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Correlation of Diabetic Symptoms with Severity of Diabetes Mellitus in Middle-Aged Population

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ABSTRACT

Purpose: To investigate the correlation of symptoms of Diabetes with the severity of Diabetes Mellitus (DM) in Middle-aged subjects with diabetes.

Participants: 68 subjects with diagnosed diabetes mellitus between the ages of 40 and 60 with/without symptoms of neuropathy were included. Participants with neurological disease, recent surgical procedures or injuries to feet, vascular disease, and cognitive impairment were excluded.

Method: In a cross-sectional observational study, a total of 68 middle-aged diabetic subjects were interviewed in terms of demographic data, Fasting Blood Sugar (FBS), Post-Prandial Blood Sugar (PPBS), HBA1c, duration of diabetes, and associated medical conditions. All participants were examined by the Michigan Neuropathy Screening Instrument (MNSI). MNSI consists of 2 parts. 1) questionnaire 2) clinical examination.

Analysis: Statistical analysis was done by SPSS 20 & Spearman correlation test was applied.

Results: In mild diabetes, hba1c has a weak positive correlation (r=0.232) with MNSI-1 and a very weak positive (0.016) correlation with MNSI-2. In moderate diabetes, hba1c has significant(p=0.003) strong positive correlation (r=0.703) with MNSI-1 and significant (p=0.019) moderate positive correlation (r=0.0596) with MNSI-2. In severe diabetes, hba1c has significant (p=0.028) moderate positive correlation (r=0.532) with MNSI-1 and significant (p=0.034) moderate positive (0.515) correlation with MNSI-2

Conclusion: Diabetic symptoms are moderately correlated with moderate & severe levels of Diabetes based on hba1c in the middle-aged population.

Keywords: *Diabetes Mellitus, Middle age, Diabetic symptoms, Michigan Neuropathy Screening Instrument.*

INTRODUCTION

Diabetes Mellitus (DM) is a chronic, metabolic disease characterized by elevated levels of blood glucose. [1] Diabetic peripheral neuropathy (DPN), which is the most common and disabling complication associated with type 2 diabetes mellitus (T2DM), affects up to approximately half of the T2DM patient population. [2] Recent evidence suggests that DPN begins during the initial stages of DM. [3]

The presence of peripheral neuropathy in newly diagnosed diabetes and the time gap between the onset of diabetes and clinical diagnosis support the notion that neuropathic changes could be initiated in the early stages of diabetes pathogenesis.

Neuropathic symptoms are equally variable and include spontaneous sensations (paresthesia), unpleasant sensations (dysesthesias), or hypersensitivity (hyperalgesia) to pressure or touch but, also,

numbness, tingling, unsteadiness, prickling or burning pain in the legs and/or feet. Neuropathic signs were defined as reduced or absent ankle reflexes and reduced or absent distal sensation, including a vibration perception, touch sensation, thermal discrimination, pinprick sensation, and proprioception. [4] However, when neuropathy does manifest symptoms like pain, tingling, and loss of sensation to temperature changes, it can disrupt the quality of life for individuals with diabetes. [5]

The clinical diagnosis of neuropathy using the Michigan Neuropathy Screening Instrument (MNSI) parts A (symptoms) and B (physical exam) is useful for its high sensitivity and specificity. [6] MNSI has been used for the early detection of diabetic neuropathy. This tool was designed to be used in outpatient setting because it can be administered in a relatively short time period (4–5 minutes). Additionally, the MNSI is useful for the evaluation of diabetic neuropathy symptoms and has been validated as a screening test.

Screening DM individuals for DPN at the initial possible stage is essential to reduce the severity of these complications. Furthermore, treatment facilities to treat DPN patients is less likely to be available in underdeveloped countries. As a result, early detection of DPN or its causes is important, specifically in developing countries with limited resources & poor level of education. [7]

Microvascular complications of diabetes may be associated with impaired time-dependent glycemic control. [8] HBA1c provides a reliable measure of chronic glycemia and correlates well with the risk of long-term diabetes complications so it is currently considered the test of choice for monitoring and chronic management of diabetes. [9]

DM symptoms, age related changes and complications has been extensively studied in older population. Research has consistently highlighted the significant impact of diabetic neuropathy on mobility and quality of life in this age group. Moreover, age-related physiological changes are known to influence diabetes progression and symptomatology in elderly individuals. [10]

While the complexities of diabetes in older adults have been well-documented, the middle-aged diabetic population remains relatively understudied. So, there is a critical need to evaluate the characteristics of diabetic symptoms in middle-aged individuals for effective preventive strategies and early interventions.

Although the association between glycemic control and neuropathy is established, the specific relationship between HbA1c levels and the severity of neuropathic symptoms in middle-aged diabetic patients remains unclear. This study aims to address this knowledge gap by examining the correlation between HbA1c and Michigan Neuropathy Screening Instrument (MNSI) scores in a population of middle-aged individuals with diabetes.

METHOD

A cross-sectional observational study was conducted among middle-aged diabetic individuals attending the General Medicine OPD of SVP Hospital, Ahmedabad, Gujarat, India. Participants were recruited using a convenient sampling technique. Inclusion criteria encompassed individuals diagnosed with diabetes mellitus aged between 40 and 60 years, irrespective of gender or presence of neuropathy symptoms. Conversely, subjects with neurological diseases, cognitive impairments, recent surgical procedures or foot injuries, or lower extremity vascular diseases were excluded.

Subjects meeting the selection criteria were selected for the study. Participants were interviewed regarding their demographic and health information about age, gender, post-diabetes duration, HBA1c level, Fasting Blood Sugar (FBS) level, and Post Prandial Blood Sugar (PPBS) level. All participants were examined by the Michigan neuropathy screening instrument (MNSI).

OUTCOME MEASURE

Michigan neuropathy screening instrument (MNSI) [11]

The MNSI includes two parts, the first part is related to the patient's perception of symptoms in relation to DPN and the second part consists of a set of examinations done to detect the presence of DPN among the patients.

Questionnaire: A 15-item questionnaire form of MNSI consisting of yes/no questions was applied to all the patients. Responses were added to obtain the total score.

Physical examination:

Foot Inspection: The feet were inspected for evidence of excessively dry skin, callous formation, fissures, frank ulceration, or deformities. Foot deformities included prominent metatarsal heads, hallux valgus, joint subluxation, and Charcot joint.

Vibration sensation: Vibration sense was evaluated using a 128 Hz vibration fork. Vibrating fork was located on the interphalangeal joint of the right great toe.

Ankle reflex: Achilles reflex was observed and reported as absent, decreased, or normal.

Monofilament Testing: The filament was applied to the dorsum of the great toe midway between the nail fold and the DIP joint. The filament was applied perpendicularly and briefly, (<1 second) with an even pressure. The patient, whose eyes are closed, was asked to respond yes if he/she feels the filament.

Positive responses and abnormal physical examination findings were recorded in the questionnaire form. In the questionnaire form risk of neuropathy was accepted to increase with a higher number of positive responses. Diabetic peripheral neuropathy was diagnosed in patients with a physical examination score ≥2.5 and a questionnaire score >7.

STATISTICAL ANALYSIS

Statistical analysis was done using SPSS (Statistical Package for Social Sciences) for Windows 20.0. Shapiro-Wilk tests revealed that both diabetes severity, measured by hba1c, and diabetes symptoms, assessed using the Michigan Neuropathy Screening Instrument (MNSI), were not normally distributed ($p < 0.05$). Due to the non-normal distribution of data, Spearman's rank correlation coefficient was employed to evaluate the association between these two variables.

RESULT

Characteristics of participants are described in Table 1. A total of 68 middle-aged diabetic subjects (27 males, 41 females) with a mean age of 53.33 ± 6.39 years were recruited. The mean post-diabetic duration was 6.29 ± 5.54 years. The mean hba1c value was 7.49 ± 1.65 %. The mean FBS level was 139.52 ± 49.08 mg/dl. The mean PPBS level was 202.24 ± 72.30 mg/dl.

The correlations between hba1c and MNSI scores for different diabetes severities are presented in Table 2. Hba1c showed a progressively stronger positive correlation with MNSI-1 (r: 0.232 to 0.703) and MNSI-2 (r: 0.016 to 0.515) across mild, moderate, and severe diabetes ($p < 0.05$). Notably, 25% of patients with severe diabetes displayed abnormal MNSI scores (>2.5).

Table 1. Clinical characteristics of participants

Variable	Mean ± SD
Age (years)	53.33 ± 6.39
Post diabetic duration (years)	6.29 ± 5.54
Hba1c (%)	7.49 ± 1.65
FBS (mg/dl)	139.52 ± 49.08
PPBS (mg/dl)	202.24 ± 72.30
Gender	Male: 27 Female: 41

FBS: fasting blood sugar, PPBS: postprandial blood sugar

Table 2. Correlation between hba1c and MNSI.

Severity of diabetes	Variables	R value	P-value
Mild	Hba1c (MNSI 1)	0.232	0.275
	Hba1c (MNSI 2)	0.016	0.016
Moderate	Hba1c (MNSI 1)	0.703	0.003
	Hba1c (MNSI 2)	0.596	0.019
Severe	Hba1c (MNSI 1)	0.532	0.028
	Hba1c (MNSI 2)	0.515	0.034

MNSI (1): Michigan neuropathy screening instrument (questionnaire)
MNSI (2): Michigan neuropathy screening instrument (physical examination).

DISCUSSION

This study investigated the correlation between the diabetes severity (Hba1c) and Michigan neuropathy screening instrument in middle-aged individuals with diabetes. Our findings indicated a progressively stronger positive correlation between hba1c and both MNSI-1 and MNSI-2 scores. This suggests that as hba1c levels increase, severity of symptoms as measured by the MNSI scales also increases.

Present study found that 11.7% of participants scored above 7 on the MNSI questionnaire and 16.7% scored above 2.5 on the physical assessment. These findings are consistent with previous research suggesting a moderate prevalence of diabetic neuropathy in middle-aged individuals with type 2 diabetes. [12] This highlights the importance of routine screening for neuropathy in this population, as early detection can help prevent complications.

The positive correlation between hba1c levels and both MNSI-1 and MNSI-2 scores in our study aligns with the established link between poor glycemic control and the severity of diabetic neuropathy or development of neuropathy symptoms. [13] This reinforces the importance of maintaining good glycemic control to manage neuropathy symptoms and prevent further progression.

Previous study demonstrates a clear association between early glycemic control and reduced DPN risk in middle-aged individuals with T2DM, highlighting the need for aggressive glucose management in this population. However, the lack of a similar correlation in elderly patients suggests that age-related factors may play a more dominant role in DPN development. [14]

Present study findings support the existing knowledge regarding the relationship between hba1c, MNSI scores, and diabetic neuropathy. The observed link between peroneal NCV study and MNSI scores in previous studies suggests the MNSI score correlates with NCV study. [7] It further strengthens the MNSI's potential as a clinical tool for neuropathy assessment. Additionally, research highlighting the MNSI's reliability and ease of use in clinical settings [15] reinforces its suitability for routine screening in diabetic patients.

CONCLUSION

In conclusion, present study found that Diabetic symptoms are moderately correlated with moderate & severe levels of Diabetes based on hba1c in the middle-aged population. It also emphasizes the Importance of glycemic control and early neuropathy detection for successful management of diabetic symptoms and prevention of complications in middle-aged individuals with type 2 diabetes. Additionally, integrating the MNSI as a routine screening tool in clinical settings can facilitate early detection and personalized intervention strategies in middle age. Future research directions could explore the efficacy of specific interventions to improve glycemic control and manage neuropathy in this population.

Declaration by Authors

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