

Original Research Article

Relationship between blood glucose levels and diabetic neuropathy examination score in patients with diabetes mellitus

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ABSTRACT

Background: Diabetic neuropathy is a specific type nerve damage that primarily affects the peripheral nervous system, causing a loss of sensation in the extremities, disruption of autonomic functions, and to a lesser extent, motor function. The length of time a person has diabetes and their haemoglobin A1C (HbA1C) levels (a measure of glycated haemoglobin which reflects average daily glucose levels) are significant factors in determining the development of diabetic neuropathy.

Methods: This was a cross-sectional study conducted between April 2023- July 2023 among 51 participants who met the selection criteria participated in the study and were assessed using the Diabetic Neuropathy Examination Score (DNE score).

Results: The study concluded that the symptoms of diabetic neuropathy in high blood sugar individuals are higher in males (59%) than females (41%) due to changes in blood sugar levels. A direct correlation found amidst blood glucose volume and diabetic neuropathy examination (DNE score).

Conclusion: Hence the study concluded that the symptoms of glycated haemoglobin neuropathy in diabetes patients are higher in males (59%) than females (41%) due to changes in blood sugar levels.

Keywords: High blood sugar individuals, DNE score, Symptoms of diabetic neuropathy

INTRODUCTION

Diabetes mellitus is a condition that affects body's metabolism leading to consistently elevated blood sugar levels due to insulin resistance, inadequate insulin production, or both.¹ The increasing commonness of diabetes worldwide has led to a rise in diabetes-related complications, including diabetic neuropathy (DN).² DN is part of predictable microvascular complexity of diabetes, affecting approximately 50% of diabetic individuals.³ It leads to sensory deficits, pain, and an increased risk of foot ulcers and amputations. Pathophysiology of DN is composite, involving redox imbalance, mitochondrial dysfunction, and inflammation, all of which contribute to nerve damage.⁴ Chronic hyperglycemia triggers metabolic pathways, and guides the establishment of advanced glycation end-products

(AGEs).⁵ These biochemical changes result in nerve ischemia and microvascular dysfunction, exacerbating neuropathic symptoms.⁶

HbA1C is a well-established biomarker for enduring blood sugar management, the average blood glucose was measured for a period of 8–12 weeks.⁷ Several studies indicate that elevated HbA1C levels correlate with increased DN severity, reinforcing the importance of glycaemic control in preventing and slowing neuropathy progression.⁸ Poor glycaemic control results in nerve conduction abnormalities, worsening neuropathic pain and sensory impairment.⁹

The diabetic neuropathy examination score widely detached tool that assesses neuropathy severity by evaluating muscle strength, tendon reflexes, and sensory

function.¹⁰ While electrodiagnostic testing contemplate benchmark for DN confirmation, the DNE score provides a cost-effective and practical alternative, particularly in resource-limited settings.¹¹

Various researches investigated the connection amidst glycated haemoglobin volume and DN severity. Dyck et al found excessive HbA1C volume of importance associated with severe neuropathy symptoms, suggesting that glycaemic control is critical in DN management.¹² Similarly, Nathan et al, reported that individuals with bad glucose regulation had more pronounced DN symptoms, further emphasizing the role of early intervention.¹⁶

Given the increasing burden of DN, this research aims to examine the connection amidst blood glucose levels (HbA1C) and DNE scores to further understand the impression of blood sugar management on neuropathy continuation.

METHODS

Study type

This was a cross-sectional study.

Study place

This study was conducted in KMCH Medical College Hospital, Coimbatore, Tamil Nadu.

Study population

Patients with diabetes mellitus included in the study.

Study duration

Study was conducted between April 2023 – July 2023.

Sampling technique

Participants were selected using a convenience sampling method. The inclusion criteria for the study were diabetic mellitus patients with glycated haemoglobin (HbA1C >6.5%) values taken from medical records; age group 20-80 years of age, both genders and the exclusion criteria were reasons of neuropathy consisting alcohol, hepatic system or nephritic disease, toxic publicity, other hormonal metabolic or dietary disorders, erythrocytic diseases or monoclonal gammopathy, cardiovascular or severe pulmonary diseases and patients who had undergone bilateral below knee amputation.

Sample size and procedure

51 participants were selected based on the inclusion criteria. Informed consent was obtained to participate in the study and subjects were assessed using DNE score and glycated haemoglobin level (HbA1C) values taken from medical records.

Data analysis

The statistical analysis done using IBM SPSS software (version 26) and descriptive statistics to analyse the demographic data.

RESULTS

The data was collected from the participants using the blood sugar glucose level (HbA1C) results and DNE score. The individuals who participated in the study were between (20-85). Also, the mean age of the participants is 53.76 (Table 1). In this investigation, correlation of blood glucose levels a strong positive correlation has been observed with a significant p value of 0.751 and r value of 0.045 (Table 2).

Table 1: Demographic characteristics of participants.

Variable	N	Mean	Std Deviation
Age (in years)			
20-40	10	53.76	15.797
40-60	26	53.76	15.797
60-80	15	53.76	15.797

Table 2: Correlation between blood glucose level and DNE score.

Variable	N	R	P value
Blood glucose level	51	+0.045	0.751
Diabetic neuropathy examination score	51	+1	0.751

Based on the gender (59% male) and (41% female) population was suffering from the symptoms of diabetic neuropathy (Figure 1). Derived from DNE score, 80% population was suffering from the abnormality of diabetic neuropathy. The study found that 59% individuals were male, 41% were female and 80% of population showed abnormalities in the DNE score >3 (Figure 2). The correlation diabetic neuropathy examination score shows direct relation with a significant p value of 0.751 and an r values of 1 (Figure 3).

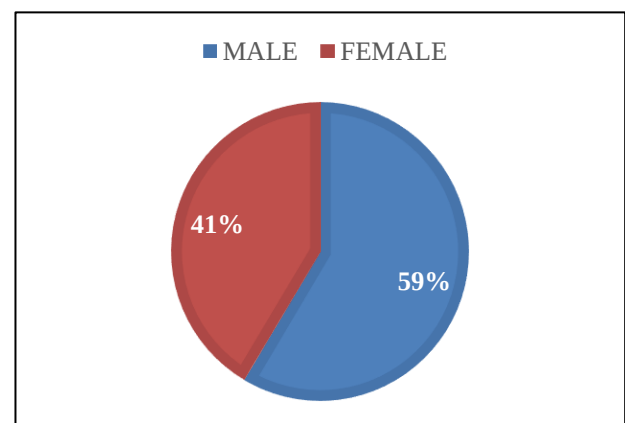


Figure 1: Gender distribution.

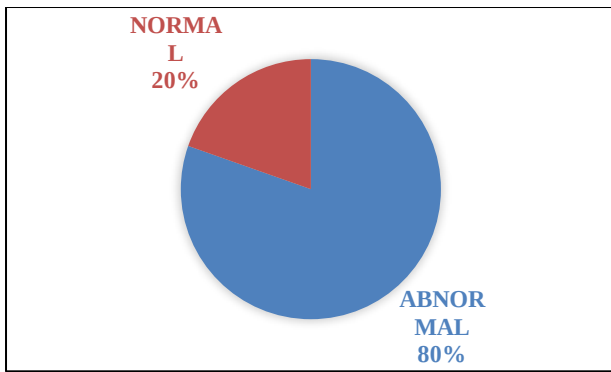


Figure 2: DNE abnormality in diabetic patients.

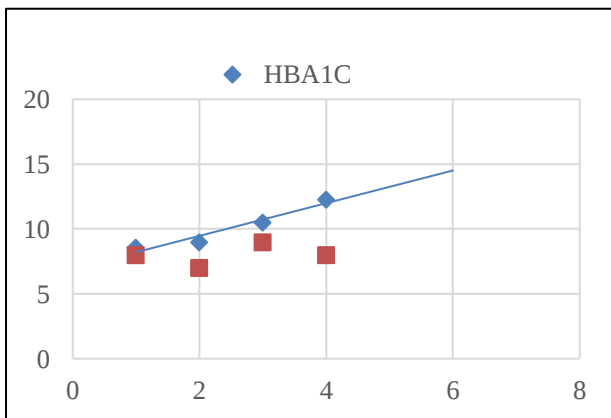


Figure 3: Correlation of DNES and HbA1C.

DISCUSSION

This research found a direct relation between HbA1C volumes and the DNE score ($r=0.751$, $p<0.05$), specifying excessive HbA1C levels related rise in neuropathy severity. These findings align with previous studies confirming that hyperglycemia plays a crucial part in DN progression.¹⁴ Chronic hyperglycemia brings about inflammatory agent damage, inflammation, and impaired vasodilation, contribute to nerve degeneration.¹⁵

Nathan et al, demonstrated exalted glycated haemoglobin volumes marked increase the risk of DN, emphasizing the need for intensive glycemic control.¹⁶ Similarly, Meijer et al, reported excessive glycated haemoglobin levels are corresponding more severe neuropathy symptoms, reinforcing the importance of routine glucose monitoring.¹⁷

Beyond hyperglycemia, other metabolic elements—such as high blood pressure, high cholesterol, and adiposity contribute to DN progression.¹⁸ A study by Pahadia et al, compared DNE scores with nerve conduction velocity (NCV) findings, concluding that patients with metabolic syndrome exhibit more severe neuropathy symptoms.¹⁹ Additionally, Brownrigg et al, explored the link between diabetic neuropathy and peripheral arterial disease (PAD), noting that both conditions contribute to an increased risk

of foot ulcers and amputations. Given that 80% of participants in this study had abnormal DNE scores, early neuropathy detection could be crucial in preventing severe complications such as foot ulcers and limb ischemia.²⁰ Boulton et al, highlighted that chronic hyperglycemia contributes to nerve damage, increasing the risk of sensory loss and foot complications in diabetic patients. Similarly, Tesfaye et al, reinforced that poor glycemic control significantly impacts neuropathy progression, aligning with the present study's findings that patients with higher HbA1C levels exhibited greater neuropathy severity.^{21,22}

Pop-Busui et al, (BARI 2D Study) further reinforced that intensive glucose management reduces neuropathy incidence, emphasizing the importance of long-term glucose monitoring.²³ Selvarajah et al emphasized the need for early detection methods, which supports this study's use of the DNE score as an accessible and cost-effective neuropathy assessment tool.²⁴

Zhang et al, suggested that LDL cholesterol levels also mediate diabetic neuropathy progression. While the present study primarily focused on HbA1C levels, these findings indicate that future research should consider lipid profiles as additional risk factors for neuropathy.²⁵

Selvin et al, reported no significant gender differences, suggesting that other metabolic and lifestyle factors may influence neuropathy risk.²⁶ Martin et al, also observed that diabetic neuropathy is more prevalent in males.²⁷ Vinik et al and Deli et al, highlighted that tight glycemic control, lifestyle modifications, and pharmacological treatments can help slow neuropathy progression.^{28,29} These findings support the need for a comprehensive treatment approach, combining glucose regulation, lipid homeostasis, and antihypertensive therapy. Our findings align with Vianni et al, who examined the connection amidst blood sugar volumes and elderly ailments in elderly diabetic individuals.³⁰ Their study found excessive HbA1C volumes suggestively related rise in frailty, fatigue, cognitive decline, highlighting that poor glycemic control impacts multiple physiological systems beyond neuropathy.

Compared to our results ($r=0.751$, $p<0.05$), which manifested a clear connection among glycated haemoglobin and DNE scores, Vianni et al. reported that HbA1C levels above 7.5% were linked more widespread functional decline in older patients. While our study focused on DN severity using the DNE score, Vianni et al, indicated glycated haemoglobin is a major predictor of overall health deterioration in elderly diabetics. These detection highlights need for multidisciplinary advance towards diabetes management, incorporating glycaemic control, lifestyle interventions, and early screening for neuropathy and other systemic complications. The limitations small sample size, results are subjective, inclusion of both T1DM and T2DM patients and long-term effects were not studied.

CONCLUSION

The study highlights that diabetic neuropathy is more common in males and strongly correlates with HbA1C levels. The DNE score an effectual tool identifying diabetic neuropathy in individuals with high blood sugar.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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