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AGE AND GENDER RELATED CHANGES IN ASSESSMENT OF TWO POINT DISCRIMINATION ON UPPER EXTREMITY IN YOUNG, MIDDLE AND OLD AGED ADULT POPULATION

Neurology

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ABSTRACT

Background: The normal ability to distinguish two points is the two-point discrimination sense. Two-point discrimination is used clinically in evaluating injuries to the nerves that supply hands & to assess outcome of surgical manipulations such as digital replantation, skin grafting and peripheral nerve repairs. Normative values are useful in interpreting test result from sensory assessments in different age groups and in gender. **Aim:** To examine normal value of two point discrimination in young, middle & old aged adults population, and to compare the values of two point discrimination according to age and gender. **Methodology:** A total of 90 patients are assessed to find out normative values using aesthesiometer to assess tactile sensitivity in normal individuals, ranging from age (20-39), (40-59), (60-79). The normative values were calculated on Fifteen major areas innervated by branches of brachial plexus identified for examination. **Results:** The normal values of two-point discrimination varies according to gender, and in age groups. Females are more sensitive than males. The difference is more on upper lateral arm, mid medial forearm and distal phalanx of little finger. An increasing value of two-point discrimination threshold increasing with age. Young adults generally exhibit the highest TPD sensitivity. Older adults tend to demonstrate the most significant decline in TPD sensitivity. **Conclusion:** This study concluded that women have more two-point discrimination ability than men. An increasing value of two-point discrimination threshold increasing with age.

KEYWORDS

Two-point discrimination, Brachial Plexuses, Aesthesiometer

INTRODUCTION

The nervous system is a network of neurons, which induce and transmit information between all the different parts of the human body. The nervous system includes both the CNS and PNS. The central nervous system is made up of brain and spinal cord and the peripheral nervous system is made up of somatic and the autonomic nervous systems. The somatic nervous system consists of peripheral nerve fibres that send sensory information from the peripheral organs and carry them to the central nervous system. These also consist of motor nerve fibres that come out of the brain and take the dispatches for movement for movement and necessary action to the skeletal muscles.[1] Two-point discrimination is introduced by Weber in 1853. It is the measure of lowest distance between two stimulants applied contemporaneously & with equal pressure[4]. The quality of two-point discrimination sense indicates viscosity of innervation of skin & somatosensory cortical Representation. It has been reported that TPD test is grounded on hypothesis that two points can be discerned from each other, when these two points are meetly separated to detector spatially distinguishable neural activity.[7]

Aesthesiometer, consists of small ruler with two sliding tips carpeted with vinyl. The vinyl coverings help to minimize the impact of temperature on perception of contact.[5] Normative values are extremely useful in interpreting test result from sensory assessments. Two-point discrimination addresses the sensitivity of overlapping receptive fields on the body surface. In evaluating nerve injuries of hand and post-surgical cases, its help is immense. Receptive field is the area in the space from which a stimulus stimulates a sensory unit A sensory unit is a sensory neuron with all its peripheral branches. In the finger pads the receptive field is approximately 2-2.5mm. That is sensory nerve ending supplied only 2.5mm. Receptive field increase in the arm and is much more at the back. High receptor density with small receptive fields helps in better two-point discrimination. Aesthesiometer and the circular two- point discriminator are among the most common devices used for measurement.[2]

In my study I am trying to see Is there any variation in normative value of two point discrimination assessment in different age groups and in both males and females. Normative value of two point discrimination in young healthy adults is established, but the age and gender related changes in normative value is not examined.

Aims And Objectives

- To examine normal value of two-point discrimination in young, middle & old aged adults population, both in males and females.
- To compare the normal values of young, middle and old aged population.
- To compare the normal values of males and females.

MATERIALS AND METHODS

- **study design:** cross sectional study
- **study setting:** In and around Eruvessy Gramapanchayath.
- **Study population:** young adults with age group 20-39, middle aged adults with age group 40-59, old aged adults with age group 60-79
- **Study duration:** February to April 2023
- **Sample Design:** Purposive sampling.

Inclusion Criteria

Normal individual between age group 20-39
Normal individual between age group 40-59
Normal individual between age group 60-79
Both males and females.

Exclusion Criteria

1. MMSE scores below 24
2. Fracture on upper limb
3. Individuals with diagnosed case of:

- Neuropathy
- Nerve injuries
- Diabetes mellitus
- Spinal cord injury
- CVA
- Leprosy

Procedure:

90 Subjects will be screened based on the inclusion and exclusion criteria. A written consent will be taken from individuals who full filled the inclusion criteria. Participants will be allocated 3 groups –young, middle and old aged adults. From each group again divided into 2 groups. Males and females.Explain and demonstrate the procedure to the patient Fifteen major areas innervated by branches of brachial plexus were identified for examination Upper lateral arm, Lower lateral arm, Upper medial arm, Mid medial arm, Medial lower arm, Upper posterior arm, Mid posterior arm, Lower posterior arm, Mid lateral forearm, Mid medial forearm, Mid posterior forearm, first dorsal interosseous, Palmar surface distal phalanx thumb, Palmar surface distal phalanx long finger, Palmar surface distal phalanx little finger.Participant's hand was supported to avoid movement of fingers when touched by the pointsUsing aesthesiometer touch the client's Upper extremity with one /two points randomly applied.Participants will be instructed to respond to each touch, with eyes closed by saying one point or two points.The force of touch pressure was just to point of blanching, in a longitudinal direction perpendicular to the skin.Now

the tip of the pointer was made close such that the measurable value starts from the 0mm and the testing of each dermatome area was proceeded in the increment of 2mm until the volunteers were consistently able to differentiate whether they had been touched by one point or two points simultaneously.Measure the minimum distance the patient can distinguish the two-point sensation.

RESULT

Comparison of two-point discrimination on upper extremity according to gender

The two point discrimination on upper extremity according to gender there was a difference ($p<0.05$) in upper lateral arm, mid medial forearm, as well as distal phalanx little finger between males and females.

Comparison of two point discrimination on upper extremity according to age groups

The One way ANOVA was used to compare the two point discrimination on upper extremity according to age groups. There was a difference ($p < 0.05$) in upper lateral arm, lower lateral arm, upper medial arm, mid medial arm, medial lower arm, upper posterior arm, mid posterior arm, lower posterior arm, mid lateral forearm, mid medial forearm, mid posterior forearm, distal thumb, distal phalanx long finger, and distal phalanx little finger according to age groups.

Multiple comparison of two point discrimination on upper extremity according to age groups

Multiple comparison of two point discrimination on upper extremity according to age groups. There was a difference ($p < 0.05$) in upper lateral arm (Age groups: 20-39 & 40-59; 20-39 & 60-79; 40-59 & 60-79), lower lateral arm (Age groups: 20- 39 & 40-59; 20-39 & 60-79; 40-59 & 60-79), upper medial arm (Age groups: 20-39 &60-79), mid medial arm (Age groups: 20-39 & 60-79; 40-59 & 60-79), medial lower arm (Age groups: 20-39 & 60-79; 40-59 & 60-79), upper posterior arm (Age groups: 20-39 & 40-59; 40-59 & 60-79), mid posterior arm (Age groups: 20-39 & 40-59; 20- 39 & 60-79;), lower posterior arm (Age groups: 20-39 & 60-79; 40-59 & 60-79), mid lateral forearm (Age groups: 20-39 & 40-59; 20-39 & 60-79; 40-59 & 60-79), mid medial forearm (Age groups: 20-39 & 40-59; 20-39 & 60-79; 40-59 & 60-79), mid posterior forearm (Age groups: 20-39 & 40-59; 20-39 & 60-79; 40-59 & 60-79), distal thumb (Age groups: 20-39 & 40-59; 20-39 & 60-79), distal phalanx long finger (Age groups: 20-39 & 60-79), and distal phalanx little finger (Age groups: 20-39 & 60-79).

The normal values of two point discrimination varies according to gender, There is slight difference between the male and female. Females are more sensitive than males. The difference is more on upper lateral arm,(male 0.29&female 0.47) mid medial forearm (0.96 male &0.59 females) and distal phalanx of little finger (males 0.45&0.29 females)and slight difference is present other area.

Table1 : Comparison Of Two Point Discrimination On Upper Extremity According To Age Groups

	20-39		40-59		60-79		"F"	p value
	Mean	S.D.	Mean	S.D.	Mean	S.D.		
Upper lateral arm	4.06	0.43	4.35	0.34	4.59	0.27	16.65	< 0.001*
Lower lateral arm	4.35	0.20	4.72	0.14	4.92	0.34	42.20	< 0.001*
Upper medial arm	4.92	0.35	4.95	0.31	5.14	0.44	3.33	0.040*
Mid medial arm	3.93	0.35	4.00	0.80	4.60	0.42	12.88	< 0.001*
Medial lower arm	3.63	0.34	3.85	0.43	4.26	0.48	17.09	< 0.001*
Upper posterior arm	4.22	0.37	4.83	0.51	4.90	0.37	23.27	< 0.001*
Mid posterior arm	4.10	0.42	4.70	0.29	4.90	0.47	32.14	< 0.001*
Lower posterior arm	3.75	0.68	3.97	0.48	4.76	0.41	28.87	< 0.001*
Mid lateral forearm	3.69	0.42	4.00	0.47	4.76	0.54	39.87	< 0.001*
Mid medial forearm	3.52	0.40	4.13	0.67	4.68	0.90	21.69	< 0.001*
Mid posterior forearm	3.83	0.31	4.09	0.33	5.05	0.42	97.40	< 0.001*
First dorsal interosseous	1.01	0.32	1.22	0.59	1.26	0.55	2.14	0.123
Distal thumb	0.38	0.17	0.61	0.37	0.77	0.50	8.03	0.001*
Distal phalanx long finger	0.31	0.07	0.47	0.34	0.61	0.42	6.71	0.002*
Distal phalanx little finger	0.39	0.14	0.61	0.48	0.78	0.43	7.58	0.001*

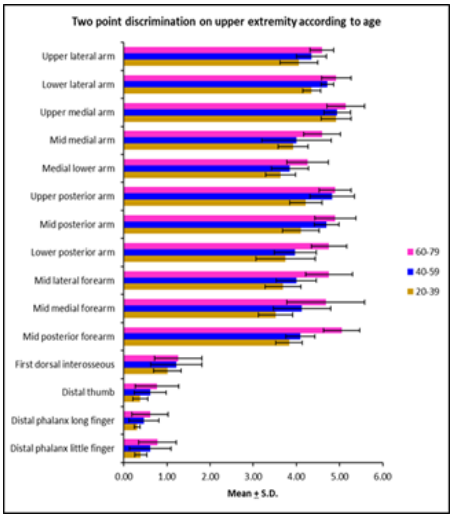

Figure1: Two point discrimination on upper extremity according to age

Table 2: Comparison Of Two Point Discrimination On Upper Extremity According To Gender

	Male		Female		"t"	p value
	Mean	S.D.	Mean	S.D.		
Upper lateral arm	4.47	0.29	4.19	0.47	3.42	0.001*
Lower lateral arm	4.71	0.34	4.62	0.33	1.38	0.171
Upper medial arm	5.08	0.42	4.92	0.32	1.98	0.051
Mid medial arm	4.27	0.58	4.08	0.68	1.43	0.157
Medial lower arm	3.97	0.47	3.86	0.51	1.14	0.259
Upper posterior arm	4.69	0.52	4.61	0.52	0.77	0.443
Mid posterior arm	4.62	0.55	4.51	0.50	1.01	0.317
Lower posterior arm	4.22	0.56	4.10	0.80	0.77	0.446
Mid lateral forearm	4.18	0.75	4.12	0.54	0.47	0.642
Mid medial forearm	4.36	0.96	3.86	0.59	3.04	0.003*
Mid posterior forearm	4.42	0.63	4.23	0.63	1.39	0.169
First dorsal interosseous	1.18	0.50	1.15	0.52	0.29	0.773
Distal thumb	0.66	0.45	0.52	0.34	1.67	0.098
Distal phalanx long finger	0.49	0.40	0.44	0.25	0.73	0.470
Distal phalanx little finger	0.70	0.48	0.49	0.29	2.46	0.016*

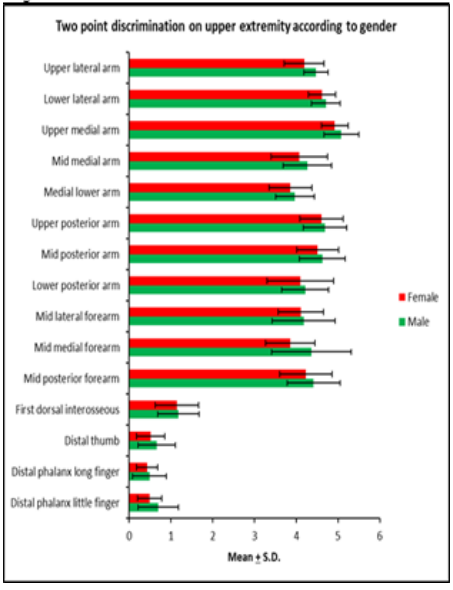

Figure 2: Two-point discrimination on upper extremity according to gender

CONCLUSION

This study concluded that, the normal values of Two-point

discrimination varies according to age and gender. An increasing value of two-point discrimination threshold increasing with age. Young adults generally exhibit the highest TPD sensitivity, indicating a finer ability to discriminate between two points. Middle aged adults may show a slight decline in TPD sensitivity compared to young adults, suggesting a gradual decrease in sensory perception. Older adults tend to demonstrate the most significant decline in TPD sensitivity, likely due to age related changes in skin elasticity and neural function.

Gender difference in TPD sensitivity may be minimal, females demonstrating slightly better 2PD threshold than males across all age groups.The two point discrimination on upper extremity according to gender there was a difference only in upper lateral arm, mid medial forearm, as well as distal phalanx little finger between males and females.

DISCUSSION

The purpose of current study is to determine the normal values of two-point discrimination on young, middle and old aged adult population and compare the difference between age groups and gender. Normative value of the tests are helpful in clinical settings. In neurological examination TPD test is used to examine hand injuries After completing the examination, the normal values are recorded from each group and gender and finally data was analyzed using ANOVA, Unpaired t test and Chi square test. It has been shown that age influences TPD test and discrimination values tend to become increased with age. In the present study the participants had an age range of 20 to 39 years, 40 to 59 years, and 60 to 79 years. As the role of height and weight was not proven on the TPD test, their evaluation was not made in the present study.

In the current study, differences in TPD test were found between the anatomical regions of the human body. The individuals were more sensitive in the distal areas than the proximal areas. The measured TPD values ranged from 3.63 to 4.86 in the upper lateral arm to 0.25 to 1.21 in the distal phalanx of little finger in the dominant upper extremity. The mean TPD Threshold measured in the present study was comparable with that found by the study of Shibin and Samuel with the reference value between 306 to 0.5 cm in the dominant upper extremity of young aged adults. Finger tips were the most sensitive areas which could discriminate the two points in a smaller distance compared to the other body parts. The receptor density in distal areas is higher and that the receptors in the parts used in daily life may be more developed than those in other parts. Smaller distance indicates higher receptor density and a denser receptor population leads to finer TPD sense.

In the present study 30 participants were young age,30 participants were middle age, and 30 participants were old age. Here the results showed large TPD values in old aged population compared to young and middle age, and small TPD values in young aged population compared to middle and old age. We observed a trend of elevated two point discrimination threshold with increasing age. Ageing related skin changes include decline in sensory nerve conduction velocity and in the amplitude of the sensory action potential.

An equal number of males and females participants were included in the present study, Which helps to make a better comparison between groups. In this study only there was a difference ($p<0.05$) in upper lateral arm, mid medial forearm, as well as distal phalanx little finger between males and females. These three regions showed measurement results were greater in men than in women. No statistically significant difference was seen between sexes in any of the other areas. In Boles and Givens study there was no significant difference concerning the sex in the TPD test. They reported that females were more sensitive than men in tactile detection threshold and not in the more spatially demanding TPD task. Shibin and Samuel also reported that men and women had similar TPD values, and sex difference does not exist. Nolan reported that the mean discrimination results for males and the females in test sample were not significantly different for any of the parts tested, except for the medial surface of the forearm, where females had a greater degree of sensitivity than males. Which is similar to present study. Corroborating Nolan's study there was no sex difference in most of the areas tested in the present study. Conversely to Nolan's study and to the present study, females showed TPD at a shorter distance than males at the most areas of the upper extremity in Koo et al.'s study.

In the present study, we could not find a biological reason for why women were more sensitive than men at the areas described above. Many aspects of the homunculus are still not clarified. (Individual variability in somatotopic map). Findings of a morphometric study shows that there are sex difference in the structure of the human cerebral cortex, characterized by more numerous, smaller neuronal units in males and fewer, larger ones in females. There may be differences between male and female primary somatosensory cortex in the respective regions, which may lead to different TPD values between males and females.

The major limitation of the study is that it was conducted in a small sample size and the discrimination sense or recognizing the 2 points will vary from individual to individual. There will be presence of human errors. Also, the testing was done only on dominant upper extremity. This study took shorter duration to complete. Based on the results of statistical analysis, it suggests that future study should modified to accommodate large sample size and conducting study for longer period of time will provide more accurate result.

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