National Journal of Physiology, Pharmacy and Pharmacology

RESEARCH ARTICLE

Perceived stress, cognitive function test, and handgrip strength in type 2 diabetes mellitus

Karthik Devaraju[1], Smrithi C Shetty[2]

[1]MBBS Student, AJ Institute of Medical Sciences and Research Centre, Mangalore, Karnataka, India, [2]Department of Physiology, AJ Institute of Medical Sciences, Mangalore, Karnataka, India

Correspondence to: Smrithi C Shetty, E-mail: smrithishetty12@gmail.com

Received: April 10, 2019; **Accepted:** May 01, 2019

ABSTRACT

Background: Type 2 diabetes a non-communicable disease with high prevalence rate globally as well as in India is known to cause mental and physical slowing and psychological stress which usually goes unnoticed in the initial stages. **Aims and Objectives:** This study aims to assess and compare the cognition functions, muscle strength, and perceived stress in diabetics and normal controls. **Materials and Methods:** Fifty-two type 2 diabetes patients and 52 age- and sex-matched controls were randomly selected for the study after the approval from the institutional ethics committee. Stress levels were recorded by perceived stress scale questionnaire, cognitive function test using Mini–Mental State Examination (MMSE), and handgrip strength of the dominant and non-dominant hand was determined using a Handgrip Dynamometer. Student's *t*-test was used to compare the various parameters among diabetics and normal controls and Pearson correlation coefficient was used to correlate all the parameters. **Results:** Diabetics had higher perceived stress score and lower MMSE than non-diabetics. Handgrip strength in diabetics was slightly reduced than non-diabetic group and was higher in males compared to females diabetic males and females with more than 10 years duration had significantly higher score for perceived stress and poor MMSE (<23). MMSE and age were negatively correlated. **Conclusions:** Diabetes leads to subtle decline in cognition and handgrip strength associated with high level of stress in the initial stages which may become profound as the disease progresses. Hence, it is important to screen all diabetic patients for stress level and decline in cognition and strength by simple bedside tests at baseline and at regular follow-up and counsel them to cope up with disease and also develops interventions such as lifestyle modification to prevent further progression.

KEY WORDS: Cognition; Diabetes; Handgrip Strength; Perceived Stress

INTRODUCTION

Type 2 diabetes mellitus is a non-communicable disease which is in the rise globally and affecting approximately 415 million people worldwide according to the International Diabetes Federation. India stands second highest in the number of diabetics in the world with approximately 69 million patients.[1]

People with diabetes have high prevalence of premature mortality and disability which are attributed to the development of various complications and comorbid conditions. Factors which increase the risk of disability in diabetes are obesity, coronary heart disease, arthritis, and stroke and these disabilities ultimately affect the quality of life.[2]

Diabetes is known to cause mental and physical slowing. Mental slowing or cognitive decline has been identified

Access this article online	
Website: www.njppp.com	Quick Response code
DOI: 10.5455/njppp.2019.9.0415501052019001	

in patients with diabetes even in the early stages of type 2 diabetes.[3] Handgrip strength is a simple marker for muscle strength and poor grip strength has been identified as one of the risk factors for mortality in patients with diabetes[4]

Diabetes patients are more prone to develop mental health disorders like psychological stress which most often goes unnoticed. Perceived stress has been an important predictor of diabetes, independent of other factors such as socioeconomic status and body mass index (BMI).[5] Due to stress, there may be poor glycemic control which may lead to the development of more complications by which there is further deterioration of health and that may lead to more psychological stress and health-related behavioral changes.

Majority of diabetic patients are between the age group of 40 and 50 years and its pivotal to detect these complications early using simple bedside tests and bring in intervention at the earliest to prevent further progression. Hence, this study is conducted to assess and compare the cognition functions, muscle strength, and perceived stress in diabetics and normal controls.

MATERIALS AND METHODS

Type 2 diabetes mellitus patients and apparently healthy normal controls both males and females aged between 40 years and 60 years, who are able to read and write English were selected randomly from the wards and medicine outpatient departments. Diabetic patients with a history of treatment with either oral hypoglycemic or insulin for more than 1 year were included in the study. Participants with a history of hypertension, with any muscular disorders and psychiatric illness were excluded from the study. Based on a previous study, using six units as the difference in handgrip strength among type 2 diabetics and normal controls, with significance level of 5% and a power of 80%, the sample size was estimated to be 52 type 2 diabetes patients and 52 age- and sex-matched controls. The study was approved by the institutional ethics committee.

All participants (type 2 diabetes mellitus patients and normal controls) received the participant information sheet explaining the study and after obtaining voluntary consent from the participants, they were given a two-part questionnaire for completion which included sociodemographic data (name, age, sex, address, and duration of diabetes mellitus) and perceived stress scale questionnaire[6] which is widely used for measuring the perception of stress. It has 10 questions asking the participants about their feelings and thoughts during the last month and the participants had to indicate by circling how often they felt that way in a 5-point Likert response format. Four of the items were reverse scored. The total score was calculated by summing the responses.

Two tests were performed, in sequence after familiarizing the subjects with the testing procedures. Cognitive function test using Mini–Mental State Examination (MMSE)[7] a simple and a practical tool to assess the mental status which is an 11-question measure that tests five areas of cognitive function: Orientation, registration, attention and calculation, recall, and language. The maximum score was 30 and a score <23 indicated cognitive impairment. Handgrip strength of the dominant and non-dominant hand was determined using a Handgrip Dynamometer, as the maximum voluntary contraction (kilograms) sustained for at least 3 s. Student's *t*-test was used to compare the various parameters among diabetics and normal controls and Pearson correlation coefficient was used to correlate all the parameters. The data were analyzed using SPSS version 17.

RESULTS

Our study included 104 male and female participants aged 40–60 years, of which 52 were diabetics and 52 were non-diabetic subjects matched by age and sex [Tables 1 and 2].

In our study, we found that diabetics had significantly higher perceived stress compared to non-diabetic control group ($P < 0.001$). MMSE which assesses the global cognitive functioning was slightly lower in diabetics than the non-diabetics but within the normal range. Although handgrip strength was slightly reduced in diabetics, we did not find any significant difference among diabetics and the control group.

Table 1: Depicts the comparison of all parameters in diabetic and non-diabetic control groups

Parameters	Diabetics (*n*=52)	Non-diabetics (*n*=52)	*P*
Age (years)	49.57±5.03	50.67±5.73	0.303
Perceived stress	18.65±4.72	15.69±4.06	<0.001
MMSE	24.59±2.62	25.36±2.48	0.138
Handgrip strength in dominant hand (kg)	15.05±4.74	16.51±5.71	0.655
Handgrip strength in non-dominant hand (kg)	13.78±5.0	13.78±5.72	0.444

MMSE: Mini–Mental State Examination

Table 2: Depicts the comparison of all parameters in diabetic male and diabetic female subjects

Parameters	Diabetic males (*n*=27)	Diabetic females (*n*=25)	*P*
Age (years)	49.29±6.11	49.88±3.62	0.68
Perceived stress	18.74±4.06	18.56±5.43	0.892
MMSE	24.37±2.81	24.84±2.71	0.544
Handgrip strength in dominant hand (kg)	18.48±2.9	11.36±3.3	<0.001
Handgrip strength in non-dominant hand (kg)	17.0±3.74	10.32±3.72	<0.001

MMSE: Mini–Mental State Examination

Of the total 52 diabetics, 25 were female and 27 males. We did not find any significant difference in perceived stress and MMSE values in males and females, but handgrip strength was higher in male diabetics than females ($P < 0.001$) which was also noted in non-diabetics. In non-diabetic control group, we found significantly high scores of perceived stress in females than males ($P = 0.011$).

We classified 52 diabetics into three groups based on the duration of diabetes [Table 3] and compared all the parameters in these groups in males and females separately [Tables 4 and 5].

Among diabetic females, perceived stress was higher in subjects with diabetes for more than 10 years of duration and 1–5 years duration but lowest in diabetics with 5–10 years duration ($P = 0.032$).

MMSE was poor <23 in diabetic females with duration >10 years ($P = 0.009$). We did not find any significant difference in handgrip strength among the three groups.

Table 3: Grouping diabetics based on duration

Duration of diabetes (years)	Males (*n*=27)	Females (*n*=25)
1–5	13	11
5–10	12	10
>10	2	4

Table 4: The comparison of all parameters in diabetic female subjects

Parameters	Duration 1–5 years (*n* = 11)	Duration 5–10 years (*n* = 10)	Duration > 10 years (*n* = 4)
Age (years)	49.18 ± 4.4	50.8 ± 2.85	49.5 ± 3.6
Perceived stress	20.54 ± 4.1	15.2 ± 2.4	21.5 ± 9.8
MMSE	26.09 ± 2.5	24.8 ± 2.1	21.5 ± 1.7
Handgrip strength in dominant hand (kg)	10.36 ± 2.2	12.4 ± 3.9	11.5 ± 4.04
Handgrip strength in non-dominant hand (kg)	8.9 ± 2.7	11.0 ± 3.8	12.5 ± 5.1

MMSE: Mini–Mental State Examination

Table 5: The comparison of all parameters in diabetic male subjects

Parameters	Duration 1–5 years (*n*=13)	Duration 5–10 years (*n*=12)	Duration >10 years (*n*=2)
Age (years)	48.1±6.2	49.5±5.7	55.5±6.3
Perceived stress	18.69±4.2	18.66±4.3	19.5±2.12
MMSE	25.23±3	24±2.42	21±0
Handgrip strength in dominant hand (kg)	18.5±2.18	18.5±3.7	18±4.2
Handgrip strength in non-dominant hand (kg)	16.7±3.05	17.4±4.7	17±3.74

MMSE: Mini–Mental State Examination

Among diabetic males, subjects with duration of diabetes more than 10 years showed slightly higher perceived stress score and poor MMSE score <23 compared to other two groups.

When we correlated all the parameters in diabetics, we found that MMSE and age were negative correlated ($P < 0.001$). Among diabetic males, there was a significant negative correlation between MMSE and age ($P < 0.001$) and handgrip strength and age ($P < 0.008$). There was no significant correlation found among diabetic females.

Among non-diabetics, there was negative correlation between MMSE and age ($P = 0.013$), perceived stress and MMSE ($P = 0.047$) and positive correlation between MMSE and handgrip strength ($P = 0.011$).

DISCUSSION

In our study, we found that perceived stress was higher in diabetics compared to control group, cognitive function (MMSE) was slightly reduced in diabetics compared to non-diabetics. MMSE in diabetic patients with >10 years duration was significantly reduced compared to diabetics with lesser duration of disease. There was a significant negative correlation between MMSE and age, indicating that as age advanced cognitive function declined in both diabetics and non-diabetics and it was greater in males. Handgrip strength was slightly reduced in diabetics only in dominant hand.

Perceived Stress and Diabetes

Perceived stress was higher in diabetics compared to control group. Similar results were reported by Sendhilkumar *et al*.[8] where high level of stress in diabetics was associated with low physical activity. Self-perceived stress has been an important predictor of diabetes independent of other factors such as socioeconomic status and BMI. Reasons for high stress in diabetes were attributed to their concerns about the long-term complications and self-management of the disease.[8] Steptoe *et al*.[9] reported that diabetic patients of age group 50–75 years showed poor post-stress recovery in blood pressure and heart rate and blunted stress reactivity when compared to non-diabetics matched with age and sex. It was also noted that diabetics experienced greater stress and also depressive and hostile symptoms more than did the healthy controls concluding that there could be dysfunctioning of biological stress-related processes or systems. Stress and related processes are known to be the contributing factors in the progression of type 2 diabetes.[10] In our study, we found that diabetics with greater duration (>10 years) and recently diagnosed diabetics (<5 years) had high level of stress when compared to diabetics with 5–10 years duration. A study conducted in Malaysia by Kaur *et al*.[11] revealed that stress, anxiety, and depression were more in diabetics with <2 years duration due to their inefficiency in coping with the

management of diabetes. Almawi *et al*.[12] showed positive correlation between duration of diabetes and depression and stress.

Cognitive Function and Diabetes

In our study, MMSE which assesses the global cognitive functions was slightly reduced in diabetics compared to non-diabetics and it was within normal range for that age group, but MMSE in both male and female diabetic patients with >10 years duration was significantly reduced compared to diabetics with lesser duration of disease. There may have been a subtle change in the cognitive functions in diabetics in the initial stages which may have been missed. It was reported that longer duration of diabetes is associated with increased incidence of mild cognitive impairment.[13] Previous studies on diabetics showed that long standing hyperglycaemia associated with glycation of various proteins in the brain cells[14] and cerebral microvascular disease[15] may be the cause for cognitive impairment in diabetics. Mythri and Quadri[16] reported a decline in short-term memory in diabetics compared to non-diabetics of age group 40–65 years. There is also evidence that stress and depression in diabetics is associated with accelerated decline in cognition and hence increased risk of mortality[10] When we tried to find association between age and cognitive function (MMSE) in diabetics and non-diabetics separately, there was significant negative correlation ($P < 0.001$) indicating that as age advanced cognitive function declined in both diabetics and non-diabetics.[17] In our study, this association was significant and profound in males both diabetic as well as non-diabetics pointing out that the cognitive decline is faster in males than females. Similar findings were reported by Mccarrey *et al*.[18] and they attributed that difference in brain structure and functions as the reason for sex differences in cognitive decline.

Handgrip Strength and Diabetes

In our study, handgrip strength was slightly reduced in diabetics. Li *et al*.[19] reported reduced muscle strength and muscle mass as a predictor of diabetes. Reduction in handgrip strength may affect their routine activities in the long run. Although handgrip strength was slightly reduced only in dominant hand, we did not find any differences between dominant and non-dominant hands. Handgrip strength in our study was greater in males in both groups. Grip strength is dependent on various factors such as gender and BMI.[20] Older studies have recorded accelerated loss of muscle mass and strength in diabetics and it is greater with longer duration of diabetes.[21]

Strength of this study is that we used simple, easy, less time-consuming bedside tests to screen diabetics for stress levels, cognitive decline, and grip strength. However, few limitations of this study are that only a limited number of subjects were involved in this study, their glycemic status was not known at the time of study and no follow-up was done to note down further changes.

CONCLUSIONS

Diabetes is one of the leading non-communicable diseases in India, affecting individuals above 40 years of age. Although this study shows subtle decline in cognition and handgrip strength associated high level of stress in diabetes, it is utmost important for us to detect these changes at the earliest by simple bedside tests and bring in awareness among public regarding these changes and also develop interventions such as lifestyle modification to prevent further progression.

ACKNOWLEDGMENT

We would like to thank all the participants of our study.

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How to cite this article: Devaraju K, Shetty SC. Perceived stress, cognitive function test, and handgrip strength in type 2 diabetes mellitus. Natl J Physiol Pharm Pharmacol 2019;9(7):678-682.

Source of Support: Nil, **Conflict of Interest:** None declared.