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Determining the Hand index and hand shape in the population of Delhi: A cross-sectional study

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ABSTRACT
This study aimed to determine and classify the hand index and hand shape of Delhi-born male individuals. Total two hundred (n=200) Delhi-born male individuals of age group 18 – 40 years were selected randomly from the population of Delhi, India. Subjects with any kind of deformity of any hand were excluded from the study. The measured parameters were linear distance from the metacarpal radiale to metacarpal ulnare and linear distance from mid interstylon to dactylion of a middle finger. The result showed that the mean index of the right hand is 42.83 with a standard deviation of 2.44 and the mean index of the left hand is 42.69 with a standard deviation of 2.49. The above values indicate that shape of the hand of Delhi people largely belongs to dolichocheir (dch). The comparison of hand index of male populations of 18 different regions of India indicates that the population of India belongs to four categories of hand index and hand shape; namely hyperdolichocheir, dolichocheir, mesocheir, brachycheir. This shows that morphological characteristics of hand are not only affected by ethnicity, socio-cultural region, environment, hereditary factors but also affected by region. The knowledge of hand index and hand shape can be utilized in many areas of medical science hand index can be very useful in determining the identity of mutilated remains in any devastating act, and evidence in crime scene for criminal proceedings. The information of hand index can be useful in designing the equipment of medical science and other fields also. The comparative data of hand index of different regions can also help in the determination of the residential place of an unknown deceased person.
KEYWORDS: *Anthropometry, Forensic, Hand index, Hand shape*

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INTRODUCTION

The human hand is designed for grasping precise movements and it serves as a tactile organ also. There is a big area in the motor cortex of the brain for muscles of the hand [1]. each hand of a human is composed of 27 bones and it contains more measurements information than any of the other body parts. Anthropometry is the systematic scientific study of the measurements of various parts of the human body to obtain the exact size of the body parts. It has recently become more and more important in various fields. Studies on the collection of anthropometric dimensions of various body parts [2-12] and especially on hand dimensions have been carried out previously [13-18].

Environment, nutrition, physique & nature of work are the factors that can affect the anthropometry within a particular group. Anthropometric dimensions of hand are useful in the field of ergonomics, biometrics, and clinical field like forensic science, reconstructive surgeries of hand, etc. Determination of hand parameters can also help in the identification of mutilated remains in any devastating act and evidence in crime scenes [19]. Measurements of hand length and handbreadth have been extensively used to determine the stature [20-27] and sex [28-30]. Chandra et al estimated that hand index for male industrial workers of Haryana for the designing of hand tools and equipment [31]. Atal et al reported that hand index has a direct relation with psychiatric illness [32].

Hand index is calculated as the percentage between the handbreadth to the hand length and based on hand index, the shape of the hand can be classified as Hyperdolichocheir, Dolichocheir, Mesocheir, Brachycheir, Hyperbrachycheir using the scale of Martin and Saller (1957) [33]
1. Hyperdolichocheir (hdch) hands with very long fingers and narrow smaller palm
2. dolichocheir (dch) hands have long fingers and a narrow small palm.
3. mesocheir (mch) hands have long fingers but short small palm
4. brachycheir (bch) hands with short fingers and long large palm.

5. hyperbrachycheir (hbch) hands have short fingers with a broader large palm.

The aim of the present study was:

1. To find hand index and hand shape from measured hand dimensions in the male population of Delhi.
2. To compare the result of hand index of this study with the existing data of hand index of other regions of India.

MATERIAL AND METHODS

Research design: Cross Sectional Study

Ethical approval (IEC): PU/PIA/IEC/02/2021/004

CTRI Number: CTRI/2021/03/031695

Research plan: In the present study, a total of two hundred (n=200) male Delhi-born individuals within the age group 18 – 40 years were selected randomly from the population of Delhi, India. The individual with any deformity, injury, fracture, or surgery of any hand was excluded from the study. Informed consent was taken from each subject before obtaining measurements. Following two measurements of each hand were recorded in millimetres using the Standard Operating Procedure (SOP) prepared for the study-

Hand length (HL) = It is measured as the linear distance from mid interstylion to dactylion of the middle finger.

Hand breadth (HB) = It is measured as the linear distance from metacarpal radiale to metacarpal ulnare

Hand index is calculated as the percentage between the hand breadth to the hand length and based on the hand index, the shape of the hand was determined as per the classification given by Martin and Saller [33].

Table 1: Hand shape based upon the value of hand index according to Martin & Saller (1957)

S.No.	Hand Index	Shape of hand
1.	≤ 40.9	Hyperdolichocheir (hdch)
2.	41.0 – 43.9	Dolichocheir (dch)
3.	44.0 – 46.9	Mesocheir (mch)
4.	47.0 – 49.9	Brachycheir (bch)
5.	≥ 50.0	Hyperbrachycheir (hbch)

The mean of the hand index of all the subjects and standard deviation was calculated for both the hands.

RESULTS

$$s = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(x_i - \overline{x})^2},$$

Where

x_i is one sample value

$\bar{x}$ is the sample mean

N is the sample size

Table 2:

S.No	Right/Left Hand	Mean hand index	Standard deviation
1.	Right hand	42.83	2.44
2.	Left hand	42.69	2.49

The result of the study showed that the mean and standard deviation of the index for right and left hand in the male population of Delhi is 42.83±2.44 and 42.69±2.49 respectively.

DISCUSSION

In the present study, a total of two hundred (n=200), male individuals of Delhi born were randomly selected and the hand length and breadth were measured. The hand index was calculated from hand length and breadth. The result showed that the mean index of the right hand is 42.83 with a standard deviation of 2.44 and the mean index of the left hand is 42.69 with a standard deviation of 2.49. The above values indicate that shape of the hand of Delhi people largely belongs to dolichocheir (dch). The comparison of the hand index of male populations of this study with eighteen (18) other different

regions of India indicates that the hand of the Indian population belongs to four types of shape namely hyperdolichocheir, dolichocheir, mesocheir, and brachycheir. The population of Indian males does not have hyperbrachycheir hands.

The male population of Karnataka & Maharashtra people has very long fingers and narrow smaller palm (hyperdolichocheir), whereas the hand of people of Rajasthan, Arunachal Pradesh, Mizoram & West Bengal has long fingers and narrow small palm (dolichocheir).

The hand of the male population of Assam, Haryana, Himachal Pradesh, Jammu & Kashmir, Madhya Pradesh, Manipur, Meghalaya, Tripura & Uttarakhand has long fingers but short small palm (mesocheir) whereas males of Gujarat, Nagaland & Odisha have short fingers and long large palm (brachycheir).

Table 3: Comparison of hand index of different regions of India.

S.No	Regions of India	Mean Hand index	Hand shape
1.	Delhi (present study)	42.83	dch
2.	Arunachal Pradesh [12]	41.81	dch
3.	Assam[6]	46.60	mch
4.	Gujarat[3]	48.92	bch
5.	Haryana[31]	45.19	mch
6.	Himachal Pradesh[25]	44.51	mch
7.	Jammu & Kashmir[34]	45.65	mch
8.	Karnataka[30]	40.70	hdch
9.	Madhya Pradesh[3]	44.62	mch
10.	Maharashtra[20]	39.78	hdch
11.	Manipur[6]	46.38	mch
12.	Meghalaya[3]	46.15	mch
13.	Mizoram[12]	43.60	dch
14.	Nagaland [6]	49.73	bch
15.	Odisha[3]	49.69	bch
16.	Rajasthan[35]	42.90	dch
17.	Tripura[6]	45.26	mch
18.	Uttarakhand[32]	44.23	mch
19.	West Bengal[36]	43.75	dch

The comparison of the above data indicates that not only factors such as genetics, sex, occupation, food habits, and lifestyle but geographical areas their environmental and climatic condition also do play a role in the phenotype of hand.

It is suggested that further studies with a larger sample size with a proportionate presentation of both genders from all over Delhi may be carried out to confirm the results of the study.

CONCLUSION

The mean of the index of right and left hand with a standard deviation of the population of Delhi, obtained in this study is 42.83±2.44 and 42.69±2.49 respectively. This shows that the hand of the people of Delhi largely belongs to dolichocheir hand shape (long fingers and narrow small palm). The information obtained in the research study can be used in determining the identity of mutilated remnants in any devastating act, and evidence in crime scenes for criminal proceedings. The information of hand index can be useful in ergonomics, designing the equipment of medical science, and other fields. The comparative data of hand index of different regions can also help in the determination of the residential place of an unknown deceased person. In the modern world with the advancement of DNA technology, the problem of identification of a deceased person has been resolved to a large extent by evaluating the genetic information from the individual's cell and it gives the most reliable results, but DNA technology has its limitations because it requires laboratories having trained persons and high costing machines that make it less cost-effective and it is not easily available in rural and suburban regions.

This study has established the standard values of hand index and shape of the hand of people of Delhi and gives a comparison of hand index of different regions of India which will serve as a useful instrument in designing instruments, products, and hand tools that will increase user satisfaction and comfort which ultimately results in a boost of productivity.

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