



## **Estimation of Tactile Sensation by Two Point Discrimination among 18 Years Old People**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Author KUM did the literature search, data collection, analysis, manuscript drafting. Author RGD did the data verification, manuscript drafting. All authors read and approved the final manuscript.*

### **Article Information**

DOI: 10.9734/JPRI/2021/v33i47B33135

Editor(s):

(1) Dr. Paola Angelini, University of Perugia, Italy.

Reviewers:

(1) G. Krishna Kumar, JIPMER, India.

(2) Rukmani Dewangan, College of Veterinary Science & A. H, Chhattisgarh Kamdhenu Vishwavidyalaya, India.

Complete Peer review History: <https://www.sdiarticle4.com/review-history/74459>

**Original Research Article**

**Received 05 August 2021**  
**Accepted 11 October 2021**  
**Published 03 November 2021**

### **ABSTRACT**

Two point discrimination (TPD) is used to distinguish the two point discriminative sense. TPD is most commonly used as neurosensory tests in clinical settings. In tactile sensation, the sensory receptors from the skin reach the somatosensory system and stimulate mechanoreceptors, thermoreceptors, pain receptors, and proprioceptors to give the response to the respective stimuli. The present study was aim to assess the value of tactiles sensation by two point discrimination test among 18 years people. 18 years old people among the normal population were selected, consisting of 17 males and 33 females. 6 sensory areas were selected for the test. Test performed on six regions of the body like fingertips, fingers, palm, forehead, forearm, back of palm. The results were tabulated and statistically analyzed by independent t test. The ability to distinguish the two point discrimination was estimated in millimeters by using a simple hand operated device. The main findings of the study are that females were more sensitive than males in TPD perception. TPD perception was more among 18 years old. The TPD values are more in females when compared to males. The normative values of two point discrimination among 18 years people were established. This study concluded that fingertips in females were more sensitive than other parts of the body.

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**Keywords:** Gender; Innovative technique; tactile sensation; two point discrimination; threshold distance.

## 1. INTRODUCTION

In tactile sensation, the sensory receptors from the skin reach the somatosensory system and stimulate mechanoreceptors, thermoreceptors, pain receptors, and proprioceptors to give the response to the respective stimuli [1]. Two point discrimination tests assess if the person is able to identify two close points on small area of skin. It is also a measure of tactile agnosia. The part of the body with the highest density of touch receptors are fingertips and lips. It shows greatest degree of two point discrimination [2]. Sensations are carried out by either the anterior lateral spinothalamic system or the dorsal column medial lemniscal system [3]. Two point discrimination test evaluates the ability to perceive two points applied to the skin simultaneously [4]. In examining nerve injuries of hand and brain injuries it's very useful [5]. Tactile sensation plays a crucial role in manual dexterity [6]. It is also used to assess information through the sense of touch by the somatosensory pathway [7]. Nervous system pathway responsible for essential survival ability, which makes humans adapt to the new environment [8]. Two point discrimination is majorly applied newly prosthetics and robotics [1,9]. Tactile sensory functions similarly to mechanoreceptors in humans [10] So, in humans it is hard to differentiate tactile stimuli [9] It is often tested with two sharp points during a neurological examination and is assumed to reflect how finely innervated an area of skin [11]. Although the test is still commonly used clinically, it has been roundly criticized by many researchers as providing an invalid measure of tactile spatial acuity, and several highly regarded alternative tests have been proposed to replace it [12].

Many studies are based on two point discrimination which had been performed in many other countries, but in India there is scarce of such kind of studies [13]. One of the major difficulties faced is that in interpretation of two point discrimination [14]. This type of study requires the assistance of a second examiner to measure the distance between two points [15]. Two point discrimination is the measure of smallest distance between two stimuli [16]. There are several factors which influence two point discrimination tests like age, sex, devices, applied force and also the state of mind of participants [17]. All these factors affect the

normative values of two point discrimination test [18]. The two point discrimination can also be hypothesised as the value of tactile sensation is not more in 18 years old people [19]. The term TPD was introduced by Weber in 1853. The primary stimuli for tactile sensation are touch, pressure, and vibration applied to skin [20]. Therefore, two point discrimination is useful in evaluating two point touch sensations. Our team has extensive knowledge and research experience that has translate into high quality publications[21–25].

The purpose of this study was to find out the normative values of tactile sensation by two point discrimination among 18 years old people.

## 2. MATERIALS AND METHODS

This research study was done at the Saveetha dental college, Saveetha University. The data was collected from the normal individuals of age 18 years. 6 sensory areas like fingertips, fingers, palm, back of palm, forehead, and forearm were selected for the test. The ability to distinguish the two point discrimination was estimated in millimeters by using a simple hand operated device. The subjects excluded are the individuals with any diagnosed cases like diabetes mellitus, head injuries, and soft tissue injuries. The investigator and principal investigator are involved in this study. The data was collected and used for the sample size estimation. Hence the sample of 50 was recruited by the independent sampling test. The study sample comprised of 17 males and 33 females of age 18 years. Independent sample t test was used to analyse the data.

The experiment was conducted on 18 years people. The participants were asked to close their eyes. A simple hand operated device was used. The study was conducted in a pleasant atmosphere. The different regions of the body like fingertips, fingers, palm, back of palm, forehead, forearm were selected. Two modalities of TPD tests were performed bilaterally at randomly selected test sites. The two point discrimination discrimination with sharp pointed tip was performed.

There was a rest period of about 1 minute between the tests using two modalities. The

participant was asked to close their eyes. Firstly, a longer distance is taken on the device and the threshold distance was measured. The person was asked to tell the points that they feel. The two points of the device were applied at the same time and perpendicularly to the test surface. Firstly, the distance taken was longer and it was large enough for the participant to clearly perceive correctly. Later, the threshold distance was reduced and the two points of the device are applied at the same time. By keeping on changing the distance the participant can feel only one point. This was the normative value of threshold distance of tactile sensation by two point discrimination test. The participants were asked to keep their eyes closed throughout the test procedure. A threshold distance was determined using a descending stimulus magnitude. This testing pattern was continued until the participant answered correctly. Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) software version 23.0 (IBM, Chicago, USA). Descriptive statistics were performed. Independent sample t test was done. P value <0.05 was considered to be significant.

### 3. RESULTS

Healthy individuals comprising 17 males and 33 females of age group 18 years. There was no significance between males and females in normative values of two point discrimination test. In Fig. 1, it showed that there was no significant between male and female. Test performed on six regions of the body like fingertips, fingers, palm, forehead, forearm, back of palm. The values of threshold distances were noted. By using SPSS software, descriptive statistics such as mean values and standard deviations were calculated for the test sites. Females are more significant threshold values than males. So, the present study showed that age factor has a significant effect on the TPD values. The present study showed that the threshold distance values of females were slightly more than the males. There was no significant difference in the values between males and females of age 18. Fig. 2 shows the mean values and standard deviation values of TPD between males and females of different parts of the body. Fig. 3 shows the percentage distribution of threshold distance of fingertips. Fig. 4 shows the percentage distribution of threshold distance of fingers. Fig. 5 shows the percentage distribution of the threshold distance of the palm.

### 4. DISCUSSION

The main findings of the study are that females were more sensitive than males in the perception. TPD perception was more in 18 years people. The same finding was shown in the previous study [26] [17]. The participants were allocated into 2 groups' i.e males and females. In this previous study, each participant was tested in a peaceful and comfortable environment [27]. Participants should be alert and attentive, during the entire testing process [28]. TPD is widely used in clinics and laboratories to characterise tactile sensation in a healthy population [29]. In the present study, mean value of fingertips, fingers, palm, forehead, forearm, back of palm, in males and females have no significant difference [29]. The same finding was shown in the previous study done by Kyoung [30]. The above results support the findings of other investigators [31]. In the previous study conducted by Kannathushibin it showed that same result as ours that the discrimination of the two-point touch sensitivity in finger tips is much more than any other areas in the upper extremity [32].

The TPD values of fingertips in both male and females are non-significant [33]. Fingertips were more sensitive and females had more TPD value than males [34]. The same result of fingertips being more sensitive was obtained in the previous study conducted by Epstein [35]. Palm [36] region has more sensory neurons, so it has more sensitivity [37]. In the forehead region, there was no significant different in TPD values of both male and female [38]. Foreheads are more sensitive to pain. In contrast to our study, Sang Yeun reported that forehead was less sensitive to pain. In the forearm region, there was no significant difference in TPD value of both male and female. In the back of the palm region, there was no significant different in TPD value of both male and female [39]. The present study demonstrates that TPD values for females were higher than males. In the previous study, it showed that the normal values of TPD of females were higher and women were more sensitive than men [40].

This study was conducted in a limited age group population. This study can be done on other parts of the body too. Comparison between different age groups can also be done. This study can be carried out in other populations and age groups.

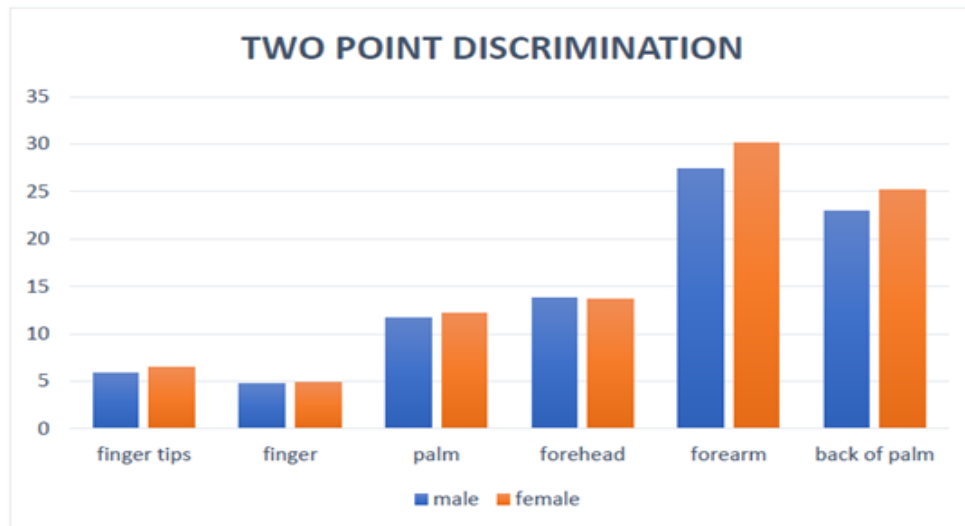
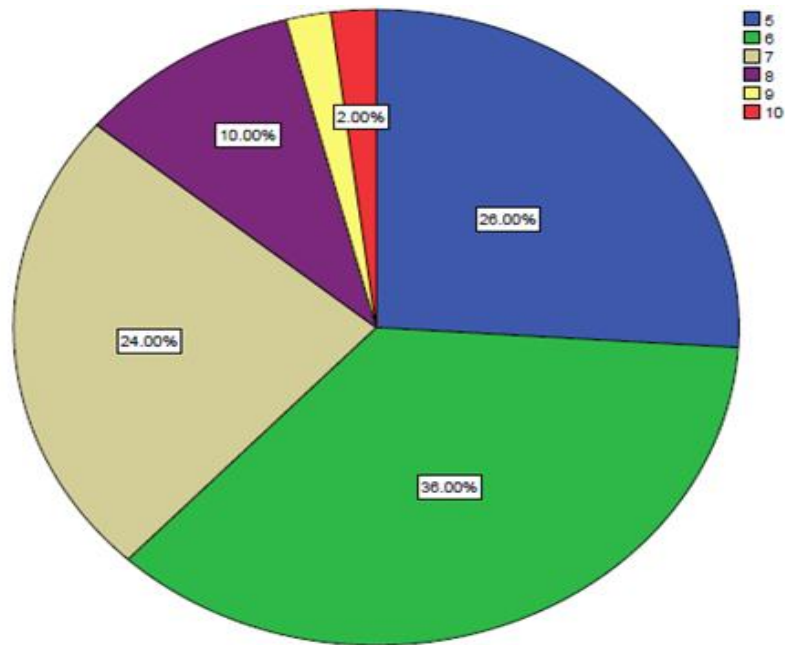


Fig. 1. The bar graph depicts the association between the gender and two point discrimination values. X axis represents the gender and Y axis represents the values of two point discrimination. Blue colour denotes males and orange colour denotes females. Threshold distance was more in females when compared to males. This bar graph shows that there is no significance in comparison of TPD values between male and female

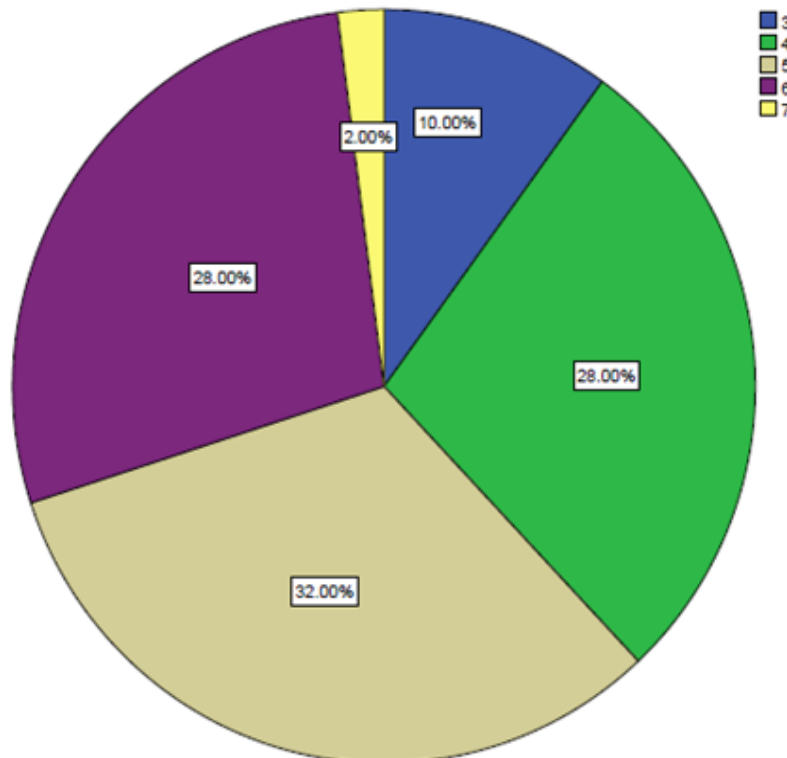
Group Statistics

	gender	N	Mean	Std. Deviation	Std. Error Mean
FingerTips	male	17	5.88	1.111	.270
	female	33	6.55	1.121	.195
Fingers	male	17	4.76	.831	.202
	female	33	4.88	1.111	.193
Palm	male	17	11.65	1.935	.469
	female	33	12.18	1.828	.318
Forehead	male	17	13.82	1.704	.413
	female	33	13.61	1.870	.325
forearm	Male	17	27.41	3.858	.936
	Female	33	30.09	4.946	.861
backofpalm	Male	17	22.88	3.333	.808
	Female	33	25.15	3.874	.674

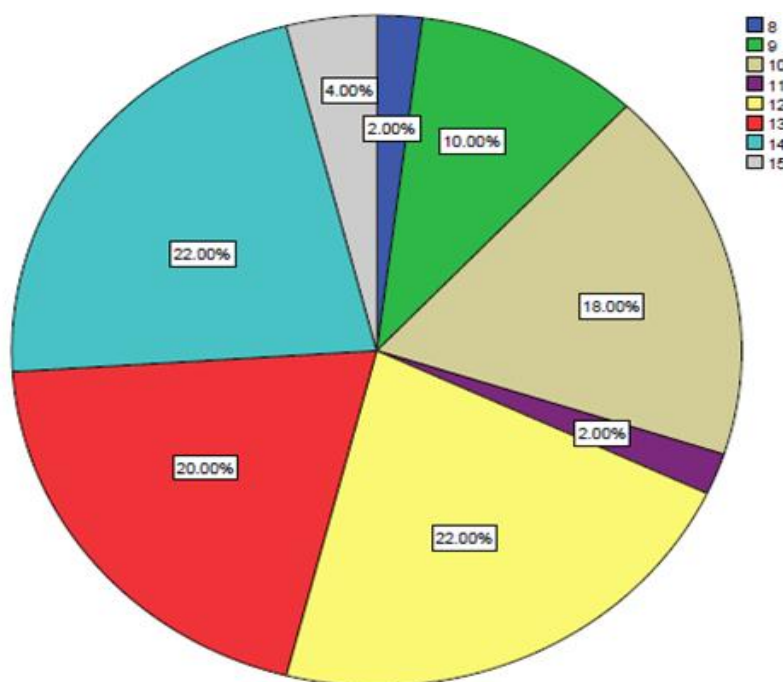
Fig. 2. This table showing the mean values and standard deviation values of two point discrimination of fingertips, fingers, palm, forehead, forearm, back of palm between males and females



**Fig. 3.** Pie Chart shows the percentage distribution of threshold distance of fingertips. 36% of participants had average TPD value of 6mm (green), 28% had 5mm (blue), 2% had 10mm (orange), 2% had 9mm (yellow), 24% had 7mm (grey), 10% had 10mm (purple)



**Fig. 4.** Pie Chart shows the percentage distribution of threshold distance of fingers. 28% of participants had an average threshold distance of 4mm (green), 2% had 7mm (yellow), 28% had 6mm (purple), 32 % had 5mm (grey), 10% had 3mm (blue)



**Fig. 5. Pie Chart shows the percentage distribution of threshold distance of the palm. 22% of participants had an average value of 12 mm (yellow) and 14 mm (sky blue), 20% had 13 mm (red), 18% had 15mm (grey), 2% had 11 mm (purple), 10% had 9mm(green)**

## 5. CONCLUSION

This study revealed that TPD values are more in females when compared to males. It could be concluded that fingertips in females were more sensitive than other parts of the body included in this study. The normative values of two point discrimination among 18 years people were established. The men and women discriminate the two point sensation in different ways and there exists gender differences. The data of the study may be useful in the clinical assessments and comparing their values with established normal values which may guide in the rehabilitation process.

## CONSENT AND ETHICAL APPROVAL

As per international standard or university standard guideline participant consent and ethical approval has been collected and preserved by the authors.

## ACKNOWLEDGEMENT

The authors would like to thank all the participants for their valuable support and Saveetha Dental College for their support to conduct the study.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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