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ORIGINAL ARTICLE

ASSOCIATION BETWEEN HANDGRIP STRENGTH AND HAND INDEX IN HEALTHY INDUSTRIAL DESK WORKERS - CROSS-SECTIONAL STUDY

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ABSTRACT:

Background: In Industry, workers perform repetitive activities may lead to cumulative traumatic disorder due to dimensional incompatibility and improper usage of tools. Hand anthropometry is useful for designing equipment and machines for better efficiency. Thus, this is to know the association of Handgrip strength and Hand Index in Industrial Desk Workers. **Methods:** It was an observational study with four months duration. A total of 20 Industrial Desk workers were recruited with a purposive sampling method. The basic data, including Hand dominance and Years of experiences, were recorded. The outcome measure assessed Handgrip strength using the Hand dynamometer and vernier calliper for the assessment of Hand Index. **Result:** There is a partial positive correlation is found between Handgrip strength and Hand Index on both sides. [r value -0.1452]. The mean value of right-hand grip strength was higher than left-hand grip strength in Industrial workers. The difference is not statistically significant. [P value is 0.4410]. **Conclusion**: The study concluded that there is an association between handgrip strength and Hand index in healthy industrial desk workers

Keywords: Anthropometry, Hand anthropometry, Industrial desk workers, Handgrip strength, Hand Index.

INTRODUCTION:

In Industry, Workers are considered organizational employees who perform various physical activities in the organization and implement the plans made by the organizational management. Work is best described as a sustained activity whose purpose is to accomplish goals and improve industry productivity. A worker can be defined as a person employed in the organization to carry out a manual, unskilled, skilled, technical, operational, clerical, or specific category of supervisory work instead of a compensation package. Specifically, in Industry, workers work with various tools, equipment, instruments, implements and processes.[1] Industrial workers perform multiple tasks, including high forces exerting activities (e.g. using a hammer) to executing exact movements [2]

Industrial workers involving in different types of repetitive movements, including hands held in a fixed position over long periods, repetitive exertions and motion with flexed or hyperextended hand or wrist, pressure at the base of the palm, persistent strain, gripping, jolting, vibration, forearm pronation or supination.[2] It is studied that these sustained repetitive activities and dimensional incompatibility lead to pathological changes like compression of nerves, tissue deformation, or decreased circulation may cause may lead to carpal tunnel syndrome and cumulative traumatic disorder.[4]

The human hand is the chief tactile apparatus and versatile part of the human body.

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. Hands perform most human, mechanical interactions with the surrounding world. This versatility is possible because of a very complex constitution composed of 27 bones and 15 joints. This complexity is already evident from the kinematics point of view, with more than 20 degrees of freedom (DOF) controlled by muscles, tendons and ligaments.[2]

Anthropometry is the systematic scientific study of the measurements of various parts of the human body. The application (engineering anthropometry) of these data in designing and evaluating systems, equipment, manufactured products, human-made environments, and facilities (Park et al., 2009). Mokdad and Al-Ansari (2009). [2]

Hand anthropometry can be defined as the comparative measurement of the human hand, involving parameters such as hand length and a handbreadth, Hand circumference, Handgrip strength, hand span. [5] Anthropometric dimensions of hand are also helpful to investigators in forensic science, forensic anthropology, criminology, biometrics, ergonomics, reconstructive surgeries, mechanical studies, clinical practice etc.[2]

In ergonomics, various hand dimensions will serve to design many handheld devices and equipment used in Industry.[5] Imrhan et al. (1993) stated that hand anthropometry helps determine various aspects of industrial machinery to design the equipment and machines for better efficiency and more human comfort. It has been a well-established fact that a hand anthropometric database is a prerequisite for the scientific design of hand tools and hand equipment. [2]

Handgrip strength is the power of forceful flexion of all finger joints with the maximum voluntary force that the subject can exert under normal biokinetic conditions by using various hand and forearm muscles. [6] Grip strength determines the handedness of an individual. It is often used as an indicator of overall physical strength. Muscle performance of the hand and forearm and as a functional index of nutritional status. [7]

Handgrip strength has been evaluated to determine Hand function by measuring the amount of static force that the hand can squeeze around a dynamometer. The force has most commonly been measured in kilograms and pounds. The Jamar dynamometer has been found to give the most accurate and acceptable measures of grip strength.[8,9] It is considered the "gold standard" of strength testing. As it offers a relatively inexpensive, light, and portable option to obtain objective measures of muscle strength

Hand index determines the shape of the hand. Hand index is the percentage variation between the handbreadth to the hand length. [2]

Anthropometric dimensions of hand are also helpful to investigators in forensic science, forensic anthropology, criminology, biometrics, ergonomics, reconstructive surgeries, mechanical studies, clinical practice etc. [2]

Imrhan et al. (1993) stated that hand anthropometry helps determine various aspects of industrial machinery to design the equipment and machines based on ergonomic principle for better efficiency and more human comfort. It has been a well-established fact that a hand anthropometric database is a prerequisite for the scientific design of hand tools and hand equipment. [2]

Thus, this study aims to know the Handgrip strength and Hand Index association in Industrial Desk workers.

PROCEDURE:

The study design is a cross-sectional study with a study duration of 4 months. Institutional Ethical approval was obtained. The sample size was calculated by openepi.com, with a confidence level (%): 90%.

Formula for calculating sample size was n=[DEFF*Np(1-p)]/ [(d2/Z21-α/2*(N-1)+p*(1-p)]. A total of 20 participants were recruited using the purposive sampling method from the Sainath Udhyog Industry, Ahmednagar. Outcome measures were Handgrip dynamometer, Vernier calliper. The inclusion criteria included Industrial Desk workers female between 20- 55 years age group involved in fine motor activities having experience of more than one year. At the same time, the exclusion criteria Worker had any neurological or musculoskeletal impairment (recent hand injury.) of upper limbs—workers with cardiovascular or systemic illness. After explaining the importance of the study, when an Industrial worker agreed to participate in the study, a verbal and written informed consent form in Marathi/English was obtained from all the Industrial Desk workers. The basic demographic details, Hand dominance, No. years' experience, Handgrip strength readings and value of Hand Index were documented and evaluated. A sample size of 20 Industrial Desk Workers recruited for the study.

Ooutcome measures:

Handgrip strength using Handgrip Dynamometer inexpensive, light, and portable option to obtain objective muscle strength measures considered a 'Gold Standard' method. At the same time, a vernier calliper is used to measure Hand Index.

Handgrip strength:

The patient is in a High sitting position. The participants were advised to keep their hand on a table with the angle in the elbow being maintained at 90 degrees, and they were asked to press the handle of the dynamometer with maximum strength. The maximal voluntary contraction was sustained for at least 3 seconds, and it was recorded as the handgrip strength in kilograms (kg). Three readings were taken with a gap of 10 minutes, and the maximum reading was taken for analysis.

Hand Index:

Participants will be made to sit in a relaxed state ask to place their hand straight on a flat surface. Measurements were taken, i.e. hand length and handbreadth from both right and left hand with the help of vernier calliper. All the measurements were repeated three times, and the mean value was taken for statistical analysis.[3]

Hand length (HL) = It is measured as the straight distance from the intersection (isty) to dactylic (daIII) of the middle finger.

Handbreadth (HB) = It is measured as the straight distance from metacarpal radialis (Mr) to metacarpal ulnare (mu), as depicted in figure 1.

$$\text{Hand index} = \frac{\text{Hand breadth X 100}}{\text{Hand length}}$$

RESULT:

The data were analyzed in an excel sheet. An instant version3 was used to calculate the mean, standard deviation and p values. The student's paired "t" test was used to compare between two groups. The Pearson correlation test is used to know the association between HG and HI.

Table 1- Baseline characteristics of Hand Anthropometric variables.

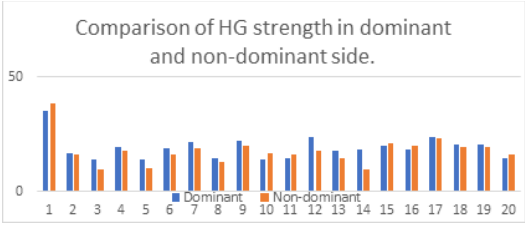
Sr.no	Variables	side	Minimum	Maximum	Mean ± SD
1.	Age		20	51	29.4 ± 7.8
2.	Hand Grip	Right	14	35	19.12 ± 5
		Left	9.6	39	17.73 ± 6.26
		Left	38	45	41.2 ± 2.3
3.	Hand Index	Right	37	47	42.6 ± 2.3

The above table 1 shows baseline characteristics property of Age, Handgrip strength and Hand Index of Industrial desk workers.

Table 2-Comparison of Dominant Handgrip strength with Nondominant Handgrip strength.

Sr.no	Variable [Handgrip strength]	Minimum	Maximum	Mean ±SD	P value
1.	Dominant	14	35	19.12 ± 5	0.0527
2.	Nondominant	9.6	39	17.69 ± 6.1	

Above table 2 describes a comparison between Handgrip strength between the dominant side and non-dominant side. The mean value of the dominant side is 19.12, while 17.67 is on the Nondominant side. The p-value is >0.05, not quite statistically significant. Thus, Handgrip strength on both sides is almost the same in Industrial workers.



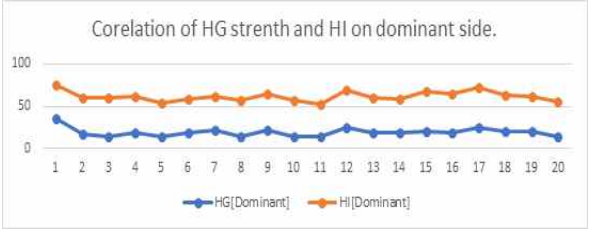
Graph 1: Comparison of Handgrip strength in Dominant and Nondominant side.

The above bar graph 1 represents a graphical representation of Handgrip strength on Dominant and Nondominant side in Industrial Desk workers. Again, there is no significant difference found.

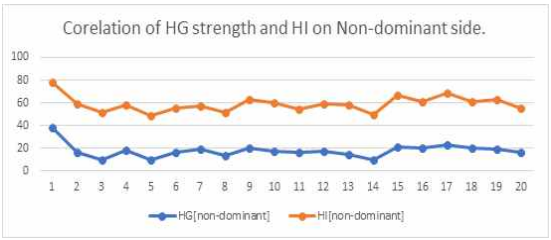
Table 3: Correlation between Handgrip strength and Hand Index in Dominant and Nondominant side.

Sr.no	Side	r value	P-value
1.	Dominant	0.1452	0.5414
2.	Non-dominant	0.1978	0.4032

Above table 3 represents the correlation coefficient of HG strength and HI on the Dominant side is r-0.1452, while 0.1978 is the correlation coefficient on the nondominant side. Thus, it shows a partial positive correlation between these variables.



Graph 2: Correlation between Handgrip strength and Hand Index on Dominant side.



Graph 3: Correlation between Handgrip strength and Hand Index on the Nondominant side

The above bar graphs 2 and 3 show the graphical representation association of HG strength and HI on dominant and non-dominant sides. There is partial positive correlation is found. It describes its mean if Hand index is more Handgrip strength also increases and vice versa.

DISCUSSION:

Anthropometry is the scientific measurement and collection of data about human physical characteristics such as shape, strength, work capacity and body size. The application (engineering anthropometry) of these data is used to design and evaluate systems, equipment, manufactured products, human-made environments, and facilities. [2,3]

Hand Anthropometry can be defined as the study of comparative measurements of various parameters of hand such as Hand length, Hand width, circumference and Handgrip strength. [5]

The human hand is the most used and versatile part of the body. It acts as a chief tactile apparatus and is endowed with gripping and precision movements for skilled works (Chaurasia, 1995). Hands perform most human, mechanical interactions with the surrounding world. They allow us to perform significantly different tasks, from exerting high forces to executing exact movements. [2] Anthropometric dimensions of hand are also helpful in forensic science, forensic anthropology, criminology, biometrics, ergonomics, reconstructive surgeries, mechanical studies, clinical practice. [3]

a worker can be defined as a person employed in the organization to carry out a manual, unskilled, skilled, technical, operational, clerical, or specific category of supervisory work instead of a compensation package. [1] In Industry, workers perform various repetitive tasks. Due to this, pathophysiological changes such as compression of nerves, deformation of tissues or decreased circulation leads to cumulative traumatic disorder for the upper limb. The proper matching of machine requirements with human capabilities is necessary for optimum performance of a man-machine system.[2]

For the efficient design of equipment, it is necessary to follow the guidelines and principles of ergonomics. The scientific discipline applies its knowledge to design and optimize human well-being.

Recent studies have estimated Hand Index and hand Anthropometric variables, and it is shown that ergo-design applications of hand tools and devices for industries of the state. [1] Also, studies have been done in association with Hand Anthropometry with Handgrip strength in the young adult male population, which proved positive co-relation between variables. But none of the research has been done related to the association of Hand Index and Handgrip strength in Industrial workers. In this study, Healthy Industrial desk workers are selected from Sai Udyog Industry, Ahmednagar.

On comparing Handgrip strength between Dominant and Nondominant side, there is more strength on the dominant side [19.12kg] than Nondominant side[17.69kg]. But it is not quite statistically significant as [P value is 0.0527].

On the association between Handgrip strength and Hand Index on Dominant and Nondominant side, there is partial positive correlation is found.

A previous article, researched by Ça¤atay Barut et al., conducted 145 basketball, 133 volleyball, and 96 handball players aged between 9-18 years. It is concluded that there is a significant difference in various anthropometric variables and Handgrip strength in the dominant and nondominant side between female and male basketball, volleyball and handball players. [10]

The study conducted by Rabina Khatoon et al. performed research in the young adult male population in North India.200 healthy males in the age group 18-25 years were selected. It is concluded that all the hand variables, including Hand length, Hand width, were positively correlated to the handgrip strength.

Chandra et al. conducted a study on 1540 male industrial workers ranging from 18 to 62 years belonging to four different divisions of Haryana state of India. Calculated as the percentage of handbreadth over the hand length; i.e. estimate a Hand Index. It is concluded that it will serve as a useful tool in forensic investigation and clinical practice and relevant to ergo-design applications of hand tools and devices for industries of the state. [2]

CONCLUSION:

The study concluded that there is an association between handgrip strength and Hand index in healthy industrial desk workers

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