Effect of Hand Anthropometry on Grip Strength in Normal Subjects

Thesis

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By

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Abstract

Force capabilities of the hand are affected by many factors including hand anthropometry. The purpose of this study to investigate the effect of structural anthropometry of the hand (hand length, palm length, palm breadth, fingers lengths, fingers breadths, wrist circumference, and forearm circumference) and functional anthropometry of the hand (grip reach and elbow grip length) on the hand grip strength in normal University students. One hundred normal students volunteered to participate in this study (50 males and 50 females). The mean age of the male group was 20.6 ± 1.26 years and female group was 20.14 ± 0.82 years. The mean weight of the male group was 76.44 ± 9.86 kg and the female group was 62.77 ± 9.54 kg. The mean height of the male group was 176.64 ± 6.66 cm and the female group was 157.16 ± 14.74 cm. Comparison between male and female groups was performed by using statistical unpaired t-test. The correlation among each one of the structural and functional anthropometry and the hand grip strength were studied using Multiple regression analysis and the Pearson Product Moment Correlation Coefficient (r). All statistical analysis was performed using StatGraphics Plus software with a significance level of 0.05. Statistical analysis revealed that there were significant differences ($p < 0.05$) between males and females regarding the eight variables (hand length, palm length, wrist circumference, MCP joint circumference, forearm circumference, grip reach, elbow grip length, and hand grip strength. For the remaining eleven variables, statistical test showed no significant differences between males and females. Regarding the relationship between hand length, palm length, palm breadth, fingers lengths, wrist circumference, MCP joint circumference, forearm circumference, grip reach, elbow grip length, statistical analysis revealed a significant moderate strong relationship between each one of these variables and the hand grip length except for the thumb finger length. The study supports the need for pre-employment screening and it is also useful for ergo-design application of hand tools and devices. The data are also needed in sports to search the talented individuals.

Keywords: Hand anthropometry, Grip strength, Body composition, Ergonomics.

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List of Abbreviations

BMC	Bone Mineral Content
BMD	Bone Mineral Density
BMI	Body Mass Index
CTD	Cumulative Trauma Disorders
DXA	Dual energy X ray Absorptiometry
LBM	Lean Body Mass
MCP	Metacarpophalangeal joint
NS	Non Significant
r	Correlation Coefficient
Sig	Significant level

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Chapter I
Introduction

Individuals use their hands and fingers every day at work and in the home. Knowledge of the force capabilities of the hand and fingers can facilitate the design of better tools and controls, and provide valuable data for comparison to current exertion levels of injured workers to determine the extent of an injury or the level of recovery (Astin, 1999). The assessment of physical dimensions of the human hand provides a metric description to ascertain human-machine compatibility in the design of manual systems. Primarily adapted for reaching, grasping and manipulating, the hand functions include activities, such as pushing, adjusting and manipulating objects. Furthermore the hand may be used as a fist or forces may be transmitted through the fingers extended in close packed positions. Prehensile movements of the hand have been described as cylinder, ball, ring, pliers and pincer grips and all such movements are the variants of precision and power grips (Nag et al., 2003).

Hand and finger force data are used in many settings, including industrial design and indicating progress during rehabilitation. The application of appropriate work design principles during the design of tools and workstations may minimize upper extremity injuries within the workplace. In addition, it is necessary to understand the capabilities of the hand and fingers in order to evaluate the level of disability caused by existing injuries and also to assess the progress made during recovery. Understanding the

physical capabilities and limitations of individuals is therefore necessary to optimize performance and minimize injury (Astin, 1999).

The dimensional and anatomical features of the human hand and the factors such as the size, shape, and texture of objects being held influence the functional aspects of hand uses. The occupational disorders associated with the improper use and cumulative exertion of the wrist and hand; include osteoarthritis, dislocations or subluxations, synovitis, ligament strains and ganglia, tenosynovitis, trigger finger, intrinsic muscle strains, and carpal tunnel syndrome. Generally these are referred to as repetitive or cumulative trauma disorders (CTD) since they occur in people performing repetitive handwork. Ergonomics consideration in the design of tools and appliances, in accordance with the dimensions of the human hand, may alleviate hand disorders in the user group (Nag et al,. 2003).

Measurement of grip and pinch strength is an important component in hand evaluation. It assesses the patient's initial limitations and provides a quick reassessment of patient's progress throughout the treatment (Ertem et al., 2003). The integration of human strength capabilities and minimization of force requirements during the design phase of hand intensive tasks may reduce the risk of occupational injuries, including CTDs, and the costs associated with them (Astin, 1999).

Anthropometry is the measurement of the dimensions of the body and other physical characteristics. There are two types of