

HAND AND FOOT ANTHROPOMETRY OF ELDERLY

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ABSTRACT

This research involves the survey of hand and foot dimensions of the elderly in North Eastern part of Thailand. The aim of the research was to study the size of hands and feet of the elderly. The research was separated into two parts. For the first part, Personal data such as age, education, status, sex, career, congenital disease were collected using a questionnaire. For the second part, body dimensions were measured using an anthropometer, a measure tape and a scale. Participants were 400 elderly, 195 males (48.8 percent) and 205 females (51.2 percent). The average age of the participants was 69.52 years old. All of them were Buddhist. Ninety seven point five percent of them were married, while two point five percent of them were single. Ninety percent of them owned their houses, while ten percent of them lived without their children. Considering their education, 94.5 percent were educated at least at primary school level, while 5.5 percent never been in school. Most of them were farmer (57.8 percent) and had a health problem of high or low blood pressure (40.8 percent). The results showed that the average hand breadth was 8.80 cm for males and 8.59 cm for females. The average hand thickness was 3.95 cm for males and 3.54 cm for females. The average hand lengths were 17.54 cm and 16.57 cm for males and females, respectively. The average foot length was 24.56 cm for males and 22.78 cm for females. The average width of the front foot was 10.31 cm for males and 9.44 cm for females, respectively. The average heights of the ankle were 9.54 cm and 8.84 cm for males and females, respectively. The data can be used to design facilities for the elderly, such as a door knob or a handle for ease of opening.

Keywords: Elderly, Hand and Foot Dimensions

1. INTRODUCTION

Thai society has been changed from agricultural society to industrial society because of economic development and also advances technology in various

field such as transportation, science, medical, etc. (Sukothai Thammathirat, 2014). This results in moving young and working age people to cities. Only middle-aged people and elderly still live in rural area. This trend increases every year. Furthermore, population structure has been changed to aging society (Foundation of Thai Gerontology Research and Development Institute, 2010; National Statistical Office, 2013). Changing to elderly associated with physical deterioration causes health problems and diseases that affect activities in daily life. (Ronnarithivichai, 1987; Kuptniratsaikul, 2008). To perform daily activities, several physical factors and functions of hand and foot are required (Mohoney and Barthel, 1965).

Past research involving hand have been done by many researchers. Nag et al. (2001) investigated hand size of females in India required to tool and equipment design. Hand anthropometry included hand length, hand breadth, hand depth, and grip circumference. The results showed that the length of hand was significantly correlated with the circumference of wrist and finger. Furthermore, hand sizes were different between age group. Chandra et al. (2011) measured size and strength of hand and fingers. The subjects were 500 students in Nigeria with the age between 18-29 years old. It was found that the hand size of male and female students were not different. Gender was an indicator of finger strength.

Repetitive work with forceful exertion of hand can induce musculoskeletal disorder (MSDs). Labor works required repetitive hand and wrist movement and exertion resulted in Cumulative trauma disorders (CTDs). The movement of the wrist used to perform industrial task was studied by researchers (Didomenico and Nussbaum, 2003; Marras and Schoenmarklin, 1993). The speed and acceleration of the wrist movement during work were important factors for high risk for CTDs. The high and low risk groups were more vulnerable to CTDs differently.

In addition to hand anthropometry, foot dimension was also important. Tomassoni et al. (2014) found that age and gender were correlated with changes in the foot

shape. The size of the feet changed over the ages. The relationship between the foot and ankle testing was related to balance significantly. Foot and ankle had specific functions such as flexibility which was important for balance for elderly. Exercise could improve foot and ankle use during walking and reduce chance of fall in elderly. (Spink et al., 2011)

Although hand and foot dimension was important for the design of product, hand and foot anthropometry of elderly was very rare in Thailand. The objective of this research was to measure hand and food size of Thai elderly.

2. EXPERIMENT

2.1 Experimental Apparatus

This research measured the size of a hand and foot using the Martin type anthropometer, anthropometric tapes and scales. A questionnaire was used to collect personal data.

2.2 Participants

In this study, participants were 400 elderly in Nakhon Ratchasima province in the North Eastern part of Thailand. They were 195 males (48.8 percent) and 205 females (51.2 percent). The average age of the participants was 69.52 years old. All subjects were Buddhist.

2.3 Data Collection

The research was separated into two parts. For the first part, personal data such as age, education, marriage status, sex, career, congenital disease were collected using a questionnaire. For the second part, hands and feet dimensions including hand breadth, hand length, hand thickness, foot length, ankle height, and front foot width were measured and recorded.

3. ANALYSIS

3.1 Sample Size

The size of the sample was computed based on Yamane's formula as shown below (Yamane, 1967).

$$n = \frac{N}{1+Ne^2} \quad (1)$$

Where: n = sample size

N = the size of population

e = the error of 5 percent points

A survey of the population aged 60 years and over in the North Eastern part of Thailand in year 2012 showed that total number of elderly in Nakhon Ratchasima was 308,608 people (National Statistical Office, 2013). Using the question 1 to determine sample size, it was found that the sample size was 399.48.

3.2 Data Analysis

The results showed that 97.5 percent of the participants were married, while the rest, 2.5 percent, were single. Most participants (90 percent) owned their houses, while 10 percent lived without their children.

Considering their education, 94.5 percent were educated at least at primary school level, while 5.5 percent had never been in school. Most of them were farmers (57.8 percent) and had health problem of high or low blood pressure (40.8 percent). Table 1 showed average hand and foot dimensions and standard deviations. Average hand lengths were 17.54 cm. for males and 16.57 for females. Average hand breaths were 8.80 cm. for males and 8.39 cm. for females. Average front foot widths were 10.31 cm for males and 9.44 for females. Table 2 revealed descriptive statistics including maximum values, minimum values, and the 5th, 25th, 50th, 75th, and 95th values, respectively. Minimum hand lengths were 7.3 cm. for males (Table 2) and 5.5 cm. for females (Table 3). Minimum foot lengths were 20 cm. for males (Table 2) and 19 cm. for females (Table 3).

Table 1. Average and standard deviation hand lengths, hand breadth, hand thickness, foot length, ankle heights and front foot widths of the participants (unit in cm.).

	Hand Lengths	Hand Breadth	Hand Thickness	Foot Length	Ankle Heights	Front Foot Widths
Male	17.54	8.80	3.95	24.56	9.54	10.31
Elderly (n=195)	±1.69	±1.09	±0.52	±1.50	±1.14	±0.77
Female	16.57	8.59	3.54	22.78	8.84	9.4
Elderly (n=205)	±1.39	±1.27	±0.61	±1.40	±1.04	±0.64

Table 2. Descriptive statistics of hand and foot anthropometry of males (unit in cm.).

	Max	Min	P ₅	P ₂₅	P ₅₀	P ₇₅	P ₉₅
Hand Lengths	20	7.3	15.8	17	17.8	18.48	19.30
Hand Breadth	12	3.3	7.7	8.2	8.5	9.00	11.10
Hand Thickness	5.6	1.5	3.2	3.6	4	4.28	4.80
Foot Length	29.6	20	22	23.7	24.5	25.50	27.16
Ankle Heights	13.1	6.9	7.8	8.8	9.5	10.20	11.40
Front Foot Widths	14.1	7.8	9.2	9.9	10.3	10.70	11.66

Table 3. Descriptive statistics of hand and foot anthropometry of females.

	Max	Min	P ₅	P ₂₅	P ₅₀	P ₇₅	P ₉₅
Hand Lengths	19.3	5.5	14.75	16.1	16.8	17.30	18.06
Hand Breadth	11.9	5.1	7.1	7.5	8.2	9.70	10.60
Hand Thickness	8.5	2	2.9	3.2	3.5	3.80	4.30
Foot Length	27.8	19	20.4	22	22.85	23.60	24.70
Ankle Heights	12.3	6	7.15	8.1	8.8	9.50	10.50
Front Foot Widths	11.4	7.8	8.4	9	9.4	9.80	10.60

Figure 1-4 were box plots showing distribution of hand and foot dimension data based on the five number summary: minimum, first quartile, median, third quartile, and maximum. Most hand and foot datasets for males and females revealed the same range. However, hand breadth data for males showed greater range than those for females (Figure 2). In plots for hand length, hand thickness, foot length and front foot width data, the distribution of female dimension was toward the weaker side of the male values. Furthermore, the boxplot of hand breadth data was skewed to the right (Figure 2).



Figure 1. Box plot for hand length data.

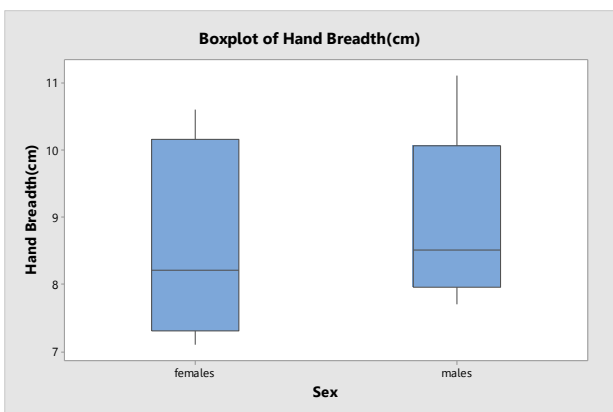


Figure 2. Box plot for hand breadth data.

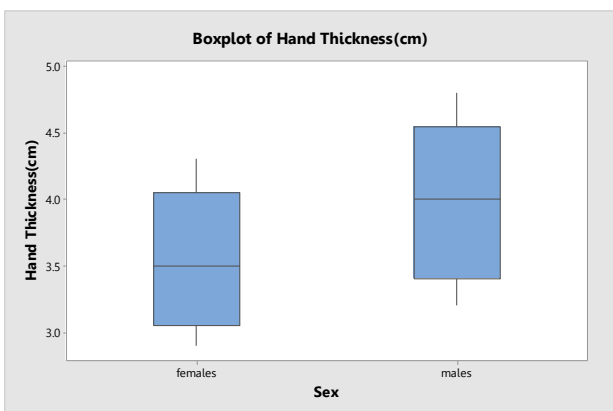


Figure 3. Box plot for hand thickness data.

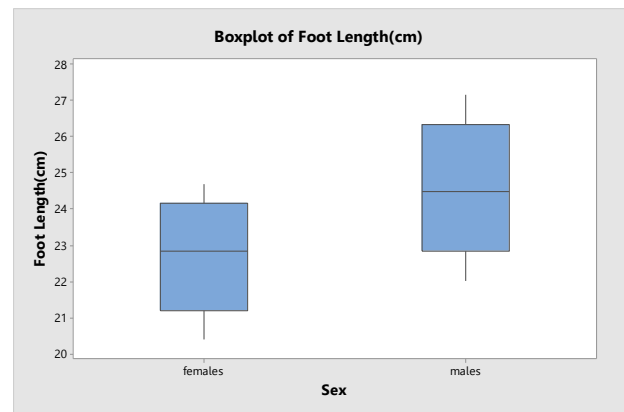


Figure 4. Box plot for foot length data.

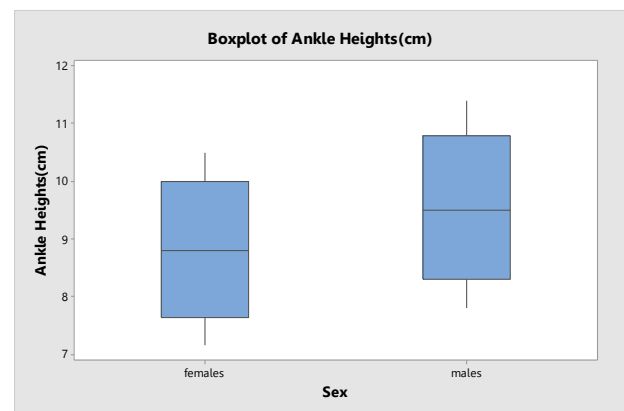


Figure 5. Box plot for ankle heights data.

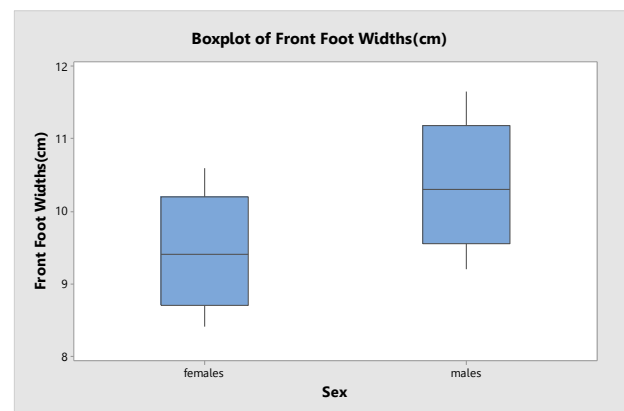


Figure 6. Box plot for front foot widths data.

CONCLUSION

The average hand breadth, hand length, hand thickness, foot length, ankle height, and front foot width for males were greater than those for females. The data can be used to design facilities for the elderly, such as a door knob or a handle for ease of opening.

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