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Research Article

### CROSS-SECTIONAL ANALYSIS OF COGNITIVE DECLINE AMONG ELDERLY INDIVIDUALS SUFFERING FROM DIABETES MELLITUS TYPE I AND TYPE II

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#### Abstract:

**Background:** The damaging consequences that diabetes mellitus holds for the body are widely understood. Less focus, however, has been allotted to the consequences it holds for the mind. Diabetes mellitus, especially type-I, has been linked to a compromised performance on various cognitive function domains. The precise pathophysiological route of cognitive dysfunction among diabetics is not fully understandable, but it is probable that modalities that bring about effects on the body, too are responsible for affecting the mind.

**Objective:** To study the effects that diabetes, a physically belittling disease, has on the mind and its ability to function by looking for clinically relevant cognitive impairment in individuals suffering from the disease.

**Methods:** This observational, cross-sectional study included a sample of 200 individuals suffering from diabetes mellitus aged 60 and above, selected using consecutive sampling, and presenting at the medicine unit 2 outpatient department at Liaquat University Hospital, Jamshoro and Hyderabad from January 1, 2016 to April 10, 2016. Verbal informed consent was obtained before administering structured interview administered questionnaires. Cognitive decline was assessed using the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE) and a supplementary self-structured questionnaire for qualitative insight into the cognitive state and its correlates.

**Result:** The presence of clinically relevant cognitive impairment was two times higher among participants with type 1 than type 2 diabetes Mellitus. Both types of diabetes showed statistically significant difference than the normal values of the population.

**Conclusion:** Clinically relevant cognitive impairment is highly prevalent among subjects with childhood-onset type I diabetes mellitus. Chronic hyperglycemia and hypoglycemia are thought to be the causes behind this cognitive impairment.

**Keywords:** Diabetes Mellitus, Childhood-onset, Cognitive impairment, Cognitive Decline.

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**INTRODUCTION:**

The damage that diabetes mellitus inflicts on the renal, retinal, peripheral nervous system and cardiovascular system are well known. Less focus, however, has been allotted to the consequences it holds for the mind. Diabetes mellitus, especially type-I, has been linked to a compromised performance on various cognitive function domains. The precise pathophysiological route of cognitive dysfunction among diabetics is not fully understandable, but it is probable that hyperglycemia, hypoglycemia play decisive roles.

Looking deeper, diabetes mellitus is an intricate metabolic ailment that can have distressing consequences for many bodily organs. This giant of a disease is the prime reason, in the United States, leading to end stage renal disease [1]. In addition to the aforementioned, diabetes is also a commonly leads to loss of vision, neuropathy, and diseases of cardiovascular origin. A seemingly less attended and poorly recognized consequence of diabetes is cognitive dysfunction. Type 1 and type 2 diabetes mellitus patients have been diagnosed with clinically relevant cognitive deficiencies that can be linked to the two types of diabetes. Both hyperglycemia and hypoglycemia have been associated with cognitive dysfunction, and the fear that recurrent hypoglycemia will weaken their memory with time, is prevalent among the patients. Though extensive research has been conducted, the underlying pathophysiology of this adverse consequence is not well understood, and the best diagnostic methods, treatment options, and prevention strategies for cognitive dysfunction in diabetes have not yet surfaced.

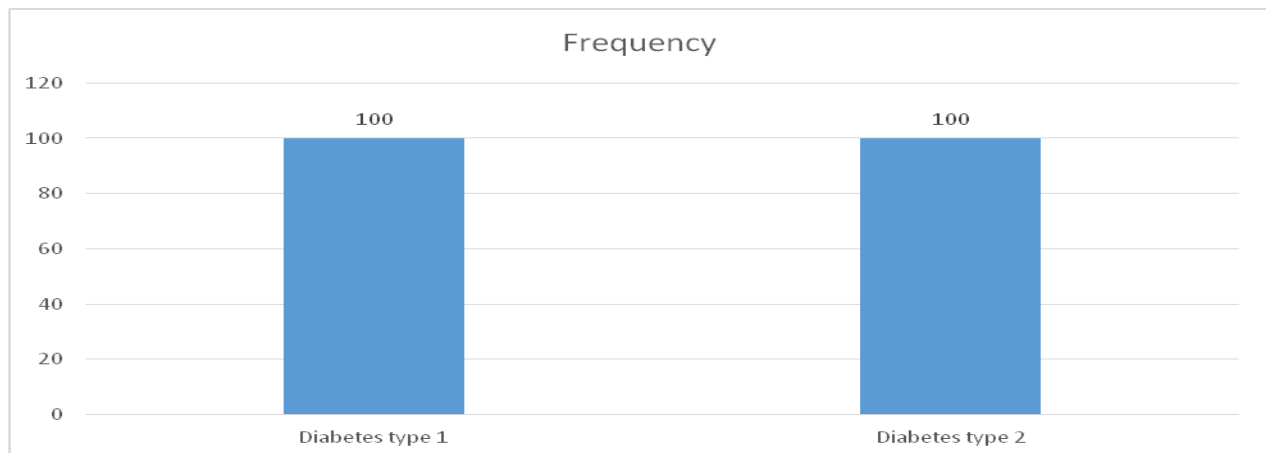
It cannot be said enough that though extensive research has been done and much insight has been gained regarding cognitive dysfunction in patients with diabetes, more is still needed, particularly regarding the natural history and mechanisms of this consequence in an attempt to to develop strategies for treatment and prevention. Here in this article we use memory as an indicator of cognitive ability and use it to draw inferences regarding the overall cognitive health of the subjects.

**METHODOLOGY:**

This observational, cross-sectional study included a sample of 200 individuals suffering from diabetes mellitus aged 60 and above, selected using consecutive sampling, and presenting at the medicine unit 2 outpatient departments at Liaquat University Hospital, Jamshoro and Hyderabad from January 1, 2016 to April 10, 2016. Verbal informed consent was obtained before administering structured interview administered questionnaires. Cognitive decline was assessed using the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE) and a supplementary self-structured questionnaire for qualitative insight into the cognitive state and its correlates.

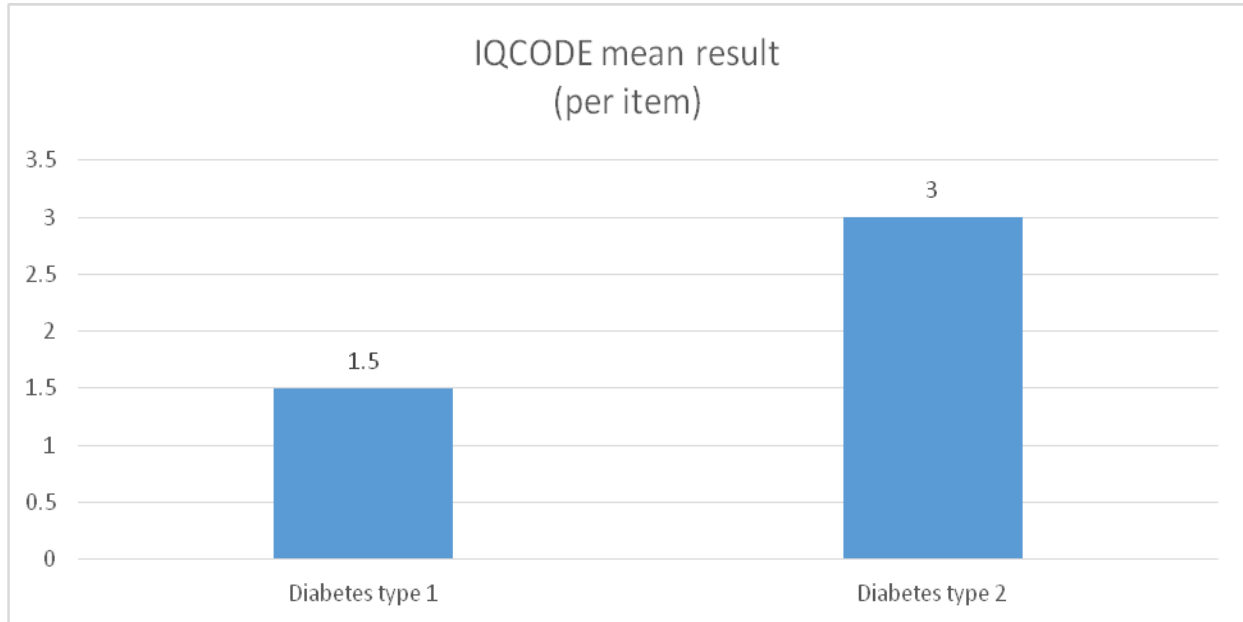
**RESULTS:**

The prevalence of clinically relevant cognitive impairment was two times greater among subjects with type 1 than type 2 diabetes Mellitus. Both types of diabetes showed statistically significant difference than the normal values of the population. The sample was divided between the two types of diabetes as shown below.



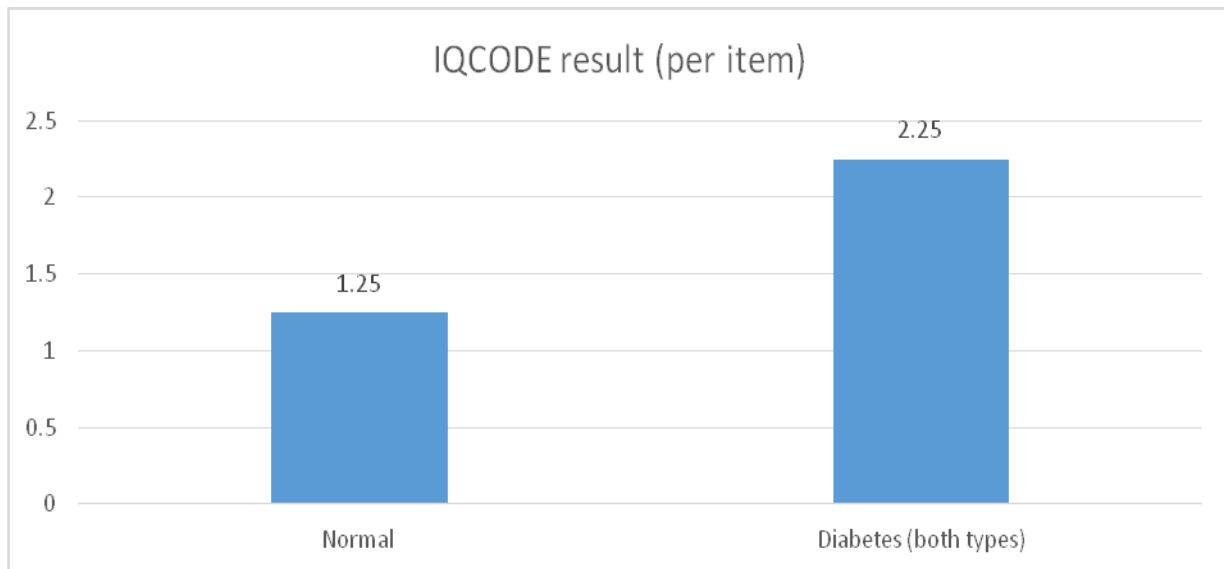
**Fig 1: The frequency was not kept intentionally equal, and it was only a matter of coincidence that the numbers turned out to be equal. The ratio equality came as a surprise since the prevalence of the two types is not similar in the study setting neither in most parts of the globe. Collection of sample over a larger time period might have yielded different results.**

The individuals suffering from diabetes type 2, as stated above, fared well in the wide test poised by the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE). In fact they fare 2 times better than the individuals suffering from diabetes type 1.



**Fig 2: The difference indicates that diabetes type 1 is more mentally debilitating than diabetes type 2. The reasons however, of such a difference did not surface in the research.**

Both types of diabetes showed statistically significant difference than the normal values of the population. The normal values were not however, derived from control subjects but the IQCODE database that gives values for normal individuals throughout the globe. An average was taken as the normal mean result (per item).



**Fig 3: The p value obtained was lower than 0.05. Thus, validating the hypothesis by a less than 5% margin of error and a greater than 95% confidence interval.**

**DISCUSSION:**

The pathophysiology that underlies the advent of cognitive dysfunction in diabetic patients has not been fully explained. Numerous hypotheses exist, that too with supporting evidence, including probable causative function of hyperglycemia, hypoglycemia, vascular disease, amyloid deposition and insulin resistance. Even though further research into each of these probable pathways is crucial, it may be very well turn out that ultimate cause might not be single but an amalgam of all these factors, depending on the patient's type of diabetes, age, comorbidities and type of therapy.

Hyperglycemia seems to be linked with abnormalities in cognitive function among type 1 and type 2 diabetes patients. Yet, the pathways via which hyperglycemia may bring about this consequence are not completely clear. In organs other than the brain, hyperglycemia affects function via a multitude of pathways including hiked synthesis of advanced glycation end products (AGEs), polyol pathway activation, hiked glucose shunting in the hexosamine pathway, diacylglycerol activation of protein kinase C [2-5]. The similar pathways might be functioning in the brain and bringing about the alterations in cognitive function that have been seen in diabetic patients.

Compromised function of the neurotransmitter has also been seen in diabetic models and might add to further aggravate the cognitive dysfunction [6]. Other changes in the neurochemicals too have been seen, including lessened acetylcholine [7], lower turnover of serotonin, hampered activity of dopamine, and hiked norepinephrine [8, 9] in the brains of diabetic animals plagued. Fascinatingly such alterations were all put to an end with insulin. A fresh hypothesis proposes that the changing low and high levels of glucose observed in patients with poorly controlled diabetes may worsen function of neurotransmitters [9].

Whether or not repeated hypoglycemic episodes aggravate cognitive dysfunction is controversial and is most probably dependent on the patients' age. Yet, it is clear that severe hypoglycemia if lasting for an extended period of time, shall cause brain damage and even death [11-14]. Autopsy studies in humans done in individuals who died due to hypoglycemia have exhibited diffuse or multifocal necrosis in the cerebral cortex and ganglion cell chromatolysis [15-17].

**CONCLUSION:**

Clinically relevant cognitive impairment is highly prevalent among subjects with childhood-onset type I diabetes mellitus. Chronic hyperglycemia and hypoglycemia are thought to be the causes behind this cognitive impairment.

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