MÜSBED 2012;2(2):72-77

The Effect of Type 2 Diabetes Mellitus on The Motor Behaviour of Elderly Individuals During Sit to Stand Activity

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Kabul tarihi / Date of acceptance: 15 Mayıs 2012 / May 15, 2012

ÖZET

Tip 2 Diabetes Mellitus'un yaşlı bireylerde oturmadan ayağa kalkma aktivitesi üzerine etkisi

Amaç: Çalışmanın amacı Tip 2 diyabet tanısı almış yaşlı bireyler ile diyabet tanısı olmayan yaşlı bireylerin oturmadan ayağa kalkma aktivitesi sırasındaki motor davranışlarını incelemektir.
Yöntem: İzmir, Narlıdere dinlenme ve bakım evinde ikamet eden 81 yaşlı birey çalışmaya gönüllü olarak katıldı. Çalışmaya alınma kriterlerine 59 kişi (26'sı tip 2 diyabetik, 33'ü diyabetik olmayan) uygundu. Oturmadan ayağa kalkma aktivitesi NeuroCom Balance Master System (versiyon 8) ile değerlendirildi. Test içerisinde oturmadan ayağa kalkma aktivitesi boyunca ağırlık aktarım zamanı, ayağa kalkma indeksi, salınım hızı ve sol-sağ simetrisi değerlendirildi.
Bulgular: Oturmadan ağaya kalkma aktivitesi boyunca diyabetik ve diyabetik olmayan grup arasında ölçülen motor parametreler arasında anlamlı fark bulunmamıştır ($p>0.05$).
Sonuç: Diyabetik ve diyabetik olmayan yaşlı bireyler oturmadan ayağa kalkma aktivitesini gerçekleştirmek için aynı motor stratejileri kullanmışlardır.
Anahtar sözcükler: Tip 2 Diabetes Mellitus, yaşlı, oturmadan ayağa kalkma aktivitesi

ABSTRACT

The effect of type 2 diabetes mellitus on the motor behaviour of elderly individuals during sit to stand activity

Objective: The aim of the study was to investigate whether there was any difference in motor behavior of sit to stand activity of elderly individuals with type 2 diabetes mellitus (DM) compared to elderly individuals without type 2 diabetes mellitus diagnosis.
Methods: Eighty one elderly individuals, who live in Izmir, Narlıdere Geriatric Home Care Center, accepted to take part in this study. Finally, 59 elderly individuals (type 2 diabetes group consisted of 26 and non-diabetic group consisted of 33 participants) met our inclusion criteria and participated in the study. Sit to stand test was performed by using the NeuroCom Balance Master System (version 8). Weight transfer time, rising index, sway velocity and left-right symmetry during sit to stand activity were assessed by the system.
Results: No significant difference between the DM and the Non-DM group was found for all measured parameters during sit to stand activity ($p>0.05$).
Conclusions: Diabetic and non-diabetic elderly individuals chose to perform similar motor strategies to perform sit to stand activity.
Key words: Type 2 Diabetes Mellitus, elderly people, sit to stand activity

INTRODUCTION

Diabetes mellitus (DM) is more common in elderly population indicating that almost one sixth of elderly population has type 2 DM in the world (1,2). An estimation states that elderly individuals will comprise two-thirds of the diabetic population in developed countries by the year 2025 (3,4). Therefore, clarifying the contribution of diabetes to disability in elderly populations is important.

Diabetes is a chronic metabolic disease with impaired glucose tolerance that may increase the risk of cardiovascular diseases related primarily to its associated long-term microvascular and macrovascular complications (5).

Neuropathies and musculoskeletal complications such as limited joint range and insufficient muscle strength are among the most common of all the long-term complications of diabetes (6-10). The metabolic changes in diabetes (microvascular abnormalities with damage to blood vessels and nerves; and collagen accumulation in skin and periarticular structures) result in changes in the connective tissue and structure of a muscle. These changes cause decline in muscular functions. Decline in muscular function together with peripheral neuropathies may increase risk for functional dependency and frailty in type 2 diabetic people (11).

Ageing appears to interact with hyperglycaemia to accelerate the onset of long-term diabetic complications (12,13). Moreover, elderly diabetic patients report reduced physical function compared with elderly individuals without DM as a result of multifactorial impairment including peripheral neuropathy and balance problems. As a result, elderly individuals with type 2 diabetes often exhibit greater impairments in physical functions such as maintaining posture, balance and gait (14,15).

The ability of the elderly individuals to live independently is upon their physical function of important activities of daily living. Besides maintaining posture and gait, rising from a chair, in another words, sit to stand (STS), is one of the important basic tasks of daily living that depends on joint torques, sufficient muscle strength and accurate balance control (16). Sit to stand is a complex motor task characterized by the transfer from one stabilized posture to another requiring the control of balance during an important displacement of the body center of mass (17).

Several studies have focused on STS activity, especially in the elderly population because they have experienced difficulty due to its complexity and physical demands to perform the task. These studies have investigated some motor strategies of STS activity by means of kinematics, kinetics and executed forces during STS in older population. The significant differences between older and young population in performing STS activity have been revealed by the previous studies with no clear evidence (18-22).

Despite the fact that approximately 50% of people with diabetes are over 60 years of age, little attention has been paid to this subgroup of elderly patients especially for the STS activity which is one of the important determinants of daily living.

Based on the literature we expected deteriorations in performing STS activity by means of motor behaviors (strategies) between elderly individuals with and without type 2 DM.

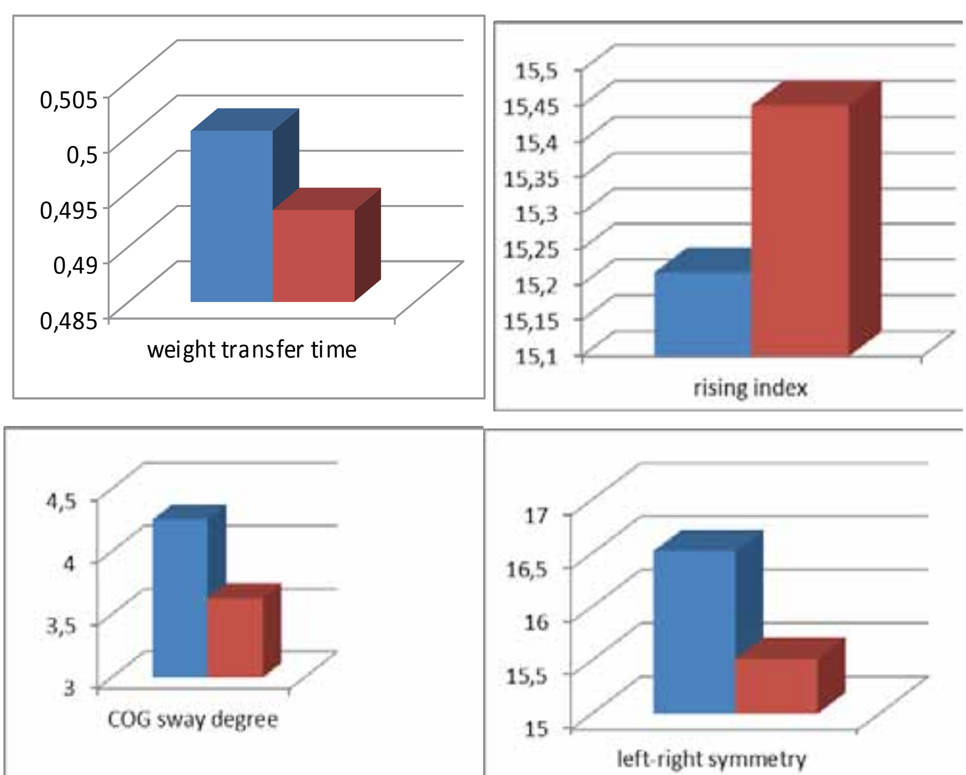

Figure 1: Measured Sit to Stand parameters of DM and non-DM elderly individuals

COG is center of gravity, blue bars (first bars) represent diabetic group, red bars (second bars) represent non diabetic group, Weight Transfer time is expressed in seconds, Rising Index is expressed as a percentage of the patient's body weight, COG sway is expressed in degrees per second

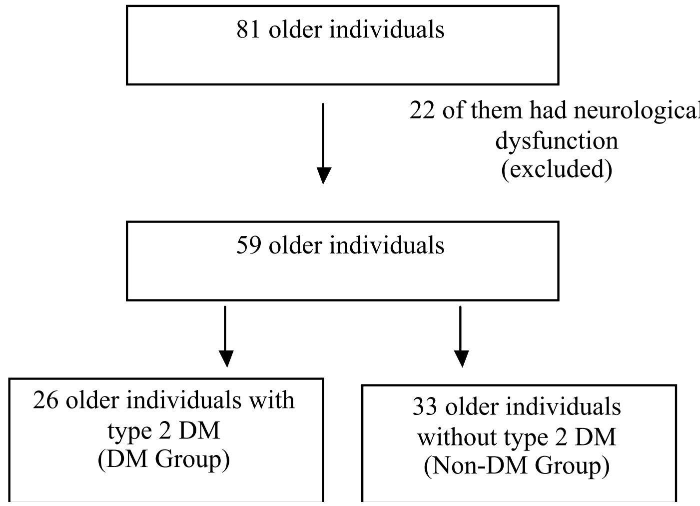

Figure 2: Distribution of Subjects

DM is diabetic group, Non DM represents non-diabetic group

The aim of the study was to investigate whether there was any difference in motor behavior of elderly individuals with type 2 DM compared to elderly individuals without type 2 DM during STS activity.

METHODS

Subjects

Eighty one elderly individual, who live in Izmir, Narlıdere Geriatric Home Care Center, accepted to take part in this study. Twenty two older individuals were excluded from the study because of having neurological dysfunction. Finally, 59 older individuals participated in the study. None had a chronic or acute illness leading to an inflammatory syndrome and pain at the occasion of the test. They had no muscular pathology, gait or balance disorders. None of them had psychiatric disorders, dementia and cognitive deficits. They were all able to see adequately and follow instructions.

Twenty six (19 female, 7 male) of the participants had the diagnosis of type 2 DM for at least ten years. Thirty three older individuals among the participants that met our inclusion criteria had no diagnosis of type 2 DM. Finally, DM group consisted of 26 older individuals while the control group (non-DM group) had 33 non-diabetic older individuals (Figure 1).

The recorded characteristics of older individuals in both groups included; age, gender, body weight, body height, body mass index and dominant lower extremity. Lower extremity dominancy was determined by asking which leg they would prefer to hit a ball.

Each subject received information about the study and gave written consent to participate. The study was approved by the Local Ethical Committee.

Testing Procedure

To evaluate STS movement, STS test was performed by using the NeuroCom Balance Master System (version 8). The system has a force platform connected to a computer which is capable of detecting center of gravity (COG) sway during different tasks. The equipment provides quantitative data through STS test that reproduce activities of daily living.

During the measurements subjects were positioned on the platform facing the monitor with barefoot (Figure 2). They performed STS movement from a seated surface. The starting position before each trial was standardized by placing knees at 90 degree flexion by adjusting foot placement. Subjects were allowed one practice trial for familiarization with the procedure of the test. Subjects were instructed to stand up as quickly as possible when start sign appeared on the monitor. They were not allowed to use arms or hands to push off their legs or the seated surface. Following the STS movement subjects were also instructed to stand as still as possible for 5 seconds to measure COG sway. System requires the STS trial three times.

Important components of this task measured by the system include shifting the body's COG sway from initial position over the seat to a location centered over the base of support, followed by extension of the body to an erect standing position while maintaining the centered COG position. The measured parameters were weight transfer time, rising index, sway velocity during rising phase and left-right symmetry.

Weight Transfer time expressed in seconds is the time required to voluntarily shift COG forward, beginning in the seated position and ending with full weight bearing on the feet. Rising Index is the amount of force exerted by the legs during the rising phase. The force is expressed as a percentage of the patient's body weight. Cog Sway Velocity documents control of the COG over the base of support during the rising phase and for 5 seconds thereafter. Sway is expressed in degrees per second. Left/Right Weight Symmetry documents differences in the percentage of body weight borne by each leg during the active rising phase (23).

Statistical Analyses

All analyses were performed with SPSS version 11.0. The data were analyzed by using Mann Whitney U test to identify the differences in measured parameters between older individuals with and without type 2 DM. Statistical significance was set at p <0.05.

RESULTS

Data were analyzed for 59 older individuals as 26 subjects in DM group and 33 subjects in non-DM group. Subjects in the DM group and the non-DM group exhibited no significant difference in weight, height and age. Demographics of the participants are described in Table 1.

Data from STS test include time to transfer weight over center of base of support, rising index, the amount of COG sway, left and right weight symmetry.

No significant difference was found for all measured parameters during STS activity between the DM and the non-DM group. Although statistically insignificant (p=0.360), weight transfer time of older individuals with DM was less than that of the non-diabetic individuals. Similarly, the DM group generated less rising index, which is the amount of forces on the force platform, than the non-DM group (p=0.901).

GOG sway degree was higher in the DM group than the non-DM group without significance (p=0,118)

It was also found that there was no significant difference by means of left and right symmetry between the individuals in the DM group and the non-DM group in our study (p=0,800) (Figure 2).

DISCUSSION

The purpose of the study was to investigate the effect of type 2 DM on the motor behavior of elderly individuals during STS activity. We expected worsening in motor strategies of STS activity in elderly individuals with type 2 DM compared to elderly without DM.

Unexpectedly, we could not find any significant difference in motor parameters of STS activity such as weight transfer time, rising index, sway velocity and left-right symmetry. Although the results showed that elderly individuals with type 2 DM had worse scores than non-diabetic elderly individuals, the differences were not statistically significant. As one of the most important daily living activity, STS requiring rising from a chair to a standing position is influenced by numerous factors including motor control and balance factors. Accurate control of COG

Table 1: Characteristics of older individuals in DM group and Non-DM Group

	DM Group Mean±SD N=26	Non-DM Group Mean±SD N=33	p value
Age (years)	80.7±6.9	81.1±7.3	0,56
Body height (cm)	159±9.2	161±11.8	0.80
Body weight (kg)	71.2± 12.1	70.6±13.3	0.87

DM is diabetic group, Non-DM represents non-diabetic group, Mean±SD represents the mean value and standard deviation, N is number of subjects.

position is critical in controlling the rise movement, as well as to maintain postural stability (23).

The weight transfer time is one of the indicators of controlled and successful rising. Slower times indicate decreased ability of moving GOG forward (21). In our study the DM group performed the STS activity by slower weight transfer times compared to the non-DM group. Increased transfer time in elderly people is expected as a result of increased reaction time and nerve conduction velocity by ageing. Ageing accompanying with DM is possible to worsen the weight transfer time due to late complications of DM as neuropathy. Another possible explanation of slower weight transfer time in DM group could be the musculoskeletal complications of diabetes.

Similarly, elderly diabetic individuals showed slightly higher COG sway velocity indicating no significant value than the non-diabetic group. Ideally, COG sway velocity during and immediately after the rise should be minimal. It means that during the rising phase and for 5 seconds thereafter, elderly people with type 2 DM had slightly weaker balance control compared with the non-diabetic elderly group. Increased sway velocity can be caused by weak or delayed trunk extension or inability to keep the COG movement to a minimum (19). Unfortunately, we did not check the subjects during STS task performance for their trunk positions. It should be taken in account for next studies on relationship of STS movement with DM in elderly.

Since the rising index is the amount of force exerted by the legs during the rising phase, it is considered to be an indicator of extensor muscle strength of lower extremity. In rising phase the legs must extend, push down against the surface to produce counterforce sufficient to raise the body to a standing position. Higher scores are defined as good, whereas low scores are defined as worse by the system (23). In our study the type 2 diabetic elderly group performed lower rising index score than the non-diabetic elderly group indicating lower extensor muscle strength of lower extremity.

Another parameter that was tested by the system during STS was left/right weight symmetry. The relative amount of weight borne by each leg during to rise to stand and for the five seconds after rise was measured and expressed as a percentage. The ideal score is zero (0) %, reflecting symmetry; the higher the score, the worse the asymmetry. Although there was no significant difference between two groups, the elderly group with DM showed higher scores than the non-diabetic elderly group. Higher loading on one limb versus the other may reflect strength and sensory loss (23). These complications are common among patients with type 2 DM (11,14,15).

Unfortunately we did not assess the muscle strength and neuropathy existence but all of the diabetic participants in our study had the diagnosis of type 2 DM at least for 10 years. Although the development of diabetic micro- and macrovascular complications is dependent on the duration of diabetes, symptoms of the complications may be concentrated in the elderly in a shorter time (12,13).

Ageing dominancy may result in nonsignificant differences between the type 2 diabetic elderly group and the non-diabetic elderly group in our study. It is well known that diabetes population has a high prevalence of syndromes such as functional disabilities, depression, fall, urinary incontinence, pain and dementia, which occur due to the aging and diabetic complications. These symptoms lead to frailty, loss of independence and low quality of life (24).

All these physiological deteriorations occurred in ageing may be more effective on motor control of STS activity than DM does. We can speculate that the age related physiological changes may have a similar effect in comparison to effect of diabetic elderly adults in our study.

We planned this study to ascertain the impact of DM in STS activity control which is one of the important activities of daily life in elderly population. The description of motor impairments in STS activity of diabetic elderly population would provide a basis for improving early intervention protocol in this population. It could prevent or at least minimize later motor disability before they become irreversible and impair quality of life (25).

CONCLUSION

No significant difference in motor parameters of STS activity such as weight transfer time, rising index, sway velocity and left-right symmetry between the elderly individuals with type 2 DM and the non-diabetic elderly individuals were found.

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