Six-minute walk test in juvenile diabetes mellitus patients

Hadeer M.A. Lotfallah[a], Emad El-Deen M. Hammad[b], Hekma S. Farghaly[b]

[a]Department of Pediatric, Assiut University Children Hospital [b]Department of Pediatrics, Faculty of Medicine, Assiut University, Assiut, Egypt

Correspondence to Hadeer M.A. Lotfallah, Bachelor's of Medicine,
Al-Helaly Street, Al Hokokeen Building No.1, Assiut, Egypt.
Postal/Zip Code: 71511;
Tel: 01013402454;
e-mail: hadeer22lotfallah@gmail.com

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Background
Six-min walk test (6-MWT) is a simple reliable test with a significant role in demonstrating type-1 diabetes mellitus (T1DM) effect on the functional capacity of children with T1DM.

Objectives
Our study aimed to estimate the incapacity of insulin-dependent diabetes mellitus patients by establishing their profile during the 6-MWT and to determine their 6-min walk distance.

Patients and methods
The study included 30 cases (six males and 24 females), who were suffering from T1DM (aged from 5 to 18 years, known to be diabetic for more than 1 year, and free from other diseases apart from T1DM) admitted to the Pediatric Endocrinology Unit at Asyut University Pediatric Hospital and 20 children (six males and 14 females) age-matched and sex-matched as a control group. All cases included in the study were subjected to anthropometric measurements, systematic examination, glycated hemoglobin, and random blood glucose before and after the test, and according to the American Thoracic Society guidelines, the 6-MWT was performed.

Results
Our study reported that the 6-min walk distance of T1DM patients was shorter than that of the controls regarding the same age and sex, T1DM lowers the physical capacity of the diabetic children and affects their daily-life activities, and a significant negative correlation was found between the duration of the DM and the walked-distance score (r=–0.392, P = 0.032) (the longer the duration of T1DM, the lower the walked distance), while there was no significant correlation of the walked distance with the glycated hemoglobin nor the BMI.

Keywords:
children, diabetes mellitus, insulin-dependent diabetes mellitus

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Introduction

One of the most common pediatric chronic diseases is type-1 diabetes mellitus (T1DM), in which a progressive autoimmune T-cell-mediated β-cell destruction of pancreatic islets in genetically susceptible individuals [1], resulting in loss of insulin secretion [2]. It has major health consequences for individuals and societies. Management of T1DM is lifelong and challenging, considered an overwhelming demanding disease that affects all aspects of patient's life and thus can negatively affect the mental and physical health of the diseased children, impacting their health-related quality of life [3]. Walking a set distance is a quick, easy, and inexpensive way to assess physical function. It is also an important component of quality of life, since it reflects the capacity to undertake day-to-day activities. Balke developed a simple test for examining functional capacity: measuring the distance walked during a defined period of time. A 12-min performance test was then developed to evaluate the physical fitness of healthy individuals. This test was subsequently modified for use in patients with chronic bronchitis. In order to allow the test to be used in patients with respiratory diseases, for whom walking 12 min was too demanding, a shortened version, the 6-min walk, was developed, and found to perform equally as well. A recent review of functional walking tests concluded that the 6-min walk test (6-MWT) is easier to carry out, more acceptable, and provides a better reflection of activities of daily living than other walk tests [4].

The test can be used to monitor the progress of disease and response to therapy in patients with various diseases. However, the most common use of 6-MWT is in pulmonary and cardiovascular diseases [5]. The American Thoracic Society Pulmonary Function Standards Committee recently developed guidelines for the 6-MWT in clinical settings.

Aim

Our study aimed to:

(1) Estimate the incapacity of insulin-dependent diabetes mellitus patients by establishing their profile during the 6-MWT.

(2) Determine their 6-minute walk distance (6-MWD).

Patients and methods

Patients

Thirty cases (six males and 24 females) were suffering from T1DM.

Inclusion criteria

(1) Insulin-dependent diabetes mellitus patients (T1DM).
(2) Age from 5 to 18 years.
(3) Duration of the disease more than 1 year.
(4) Free from other chronic diseases apart from T1DM.

Exclusion criteria

(1) T1DM with duration less than 1 year.
(2) T2DM.
(3) Children with chronic systemic illnesses like respiratory, hepatic, renal, neurologic, cardiac, or gastrointestinal conditions.
(4) Children with skeletal or surgical disorders interfering with walking.

The controls

Twenty healthy children (six males and 14 females) from primary, preparatory, and secondary schools of the same-age category of the patients.

Tools of study

All cases (patients and controls) included in the study were subjected to:

(1) Anthropometric measurements (weight, height, and BMI).
(2) Systematic examination (chest, heart, abdomen, neurological, and skeletal).
(3) Glycated hemoglobin (HbA1c).
(4) Random blood glucose before and after the test.

According to the American Thoracic Society guidelines, the 6-MWT was performed.

Patient preparation

All patients wore comfortable clothes, appropriate shoes for walking were worn, the patient's usual medical regimen was continued, a light meal was taken before the test, and patients were not exercised vigorously 2 h before the test.

Safety issues

The test was performed in the Pediatric Endocrinology Unit at Asyut University Pediatric Hospital, where rapid response to an emergency was possible. Oxygen source and telephone were in place to enable a call for help.

Technical aspects of the 6-min walk test

Location

The 6-MWT was performed in the pediatric endocrinology unit at Asyut University Pediatric Hospital, where a long, flat, straight, and an enclosed corridor at a course of 30 m was assigned. The length of the corridor was marked every 3 m. The turnaround point was marked with a cone.

Ethical consideration

Reviewing the proposal was carried out by the ethical committee of Assiut Faculty of Medicine. The aim of the study was explained to each patient before the beginning of the process, written consent was obtained from those who welcomed to participate in the study.

Patients signed informed consent.

IRB number: 17101455.

Results

This study was conducted on pediatric patients with T1DM (aged from 5 to 18 years, known to be diabetic for more than 1 year, and free from other diseases apart from T1DM) admitted at the Pediatric Endocrinology Unit at Asyut University Pediatric Hospital, it included 30 children with T1DM and 20 children age-matched and sex-matched as a control group.

Glycated hemoglobin of the studied groups

It was found that the mean HbA1c was significantly higher in the patients than in the controls ($P = 0.000$), as shown in Fig. 1.

Walked distance of the studied groups (m)

It was observed that the mean 6-MWD of the patients was significantly lower than the mean 6-MWD of the controls ($P = 0.000$), as shown in Fig. 2.

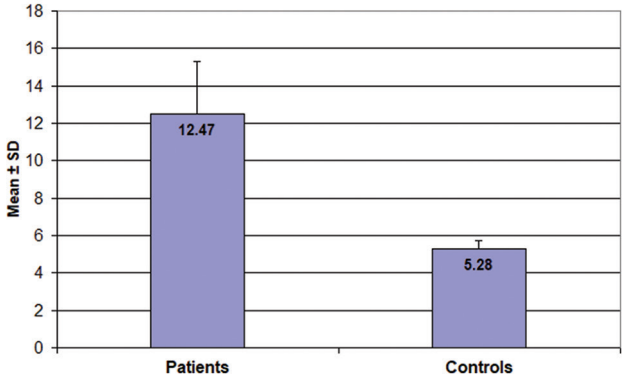
Correlation between walked distance and duration of diabetes mellitus

A significant negative correlation was found between the duration of the DM and the walked-distance score (r=–0.392, $P = 0.032$), while there was no significant correlation of the walked distance with the HbA1c nor the BMI, as shown in Fig. 3.

Discussion

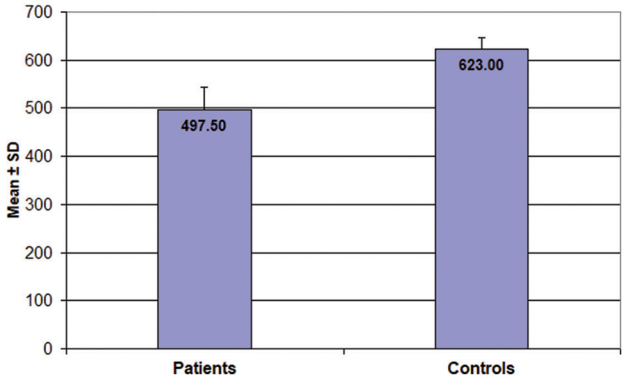
Our study is a cross-sectional study that was conducted in the Pediatric Endocrinology Unit at Asyut University Pediatric Hospital to demonstrate T1DM effect on the functional capacity of children. It included 30 children with T1DM (aged from 5 to 18 years, known to be diabetic for more than 1 year, and free from other diseases apart from T1DM) and 20 children age-matched and sex-matched as a control group.

Figure 1



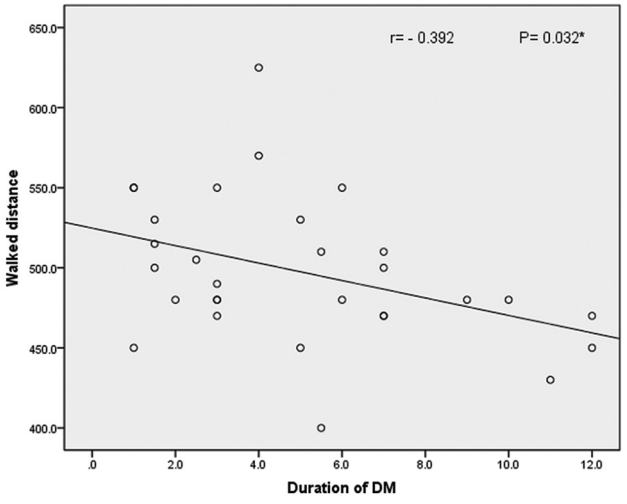
HbA1c of the studied groups. HbA1c, glycated hemoglobin.

Figure 2



Walked distance of the studied groups (m).

Figure 3



Correlation between walked distance and duration of DM. DM, diabetes mellitus.

According to our study, the mean 6-MWD of the patients was significantly less than that of the controls. This indicates that T1DM lowers the physical capacity of the children and affects their daily-life activities.

Our results were in agreement with Hagag *et al*. [6], who reported that the physical functional capacity is much lower in diabetic children than in age-matched controls, and with Jegdic *et al*. [7], who reported that children with T1DM are less physically fit than matched healthy controls as measured by the 6-MWT. This could be explained by the fear of hypoglycemia as a consequence of exercise [8], diabetic myopathy, cardiovascular autonomic dysfunction, microangiopathic vascular lesions, and peripheral neuropathy [9].

According to our results, the duration of DM affects the physical capacity of the diabetic children, this could be explained by Ramanathan [10], who reported that long duration of diabetes, poor glycemic control, and associated hypertension all increased the chances of microvascular complications of diabetes. These microvascular complications could lead to visual, renal, as well as neurological function impairment, including death. As the microvascular complications affect the physical capacity of the diabetic children, this may explain our results. While the HbA1c and the BMI did not significantly affect the physical capacity of the diabetic children. This was in agreement with Jegdic *et al*. [7], who reported that the level of HbA1c did not affect the physical fitness of children with T1DM.

Our study reported that:

(1) The 6-MWD of T1DM patients was shorter than that of the controls regarding the same age and sex.
(2) T1DM lowers the physical capacity of the diabetic children and affects their daily-life activities.
(3) The duration of DM affects the physical fitness of the diabetic children (the longer the duration of T1DM, the lower the walked distance).
(4) The level of the HbA1c did not significantly affect the physical capacity of the diabetic children.

Conclusion

We concluded that T1DM lowers the physical capacity of the diabetic children and affects their

daily-life activities by decreasing the walked distance as measured by the 6-MWT, the duration of DM affects the physical fitness of the diabetic children (the longer the duration of T1DM, the lower the walked distance), and the level of the HbA1c and the BMI did not significantly affect the physical capacity of children with T1DM.

Recommendations

(1) It is recommended to encourage the patients to exercise and to do physical activities that help in controlling the DM and improving their physical fitness.
(2) The patients need good monitoring and control of the diabetes, which helps to prevent and to early detect the complications.

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Nil.

Conflicts of interest

None.

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