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RESEARCH ARTICLE

Short-term memory and verbal fluency in Type 2 diabetes

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ABSTRACT

Background: Neuropathy is common in people with Type 2 (non-insulin-dependent) diabetes for a long duration. Hence, it is possible that deficits in cognitive function might also be found in those who have had diabetes for a long duration. Our objective was to assess the short-term memory and verbal fluency in subjects above 40 years with Type 2 diabetes. **Aims and Objectives:** The aims and objectives of this study were to determine the effect of duration of uncomplicated Type 2 diabetes on short-term memory and verbal fluency. **Materials and Methods:** A cross-sectional comparative study was done. One hundred male participants, between 50 and 60 years of age with uncomplicated Type 2 diabetes for at least 2 years duration, were selected. They did not have any other chronic medical disorders. An informed consent was obtained. The duration of diabetes was noted from the date of the first diagnosis. The addenbrooke's cognitive examination-revised (ACE-R) was used to evaluate short-term memory and verbal fluency. A cross-sectional comparative study was done, and the performances were based on the scores obtained. Statistical analysis was performed using the coefficient of correlation. We considered $P < 0.05$ to be significant. **Results:** For short-term memory, the mean score obtained by the subjects was 6.35 ± 0.66, and for verbal fluency, the mean scores obtained were 7.07 ± 2.05. Duration of diabetes correlated significantly with poorer performance on short-term memory ($r = -0.371$) and verbal fluency ($r = -0.837$). **Conclusion:** Within the study group, an association between duration of diabetes and short-term memory and verbal fluency was found. Early diabetics performed well, whereas those who were diabetics for a longer duration performed less well. Such changes may give us insight to the process of accelerated aging in diabetes.

KEY WORDS: Neuropathy; Type 2 Diabetes; Addenbrooke's Cognitive Examination-Revised; Short-Term Memory; Verbal Fluency

INTRODUCTION

Type 2 diabetes is a chronic non-communicable disease with several microvascular and macrovascular complications.[1,2] Studies have shown that chronic diabetes can affect the cognitive process. Current research shows an increased incidence of cognitive dysfunction in subjects with Type 2 diabetes, especially that of verbal fluency, i.e., the ease of processing information as well as short-term memory.[3-5] Long-term follow-up studies show an early slowing in cognitive functions.[6,7] An increase in the risk of developing dementia in subjects with diabetes has been described as well.[7-9] Various studies have revealed that the effect of diabetes on cognition is most evident among aged individuals.[10] A wide range of biological systems work to maintain optimal cognitive function and mental ability. Change in the harmonization of these systems, such as chronic inflammation, oxidative stress, insulin resistance, and endothelial dysfunction, as seen with aging or Type 2 diabetes leads to an accelerated deterioration of cognitive functions.

The term "cognition" is "the mental action or process of acquiring knowledge and understanding through thought,

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experience, and the senses." Effects of diabetes on cognition and memory are being studied by many researchers. Similarly, dementia is one of the most important problems which affects the normal life of elderly individuals and their family. Mild and early cognitive impairment is one of the most important precursors of dementia, and the early diagnosis of these factors is of paramount importance.

The effect of the duration of diabetes on cognitive functions is not well studied. Hence, we decided to find the factors related with cognitive decline in diabetic patients and also use simple techniques to assess cognitive function which will be practical for a quick outpatient department (OPD) evaluation. Our objective was to find the association between the duration of the disease and cognitive function (short-term memory and verbal fluency) of elderly subjects with Type 2 or non-insulin-dependent diabetes mellitus.

If such an association is present, appropriate intervention would aid in preventing or early diagnosis of cognitive impairment in patients with diabetes.

MATERIALS AND METHODS

The study was conducted after obtaining the permission from the Institutional Ethics committee. A cross-sectional study was done. A total of 100 male subjects, aged between 50 and 60 years with Type 2 diabetes without any complications, for at least 2 years' duration on regular follow-up were selected from the population of Chennai. All the subjects with a history of comorbidities and those on cardiovascular drugs were also excluded from the study. The subjects were matched for intellectual history, and they did not have major illnesses which were likely to affect cognition. They did not have any other chronic medical disorders. The scope of our study was explained to them in detail. An informed consent was obtained. The duration of diabetes was noted from the date of the first diagnosis. The Addenbrooke's Cognitive Examination-Revised (ACE-R) was used to evaluate short-term memory and verbal fluency.[10] ACE-R is used to evaluate five major areas of cognition, namely memory, attention and concentration, verbal fluency, language, and visuospatial functioning. A short pre-test demonstration was given to the subjects. It took around 12 min to complete the test for each subject.

Short-term Memory (Total Score of 10)

- The participants were asked to repeat and remember 3 words. They were asked to recall after 2 min. 1 point for each correct item
- Recall - scores 0–7.

Verbal Fluency (Total Score of 14 Letters - Scores 0–7 and Animals - Scores 0–7)

- Letters - scores 0–7 - the participant is to generate as many words as he can, beginning with the given alphabet 1 min
- Animals - scores 0–7 - the participants are to name as many animals as possible in 1 min.

This was a cross-sectional comparative study, and the scores obtained were recorded. Statistical analysis was performed using the coefficient of correlation. A $P < 0.05$ was considered to be statistically significant.

RESULTS

The mean scores obtaines by the subjects for short-term memory and verbal fluency were (6.35 ± 0.66) and (7.07 ± 2.05) respectively. There was a significant correlation between the duration of diabetes and the scores obtained for short-term memory ($r = -0.371$) and verbal fluency ($r = -0.837$) [Tables 1 and 2].

DISCUSSION

In the present study, a significant negative correlation was observed between duration of Type 2 diabetes and the scores of short-term memory and verbal fluency. The results of our study are in concurrence with the study by

Table 1: Negative correlation between duration of diabetes and verbal fluency

Variables	Duration of diabetes	Verbal fluency
Pearson correlation		
Duration of diabetes	1.000	−0.837**
Verbal fluency	−0.837**	1.000
Significant (two-tailed)		
Duration of diabetes	−	0.000
Verbal fluency	0.000	−

**The correlation is significant at the 0.01 level

Table 2: Negative Correlation between the duration of diabetes and short-term memory

Variables	Duration of diabetes	Short-term memory
Pearson correlation		
Duration of diabetes	1.000	−0.371**
Short-term memory	−0.371**	1.000
Significant (two-tailed)		
Duration of diabetes	−	0.038
Short-term memory	0.038	−

**The correlation is significant at the 0.05 level

Luchsinger *et al*. They have reported that diabetes mellitus is related to a significantly higher rate of mild cognitive impairment compared to the general population.[11] In a study done by Solanki *et al*.,[12] on patients with Type 2 diabetes and normal subjects, it was found that 48% of elderly diabetic patients showed cognitive impairment,[13] which was in line with our results. In another study by Ruis *et al*., cognitive testing was performed 3–4 years after diabetes diagnosis. Similar to our study, the authors also found a lower performance in verbal memory in particular in immediate and incidental memory in patients with Type 2 diabetes compared to healthy individuals.[14] Alencar *et al*. used the mini-mental state examination, which takes up a lengthy duration to apply in a OPD setup. Hence, it is not possible to administer this test during the few minutes of follow-up consultations in the clinic. In the present study, the ACE-R which was used to assess the scores of short-term memory and verbal fluency is a simpler and well-established tool that takes up lesser time during the medical consultation, which is also easy to administer and friendlier to the subjects.[15] In future, the cognitive performance of the patients could be assessed with this cost-effective and less time-consuming tests.

Our study used a simple and cost-effective tool to assess cognition in diabetics. The sample size of the study was less which may not be an exact representation of the general population.

CONCLUSION

There is much evidence that shows that Type 2 diabetes can increase the risk of early cognitive dysfunction and hence can lead to dementia. It may also be an important factor in the pathophysiology of accelerated aging. However, further studies are needed to address and prevent cognitive impairment in diabetics.

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