key to have valid alternative approaches available to measure Cardiorespiratory fitness (CRF) (Bergmann et al., 2014).

The assessment of physical work capacity through submaximal exercise tests including the 6-minute walking test (6MWT) which is a simple and inexpensive test that is well-tolerated by the patient. 6MWT is considered as an alternative to cardiopulmonary exercise testing (Ponikowski et al., 2016).

So the current study aimed to assess the physical work capacity of children with down syndrome through 6-minute walking test.

MATERIALS AND METHODS

Study Design

This study is Cross sectional one shot design study. It was conducted from April 2019 up to July 2020.

Subjects

A convenience sample of 30 students. Children were selected from public primary and middle schools and special needs schools from Al-Fayoum government. Students age ranged from 8 to 12 years and both genders were selected. The children were assigned into two groups: group A which included typically developing children; n=15 and group B which included down syndrome children n=15. Inclusive criteria included children with good cognition that enables them to understand the study, children with normal or corrected vision and hearing and non athletic students. Exclusive criteria included history of congenital cardiovascular or cardiopulmonary disease, participants who had participated in fitness training in the last 6 months and children with musculoskeletal problems as connective tissue disorders.

Ethical considerations:

Written consents were obtained from all students parents before the study, the steps of assessment polices were explained to students'

parents by the investigators. Approval by the Ethical Committee of the Faculty of Physical Therapy, Cairo University were obtained

Procedures

A) Evaluative procedure

1- Anthropometric assessment

Participant Height was measured without shoes near a wall to the nearest 0.1cm, body weight measured using standard weight and height scale when not available portable weight scale were used in light indoor clothing without shoes.

2-Six Minute Walk Test

Six Minute Walk Test is a sub-maximal exercise test used to assess aerobic capacity and endurance. The distance covered over a time of 6 minutes is used as the outcome by which to compare changes in performance capacity.

Application

- The child was instructed to walk as far as possible for 6 minutes back and forth in the hallway. Six minutes is a long time to walk, so the child would be exerting himself and he would probably get out of breath or become exhausted. The child was permitted to slow down, to stop, and to rest as necessary. He could lean against the wall while resting, but resume walking as soon as he was able. He walked back and forth around the cones. He should pivot briskly around the cones and continue back the other way without hesitation.
- The physical therapist demonstrated the test before starting
- The physical therapist Read this standardized encouragement during the test.
- After the 1st minute: "You are doing well. You have 5 minutes to go."
- When the timer shows 4 minutes remaining: "Keep up the good work. You have 4 minutes to go."
- When the timer shows 3 minutes remaining: "You are doing well. You are halfway done.
- When the timer shows 2 minutes remaining: "Keep up the good work. You have only 2 minutes left.
- When the timer shows 1 minute remaining: "You are doing well. You only have 1 minute to go.
- With 15 seconds to go: "In a moment I'm going to tell you to stop. When I do, just stop right where you are and I will come to you." At 6 minutes: "Stop"
- If the child stops at any time prior, the therapist can say: "You can lean against the wall if you would like; then continue walking whenever you feel able."

- The therapist did not use other words of encouragement (or body language) to influence the patient's walking speed. The therapist accompanied the participant along the walking course, but kept just behind them. And did not lead them.
- The walking distance was measured and recorded.
- Reasons for immediately stopping a 6MWT included the following: (1) chest pain, (2) intolerable dyspnea, (3) leg cramps, (4) staggering, (5) diaphoresis, and (6) pale or ashen appearance (**ATS statement: guidelines for the six-minute walk test, 2002**).

Data Analysis:

Subject characteristics were compared between groups using the independent t-test. Chi squared test was conducted for comparison of sex distribution between groups. Normal distribution of data was checked using the Shapiro-Wilk test. Levene's test for homogeneity of variances was conducted to test the homogeneity between groups. Independent t-test was conducted for comparison of distance between groups. The level of significance for all statistical tests was set at $p < 0.05$. All statistical analyses was conducted through the statistical package for social studies (SPSS) version 25 for Windows (IBM SPSS, Chicago, IL, USA).

RESULTS

Subject characteristics:

Table (1) showed the subject characteristics of the study groups. There was no significant difference between children with down syndrome and normal children in age and sex distribution ($p > 0.05$).

Table 1. Basic characteristics of participants.

	Children with down syndrome	Normal children	p-value
Age (years)	9.93 ± 1.14	10.22 ± 1.07	0.27
Sex, n (%)			
Girls	13 (43.3%)	18 (45%)	0.89
Boys	17 (56.7%)	22 (55%)	

SD, standard deviation; p-value, level of significance

Comparison of distance between children with down syndrome and normal children:

There was a significant increase in distance in the normal children compared with that of children with down syndrome ($p > 0.010$), with mean difference of -254.7 meter and 95% CI of (-270.47: -238.92).

Table (2). Comparison of distance between children with down syndrome and normal children:

	Children with down syndrome	Normal children			
	Mean ±SD	Mean±SD	MD (95% CI)	t- value	p-value
Distance (meters)	257.8 ± 7.41	512.5±36.19	-254.7 (-270.47: -238.92)	-32.21	0.001

SD, standard deviation; MD, Mean difference; CI, confidence interval; p-value, level of significance.

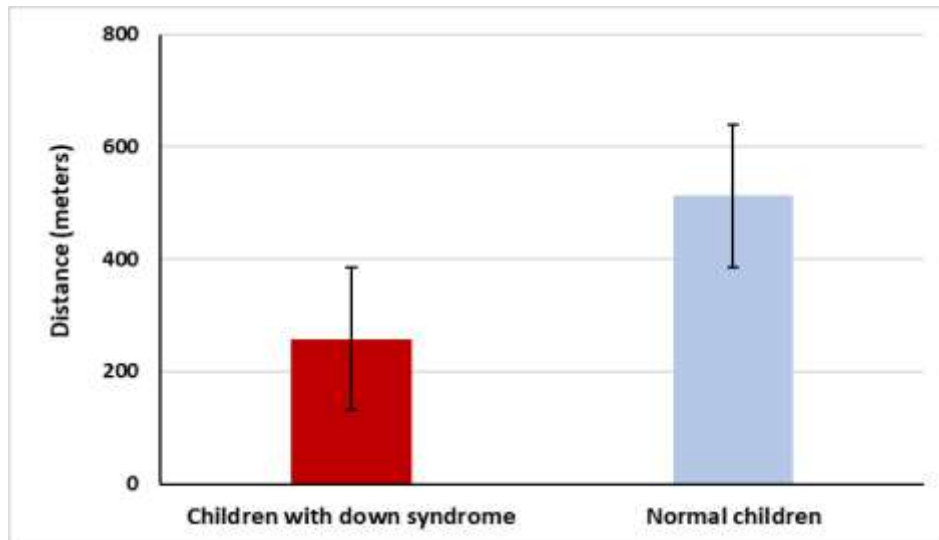


Figure (1). Mean distance between children with down syndrome and normal children.

DISCUSSION

Down Syndrome (DS) is a genetic disorder caused by a trisomy of chromosome 21 and is the most common genetic cause of intellectual disability (ID) (Franceschi et al., 2019). DS is associated with significant health problems as diseases such as congenital heart disease, obstructive sleep apnea, celiac disease and endocrinopathologies. Endocrine disorders are usually characterized by thyroid disorders, low bone mass, diabetes, short stature and propensity to be overweight/obese (Franceschi et al., 2019 and Whooten et al., 2018).

Because ambulation is one predictor of survival among adults with DS, the aim of this study was to investigate the physical work capacity in children with down syndrome via 6 minute walk test.

The results of the current study revealed that physical work capacity of down children is significantly lower than normal children of comparable age and gender. This is may be due to that young people with DS have higher rates of overweight and obesity than young people without DS. Prevalence in overweight and obesity varied between 23–70% in DS patients (13.3–52.9 and 0–62.5%). (Bertapelli et al.,2016). The causes of the development of overweight and obesity in DS are: hypotonia (decreased muscle tone), susceptibility to systemic inflammation, metabolic diseases and/or slow metabolism (Brantmüller, et al., 2015). Usually, people affected by DS consume less healthy food, and show physical limitations, depression, and lack of social and financial support. Besides, medications contribute to weight gain

(Cushing et al., 2012). It was also reported that people with DS have poor strength, poor muscle mass (Andriolo et al., 2010). So all these factors contributed to the results of physical work capacity of DS children.

Significant difference of physical work capacity in this study is supported by the findings of Mendonca et al., 2010 who concluded that Persons with (DS) have reduced peak and submaximal exercise capacity. Available data suggest that reduced exercise capacity in persons with DS results from an interaction between low peak oxygen uptake (VO₂peak) and poor exercise economy. Of several possible explanations, chronotropic incompetence has been shown to be the primary cause of low VO₂ (2peak) in DS. In contrast, poor exercise economy is apparently dependent on disturbed gait kinetics and kinematics resulting from joint laxity and muscle hypotonia. Importantly, there is enough evidence to suggest that such low levels of physical fitness (reduced exercise capacity and muscle strength) limit the ability of adults with DS to perform functional tasks of daily living.

Moreover, the results of this study agree with findings of (Casey et al., 2012) who evaluated the reliability of the 6-minute walk test (6MWT) in individuals with Down syndrome and explored factors affecting walking distance. 6MWT showed good test-retest reliability and the reported 6MWD appeared lower than that previously reported for individuals without Down syndrome.

The current study has some limitations such as the small sample size that it may not be possible to generalize these results to the whole population of down syndrom. Further studies on a larger population of children with DS have to be carried out. Additionally, the children who participated in this study were restricted to definite age group to one type of CP with the age group from eight to twelve years. So, more studies are needed on other age groups of DS.

Based on current study results, clinical management of reduced physical work capacity in DS seems important to ensure that these individuals remain productive and healthy throughout their lives.

CONCLUSION

Based on the results of this study, physical work capacity of down children significantly differs from typical development children .

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سعة العمل البدني لدي الأطفال المصابين بمتلازمة داون

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المخلص

الخلفية: يمتلك الأشخاص المصابين بمتلازمة داون مستوي منخفض من اللياقة البدنية مقارنة بأقرانهم الاصحاء

الغرض: الهدف من هذه الدراسة هو مقارنة الاطفال المصابين بمتلازمة داون و الاطفال طبيعي التطور من ناحية سعة العمل البدني بواسطة اختبار المشي لمدة 6 دقائق .

الطرق: شارك في هذه الدراسة 30 طفلا، تراوحت اعمارهم ما بين 8 الي 12 عاما من كلا الجنسين . تم اختيارهم من مدارس عامة و مدارس لذوي الاحتياجات الخاصة بمحافظة الفيوم . تم توزيعهم الي مجموعتين المجموعة ا و التي اشتملت علي 15 طفل طبيعي التطور. و المجموعة ب و التي اشتملت علي 15 طفل من المصابين بمتلازمة داون.تم إجراء تقييم سعة العمل البدني بواسطة اختبار المشي لمدة 6 دقائق

النتائج: أظهرت النتائج زيادة ذات دلالة احصائية في مسافة المشي في الاطفال طبيعي التطور مقارنة بالاطفال المصابين بمتلازمة داون

الاستنتاجات: سعة العمل البدني لدي الاطفال المصابين بمتلازمة داون اقل من الاطفال طبيعي التطور

الكلمات المفتاحية: متلازمة داون ، سعة العمل البدني ، اختبار المشي لمدة 6 دقائق