

# PERIPHERAL SENSORY PERCEPTION OF DIABETIC USING SEMMES WESTEIN 5.07 MONOFILAMENT

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## ABSTRACT

Gradual loss of sensation in the foot is a major consequence of diabetes mellitus. It is a precursor to foot ulcers, which may necessitate amputation eventually. Early detection of peripheral sensory loss in the foot would help to prevent further complications. In developed countries the ability to perceive 5.07 monofilament is accepted as normal, but in Nigeria the assessment of peripheral sensory perception with 5.07 monofilament method is not common. The aim of this study was to compare peripheral sensory perception (PSP) in patients with diabetes and apparently healthy controls without diabetes. Subjects were 100, and were diagnosed as having diabetes mellitus and 100 apparently healthy controls. The subjects were recruited using purposive non-probability sampling technique. The design was ex-post facto research design. The sensation was tested on eleven pressure points on the sole and dorsum of the right foot using 5.07 semmes weinstein monofilament in all the subjects. Data were analyzed using independent student t-test to compare the scores between Group I and II subjects. The effect of gender on peripheral sensory perception in each group was analyzed using the independent student t-test. One way analysis of variance was used to determine if peripheral sensory perception scores of subjects in each group differed significantly across the age groups. Level of significant was set at 0.05. Results showed that 71% of subjects with diabetes had intact sensation and 29% had impaired sensation. While 96% control subjects had intact sensation and 4% had impaired sensation. Subjects with diabetes had significantly lower peripheral sensory perception than the control subjects ( $p < 0.05$ ). Age and gender have no influence on subjects peripheral sensory perception ( $p > 0.05$ ). It was concluded that peripheral sensory perception was significantly lower in subjects with diabetes than in apparently healthy control subjects. The gender or age of the subject had no significant effect on peripheral sensory perception. The use of semmes-westein 5.07 monofilament is recommended for preliminary diagnosis of peripheral neuropathy in subjects with diabetes. Also, more studies involving subjects with peripheral neuropathy and studies of other monofilament sizes as well as data on associated risk factors such as duration of diabetes, smoking habits, and height of diabetics are advocated.

**Keywords:** Diabetics, Non-diabetics, Semmes-Westein 5.07 monofilament, Sensation

## INTRODUCTION

Patients with diabetes mellitus are found having hyperglycaemia<sup>1</sup>, which causes microvascular and neurological complications seen in diabetes mellitus<sup>2,3</sup>. The neurological complications, often referred to as neuropathy, are characterized by a progressive loss of nerve fibers. Pathologically, numerous changes have been demonstrated in both myelinated and unmyelinated fibers, although, Schwann cells involvement may be the primary pathological change<sup>3</sup>.

Neuropathy affects sensory, motor, and autonomic fibers bilaterally<sup>4</sup>. Involvement of sensory fibers leads to early reduction in sensation<sup>5</sup> with resultant numbness (insensitive foot), which renders sufferers unable to appreciate injury<sup>6</sup>. Therefore, it is a prime ingredient necessary for the formation of the diabetic foot ulceration, which is present in over 80% of diabetic patients with pedal wound<sup>4</sup>. In fact, of approximately 125, 000 lower extremity amputations carried annually in Australia, 56-83% of the causative factors were directly attributed to complication attributed to diabetes mellitus<sup>4</sup>. Risk factors

such as smoking, age, gender (male), height, and duration of the disease are associated with the likelihood of neuropathy in diabetes<sup>7</sup>.

Early detection of peripheral neuropathy in diabetes is important considering its role as the main risk factor for lower limb lesions<sup>8</sup>. As a result of this, tests for screening patients with diabetes for loss of sensation such as Sensorimotor Conduction Test (SCT), Sensory Nerve Action Potential (SNAP) and Quantitative Sensory Test (QST) have been developed<sup>9</sup>. Qualitative sensory test, also in use, involved testing for pressure, vibration, and temperature. However, another quantitative test, which is simple and inexpensive, is used in developed countries. This involves the use of the semmes-weistein monofilament nylon described by Armstrong<sup>4</sup>. In these countries, manufacturers-assigned number of the monofilament accepted for this test is 5.07 as against other assigned values (4.17 and 6.10) also in use<sup>7</sup>.

In Nigeria, the assessment of peripheral sensory perception in diabetic patients using 5.07 monofilament is not common and where it is used, there is not yet a scientific evidence for its appropriateness. This study, therefore, examined the Peripheral Sensory Perception (PSP) of diabetics in South-Eastern Nigeria with respect to the use of semmes-weistein 5.07 monofilament.

## METHODS

The study was an ex-post facto design involving one hundred diabetic subjects recruited purposively from Nnamdi Azikiwe University Teaching Hospital, Nnewi, Anambra State, Nigeria (50 males and 50 females) and 100 apparently healthy non-diabetic control subjects (50 males and 50 females) that were also recruited from staff members of the same hospital. All the participants gave their informed consent to participate prior to commencement of the study. Ethical approval was obtained from the University of Ibadan/University College Hospital Institutional Review Committee. Before commencing the study, permission

was obtained from the hospital management and consultant in charge of diabetic clinic of the medical outpatient department of the hospital from where the diabetics were recruited.

The diabetics and non-diabetics had no healed or ongoing ulcer, at the right foot presented during the test and had sound cognitive status which was confirmed by a mini mental state examination score ranging from 25-30<sup>10</sup>. Both the diabetics and non-diabetic participants were neither on prolonged steroid therapy nor suffering from any of the following conditions. Vitamin B1, B6, and B12 deficiency, leprosy, alcoholism, malignancy causing neuropathy, nerve injury, Guillain-Barre syndrome, and thick callus on the skin of the right foot. At the point of participants recruitment for this study, information was collected concerning their smoking habits, alcohol consumption, drug usage, occupation, and physical complaints suggestive of any of the above conditions<sup>11</sup> the sex and age at the last birthday of the participants were also recorded. The recorded age was used to categorize participants into three age groups: <40 years, 40-49 years, and ≥50 years.

Before carrying out the peripheral sensory perception test on the participants, the procedure involved and expectations were explained in details to the participants. The participants were instructed to lie supine on a plinth while the test was carried out on them with the eyes open and then asked to close the eyes to eliminate visual input. Both the dorsum and the plantar surface of only the right foot were tested. The research instrument was semmes-weistein 5.07 monofilament and the psychometric properties of the instrument have been determined in previous study by Burke<sup>12</sup> and were applied perpendicularly to the skin, on eleven sites (Fig one), with enough force to cause the monofilament to buckle for approximately 1 second<sup>7</sup>. The sites of application were the sites of pressure where ulcers often develop in patients with diabetes<sup>7</sup>.

The participants were required to indicate feeling or no feeling of sensations, the responses, which were recorded as 'felt' or 'unfelt' respectively. Ten trials were carried out on each site randomly, and the participants needed to indicate "feeling" 80% of the trial before scoring the maximum score (2), 60-70% to score one (1), while indicating "feeling" less than 60% of the trial attracted zero (0). Therefore, the maximum obtainable score for

the eleven points of application is twenty-two (22). After the test, participants were informed of the outcome, and advised accordingly with regard to foot care.



Fig. 1: Application of monofilament testing on a participant

## RESULTS

The mean age of the diabetics was  $46.12 \pm 7.48$  years while that of the non-diabetics was  $43.75 \pm 8.24$  years (Table 1). Forty-nine percent of the diabetic participants were  $\geq 50$  years while only 16% were  $< 40$  years. Among the non-diabetics, the participants were fairly evenly distributed to the age categories except for those  $\geq 50$  years constituting only 28% (Table 2).

Table 1: Age (years) distribution of participants

	Diabetics X±S.D	Non-diabetics X±S.D
Age (years): Overall	48.12±7.48	43.75±8.24
Male	48.58±7.39	45.80±8.14
Female	47.66±7.62	41.70±7.90

**Table 2: Frequency distribution of participants in different age groups**

Age Group (years)	Diabetics (100)		Non-diabetics (100)	
	Male	Female	Male	Female
<40	8	8	14	21
40-49	17	18	18	19
≥50	25	24	18	10
Total	50	50	50	50

After the peripheral sensory perception test, 71% of the diabetics had intact sensation as opposed to 96% among non-diabetics while 3% as against 0% participants had impaired sensation respectively (Table 3).

**Table 3: Frequency distribution of subjects by Peripheral Sensory Perception Levels (PSPL)**

PSPL	Diabetics (100)	Non-diabetics (100)
Equivocal (60-70%)	26	4
Impaired (<60%)	3	0

There was a significant difference in PSPs of the diabetics and non-diabetics ( $P=0.00$ ) (Table 4). The PSPs of male and female for the diabetics ( $P=0.33$ ) and non-diabetics ( $P=0.31$ ), however, showed no significant difference (Table 5). In the like manner, the PSPs of the participants across the age groups (<40; 40-49; and  $\geq 50$  years) showed no significant difference for the diabetic ( $P=0.16$ ) and non-diabetics ( $P=0.30$ ) Table 6).

**Table 4: Comparison of peripheral sensory perception of diabetic and non-diabetic participants**

Diabetics (100)	Non-diabetics (100)	t-value	P-value
$X \pm S.D$	$X \pm S.D$		
18.35+2.16	19.61+1.27	- 5.03	0.00*

\* = Significant.

**Table 5: Peripheral Sensory Perceptions (PSPs) between male and female diabetics and non-diabetics**

Gender	Diabetics (100)	Non-diabetics (100)
	X±S.D	X±S.D
Male (50)	18.56+1.80	19.48+1.13
Female (50)	18.14+2.47	19.74+1.40
t-value	0.97	-1.02
P-value	0.33	0.31

**Table 6: Peripheral Sensory Perception (PSPs) of the diabetics and non-diabetics across different age groups**

Age Groups (years)	Diabetics (100)	Non-diabetics (100)
	X±S.D	X±S.D
<40	19.06 +2.08	19.37+1.44
40-49	18.57+1.85	19.84+1.07
t-value	1.90	1.22
P-value	0.16	0.30

### Discussion

The diabetics in the study were older than the non-diabetics in contrast to the study by Mayne<sup>14</sup>. This disparity may, hence, have influence on the result of this study relative to age-matched studies. Furthermore, as expected, fewer diabetics had intact sensation than the non-diabetics while more diabetics had equivocal and impaired sensation than the diabetics. Although, the difference in peripheral sensory perception between the diabetic and non-diabetics is not very large and this may mean that the majority of the diabetics did not have long-standing cases. Anyway, the semmes-westein 5.07 monofilament had proven a diagnostics device differentiating diabetics (commonly affected by neuropathy) from non-diabetics (rarely affected by neuropathy). On this note,

it will make possible identification of patients with high risk of skin breakdown, hence their timely education of the care of their feet, in terms of foot wears, and avoidance of injury as well as self-examination. This will go a long way in reducing the prevalence of ulcer, hence the reduction of need for amputation. Furthermore, patients and relatives will be saved from the emotional stress of coping with discomfort, disability and financial burden that often result from amputation.

There was a significant difference in the peripheral sensory perception among the diabetics and non-diabetics. This conforms to the finding in the studies of Chia<sup>15</sup> and Mueller<sup>6</sup>. The differences in peripheral sensory perception between male and female diabetics and non-diabetics were, however,

not significant. Also, the distribution of peripheral sensory perception between male and female follows no particular trend in diabetes and non-diabetics, which indicates no influence of gender on neuropathy. Anyway, male tends to have higher perception than female. This finding is consistent with that by Raelene (1989)<sup>16</sup>, who stated that prevalence of neuropathy in all the participants more than 18 years showed no difference by sex. Also, Ives-Smith<sup>7</sup> linked his study with neuropathy and being male; and this explains the trend of sensory perception for the diabetics, albeit, not significant.

Across different age groups, the diabetics and non-diabetics showed no significant difference. Also, the distribution of the peripheral sensory perception across the different age groups nor particular trend for the non-diabetics, which indicates no influence of age on neuropathy. However, for the diabetics, peripheral sensory perception decreases with advancing age. This finding conforms to the studies<sup>17, 18</sup> who stated that the incidence and severity of impaired sensory perception correlate with duration of diabetes and age.

### CONCLUSION

In view of the forgoing, it is obvious that peripheral sensory perception was significantly influenced by diabetic morbidity and that gender or age had no significant influence on peripheral sensory perception in diabetic and non-diabetics neuropathy.

The use of semmes-westein 5.07 monofilament is hereby, recommended for reliable, simple, and inexpensive screening for preliminary diagnosis of peripheral neuropathy in subjects with diabetes. Also, more studies involving diabetic subjects with peripheral neuropathy and use of other monofilament sizes as well as data on duration of diabetes, smoking habits, and height of diabetics, as risk factors indicated by Ives-Smith<sup>7</sup> are advocated.

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