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Scientific/Clinical Article

Normative data on functional grip strength of elderly in Singapore

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ABSTRACT

Study Design: Cross-sectional study for clinical measurement.
Introduction: Most daily tasks require individuals to exert grip strength with torque, which can be challenging for elderly as their strength diminishes with age. We postulate that to assess the functional capacity of an individual, it is important to evaluate the functional grip strength instead of the maximal static grip strength.
Purpose of the Study: The objective of this cross-sectional study is to establish normative data for the functional grip strength of elderly aged 60 years and older in the Singapore population.
Methods: In this study, 233 healthy subjects aged 60 years and older were recruited. Using a custom-made hand strength measurement device, the following measurements were recorded: grip strength at neutral position, grip strength with resistive pronation torque, and grip strength with resistive supination torque.
Results: Grip strengths measured for both genders decreased by 13% and 16% for males and females respectively, when pronation torque was exerted, and with supination torque, the strength decreased by 18% and 17% for males and females respectively.
Conclusion: Normative data for the elderly population in Singapore had been established. The findings from this study can complement the existing ergonomic hand data in designing better assistive tools to improve the independent living of elderly.
Level of Evidence: NA.

Introduction

The ability to perform daily tasks is highly dependent on the functionality of the hands. The elderly are more likely to face difficulties with their activities of daily living as hand strength diminishes with age and diseases. Measuring grip strength is one of the standard practices in evaluating hand function, and many studies have been done on the collation and evaluation of normative data on the grip strength in adults.[1-7] However, most of these studies only reported the maximal grip strength with the wrist in the standard neutral position, also referred to as static grip strength measurement.[8,9] Despite being the clinical standard in assessing individuals, the data collected are still insufficient for thorough understanding of how an individual functionally grips an object. In addition, Peebles and Norris[10] had also reported that the data from these static grip strength measurement studies have limited applicability as ergonomic data for designing of assistive devices or aids for the elderly. This is because most of the data are not true representations of the strength used in daily activities.

Evaluating the functional grip strength of individual is not limited to the measurement of static grip strength alone; several studies evaluated the functional grip strength based on the dynamic motion of the forearm and had reported that this approach might potentially be a more accurate method for the measurement of functional grip strength. For example, studies conducted by LaStayo et al[8,9] and De Smet et al[11] observed that forearm rotation caused changes in the grip strength and that the strength differed with direction and arc of motion. However, the question remains: how much strength can an elderly exert against a resistive force? We hypothesized that functional strength should not only be measured using dynamic motion but should also include the strength applied against a static resistive force, which is more related to daily tasks, such as opening a tight medicine bottle cap. Therefore, the primary objective of this study was to investigate changes in grip strength against resistive torque force. The term functional grip strength used in this study thus refers to the grip strength applied against resistive pronation and supination torque.

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Table 1
Subjects information

Age, y	N	Ethnicity				Hand dominance		
		Chinese	Malay	Indian	Others	Right	Left	Ambidextrous
Male								
Younger than 65	6	5	0	1	0	5	1	0
65-69	24	21	0	3	0	23	1	0
70-74	24	23	0	1	0	23	0	1
75-79	19	19	0	0	0	19	0	0
80-84	15	14	0	1	0	15	0	0
85 and older	11	8	0	2	1	11	0	0
Female								
Younger than 65	11	10	1	0	0	11	0	0
65-69	35	31	2	1	1	31	2	2
70-74	33	28	2	3	0	32	0	1
75-79	21	20	0	1	0	20	1	0
80-84	18	17	0	1	0	17	0	1
85 and older	16	14	1	1	0	14	2	0

It is also important to develop normative data for specific populations,[12] especially because Caucasians are found to be generally stronger than Asians. Presently, there are no normative data for the functional grip strength in an Asian elderly population. Thus, the other objective of this study is to establish normative data for the functional grip strength of elderly aged 60 years and older in Singapore population.

Materials and method

Study design

Singaporeans aged 60 and older, from various socioeconomic backgrounds and ethnicity, were recruited in this community-based and cross-sectional study. Only healthy participants, who were independent and free from disease or disability that could affect their upper limb function, were eligible. Participants were required to go through 3 types of measurements for each hand: (1) static grip, (2) grip with resistive pronation, and (3) grip with resistive supination. This study had been approved by SingHealth Centralised Institutional Review Board. Informed consent was obtained from all participants before the test.

Subjects

A total of 233 (99 males and 134 females) healthy Singaporean adults aged 60 and older had been recruited for this study. Subjects were categorized into age groups with gradation of 5 years (younger than 65, 65-69, 70-74, 75-79, 80-84, and 85 years and older). Characteristics of the subjects are presented in Table 1.

Equipment

A custom-made multifunctional hand strength measurement device with a nonrotating torque sensor was used to measure functional grip strength, and measurements were digitally recorded using Digivision software (Burster praezisionsmesstechnik gmbh & co, Germany) (Fig. 1). The sensors used in this device had been calibrated and certified. The handle grip of the device was designed to be similar to that of a standard hand dynamometer used in clinics. The device had been calibrated using known weights and sensors, and the grip force measured was validated against the gold standard Jamar dynamometer.

Procedure

To minimize the effects of body positioning on hand strength measurements, this study followed the recommendations of Mathiowetz et al[13] and the American Society of Hand Therapist.[14] Subjects were seated upright on a chair with feet planted flat on the ground, shoulders adducted with hands in neutral rotation and flexion, and elbows flexed at 90°, with the forearm in neutral position (Fig. 2). Only 1 tester carried out the measurements.

Grip strength measurement

The measurements were taken in the following order:

1. Grip strength at fixed neutral position.
2. Grip strength while exerting resistive pronation force (static pronation).
3. Grip strength while exerting resistive supination force (static supination), as shown in Figures 3A-C, respectively.

The average torques applied for resistive pronation force were 4.8 (±1.8) Nm and 3.2 (±2.3) Nm, whereas for that of resistive supination were 3.3 (±1.6) Nm and 2.0 (±1.0) Nm, for male and female subjects respectively.

Both hands of each subject were tested, with the right hand measured first. Subjects were instructed to maintain their grip at maximum strength for up to 10 seconds. To avoid inconsistency due to fatigue, measurement was alternated between the 2 hands, and

Fig. 1. A custom-made multifunctional hand strength measurement device.