

Original Research Article

Assessment of two point discrimination threshold on the thumbs of healthy adult Nigerians

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Abstract: Two-point discrimination threshold test is a widely employed method of evaluating tactile acuity. It is valuable for assessing injuries to nerves supplying the hands and outcome of surgical manipulations. Availability of normative values for comparison is imperative for objective interpretation of two-point discrimination threshold tests. This study aims to determine the normative values of two-point discrimination thresholds in the thumbs of adult male Nigerians. In the methods, two-point discrimination tests were conducted, using a pair of blunt dividers and a meter rule, on the palmar surface of the distal portion of the thumb in the dominant hands of 146 healthy adult male Nigerians drawn from a university community. Participants were screened by conducting simple test of fine touch with a wisp of cotton wool; to exclude those with impaired results. In results, one hundred and forty six participants aged 18 to 55 years completed the study. The overall mean two point discrimination threshold distance was 3.2 ± 0.93 mm. The mean two point discrimination threshold values for the age groups 18 to 25 years, 26 to 35 years, 36 to 45 years and 46 to 55 years were 2.5 ± 0.5 mm, 2.8 ± 0.7 mm, 3.8 ± 0.6 mm and 3.9 ± 0.9 mm, respectively ($p < .001$). In conclusion the mean two-point discrimination value obtained in our study, for the subjects aged 18 to 25 years is comparable to the normative value reported for a similar age group in other regions. Our study demonstrated increasing values of two-point discrimination threshold with increasing age.

Keywords: Two-point discrimination, tactile acuity, normative values, Nigeria.

INTRODUCTION:

Test of two-point discrimination is a simple, inexpensive, widely known and used method of assessing tactile gnosis [1, 2, 3], although its use has been fraught with valid criticisms [4, 5, 6]. The method is reported to be of particular use in evaluating injuries to nerves that supply the hands [1, 7]. Some have used two-point discrimination to assess the outcomes of surgical manipulations such as; digital replantation [8], skin grafting [9] and peripheral nerve repairs [1,10], employed in the management of hand injuries.

Advancing age and chronic regional pain are known to affect the outcomes of tactile spatial acuity assessments [11, 12, 13]. Some investigators have reported no gender variation in the normative values of tactile acuity as assessed with two point discrimination [14]. There is also no difference in tactile spatial acuity between homologous fingers of both hands, despite observed differences between the different fingers of the same hand [12,15,16]. Two point discrimination thresholds differ for different body areas, ranging from

2mm to 4mm on the fingers and lips, 8mm to 15mm on the palms and up to 30mm to 40mm on the shins and back [17].

Availability of normative values needed for comparison is necessary for objective interpretation of two point discrimination threshold findings. Some investigators have put the two-point discrimination threshold in the thumb as determined in some populations in India and the USA at 3.1 ± 0.2 mm and 2.6 ± 0.6 mm, respectively [14,18]. There is paucity of data on the normal values of two-point discrimination threshold in Africans. At present, there is no existing data on the normative values of two-point discrimination threshold distances in Nigerians.

In order to establish the local normative values of two point discrimination threshold on the thumbs, in this study, we determined two point discrimination distances in healthy adult male Nigerians drawn from the staff and students of a university community in south eastern Nigeria.

SUBJECTS AND METHODS

This cross sectional study involved one hundred and forty six apparently normal male participants, aged 18 to 55 years, drawn from volunteering staff and students of Abia state University community in south eastern Nigeria. Those with localized findings on the thumb such as injuries, scars, tattoos, calluses or dermatologic conditions that may impair sensation over the area, and those who declined to fully participate in the study were excluded. A history of diabetes mellitus, hypertension, renal or peripheral neuropathy was also a ground for exclusion. The study involved only participants who gave informed consent.

A simple random sampling technique was applied in the selection of the participants. Questionnaires were used to obtain data on demographics. In the first phase of the study, fine touch sensation was tested on the tip of the index finger of the participants` self-reported dominant hand (right), with a wisp of cotton wool while their eyes were closed and the results noted accordingly. Those who had impaired fine touch sensation were further excluded from the study. During the second phase, two point discrimination tests were carried out with a pair of blunt dividers and a meter rule, on the right thumb (self-reported dominant hand) of the selected participants who had normal results of fine touch sensation during the first phase. After explaining and demonstrating the two point discrimination test procedure, participants had their eyes closed. The test was commenced with the points of the blunt divider opened greater than the normal values for the thumb, with application of light and equal pressure applied on the two points. The two points of the blunt dividers were moved closer together across consecutive attempts and the results corresponding to the inter-point distances at which the participants could no longer distinguish two points as separate were recorded.

ETHICAL APPROVAL

Ethical approval for this study was obtained from the ethical committee, College of Medicine and Health sciences of Abia state university, Uturu, Nigeria.

Data Analysis:

SPSS version 22 statistical package was used to analyse data. Means and standard deviation (SD) were used for continuous variables, and simple proportions were used for categorized data. Chi square and student`s t test were used to compare proportions and numerical variables respectively. Linear correlation was used to determine the association between two point discrimination distance and age of the participants. The level of significance was set at $p < .05$.

RESULTS

The study involved one hundred and ninety eight healthy initial participants out of which fifty two were dropped as a result of impaired fine touch test outcome during the first phase. One hundred and forty six participants, with the age range of 18 to 55 years, went on to participate in and complete the second phase of the study. Of these, 15.75% were in the age group of 18 to 25 years, 36.30% were aged between 26 to 35 years, 23.29% were aged between 36 to 45 years and 24.66% were in the age group of 46 to 55 years. The mean ages of the groups were 22.1, 29.8, 40.8 and 49.9 years, respectively ($p < .001$). The overall mean age of the participants was 36.1 ± 10.2 years. See table 1.

The two point discrimination threshold distances obtained in the tested thumbs of the participants ranged from two to five millimetres. The overall mean two point discrimination threshold distance was 3.240 ± 0.9270 mm. The mean two point discrimination threshold values for the age groups 18 to 25 years, 26 to 35 years, 36 to 45 years and 46 to 55 years were 2.5 ± 0.5 mm, 2.8 ± 0.7 mm, 3.8 ± 0.6 mm and 3.9 ± 0.9 mm, respectively ($p < .001$). See table 2.

There is a positive linear association between the ages of the participants and their two point discrimination threshold distances ($r = .604$; $p < 0.001$). See figure 1.

Table 1: Mean age distribution of the participants

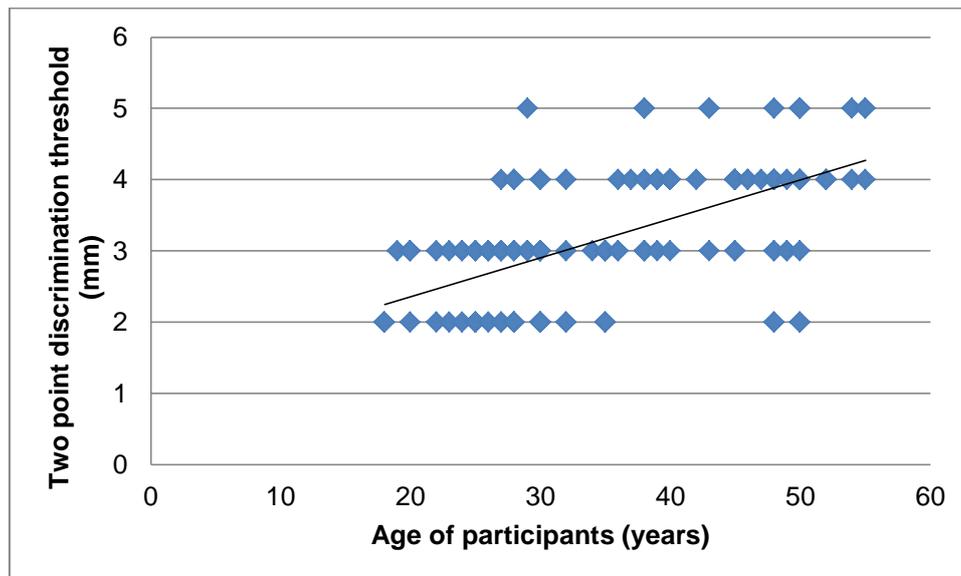
Age group	Number (%)	Mean age (in years)	Std. Dev
18 – 25 years	23 (15.75)	22.1	2.75
26 – 35 years	54 (36.30)	29.8	2.79
36 – 45 years	34 (23.29)	40.8	3.11
46 – 55 years	36 (24.66)	49.8	2.42
Overall (18 – 55 years)	146 (100)	36.1	10.25

p value < 0.001 ; F-stat = 609.94

Table 2: Two-point discrimination threshold findings in the participants

Age group	Number (%)	Mean two-point threshold (mm)	Std. Dev
18 – 25 years	23 (15.75)	2.5 ±	0.51
26 – 35 years	53 (36.30)	2.8 ±	0.72
36 – 45 years	34 (23.29)	3.8 ±	0.63
46 – 55 years	36 (24.66)	3.9 ±	0.9
Overall (18 – 55 years)	146 (100)	3.2 ±	0.93

P value < 0.001; F-stat = 32.08



$r = 0.604; p < 0.001$

Fig-1: Correlation of two point discrimination threshold distance with age of participants

DISCUSSION

Assessment of tactile spatial acuity is relevant in the clinical evaluation of sensory loss in persons with peripheral nerve injuries, and in monitoring the recovery made by these individuals [1,19]. Two-point discrimination is an important component of sensory evaluation employed in the assessment of spatial acuity [20]. It is thought to be a reflection of the density of sensory innervations and cortical representation of the given part of the body [21].

The mean value of 2.5mm obtained in our study, for the subjects aged 18 to 25 years is comparable to the normative value of 2.6mm obtained by Nolan who studied a group of young subjects aged between 20 to 24 years in USA [18]. Kannathu and Asir obtained a comparably higher average value of 3.1mm on the thumbs of Indian students aged 18 to 28 years [14]. Variation may be explained by differences in the methodology as we believe that the two-point discrimination threshold performance of our subjects was enhanced by the further step of screening out apparently healthy subjects who had poor performances in simple test of fine touch using a wisp of cotton wool. Alsaeed and his co-workers reported a relationship between students` course of study and their two-point

discrimination values, when they assessed two-point discrimination thresholds in students aged 20 to 23 years, recruited from a university in Riyadh, Saudi Arabia. They observed that those with better hand dexterity had better two-point discrimination values and an inverse trend between the two point discrimination threshold values and the visual acuity of the study participants [22]. In addition to some of the factors noted above, other variations in baseline settings such as the room temperature during which the studies were conducted may account for differences in obtained values [23].

It is noteworthy that a majority of our subjects are within the middle and upper socio-economic strata, usually exempted from manual labour, as they comprised of staff and students from a university community. The latter observation is relevant as excessive pressure on the cutaneous mechanoreceptors on the palms and fingers, as a consequence of manual labors, can result to impairment of tactile acuity in those parts of the body. [3,24].

In our study we observed a trend of increasing values of two point discrimination threshold with increasing age. This finding is in keeping with well

documented age related variation in tactile acuity performance at the fingertips, with worsening values as people get older [11,12,25]. Shimokata and Kuzuya, in their study, reported the presence of age related changes on the fingers of elderly subjects [26]. In addition, histological studies have suggested loss of cutaneous mechanoreceptors, with advancing age, as a contributing factor [27].

In view of the reported absence of gender differences in the value of two point discrimination threshold, the normative values obtained in our study could be applied to healthy female subjects in our locality [14, 18]. In the same vein, the practical applications of the normative values obtained in our study can be extended to the thumbs of both the dominant and non dominant hands of persons in our locality. The latter proposition stems from earlier reports that the values of two point threshold distance is similar for homologous fingers of the different hands, despite varying values for fingers of the same hand [12, 15, 16].

Our study is the first to attempt to establish the normative values of two-point discrimination threshold in Nigerians. We intend the outcome of this study to be useful in the comparative evaluation of sensory loss and progress of recovery in Nigerians with peripheral nerve injuries. There have been justifiable reservations regarding the use of two point discrimination test, chosen for assessing tactile spatial acuity in our study, especially with the availability of better and less controversial methods [5, 6, 28]. The test of two point discrimination threshold using a pair of blunt divider, as described in our study, being an inexpensive and simple method of tactile spatial acuity evaluation by the bedside or outpatient clinics, has remained attractive to clinical practice in resource poor regions lacking the requisite expertise and access to more modern procedures.

CONCLUSION:

The mean two-point discrimination value obtained in our study, for the subjects aged 18 to 25 years is comparable to the normative value reported for a similar age group in other regions. Our study demonstrated the trend of increasing value of two point discrimination thresholds with increasing age

ACKNOWLEDGEMENTS

We would like to acknowledge Dr. Nwankwo for his helpful suggestions during the design of the study

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