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The relationship between anthropometry and hand grip strength among elderly Malaysians

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ABSTRACT

It is known that the ageing process will result in a decrease in anthropometric dimensions as well as loss of hand grip strength, which is natural among elderly people. Previous studies have shown that the decrease in anthropometric dimensions may influence hand grip strength of elderly people. Hence, this paper seeks to determine the relationship between anthropometric dimensions and hand grip strength among elderly Malaysians. A total of 112 elderly subjects aged 60 years and above residing in Petaling Jaya, Selangor, are recruited in this study. The subjects comprise 56 males (age range 60–79 years, mean: 66.88, SD: 5.35) and 56 females (age range: 60–82 years, mean: 66.98, SD: 5.16). In this study, 38 anthropometric dimensions are measured, along with hand grip strength. The anthropometric dimensions are measured using a professional standard anthropometry set whereas hand grip strength (in Newtons) is measured using a dynamometer. The mean values, standard deviations and percentiles are determined and the data are analysed by correlation analysis. The results show that there is a significant correlation between the following anthropometric dimensions (stature, sitting hip breadth, wrist circumference, hand circumference and heel ankle circumference) and hand grip strength. These findings of this study are indeed useful for product designers to design and develop ergonomic hand-held products for elderly Malaysians.

1. Relevance to industry

It is essential for product designers to use anthropometric and hand grip strength data that are relevant and up to date when designing and developing products for elderly people. However, such data are rather scarce in Malaysia, which forms the main motivation of this study. The goal of this study is to develop a comprehensive database consisting of anthropometric dimensions and hand grip strength data of Malaysian elderly. It is believed that this database will be useful as a guideline for product designers and manufacturers to design and develop products which take into consideration the special needs of this target group.

2. Introduction

The elderly population is escalating at a steady pace over the years (Sussman et al., 2014). It has been forecasted that the number of elderly people will increase from 24 million to 418 million within four decades, from year 2011–2050 (United Nations, 2011). An elderly is defined as an individual aged 60 years or above. Malaysia is also not spared from demographic transition which occurs all over the globe. According to a report published by the Department of Statistics Malaysia (2010), it is expected that Malaysia's population will increase from 28.6 million to 38.6 million in 2040. This corresponds to an increase of 10 million people, which is equivalent to a percentage increase of 35% (Department of Statistics Malaysia (2010)). Based on this forecast, Malaysia will be populated with elderly people aged 60 and above by 2040, which constitutes 7.3% of the total population. This demographic transition presents certain challenges as to whether the society is ready to fulfil the special needs of these older individuals.

Ageing is inevitable and therefore, it is imperative that the physical limitations of the elderly population are considered. It is

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common knowledge that an individual's height (Kenny et al., 2008), weight (Kenny et al., 2008), body mass index (Corish and Kennedy, 2003) and muscle strength (Tsubaki et al., 2010) will decrease with ageing. They have shown that the decrease in muscle size is positively correlated with a decrease in hand grip strength. Metter et al. (2002) reported that there is a noticeable decrease in muscle strength at the age of 50 and this decrease accelerates after the age of 65. A number of cross-sectional studies have been carried out over the years and the findings reveal the muscle strength differs significantly between males and females. For instance, Matsuoka et al. (2006) discovered that men in general, have higher muscle strength compared to women.

Muscle strength can be measured in terms hand grip strength, which is a reliable measure provided that the user implements standardized techniques and calibrated instruments (Massy-Westropp et al., 2011). In addition, hand grip strength can also be used to indicate and predict other health conditions among the elderly. It has been suggested that frailty and disability among elderly people are associated with how their muscles are used. Hand grip strength is a reliable indicator of muscle strength and it can be measured easily in the laboratory using hand dynamometers (Syddall et al., 2003). Anthropometric dimensions also reflect the physical limitations that need to be considered among the elderly. Perissinotto et al. (2002) discovered that changes in body composition is different between men and women and this influences anthropometric measurements.

Researchers in Malaysia have also explored anthropometric dimensions and hand grip strength among Malaysians. Anthropometry is one of the areas which is of great interest among Malaysian researchers, and a number of key works pertaining to this study are highlighted in this paper. In brief, some studies are focused on collecting anthropometric data in order to create a database on anthropometric dimensions for Malaysians, while some studies are focused on investigating the influence of ethnicity on anthropometric dimensions. In addition, some studies are focused on anthropometric measurements in order to produce ergonomic school furniture and household products as well as for medical purposes. A number of studies have estimated stature using mathematical equations, while others are comparative in nature, in which the local data are compared with those from other countries.

Several studies have been carried out to collect anthropometric data of Malaysians and among these are the works of Nasir et al. (2011), Mohamad et al. (2010) and Ngoh et al. (2011). They have successfully produced a comprehensive database on anthropometric measurements for the Malaysian population. Rosnah et al. (2009) and Karmegam et al. (2011) discovered that there is a significant difference in various body dimensions between ethnic groups in Malaysia, and the data suggest that ethnicity is a factor which influences anthropometric dimensions.

A number of studies have been conducted on the anthropometric dimensions of a specific target group with the aim of improving product designs in order to cater to the needs of the group. Nazif et al. (2011) and Afzan et al. (2012) investigated the relationship between anthropometric dimensions of children and school furniture and they proposed that school furniture needs to be redesigned in order to conform to the physiological measurements of the children. Zakaria (2011) determined a sizing system for school uniforms. Daruis (2011) and Deros et al. (2009) focused on improving chairs and seats for the Malaysian population, and the findings showed that the sitting dimensions of Malaysians are larger than the 95th percentile of other Asians. However, the sitting dimensions of Malaysians are smaller than those for Filipinos and Thais.

Studies have been carried out to estimate stature from mathematical equations such as those by Shahar and Pooy (2003) and Hisham et al. (2012). Other studies are more focused on medical aspects. For example, Yap et al. (2001) investigated the difference in the lung volumes between ethnic groups whereas Hussain and Abdul Kadir (2010) collected anthropometric data of the distal femur and proximal tibia of Malays in Malaysia.

Several researchers have conducted comparative studies, whereby the anthropometric dimensions of locals are compared with those of other nationalities. Taha et al. (2009) compared the anthropometric dimensions of Malaysian and Saudi Arabian males with an age range of 20–30 years. They noted a significant difference in a number of anthropometric dimensions between these nationalities with the exception of the following dimensions: eye height, elbow height (standing), elbow height (sitting), height and shoulder height. Chong and Leong (2011) compared Malaysian anthropometric data with those for Dutch, British and Japanese populations. The largest difference is observed in the stature between Malaysian and Dutch populations, with a value of 84 mm.

Unlike anthropometric studies, there is less research focused on muscle strength in Malaysia. Most of these studies use hand grip strength test as an indicator of the overall muscle strength (Foo, 2007). Hand grip strength is an appropriate measure of evaluating muscle strength since hand grip strength tests do not require much physical effort and are therefore suitable for elderly people. In addition, hand grip strength is often used as a functional index of nutritional status (Jurimae et al., 2009; Kaur, 2009; Tsunawake et al., 2003) and physical performance (Samson et al., 2000). Studies on hand grip strength in Malaysia have been carried out by a number of researchers in different fields (Taha and Nazaruddin, 2005; Keevil et al., 2013; Kamarul et al., 2006; Shahar et al., 2007).

Hand grip strength is also associated with various factors. Gender and age have been shown to be the primary factors that influence hand grip strength, regardless of the ethnicity and nationality of the population. This is reflected by the following studies. Hong et al. (2010) investigated the correlation between hand grip strength and falls among elderly Koreans, whereas Auyeung et al. (2011) studied the correlation between hand grip strength and the decrease in cognitive ability. Sasaki et al. (2007) studied the increase in mortality among middle-aged Japanese men and women.

On the other hand, a couple of studies have found that there is a strong correlation between hand grip strength and various anthropometric characteristics such as weight, height and hand length (Jurimae et al., 2009; Koley and Yadav, 2009). However, there is a lack of studies focused on determining the relationship between anthropometric variables and muscle strength among elderly Malaysians. To date, most of the studies are centred on Caucasian populations and therefore, the validity of normative data which shows the correlation between anthropometric dimensions and hand grip strength in Asian population is still debated. Little is known regarding the relationship between these parameters among elderly Malaysians. It is hypothesized that hand grip strength varies with specific anthropometric dimensions. Thus, the aim of this study is to determine the relationship between anthropometric measurements and hand grip strength among Malaysian elderly.

3. Methodology

3.1. Subjects

This study was carried out in the Petaling Jaya, a city located in state of Selangor, Malaysia. The inclusion criteria for the subjects of this study are as follows: