

Mitsui Sumitomo Insurance Welfare Foundation Research Grant Final Report

Title: Normative data for concurrent grip-torque and pinch-torque hand strength of older adults – A novel approach.

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Summary:

The ability to perform daily activities is highly dependent on the strength of the hand. Older adults, particularly those above 70, are more likely to face difficulties with activities of daily living (ADL) as the hand strength diminishes with age and diseases. There have been studies done on evaluating and collating normative data on older adults by measuring grip, and pinch strength independently. However, in real life situations, we require more than a single strength to perform our daily task.

Concurrent strengths such as grip with torque strength are more relatable in real life, example opening a jar or turning a doorknob. The objectives of this study are: (1) To develop a normative reference values for concurrent hand strength (grip-torque and pinch-torque strength) of older adults aged 70 years and older in Singapore, and (2) to determine the peak and the sustained strength that they can exert.

120 subjects (50 male and 70 female) aged 70 years and above, without any diseases or impairment that affect the upper limb functions, have been recruited in this study.

Prior to the study, subjects will be asked to filled-in a general health status questionnaire. Example of the questions asked was past medical history, their anthropometric measurement (eg: body mass index, weight, and height), and ADL indicator score/quality of life assessment. Using a custom-made hand strength measurement device (SIMTech – A*Star), the following measurements were taken: (1) Grip strength, (2) Pinch Strength, (3) Wrist torque, (4) Concurrent grip-torque strength, and (5) Concurrent pinch-torque strength.

The average grip strength was 15.7kg and 13.3kg for single strength and concurrent strength respectively. The average pinch strength was 4.6kg and 4.1kg for single and concurrent strength respectively. We have observed that the strength is lower when a torque force is applied, with 15% decrease in the grip strength and 11% decrease in pinch strength.

Aim of Research:

As one of the fastest aging population in Asia, there is a need to address issues and difficulties that older adults in Singapore, aged 70 and above, might encounter in their life, especially their capacity to carry out daily activities. In addition, Peeble et al¹ has also reported that there are still many 'gaps' in the ergonomics data and only few of these data are directly applicable in the design process. Thus the aims of this study are: (1) To develop a normative reference values for concurrent hand strength (grip-torque and pinch-torque strength) of older adults aged 70 years and older in Singapore, and (2) to determine the sustained concurrent hand strength as well as the peak strength.

With the data collected, it can be used as a reference to engineers or designers in designing better assistive devices for the elderly.

Methods:

Following IRB approval, 120 subjects (50 male and 70 female) aged 70 years and older, from various socio-economic backgrounds have been randomly recruited. Subjects who participated in this study do not have any diseases or impairment that may affect their upper limb functions.

Prior to the hand strength measurement, subjects were asked general questionnaire pertaining to their health status, occupation, age, as well as their level of independence using ADL scoring tool (Katz index of independence in ADL and Lawton instrumental ADL).

A multi-function hand strength measurement device (fabricated by SIM-Tech, A*Star) was used to measure the hand strength, and the measurements were recorded using Digivision software (*Burster praezisionsmesstechnik gmbh & co, Germany*).

The following measurement (Figure 1) was taken: (1) Grip strength, (2) Pinch Strength, (3) Wrist torque, (4) Concurrent grip-torque strength, and (5) Concurrent pinch-torque strength, with about one minute rest between each measurement. Both hands were tested, with the dominant hand tested first. Subject was required to exert and constantly maintain their maximum strength for 10 seconds or the maximum time that they can hold – whichever lower.



Figure 1: Hand strength measurements

To minimize the effects of the body position on the measurements, this study follows Mathiowetz et alⁱⁱ and the American Society of Hand Therapist recommendations, whereby the body position of the subject should be as follow: - Subject should be seated on a chair with feet flat on the floor. Shoulder adducted and in neutral rotation and flexion. Elbow flexed at 90°, with forearm in neutral position (Figure 2).



Figure 2: Body position

Results:

All the subjects have a full ADL score based on Katz Index of Independence. In terms of level of lifestyle activity, only 6% of the subjects lead a sedentary lifestyle, while 19% are mildly active and the rest lead a relatively active lifestyle.

The average grip strength was 15.7kg and 13.3kg for single strength and concurrent strength respectively. The average pinch strength was 4.6kg and 4.1kg, for single and concurrent strength respectively. We have observed that the strength is lower when a torque force is applied, with 15% decrease in the grip strength and 11% decrease in pinch strength.

The average sustained (10 seconds) grip strength was 13.6kg and 11kg for single and concurrent strength respectively. The average sustained (10 seconds) pinch strength was found to be 3.7kg and 2.9kg for single and concurrent strength. Similar to the results we observed from the average strength, the sustained strength that the subjects can exert was lower when a torque force is applied, with 19% decrease in grip strength and 23% decrease in pinch strength.

We found there's no correlation between subjects' lifestyle activity level and their hand strengths measured. However, the limitation of this study is that level of lifestyle activity is based on subjective assessment.

Future plans:

The data collected in this study can be used as a baseline for future studies in investigating the weakness in muscle strength due to diseases (such as arthritis) in elderly.

Means of official announcement of research results:

Paper will be published in international academic journal. We are currently in the process of writing the manuscript.

ⁱ Peebles L, Norris B. Filling 'gaps' in strength data for design. *Appl Ergon.* 2003;34(1):73-88

ⁱⁱ Mathiowetz V, Kashman N, Volland G, Weber K, Dowe M, Roger S. Grip and pinch strength: Normative data for adults. *Arch Phys Med Rehabil.* 1985;66(2):69-74