ORIGINAL ARTICLE

Prevalence of Somatosensory Disorders in Individuals with Type 2 Diabetes in Lahore: A Cross-Sectional Survey

Noor Fatima[1], Maira Sarfaraz[2], Arnab Altaf[3], Malia Younas[4]

[1] Department of Physical Therapy, Riphah International University, Lahore

Corresponding Author: Noor Fatima, Physiotherapist/Riphah International University, Lahore
Email: noorfatima1656@gmail.com

Received: 29-05-2024
1st Revision : 21-08-2024
2nd Revision: 06-10-2024
Accepted: 13-12-2024

ABSTRACT

Background: Sensory system is important to perceive different sensation in the whole body and sensory system may be impacted by the high blood glucose level at chronic stage of diabetes mellitus.
Objective: The objective of this study is to find out the Prevalence of somatosensory disorders in individuals with type 2 diabetes in Lahore.
Methods: A cross sectional study conducted of 191 patients at Diabetic Center of Jinnah Hospital Lahore. Both male & female, being aged 41-65 years, duration of diabetes less than 5, 10 & 15 years and 8 hours of physical activity were included visually & mentally impaired, with locomotive challenges, post-stroke, with known trauma, and pregnant women were excluded. The Revised Nottingham Sensory Assessment (RNSA) was used for data collection and data analyzed using the SPSS version 21.0 software.
Results: The Revised Nottingham Sensory Assessment somatosensory questionnaire showed that there are 8.3% worse cases, 32.3% moderate cases, 46.9% mild cases, 12.0% normal cases of tactile sensation. 3.6% worse cases, 13.0% severe cases, 20.8% moderate cases, 28.1 % mild cases, 33.9% normal cases of proprioception, 8.3% severe cases, 46.4% moderate cases, 30.2% mild cases, 14.6% normal cases of stereognosis.
Conclusion: More females complained of symptoms such as numbness, tingling & parasthesia. This study concluded that the prevalence of somatosensory disorders was prevalent in females as compare to males. The variable such age, gender, working hours, duration of diabetes; side of body affected had a significant effect on their symptoms of severity and functional status.

Keywords: *Diabetes type 2, nerves, pain and dysfunction, sensory loss, somatosensory system.*

INTRODUCTION

Diabetic peripheral neuropathy (DPN) is a well-known microvascular consequence of T2DM caused by persistent hyperglycemia and is defined as the existence of peripheral nerve damage in diabetics after all other causes have been ruled out. Diabetic neuropathy is a degenerative condition of the peripheral nerve that causes pain, paresthesia, or issues due to neurological impairment.[1]

Of Type II DM (T2DM) patients, diabetic peripheral neuropathy (DPN) affect around 50% of them. Both painful DPN and possible DPN were separately and additionally linked to decreased life satisfaction, restless sleep, and signs of worry and sadness. DPN may have had a more detrimental effect on mental health than neuropathic pain. This substantial study highlights the need of rigorous DPN and pain assessment early in the course of type 2 diabetes. [2, 3]

Patients with Type 2 DM who have neuropathy have substantial health risks since it can impair function and potentially result in disability. Muscle weakness and reflex loss are two effects of peripheral neuropathy, particularly around the ankles. The main issue with DPN development is that while the changes are gradual & occur with ageing, individuals frequently disregard the warning indications of nerve damage because they believe they are simply a natural part of ageing.[4,5]

Diabetic peripheral neuropathy (DPN) is a complex and potentially fatal complication of diabetes that is commonly experienced by patients with the disease. Ankle position sense may be diminished before the clinical signs of diabetic peripheral neuropathy appear. This has been connected to falls, poor gait, and foot ulcers. Painful-DPN appears to be linked to small fiber dysfunction and the feminine gender.[6-8]

Two types of DNP exist: sensory dNP (dNPs), which is typified by isolated sensory complaints without motor impairment, and sensorimotor dNP (dNPsm), which affects the neuromuscular system and results in muscle weakness and atrophy of the leg and foot musculature

DPN causes problems walking, a decrease in proprioceptive input, and a loss of tactile and vibrational feeling. Large and small sensory fiber function was most lost in patients with painful DPN.[9-11]

The study, The Prevalence of Complications Associated with Diabetes among Pakistani Patients: A Questionnaire-based Survey, found that various abnormal body conditions and complications related to diabetes were present in all age groups. The age groups ranging from 30 to 80 years old showed more issues.[12]

Diabetic neuropathy (DN) can present with a complex array of symptoms and signs depending on the affected organ. DN symptoms vary and depend on the nervous system involved (vegetative or peripheral sensory/motor). Peripheral neuropathy is the most prevalent type of diabetic neuropathy and nearly 50% of people with DM may experience it at some point in their lives.[13]

The most prevalent form of DN, distal symmetric polyneuropathy (DPN), can be further subdivided into three groups according to the kind of nerve fibers impacted: small fiber neuropathy (SFN), large fiber neuropathy (LFN), and mixed fiber neuropathy (MFN).The loss of cutaneous sensation in the feet is one of the most typical signs of peripheral neuropathy.[14,15]

Neuropathic pain, sensory loss, and impaired gait are the main clinical manifestations of diabetic sensorimotor polyneuropathy, and they are all linked to depressive symptoms. Type II diabetes (T2D) in older adults increases the risk of nerve disorders that impair function. The majority of research on proprioceptive dysfunction in older adults with type 2 diabetes has concentrated on lower limb functional deficits.[16,17]

Depending on factors like age, length of diabetes, and glucose control, the prevalence of peripheral neuropathy in people with diabetes is thought to range from 6 to 15%. Over five years, confirmed DPN in well-regulated T2D patients increased due to progression from probable DPN. More patients improved in nerve parameters, while fewer regressed, with elevated triglycerides potentially being a risk factor.[18,19]

The aim of this research is to focus on the prevalence and severity of somatosensory impairments in type 2 diabetic male and female patients. The other aim of our study is to find out the known risk factors for development of somatosensory impairments, dysfunction, prediction of loss of sensation and effected part of body that reduce quality of life in type 2 diabetic population with 5 years, 10 years and 15 years of diabetes which help to find out the measures and safety precautions. This will help the Physiotherapist to estimate the severity of somatosensory disorders by looking at the duration of diabetes.

METHODS:

This cross-sectional study was conducted at the Diabetic Center of Jinnah Hospital Lahore on a uniform standard population of type 2 diabetic males and females. The data was collected from October 2022 to January 2023 using the Revised Nottingham Sensory Assessment Tool (RNSA). For sample selection, non-probability convenience sampling method was used. The inclusion criteria were patients aged 41 to 65 years with duration of type 2 diabetes less than 5 years, less than 10 years, or less than 15 years, regardless of gender, and engaging in physical activity for 8 hours a day. The exclusion criteria included visually impaired and mentally impaired patients, those with locomotive challenges, post-stroke patients, individuals with known trauma, and pregnant women. Ethical permissions were obtained from the Institutional Review Board (IRB), and informed consent was taken from all participants. The data was analyzed using IBM SPSS 21.0 and presented in the form of frequencies and percentages, including tactile sensations, proprioception, and stereognosis, as well as the side of the body affected, gender, duration of physical activity, age, and onset of diabetes, which were presented as Mean±SD.

RESULTS

Revised Nottingham Sensory Assessment (RSNA) the n (%) value of the side of body involved Right was 16(8.4%), Left was21(11.0%), Both sides was 102(53.4%), Neither sides was 52(27.2%). The n (%) value of the tactile sensation severe was 16(8.4%), moderate was 62(32.5%), mild was 90(47.1%) and normal was 23(12.0%). The n (%) value for proprioception worse was 07(3.7%) severe was 25(13.1%). Moderate was 40(20.9%), mild was 54(28.3%), normal was 65(34.0%). The n (%) value for the stereognosis was severe was 16(8.4%), moderate was 89(46.6%), mild was 58(30.4%) & normal was 28(14.7%) (Table-1).

Table 2 shows the mean,standard deviation, n(%) of Demographics & Duration of physical activities.The Mean±SD of age was53.5550±7.08117 and Mean±SD of onset of diabetes was 8.7120±3.22585. The n (%) of duration of physical activity was 8 hours has 95(49.7%), 9 hours 43 (22.55%), 10 hours 29(15.2%), 11 hours 4(2.1%), 12 hours 20(10.5%).

Table I: *Conclusion of Revised Nottingham Sensory Assessment (RSNA) Revised Nottingham Sensory Assessment (RNSA)*

	n (%)	Total
Side involved		191
Right side	16(8.4%)	
Left side	21(11.0%)	
Both sides	102(53.4%)	
Neither sides	52(27.2%)	
Tactile sensation		191
Severe	16(8.4%)	
Moderate	62(32.5%)	
Mild	90(47.1%)	
Normal	23(12.0%)	
Proprioception		191
Worse	07(3.7%)	
Severe	25(13.1%)	
Moderate	40(20.9%)	
Mild	54(28.3%)	
Normal	65(34.0%)	
Stereognosis		191
Severe	16(8.4%)	
Moderate	89(46.6%)	
Mild	58(30.4%)	
Normal	28(14.7%)	

Table 2: *The Mean, Standard Deviation, n(%) of Demographics & Duration of Physical Activities*

Variables	Mean±SD	n(%)
Age (years)	53.5550±7.08117	
Onset of Diabetes	8.7120±3.22585	
Gender		62 (32.5%)
Male		129 (67.5%)
Female		
Duration of physical activity		
8 hours		95(49.7%)
9 hours		43(22.5%)
10 hours		29(15.2%)
11 hours		4(2.1%)
12 hours		20(10.5%)

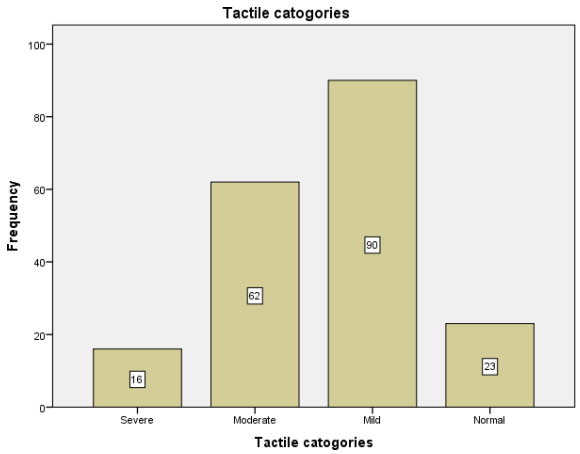

Figure 1: *Tactile Sensory Impairment*

Figure 1 shows the relationship between frequency and percentage of tactile sensory impairment this value shows that there are 16 (8.3%) have severe tactile sensory loss, there are 62 (32.3%) have moderate tactile sensory loss, 90 (46.9%) have mild tactile sensory loss, 23 (12.0%) have normal tactile sensation.

Figure 2 shows the proprioception impairment this value shows that there were 7 (3.6%) have worse proprioception, 25 (13.0%) have severe proprioception, 40 (20.8%) have moderate proprioception, 54 (28.1%) have mild proprioception and 65 (33.9%) have normal proprioception.

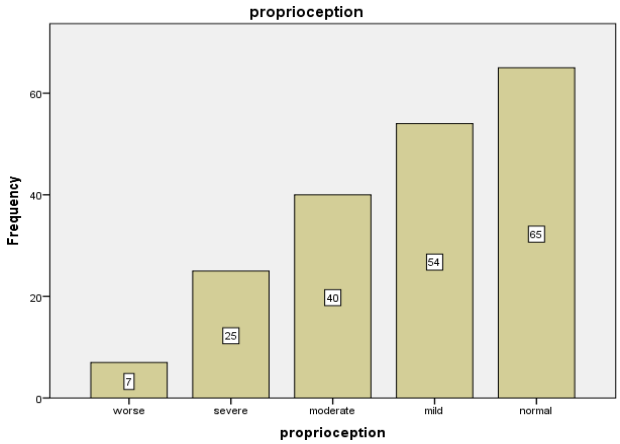

Figure 2: *Proprioception Impairments*

Figure 3 shows the stereognosis impairment this value shows that there were 16 (8.3%) have severe stereognosis loss, 89 46.4%) have moderate stereognosis loss, 58 (30.2%) have mild stereognosis loss, 28 (14.6%) have normal stereognosis.

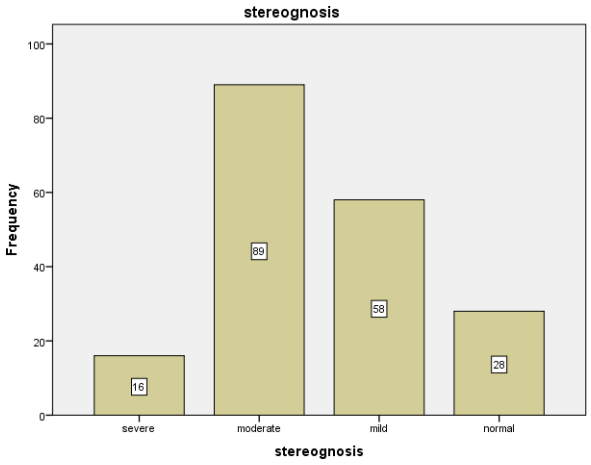

Figure 3: *Stereognosis Impairment*

DISCUSSION:

E Hindi et al, studied the cross-sectional study, Diabetic Polyneuropathy in Type 1 and Type 2 Diabetes Mellitus: A Study That Found a Significant Association between the Development of DPN and the Persistence of

DM. As a result, the average lifespan of DPN patients was 17.7 9.42 years. Furthermore, we examined the relationship between DPN and the development of additional symptoms associated with diabetes mellitus and found that these problems also occurred in 65% of DPN patients.[20]

Faselis Charles et al (2020) studied the microvascular complications of type 2 diabetes mellitus and came to the conclusion that, because early management improves outcomes, early diagnosis of microvascular issues related to T2DM is essential. However, in order for that to occur, one needs to be aware of their definition, prevalence, and methods of diagnosis.[21]

Elbarsha A et al (2019) studied the prevalence of peripheral neuropathy and its impact on activities of daily living in people with type 2 diabetes mellitus found that participants with diabetic neuropathic pain had more difficulties with specific upper and lower extremity activities than those without the condition. There was also a high prevalence of neuropathy (33.7%) and neuropathic pain (59.5%), along with an increased risk of old age, longer duration of diabetes, and smoking history. [22]

Gillani AH et al (2018) studied Macro and microvascular complications, as well as associated risk factors, were examined in patients with diabetes mellitus in Southern Punjab, Pakistan. The study's findings indicated that complications were widespread among the patients, and a high frequency of risk variables appeared to precede the complications. Providing appropriate education and preventative methods will be very helpful in reducing co-morbidities.[23]

SL Gorniak (2020) studied data indicate that the development of reduced tactile sensitivity is highly impacted by male sex, age, handedness, self-identified minority status, and metabolic health. Sex-based variations and aging in tactile function loss in adults with type 2 diabetes were also found. This mix of modifiable and non-modifiable factors must be considered in the monitoring and treatment of problems related to diabetes mellitus.[24]

An J et al (2021) studied Delaying the start and progression of type 2 diabetes issues with early preventative treatments and addressing controllable factors was found to be effective in preventing the incidence and prevalence of microvascular and macrovascular complications throughout a 15-year period among individuals with incident diabetes.[25]

According to the current study finding of this cross-sectional survey showed that diabetic population experience difficulty with their tactile, proprioception and stereognosis sensation. Previous study showed many factors that differ from the finding of our study. This study is aimed towards the prevalence of somatosensory disorders in type 2 diabetic population in Lahore. Previous evidence suggest that diabetic neuropathy was more common in both gender in contrast this studied showed that somatosensory disorder is less common in males as compare to females. Researcher in past studied those somatosensory disorders is more prevalent in lower limb and it is associated with duration of diabetes. In contrast this study showed that it is prevalent not in a specific region but it also prevalent in other regions of the body and it is not only associated with duration of diabetes but also associated with severity of diabetes& physical activity or life style.

In past studies researchers studied that the tactile function loss in person is associated with male gender, age, self-identified minority status, and metabolic health. In contrast this study showed that the tactile function loss, proprioception loss and stereognosis loss associated with the female gender, duration of physical activity and severity of diabetes& life style. Since this study has its limitation so the results of one area cannot be generalized to the entire diabetic population so it is recommended that more studies should be conducted on this topic which includes diabetic population of other areas as well. Other than that awareness should be raised among general diabetic population regarding somatosensory disorders and its adverse effects on the livelihood and the challenges they encounter in their day-to-day activities.

CONCLUSION:

This study concluded that a maximum number of diabetic patients were symptomatic in Lahore. The variable such age, gender, working hours, duration of diabetes; side of body affected had a significant effect on their symptoms of severity and functional status. However, more females complained of symptoms such as numbness, tingling & parasthesia. So, it is concluded in this study that the occurrence of diabetes was prevalent in females as compare to males. It is concluded in our study that the somatosensory disorders are present is type 2 diabetic population.

ETHICAL PERMISSION: The Riphah International University Lahore, approved this study vide letter No. Ref. No RCRS/AHS DPT Fall 2022/03

CONFLICT OF INTEREST / DISCLOSURE: Nil.

FUNDING SOURCE: Nil.

AUTHORS' CONTRIBUTION:

NF: Acquisition of data, or analysis & interpretation of data, drafting the article

MS: Acquisition of data, drafting the article or revising it critically for important intellectual content.

AA: Conception and design, analysis & interpretation of data, revising it critically for important intellectual content.

MY: Drafting the article or revising it critically for important intellectual content, Final approval of the version to be published.

REFERENCES

1. Lu Y, Xing P, Cai X, Luo D, Li R, Lloyd C, et al. Prevalence and risk factors for diabetic peripheral neuropathy in type 2 diabetic patients from 14 countries: estimates of the INTERPRET-DD study. Front Public Health.. 2020;8: 534372.
2. Gylfadottir SS, Christensen DH, Nicolaisen SK, Andersen H, Callaghan BC, Itani M, et al. Diabetic polyneuropathy and pain, prevalence, and patient characteristics: a cross-sectional questionnaire study of 5,514 patients with recently diagnosed type 2 diabetes. Pain. 2020;161(3):574-83.
3. Macharia PW. Diabetic Foot Disease: the Association of Foot Deformities, Sensory Testing and Sugar Control in Type 2 Diabetic Patients in Kenyatta National Hospital: Uon; 2021.
4. Darivemula S, Nagoor K, Patan SK, Reddy NB, Deepthi CS, Chittooru CS. Prevalence and Its Associated Determinants of Diabetic Peripheral Neuropathy (DPN) in Individuals Having Type-2 Diabetes Mellitus in Rural South India. Indian J Community Med. 2019;44(2):88-91.
5. Amelia R, Wahyuni AS, Yunanda Y. Diabetic Neuropathy among Type 2 Diabetes Mellitus Patients at Amplas Primary Health Care in Medan City. Open Access Maced J Med Sci. 2019;7(20):3400-3.
6. Wu B, Niu Z, Hu F. Study on risk factors of peripheral neuropathy in type 2 diabetes mellitus and establishment of prediction model. Diabetes Metab J. 2021;45(4):526-538.
7. Shillo P, Sloan G, Greig M, Hunt L, Selvarajah D, Elliott J, et al. Painful and Painless Diabetic Neuropathies: What Is the Difference? Curr Diab Rep. 2019;19(6):32.
8. Maras O, Dulgeroglu D, Cakci A. Ankle proprioception in patients with type 2 diabetes mellitus. J Am Podiatr Med Assoc. 2021;111(4).
9. Van Eetvelde BLM, Lapauw B, Proot P, Vanden Wyngaert K, Celie B, Cambier D, et al. The impact of sensory and/or sensorimotor neuropathy on lower limb muscle endurance, explosive and maximal muscle strength in patients with type 2 diabetes mellitus. J Diabetes Complications. 2020;34(6):107562.
10. Kraiwong R, Vongsirinavarat M, Hiengkaew V, von Heideken Wågert P. Effect of Sensory Impairment on Balance Performance and Lower Limb Muscle Strength in Older Adults With Type 2 Diabetes. Ann Rehabil Med. 2019;43(4):497-508.
11. Gylfadottir SS, Itani M, Kristensen AG, Karlsson P, Krøigård T, Bennett DL, et al. The characteristics of pain and dysesthesia in patients with diabetic polyneuropathy. PloS one. 2022;17(2):e0263831.
12. Eijaz S, Lalpuria S, Afzal M, Yasmeen A, Saleem S, Begum A. Prevalence of Complications Associated with Diabetes among Pakistani Patients: A Questionnaire-based Survey. Curr Diabetes Rev. 2022;18(9):87-95.
13. Galiero R, Caturano A, Vetrano E, Beccia D, Brin C, Alfano M, et al. Peripheral Neuropathy in Diabetes Mellitus: Pathogenetic Mechanisms and Diagnostic Options. Int J Mol Sci.2023;24(4):3554.
14. Mooshage CM, Schimpfle L, Kender Z, Tsilingiris D, Aziz- Safaie T, Hohmann A, et al. Association of Small Fiber Function with Microvascular Perfusion of Peripheral Nerves in Patients with Type 2 Diabetes: Study using Quantitative Sensory Testing and Magnetic Resonance Neurography. Clin Neuroradiol. 2024 Mar;34(1):55-66.
15. Ennion L, Hijmans JM. Retention of Improved Plantar Sensation in Patients with Type II Diabetes Mellitus and Sensory Peripheral Neuropathy after One Month of Vibrating Insole Therapy: A Pilot Study. Sensors. 2024;24(10):3131.
16. Azmi S, Alam U, Malik RA. Diabetic Neuropathy. Textbook of Diabetes. 2024:655-78.
17. Cox LIG, Dias N, Zhang C, Zhang Y, Gorniak SL. Effects of Type II Diabetes on Proprioception during a Reach to Pinch Task. J Mot Behav. 2024;56(3):263-274.
18. Hicks CW, Selvin E. Epidemiology of peripheral neuropathy and lower extremity disease in diabetes. Curr Diab Rep. 2019;19:1-8.
19. Brask-Thomsen PK, Itani M, Karlsson P, Kristensen AG, Krøigård T, Jensen TS, et al. Development and Progression of Polyneuropathy Over 5 Years in Patients With Type 2 Diabetes. Neurology. 2024;103(3):e209652.
20. Hindi E, Almusally BA, Bawareth R, Alhamadah W, Alfaraj R, Almwled A, et al. Diabetic Polyneuropathy in Type 1 and Type 2 Diabetes Mellitus: A Cross-Sectional Study. Cureus. 2022;14(10).
21. Faselis C, Katsimardou A, Imprialos K, Deligkaris P, Kallistratos M, Dimitriadis K. Microvascular Complications of Type 2 Diabetes Mellitus. Curr Vasc Pharmacol. 2020;18(2):117-24.
22. Elbarsha A, Hamedh M, Elsaeiti M. Prevalence and risk factors of diabetic peripheral neuropathy in patients with type 2 diabetes mellitus. Ibnosina J Med Biomed Sci. 2019;11(01):25-8.
23. Gillani AH, Bashir S, Ahmed AB, Usman M, Mustafa A, Iqbal T, et al. Macro and Micro-Vascular Complications and their Risk Factors in Diabetes Mellitus Patients of Southern Punjab, Pakistan. J. pharm. pract. community med. 2018;4(2).
24. Gorniak SL, Ochoa N, Cox LIG, Khan A, Ansari S, Thames B, et al. Sex-based differences and aging in tactile function loss in persons with type 2 diabetes. PloS one. 2020;15(11):e0242199.
25. An J, Nichols GA, Qian L, Munis MA, Harrison TN, Li Z, et al. Prevalence and incidence of microvascular and macrovascular complications over 15 years among patients with incident type 2 diabetes. BMJ Open Diabetes Res Care. 2021;9(1):e001847.