PRELIMINARY STUDY OF HAND-STRENGTH AND HAND-FUNCTION PERFORMANCES IN THAI ADULTS AGED 21-60 YEARS

RIENPORN PHOOJAROENCHANACHAI

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Rienporn Phoojaroenchanachai

Mrs.Rienporn Phoojaroenchanachai

Candidate

Chanut Akamanon

Assoc.Prof.Chanut Akamanon, M.A.

Major-Advisor

Karnda Chaipackdee

Assoc.Prof.Karnda Chaipackdee, M.Sc.

Co-Advisor

Kompakorn Limpasutirachata.

Lect. Kompakorn Limpasutirachata, M.Sc.

Co-Advisor

Rassmidara Hoonsawat

Assoc. Prof. Rassmidara Hoonsawat, Ph.D.

Dean

Faculty of Graduate Studies

Chanut Akamanon

Assoc.Prof. Chanut Akamanon, M.A.

Chair

Master of Science Programme in Physiotherapy

Faculty of Medicine, Siriraj Hospital

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Rienporn Phoojaroenchanachai

Mrs.Rienporn Phoojaroenchanachai

Candidate

Chanut Akamanon

Assoc.Prof.Chanut Akamanon, M.A.

Chair

Karnda Chaipackdee

Assoc.Prof.Karnda Chaipackdee, M.Sc.

Member

Sidhi Techakampuch

Clin.Prof.Sidhi Techakampuch, M.D.

Member

Kompakorn Limpasutirachata

Lect. Kompakorn Limpasutirachata, M.Sc.

Member

Assoc. Prof. Rassmidara Hoonsawat, Ph.D.

Dean

Faculty of Graduate Studies

Mahidol University

P. Sakolsatayadorn

Clin.Prof. Piyasakol Sakolsatayadorn, M.D.

Dean

Faculty of Medicine, Siriraj Hospital

Mahidol University

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Rienporn Phoojaroenchanachai

PRELIMINARY STUDY OF HAND-STRENGTH AND HAND-FUNCTION PERFORMANCES IN THAI ADULTS AGED 21-60 YEARS

RIENPORN PHOOJAROENCHANACHAI 4236634 SIPT/M

M.Sc. (PHYSIOTHERAPY)

THESIS ADVISORS: CHANUT AKAMANON, M.A. (COMMUNICATION DISORDERS & SPEECH SCIENCE), KARNDA CHAIPACKDEE, M.Sc. (ANATOMY), KOMPAKORN LIMPASUTIRACHATA, M.Sc. (PHYSIOTHERAPY).

ABSTRACT

Strength and hand function tests are widely used and reliable clinical measures of human strength. Due to their relative simplicity of administration, they are also exploited as an index of many other aspects of general health, quantified degree of impairment or disability, and as a means to determine treatment effectiveness. The purpose of this study was to establish the preliminary data of hand strength and hand function performances in categories of Thai adults. The subjects for the study comprised of 169 volunteers (age 21-60 years), who were workers employed at Siriraj Hospital and other volunteers without evidence of abnormality of upper extremity structures or functions. The measured lines of both hands were precisely determined according to the procedure recommended by Firrell and associates. The assessment of hand strength/hand function test was based on standard protocols of measurement and the combined versions of the Jebsen Hand Function Test and the Smith Hand Function Evaluation.

The results revealed that male subjects had longer length measured lines A, B, and C for both hands and the measured line D only for the dominant hand as compared to those of females. Grip-strength and pinch-strength of the dominant hand was generally stronger than that of the non-dominant hand. Grip-strength and pinch-strength in males were also generally stronger than those of females. Regarding hand function tests, the dominant hand usually performed at a faster rate than the non-dominant hand in both genders. Lastly, there were significant correlations between grip-strength and pinch-strength of both hands in both genders. The results of this study could therefore provide preliminary data for determination of treatment effectiveness in Thai patients.

KEY WORDS: HAND-STRENGTH / HAND-FUNCTION
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การศึกษาเบื้องต้นด้านความแข็งแรงและการใช้งานของมือในคนไทยอายุ 21-60 ปี (PRELIMINARY STUDY OF HAND-STRENGTH AND HAND FUNCTION PERFORMANCES IN THAI ADULTS AGED 21-60 YEARS)

เหรียญพร ผู้เจริญชนะชัย 4236634 SIPT/M

วท.ม. (กายภาพบำบัด)

คณะกรรมการควบคุมวิทยานิพนธ์ : ชนัตถ์ อาคมานนท์, M.A. (Communication Disorders & Speech Science), กานดา ใจภักดี, M.Sc. (Anatomy), คมปกรณ์ ลิมป์สุทธิรัชต์, M.Sc. (Physiotherapy).

บทคัดย่อ

การประเมินความแข็งแรง และสภาพการทำงานของมือทางคลินิกนั้น เป็นวิธีการที่น่าเชื่อถือและใช้กันโดยแพร่หลายในการประเมินระดับความบกพร่องในการใช้งานของมือ ผลของการรักษาและภาวะสุขภาพโดยทั่วไปของผู้ป่วย วัตถุประสงค์หลักในการศึกษาเพื่อหาค่าของกำลังมือและการทำงานของมือในคนไทยช่วงอายุระหว่าง 20-60 ปี ประชากรที่เข้าร่วมการศึกษาจำนวน 169 ราย ประกอบด้วยเจ้าหน้าที่โรงพยาบาลศิริราชและอาสาสมัครที่ไม่มีความผิดปรกติทางกายภาพและความสามารถในการใช้งานของแขนและมือ วิธีการวัดขนาดของมือทำโดยวิธีของ Firrell และคณะ วิธีการศึกษาโดยทดสอบความแข็งแรงของแรงบีบมือ แรงบีบด้วยนิ้วมือ และการใช้งานของมือโดยวิธีมาตรฐานของ Jebsen และวิธีของ Smith ร่วมกัน

ผลการศึกษาพบว่า ประชากรเพศชายที่เข้าร่วมการศึกษามีความยาวโดยเฉลี่ยของเส้นวัด A, B, และ C ของมือทั้ง 2 ข้างและมีความยาวโดยเฉลี่ยของเส้นวัด D ของมือข้างที่ถนัดมากกว่าในเพศหญิง การศึกษาเปรียบเทียบความแข็งแรงของแรงบีบมือและแรงบีบด้วยนิ้วมือกับปัจจัยต่างๆในการศึกษาพบว่ามือข้างที่ถนัดจะมีความแข็งแรงของแรงบีบมือและแรงบีบด้วยนิ้วมือมากกว่ามือข้างที่ไม่ถนัด เพศชายจะมีค่าเฉลี่ยความแข็งแรงของแรงบีบมือและแรงบีบด้วยนิ้วมือมากกว่าเพศหญิง การศึกษาความสามารถในการใช้งานของมือโดยวิธีมาตรฐานของ Jebsen และวิธีของ Smith พบว่าผู้เข้าร่วมการศึกษาใช้มือข้างที่ถนัดทำการทดสอบได้สำเร็จรวดเร็วกว่าใช้มือข้างที่ไม่ถนัด และการศึกษาความสัมพันธ์ระหว่างความแข็งแรงของแรงบีบมือและความแข็งแรงของแรงบีบด้วยนิ้วมือพบว่ามีนัยสำคัญทางสถิติในการทดสอบของมือทั้ง 2 ข้างของผู้เข้าร่วมการวิจัยทั้งชายและหญิง ผลการศึกษาในครั้งนี้สามารถนำไปใช้เป็นข้อมูลสำหรับการประเมินผลการรักษาในผู้ป่วยคนไทยได้

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LIST OF ABBREVIATIONS

ANOVA	Univariate Analysis of Variance
ASHT	The American Society of Hand Therapy
B	Both hands
BMI	Body Mass Index
Cm	Centimeter
DH	Dominant hand
et al	(et alli) and others
F	Female
Lbs.	Pounds
HTDT	Bennett Hand Tool Dexterity Test
ICC	Intraclass correlation coefficient
JHFT	Jebsen Hand Function Test
Kg	Kilograms
Kg/m^2	Kilograms per meter square
L, LH	Left hand
M	Male
N	Number
NDH	Non-dominant hand
R, RH	Right hand
SADLE	Simulated Activities of Daily Living Examination
SD	Standard Deviations
SE	Standard Error of Estimate
Sec.	Seconds
SHFE	Smith Hand Function Evaluation
SPSS	Statistical Package for Social Science

CHAPTER 1
INTRODUCTION

Background

The hand is one of the most important organs of our bodies. People use their hands for manual works in activities of daily living and in general or specific tasks. To achieve the works, good muscle co-ordinations as well as sensory inputs, for discrimination of temperature, texture, size or shape, are necessary. The hands are also used for communication or presentation of personality. When a person has injured his or her hand, muscles and tendons, osseous structures, nerves, vascular supplies, skin or fascia may be destroyed and the function of hand may not be possible (1).

Impairment of hand function may be caused by traumatic injuries or destructive diseases. The purpose of rehabilitation of this impairment is to restore a patient's maximal function by using minimal amount of time. A selective treatment plan is a predictor of a successful rehabilitation program. This plan comes from the information of initial evaluation and periodic assessment. The components of evaluation consist of subjective and objective data such as history, inspection, palpation, edema, range of motion, muscle strength, sensation, and hand function test (1, 29). These evaluations, providing a method for communication among therapists, can be used to determine the degree of disability and severity, to confirm change or improvement resulting from treatment and to plan effectiveness and successfulness of the rehabilitation programs (1-4).

Measurements of hand strength and hand function have been widely used to assess the severity of trauma or diseases and the outcome of rehabilitation. They are reliable clinical measures on human strength due to their simplicity of administration. They are also exploited to implicate in many other aspects such as an index of general

health, indication of change in physical status, objectivity of measurement devices, quantified degree of impairment or disability, determination of appropriate treatment-methods and treatment-effectiveness, and establishment of normative data (4, 6-9, 11).

Normative data provide therapists with a valid basis of determining “normal” and “abnormal” interpretation, evaluation of data, establishing treatment goals, and assessment of patients’ ability to return to work (2, 15). The studies of normative data showed different conclusions of strength and hand function between dominant and non-dominant hand of right-handed or left-handed subjects, gender, and age group. Several studies supported the use of 10% rule to predict hand strength of the non-dominant hand compared with the dominant hand whereas others did not (15-16, 22, 24).

There are many differences in testing procedures such as extremity position, verbal instruction, and numbers of trial for collecting data, age grouping, occupation, devices, and terminology usage. The collection of reliable and valid evaluated data depends on the use of accurate instruments and standardized procedures during their administration. In Thailand, there are few reports of normative data for hand strength and hand functional tests and these data are represented only some group of population. There are also no consistency in methods and instruments (18-19, 43-44). Therefore, the goal of the present study was to establish preliminary data in men and women aged 20 to 60 years for hand strength and selective hand functional performance based on accurate instruments, standardized procedures and instructions which could be used as database of Thai adults.

Purpose of the study

General objective

The purpose of this study was to establish the preliminary data on hand strength (grip and pinch strength) and hand functional performances in categories of Thai adults.

Specific objectives

1. To establish preliminary data of hand strength and hand functional performances among Thai adults aged 21 to 60 years old.
2. To examine the relationship between hand functional performances and
   2.1 Gender
   2.2 Hand dimensions
   2.3 Age
   2.4 Body mass index (BMI)
   2.5 Dominant / non-dominant hand
3. To examine the relationship between hand strength and
   3.1 Genders
   3.2 Age
   3.3 Hand dimensions
   3.4 Body mass index (BMI)
   3.5 Dominant / non-dominant hand
4. To examine the utility of 10% rule of hand strength in this study
5. To examine the relationship between hand strength and hand functional performances

Parameters of the study

1. Weight read from the Jamar dynamometer scale (kilogram)
2. Weight read from pinch gauge scale (kilogram)
3. Length of time from functional test (second)
4. Data from the variables: gender, weight, height, age, hand dominant, and hand measurement.

Scope of the study

This study focused on hand strength and performances of Thai subjects aged 21 to 60 years old.

Hand functional test used in this study was a combined version of the Jebsen Hand Function Test (JHFT) and Smith Hand Function Evaluation (SHFE).

Other variables such as gender, age and BMI were investigated including their relationships with hand strength and hand functional performances.

Limitation of the study

Depend on the scope of the study; subjects in this study may not be the representatives of Thai population.

Hypotheses of the study

1. There was a significant difference in hand strength between male and female subjects.
2. There was a significant difference in hand strength among different age groups.
3. There was a significant correlation between hand strength and BMI.
4. There was a significant difference in hand strength between dominant and non-dominant hand.
5. There was a significant correlation between hand strength and hand measurement.
6. There was a significant difference in hand function between male and female subjects.
7. There was a significant difference in hand function among different age groups.
8. There was a significant difference in hand function between dominant and non-dominant hand.
9. There was a significant correlation between hand strength and hand function.

Advantages of the study

1. This study would establish preliminary data on hand strength and hand function for Thai adults aged 21-60 years.
2. The data could be helpful in assessment of patients' hand strength and hand function among different types of hand injuries or diseases.

CHAPTER 2
LITERATURE REVIEW

Hand Evaluation

General evaluation of hand function consists of several examinations. Most of these need instruments which have a high degree of validity and reliability (1, 29, 37).

1. History

This is the initial part of the evaluation. Patients are always asked about the following information: age, sex, hand dominance, occupation, recreational activity, onset time and mechanism of injury.

2. General Observation

Therapist can observe deformities or abnormalities while patient is giving his or her history.

3. Upper Extremity Screening

Screening of upper extremity should be examined before hand evaluation. These will confirm that patient's problems are not arisen from proximal parts.

4. Inspection

This examination will give more details of hand problems. Every detail must be inspected and compared with normal extremity. These details consist of: surface anatomy of the hand related wrinkles, creases, nails, eminences and skin textures; muscle volume; edema; scaring; nodule; mass; digits and joints posture.

5. Palpation

After inspection, skin, scar, nodule or tenderness are carefully palpated to confirm the information. These will lead to the problem sites of patient.

6. Range of Motion

Joint motions can be actively and passively measured. Universal goniometer is widely used, valid and reliable tool (38). Goniometric assessment is also reproducible method and can be interpreted with reference norm. The distance of the fingertips toward the palm or from the table is another method for measurement. This method is used when the individual joint cannot be measured.

7. Edema

Changing in hand size is resulted from abnormal accumulation of fluid after hand injury or surgery. The methods for circumferential measurement of the edematous part are the use of tape or jeweler's rings. Reliability of these methods depends on anatomic landmarks and placement site. In generalized edema over the hand, volumetric measurement is another method that has reliability too.

8. Muscle Performance Testing

Manual muscle testing provides information of muscle strength. Spring, tensiometer, dynamometer, weight or manual resistances are used for this test. For hand-strength assessment, grip strength and pinch strength are often measured using manual testings or standardized instruments. The most common instruments for grip strength and pinch strength are the Jarmar adjustable dynamometer and pinch gauge, respectively. They are also shown to be reliable and valid instrument (17). Normative data of different age groups of both tools have been established (2, 15, 22, 39).

9. Sensation

Hand is the important organ for receiving sensation, especially palmar surface that has all of the sensory receptors of the body (40). So there are a number of tests using for sensory assessment that can be divided into 2 tests.

a) Functional tests consist of:
   - Static and moving two-point discrimination
   - Pressure sensitivity
   - Point localization
   - Object recognition

b) Threshold tests consist of:
   - Pain
   - Temperature
   - Light touch
   - Vibration

Instruments used in some tests are studied in reliability and validity. Two-point discriminator has been proved to have intratester reliability and validity (41). For pressure sensitivity, the Semmes-Weinstein monofilament was shown to have test-retest reliability and validity. Tuning fork is used for vibratory testing; however, frequencies of tuning forks are different and suitable for different types of receptors.

10. Hand function tests

Functional tests can provide information about progression and effectiveness of the treatment. These tests are used to assess hand and upper extremity function including activities of daily living, gross and fine motor ability, tool usage, manipulation, dexterity, grasp and release of objects, unilateral and bilateral hand use, and sensibility (36). These are some of standardized tests of hand function.

- Bennett Hand Tool Dexterity Test (HTDT)
- Box and Block Test of Manual Dexterity Test
- Jebsen-Taylor Hand Function Test (JHFT)
- Nine-Hole Peg Test
- Purdue Pegboard
- Simulated Activities of Daily Living Examination (SADLE)
- Smith Hand Function Evaluation (SHFE)
- Crawford Small Parts Dexterity test

Most tools are reported to have validity and reliability. And some tests have normative data which are based on the study group.

Hand strength evaluation

Functions of the hand, defined in terms of movements of joints and the action of individual muscles, are well understood. Several methods of analysis of the function as a unit are developed for disability evaluation of the hand. In 1943, Griffiths has divided the functions of the hand into cylinder grip, ball grip, ring grip, pincer grip and pliers grip. These terms represent a series of functional end-results. In 1946, Stocum and Pratt defined in terms of grasp, pinch and hook. In 1956, Napiers (45) identified and classified function of the hand into two main groups: prehensile movements: power grip and precision grip, and non-prehensile movement. In 1962, Landsmeer (77) described two basic patterns: grasp for power and pinch for pressure.

Hand strength represented the interaction of the strength of intrinsic and extrinsic muscles of the wrist and hand is necessary for various activities of daily living. The ability to maintain these activities will help to improve and maintain the quality of life especially for the older person. Hand strength has been used as an indicator for determining body strength since 1880 and to establish baseline strength. The measurement of grip strength is a standard feature of patient examination and a measurement of effectiveness of surgical and other rehabilitation treatments (47, 48). Different devices are used to examine grip strength such as hand-held dynamometer, Jamar dynamometer, sphygmomanometer, vigorometer and etc. The Jamar dynamometer is the most commonly used device to assess total grip strength because of their reliability, validity, and the highest accuracy of the instrument tested (5, 17, 29, 46).

There are some studies on children hand strength. These studies are useful because the data are related to childhood development and functional performance. There are different types of devices and methods used in children because of their hand size, strength, and ability. For example, children by the age of 1 to 1.5 years have established a fine pinch grasp and developed tripod grasp, which is used to hold a pencil at 6 years old. In children younger than 7 years old, the strength is not different between genders. However, in older children with an age of 7 to 15 years old, there are significantly higher scores on the strength of the boy compared to that of the girl.

Most of the previous studies showed no significant difference between the scores of right and left grip strength (2-7). On the other hand, the result of the studies about adult hand strength and function test differed from the children.

Most occupational therapists (more than 79%) recommended the use of Jamar dynamometer (8). The researchers also recommended that grip strength should be routinely measured at setting 2 of Jamar dynamometer. Nevertheless, there was a study reported that only 60% of subjects had maximum grip strength at level 2. In research studies, complicated dynamometer and pinch meter are used such as computerized dynamometer, pinch transducer, grasp transducer, grasp-meter, Jamar Hydraulic Dynamometer and Jamar Hydraulic Pinch Gauge, BTE work simulator (25-27, 29, 35). Furthermore, Jamar dynamometer is also used to distinguish sincerity of effort from feigned hand weakness although there is a limitation of its sensitivity (31-33). Age, gender, and hand dimension were also related to handgrip strength (12, 22).

Position of the extremity during the test and number of trials are important. ASHT (the American Society of Hand Therapy) suggests standardized arm positioning for grip strength test that subjects sit with their shoulder adducted and neutral rotated, elbow flexed to 90^0, and the forearm and wrist in neutral position. Mathiowetz et al studied the effect of elbow position on grip strength, they reported that the group of subjects with an elbow flexed to 90^0 showed a significantly higher score of strength than those with an elbow fully extended (5). Richards et al agreed with this report and indicated that there was no significant difference in strength between grip strength measured in the supine and sitting position and the data could be compared with established norm (28). One study suggested to rest forearm on the table (8). Later studies had shown that the maximal grip strength could be influenced by body position whether elbow was flexed or not, as well as wrist position. Researchers were also interested in wrist position and suggested different position for maximal grip strength value (9).

A number of trials also affect the hand strength. ASHT suggests the use of the mean of three trials. A lot of researchers followed this suggestion, but some did not (5, 8-9, 17). Ager et al instructed subjects to exert one maximum effort for each hand, while Kellor et al gave each subject two trials for grasp and one trial for pinch measurement (8, 66). The study in Finnish adults, subjects were suggested to grip twice and if the difference was more than 10%, the subjects were asked to grip the third time. This study also reported that subjects could exert highest grip strength with third handle position (10). Another interesting study was the fluctuation in hand strength among normal subjects. There was no difference between morning and afternoon values(13). So repeat testing is necessary to accurately assess hand strength more than diurnal variation. Different brand of dynamometer could result in different grip strength data, although the same protocol is used (28).

The combinations of the intrinsic and extrinsic hand muscles generate power and pinch. Injured hand could affect hand strength so grip strength alone is not adequate for assessment hand strength, thus pinch strength should also be included (25, 27). Pinch strength may be measured by the pinch-meter. Three types of pinch are always assessed: key pinch or lateral pinch, three-point pinch or palmar pinch, and tip-to-tip pinch or tip pinch (36). Palmar pinch and key pinch are also used in high percentage in activities of daily living than the other types of pinch (30). Because of the various definitions for the different types of pinch, it is important to define them clearly in the research study (5).

Pinch gauge is widely recommended for pinch measurement. Because it is inexpensive, easy to use, and gives reproducible results, it is frequently used to measure the ability of patient to stabilize and apply force through all the joints and tissues from the forearm to the thumb and finger pulps. To obtain reliable clinical data, the pinch meter should be freely suspended while pinch strength is testing. If the pinch meter is held or stabilized by the therapist, subject can use this stability to produce higher values (14).

ASHT (the American Society of Hand Therapy) suggests standardized arm positioning for pinch strength test that subjects sit with their shoulder adducted and neutral rotated, elbow flexed to 90^0, and the forearm and wrist in neutral position or mid-position. Some researchers did not follow this suggestion. Pinch strength is recorded during subjects' forearm pronated. ASHT also suggests the use of the mean of three trials. Kellor et al instructed each subject one trial for pinch strength (8, 66). The position of free fingers also influences on the pinch strength. Hook and Stanley established that tip pinch was stronger when the other fingers were flexed than when extended (49). Many factors influence maximal voluntary pinch contraction such as: instructions, index of measurement, motivation, fatigue, and learning effects (48).

Hand function test

For hand function evaluation, assessments include questionnaires, interview, or structural observation. Besides these three assessment-tools, the use of standardized functional test is appropriate tool to permit objective measurement on patient performance as a task is completely done. It should consist of tasks representative of everyday functional activities. But no hand function evaluation is appropriated for all types of patients (30). Box and Block Test, the Jebsen-Taylor Hand Function Test, Nine Hole Peg test, Simulated Activities of Daily Living Examination, Physical Capacity Evaluation, and the Smith Hand Function Evaluation are examples of standardized functional tests (36).

Numerous studies assess hand function activity by using the Jebson-Taylor Hand Function Test. The test is chosen because of a short time of administration, objective measurements of standardized tasks, norm for comparison, daily living patterns of hand function, continuous ability within each category, available testing equipment and materials, separate measurement for dominant and non-dominant hands, and its reliability. This can also be used to determine hand function between gender, age group, normal and abnormal subjects. However, this test lacks a hand coordination assessment (20-21, 23). Therefore, the combination of hand functional tests will be more useful as the study in 1993. The hand evaluation consisted of the Jebsen Hand Function Test and the Smith Hand Function evaluation. This test was

divided into four factors, which covered most aspects of hand function (34). In elderly subjects, hand function ability may serve as a useful measurement and early marker of dependency (23). Clarifications of definition, thorough appreciation in method of measurement and awareness of remarkable detail during performed clinical evaluation was mandatory.

Many studies have established norms of hand strength and function for their own population (9-10, 22, 24-25, 48, 53-57). Crosby and colleagues in 1994 had determined normal grip and pinch strength with Jamar dynamometer and B&L pinch gauge on 250 healthy American aged 16 to 63 years (table 2.1) (22). They could predict maximum dominant-hand grip-strength through the use of a formula of which composed of "2.4*height + 1.4*weight – 100.2 + 33.5*sex (men = 1, women = 0) – 9.6*handedness (R = 0, L = 1) + 2.98*hobby demand (A = 1, B = 2, C = 3 etc.)."

Table 2.1 Hand strength (lbs.) data (22)

	Dominant hand		Non dominant hand	
Hand strength	Men (N = 105)	Women (N = 109)	Men (N = 105)	Women (N = 109)
Grip-strength	137±24	81±16	129±22	75±16
Key pinch-strength	27±5	20±5	26±5	19±4
Tip pinch-strength	19±4	14±4	18±4	13±3

Values are mean ± standard deviations,
N = number of subjects

Imrhan and co-workers examined the grip-strength in Texas and suggested their own data in 1989 (48). Thereafter, Angel Idomenico Astin, submitted an unpublished thesis for the degree of Master of Science to the faculty of the Virginia Polytechnic Institute and State University in 1999, also suggested that finger strength can be predicted from anthropometrical measures and proposed a normative data for grip-strength (table 2.2) (53).

Table 2.2 Hand strength (kg.) data (53)

Hand strength	Imrhan et al. 1989		Astin et al. 1999	
	Men (N = 40)	Women (N = 30)	Men (N = 50)	Women (N = 50)
Grip-strength	49.4±1.9	31.4±2.5	46.2±2.3	29.5±2.2

Values are mean ± standard deviations,
N = number of subjects

Petersen and associates in 1989, had examined hand strength with Jamar dynamometer and B&L pinch gauge on 310 American volunteers aged 17 to 50 years and proposed that the dominant hand possessed a 10% greater grip strength than the non dominant hand (table 2.3) (24).

Table 2.3 Grip-strength of right- and left-handed subjects (24)

Subjects	Right handed			Left handed		
	Number	Handed	Mean (lbs.)	Number	Handed	Mean (lbs.)
Men	108	Right	114.58	17	Right	110.71
		Left	105.64		Left	109.12
Women	154	Right	70.90	31	Right	66.84
		Left	61.87		Left	68.58
Total	262	Right	88.91	48	Right	82.38
		Left	79.92		Left	82.94
Both handed	310	Right	87.90			
		Left	80.38			

Number = number of participated cases

Schmidt and Toews in 1970, had also proposed that grip-strength in the major hand equals – 7.9413 - 0.1382*age + 1.2671*height + 0.2041*weight ± 29.1966 lbs; grip strength in the minor hand equals – 19.5095 – 0.0286*age + 1.3755*height + 0.1896*weight ± 30.6438 lbs with a predictive reliability of 95 per cent (table 2.4) (54).

Table 2.4 Mean values (lbs.) of right handed and left handed individuals from Schmidt's file (54)

Parameter	Right handed (N = 1001)	Left handed (N = 127)
Major grip	113.0	117.4
Minor grip	109.5	114.0
Pound difference	3.5	3.4
Per cent difference	3.2	3.0
Major/minor	1.032	1.030

N = number of subjects

Thorngren and Werner had investigated 450 Swedish (225 men, 225 women), aged 21 –65 years, in Lund 1979 (55). Normative data for hand strength had been shown. They claimed that grip-strength did decrease with age. Men were stronger than women and in both gender, dominant hand was stronger (table 2.5).

Table 2.5 Grip-strength (kp/cm^2) in normal men and women from Thorngren's file (55)

Age	Men		Women	
	DH	DH/NDH	DH	DH/NDH
21-25	1.13±0.18	1.07±0.08	1.03±0.16*	1.10±0.12 ^{ns}
26-30	1.16±0.23	1.05±0.08	0.96±0.16***	1.10±0.08*
31-35	1.12±0.17	1.06±0.08	0.95±0.17***	1.07±0.14 ^{ns}
36-40	1.10±0.18	1.07±0.10	0.95±0.19**	1.06±0.15 ^{ns}
41-45	1.06±0.14	1.05±0.10	0.90±0.19***	1.09±0.12 ^{ns}
46-50	0.97±0.19	1. 03±0.08	0.82±0.22**	1.06±0.17 ^{ns}
51-55	0.97±0.17	1.05±0.10	0.79±0.18***	1.12±0.11*
56-60	0.81±0.16	1.09±0.13	0.74±0.17^{ns}	1.05±0.14 ^{ns}
61-65	0.79±0.16	1.06±0.16	0.66±0.18**	1.09±0.13 ^{ns}

***$p < 0.001$, **$0.001 < p < 0.01$, *$0.01 < p < 0.05$, ^{ns} $p > 0.05$

Values are mean ± SD, DH = dominant hand, NDH = non dominant hand

Harkonen et al also proposed the Finnish normative data for grip-strength in 1993 among 204 volunteers aged of 19 to 62 years. They had demonstrated that female grip-strength was approximately 60 to 70 % of male's grip strength (table 2.6). Nevertheless, they did not support the possibility of the difference in strength between dominant and non-dominant hands (10).

Table 2.6 Grip-strength of dominant hand (mean ± SD.) (kg.) according to age group (10)

Age (years)	Male	Female
< 30	47.5±9.3	30.1±6.6
30-39	51.9±11.0	31.9±5.4
40-49	50.8±10.9	30.2±7.1
> 50	45.3±8.6	29.5±8.0

SD = standard deviations

Su and coworkers in 1994 had also examined 160 Chinese aged 20 to 69 years in Southern Taiwan on grip-strength (table 2.7) (9).

Table 2.7 Mean scores (lbs.) and SD of grip-strength according to age group (9)

Age (years)	Men		Women	
	Mean ±SD	Range	Mean ±SD	Range
20-29	110.62±15.42	90 – 142	61.56±13.04	36 - 85
30-39	121.81±12.38	95 – 140	61.68±9.23	44 - 80
40-49	103.68±17.88	72 – 132	67.06±12.03	40 - 75
50-59	96.75±14.69	75 – 120	56.50±8.98	40 – 75
60-69	91.06±13.23	70 – 123	51.43±10.57	30 - 72

SD = standard deviations

Josty and colleagues in 1997 had measured grip- and pinch-strength in non-manual English workers aged 19 to 45 years using a Jamar dynamometer and a pinch-measuring device (table 2.8) (56).

Table 2.8 Grip- and pinch-strength (kg.) within English population (56)

Test	Dominant hand		Non dominant hand	
	Mean	Range	Mean	Range
Grip-strength	46.1	33-62	41.9	25-60
Pinch-strength	10.5	7.5-14	9.7	6-12.5

Rantanen and associates in 1998 had described changes in grip-strength among 8,006 Japanese ancestry living in Hawaii over a follow-up period of ~27 years (table 2.9 and 2.10). They showed significant decline in strength values at follow-up periods (57).

Table 2.9 Baseline grip-strength (kg.) according to each age group (57)

Age (years)	N	Grip-strength (kg.)
45-49	1,831	41.7±0.13
50-54	2,792	40.1±0.11
55-59	1,590	37.9±0.14
60-64	1,334	35.3±0.15
65-68	450	33.3±0.24

Values are mean ± standard error (SE.), N = number of subjects

Table 2.10 Annualized grip-strength change over 27 years among 8,006 Japanese ancestry living in Hawaii (57)

Age (years)	N	Annualized change (%)
45-49	1,129	- 0.85±0.01
50-54	1,491	- 0.99±0.01
55-59	647	- 1.10±0.02
60-64	343	- 1.31±0.03
65-68	67	- 1.49±0.07
Total	3,677	- 1.00±0.008

Values of annualized change are mean ± SE. in per cent; N = number of subjects

Jain and coworkers in 1985 had examined 96 volunteers aged 18 to 60 years on hand strength using of a micrometer (table 2.11). They concluded that tip pinch was weaker than lateral (key) pinch (25).

Table 2.11 Mean (kg.) values of hand strength (25)

Age (Years)	Lateral (key) pinch-		Tip pinch-	
	Right hand	Left hand	Right hand	Left hand
18-30	7.2	6.868	4.547	4.498
31-40	8.359	7.729	5.186	4.561
41-50	7.31	7.005	4.268	4.088
51-60	6.495	6.136	4.251	3.835

Young and coworkers had demonstrated no differences between the morning and afternoon values of grip- and pinch-strength among 95 American subjects age 18 to 67 years (table 2.12) (13).

Table 2.12 Mean grip- strength (kg.) and pinch-strength (lbs.) (13)

Sex	Handed	Grip-strength (kg.)		Key pinch-strength (lbs.)	
		Mean ±SD	Range	Mean ±SD	Range
Male	DH	43.7±6.49	30.5-54.1	25.4±3.69	18.5-33.4
Female	DH	41.8±7.29	27.6-56.2	24.3±3.56	16.6-28.9
Male	NDH	24.5±4.40	12.0-36.2	16.0±2.45	9.1-22.7
Female	NDH	21.9±4.27	9.9-31.1	14.8±2.11	10.0-19.3

SD. = standard deviations, DH = dominant hand, NDH = non-dominant hand

A classic study performed by Mathiowetz and his colleagues in 1985 on 628 American volunteers aged 20 to 59 years had shown a comparison between hand dominant and hand strength measuring with Jamar dynamometer and B&L pinch gauge (table 2.13) (15).

Table 2.13 Hand-strength (mean ± SD.) (lbs.) from Mathiowetz et al in 1985 (15)

Hand strength	Handed	Right hand dominant		Left hand dominant	
		Men (N = 288)	Women (N = 295)	Men (N = 22)	Women (N = 23)
Grip	R	104.4±28.4	62.7±17.1	103.3±28.6	63.3±16.4
	L	92.5±27.3	53.8±15.6	99.9±31.2	55.8±17.4
Tip pinch	R	17.0±4.1	11.4±2.6	17.1±3.3	11.2±2.5
	L	16.3±4.0	10.7±2.5	16.8±3.9	11.7±1.9
Key pinch	R	24.6±4.7	16.3±3.1	23.8±3.7	15.8±3.2
	L	23.7±4.7	15.3±3.2	22.9±4.1	15.1±2.5
Palmar pinch	R	23.4±5.1	16.3±3.8	22.9±4.0	15.7±3.5
	L	23.1±5.3	15.7±3.6	22.4±4.2	15.7±3.1

SD = standard deviations,

N = number of subjects,

R = right hand, L = left hand

In USA, therapists supplement manual strength testing with standard dynamometric evaluations on the normative data of grip-and pinch-strength suggested a mean of three trials of Mathiowetz in 1984, 1985 and 1991 of which believed to be valid and reliable (table 2.14 and 2.15) (39).

Table 2.14 Jamar grasp dynamometer norms in pounds (mean of three trials) (39)

Parameter		Norms at age (years)											
		20	25	30	35	40	45	50	55	60	65	70	75+
Male	R	121	121	122	120	117	110	114	101	90	91	75	66
	SD	21	23	22	24	21	23	18	27	20	21	21	21
	L	104	110	110	113	113	101	102	83	77	77	65	55
	SD	22	16	22	22	19	23	17	23	20	20	18	17
Female	R	70	74	79	74	70	62	66	57	55	50	50	43
	SD	14	14	19	11	13	15	12	12	10	10	12	11
	L	61	63	68	66	62	56	57	47	46	41	41	38
	SD	13	12	18	12	14	13	11	12	10	8	10	9

Number of cases = 628 cases, aged range of 20 – 94 years

R = Right hand, L = Left hand, SD. = standard deviations

Table 2.15 B&L pinch-meter norms in pounds (mean of three trials) (39)

		Norms at age (years)						
		20	30	40	50	60	70	75+
<u>Tip pinch-strength</u>								
Male	Right	18	18	18	18	16	14	14
	Left	17	18	18	18	15	13	14
Female	Right	11	13	11	12	10	10	10
	Left	10	12	11	11	10	10	9
(average SD: Males = 4.0; females = 2.5)								
<u>Lateral pinch-strength</u>								
Male	Right	26	26	26	27	23	19	20
	Left	25	26	25	26	22	19	19
Female	Right	18	19	17	17	15	14	13
	Left	16	18	16	16	14	14	11
(average SD: Males = 4.6; females = 3.0)								

Number of cases = 628 cases, aged range of 20 – 94 years, SD. = standard deviations

Table 2.15 (continued) B&L pinch-meter norms in pounds (mean of three trials) (39)

		Norms at age (years)						
		20	30	40	50	60	70	75+
Palmar pinch-strength								
Male	Right	27	25	24	24	22	18	19
	Left	26	25	25	24	21	19	18
Female	Right	17	19	17	17	15	14	12
	Left	16	18	17	16	14	14	12
(average SD: Males = 5.1; females = 3.7)								

Number of cases = 628 cases, aged range of 20 – 94 years, SD. = standard deviations

Su and coworkers described norms of pinch strength in normal 356 Taiwanese aged of 20 to 88 years. Male were stronger than females on all prehensile patterns (tip, key, and palmar pinch). The overall 13% pinch-strength difference between the dominant and non-dominant hands was demonstrated (65).

In Thailand, Tantibhaedhyangkul and colleagues in 2001 had examined 744 healthy urbanized volunteers aged 8 to 96 years on grip strength (table 2.16) (44).

Table 2.16 Mean and SD (kg.) of grip-strength (44)

Age (years)	N	Male	N	Female
< 20	11	42.4±14.2	11	25.3±6.5
20-39	75	47.9±6.7	145	29.9±4.7
40-59	134	45.8±7.9	275	28.7±5.5
≥ 60	45	39.9±6.4	48	23.8±5.2
Total	265	45.2±8.2	479	28.5±5.6

SD. = standard deviations,

N = number of subjects

Wattanavitthawat and colleagues in 1998 had examined 360 healthy subjects dwelling in Chiang Mai aged 20 to 40 years (18). They claimed that male had stronger grip- and pinch-strength whereas female performed better in object manipulation tests, Grooved Pegboard (table 2.17). They also demonstrated a moderate correlation between grip- and palmar pinch-strength ($r = 0.50$, $p = 0.05$).

Table 2.17 Hand-strength (kg.) and manipulation tests (sec.) stratified according to age group (18)

Test	Age (years)	Men		Women	
		Mean ±SD	Range	Mean ±SD	Range
Grip-strength	20-30	42.8±7.3	25.0-58.0	29.3±4.8	18.0-39.5
	31-40	43.3±6.3	30.0-54.0	28.9±5.3	19.5-48.0
Palmar pinch-strength	20-30	8.2±1.7	4.5-12.0	6.4±1.2	4.0-10.0
	31-40	8.2±1.3	5.0-11.0	6.7±1.3	3.0-10.0
Peg board: Grooved test	20-30	124.9+35.4	88.0-268.0	109.5+21.8	80-210.0
	31-40	123.5+28.8	83.0+282.0	118.1+24.9	92-280.0
Peg board: Purdue test	20-30	77.9+14.0	45-148	87.2+11.1	58-123.0
	31-40	76.1+11.7	47-102	80.3+10.6	50-100.0

SD. = standard deviations,
N = number of subjects

Agnew and colleagues in 1982 had examined 382 healthy Australian subjects and giving a set of norms for their own population (table 2.18) (58).

Table 2.18 Mean ± SD of all test items as a function of sex and age (58)

Items	Sex	16-25	26-35	36-45	46-55	56-65	66-90
Grip strength (kg.)	M	39.64 ±7.96	44.2 ±8.38	44.96 ±8.17	42.65 ±8.06	41.12 ±8.91	23.37 ±8.27
	F	29.48 ±4.24	27.23 ±3.68	29.84 ±7.35	24.30 ±5.99	21.61 ±6.13	15.9 ±4.85
Small objects (sec.)	M	6.13 ±1.36	6.18 ±0.84	5.94 ±0.98	6.52 ±1.27	6.28 ±1.15	9.88 ±6.14
	F	5.49 ±0.63	5.76 ±0.76	5.85 ±0.83	6.32 ±0.96	7.03 ±1.28	7.01 ±1.45
Simulated feeding (sec.)	M	6.54 ±1.35	6.51 ±1.76	6.53 ±1.83	6.64 ±1.96	6.88 ±0.09	7.74 ±2.61
	F	6.90 ±1.60	6.26 ±1.76	5.89 ±0.95	6.03 ±1.06	7.21 ±1.98	6.89 ±1.67
Checkers (sec.)	M	3.78 ±0.80	4.11 ±0.69	3.91 ±0.71	3.82 ±0.66	4.47 ±0.72	6.96 ±4.90
	F	3.48 ±0.78	3.68 ±0.53	3.73 ±0.72	4.01 ±0.67	4.72 ±2.08	5.11 ±0.99
Large light objects (sec.)	M	2.90 ±0.55	3.13 ±0.54	3.00 ±0.43	3.19 ±0.63	3.41 ±0.51	4.60 ±1.56
	F	3.27 ±0.74	3.13 ±0.57	2.99 ±0.41	3.40 ±0.54	3.92 ±0.77	3.76 ±0.67
Large heavy objects (sec.)	M	2.91 ±0.55	3.06 ±0.64	2.89 ±0.49	3.26 ±0.61	3.27 ±0.48	4.44 ±1.52
	F	3.39 ±0.62	308 ±0.41	3.21 ±0.50	3.44 ±0.49	3.75 ±0.69	4.01 ±0.59

SD. = standard deviations, M = male, F = female

Jebsen and associates in 1969 had examined 240 healthy American volunteers on hand function tests to provide an objective evaluation of several aspects of hand

function as well as an objective evidence of possible value for physician/physical therapist in improving hand function (table 2.19) (59).

Table 2.19 Mean times (sec.) and standard deviations for normal subjects (59)

Factors	Dominant hand		Non dominant hand	
	Men (N = 120)	Women (N = 120)	Men (N = 120)	Women (N = 120)
Small object	5.9±1.0	5.5±0.8	6.2±0.9	6.0±1.0
Simulated feeding	6.4±0.9	6.7±1.1	7.9±1.3	8.0±1.6
Checkers	3.3±0.7	3.3±0.6	3.8±0.6	3.8±0.7
Large light objects	3.0±0.4	3.1±0.5	3.2±0.6	3.6±0.6
Large heavy objects	3.0±0.5	3.2±0.5	3.1±0.4	3.3±0.5

N = number of subjects

Hilda Smith, a staff occupational therapist at the University of Michigan Medical Center had established a normative data from a non-handicapped population in assessing of hand function and using it in evaluation and estimate patient progress in therapy (table 2.20) (60).

Table 2.20 Mean times (sec.) and standard deviations for task norms comparing right and left hand scores in normal subjects (60)

Factors	Men (n = 40)		Women (n = 51)	
	Right hand	Left hand	Right hand	Left hand
Blocks	5.1±1.7	4.4±1.2	4.8±1.3	4.8±1.1
Nails	6.3±1.4	6.4±1.6	5.5±1.2	5.4±1.2
Large-peg	10.4±1.7	10.7±3.0	10.4±1.2	11.2±1.7
Small-peg	12.9±2.6	13.7±3.1	13.3±2.9	13.7±2.6
Buttons	14.9±4.0		12.1±2.5	

N = number of subjects

CHAPTER 3
MATERIALS AND METHODS

Subjects

Volunteers were men and women 21 to 60 years of age. Subjects were divided into four age groups of ten year intervals: 21-30 years, 31-40 years, 41-50 years, 51-60 years. Some of them were recruited from people who accompanied the patients to the Out Patient Clinic, Division of Physical Therapy, Department of Orthopedics Surgery and Physical Therapy, Siriraj Hospital. Additional, subjects were recruited from workers employed at Siriraj Hospital. Informed consents were obtained from all participants before participating in this study. Women at childbearing age had to be non-pregnant. Major exclusions consisted of ambidextrous subjects, subjects with history of hand injury/disease, subjects with evidences of abnormality of upper extremity structure, mobility, strength, sensation, coordination or degenerative condition that might be able to influence their hand strength and functions. In addition, subjects who were not able to perform a complete set of test or with possibility to deteriorate their clinical conditions or functional class i.e. significant anemia, cardiovascular, neurological, renal or hepatic disease etc. were also excluded.

Instruments

- The standard, adjustable-handle Jamar dynamometer
- The B&L pinch gauge
- The combined version of the JHFT and the SHFE
- Questionnaire
- Digital stopwatch
- Hand dominance test
- Calipers
- Measurement tape

Procedures

Prior to each examination, a questionnaire was filled out for each individual concerning his/her name, surname, occupation, gender, age (to the nearest birthday), height, weight, hand dominance, medication, etc. The size of hand was measured, using calipers and measurement tape (figure 3.1 & 3.2).

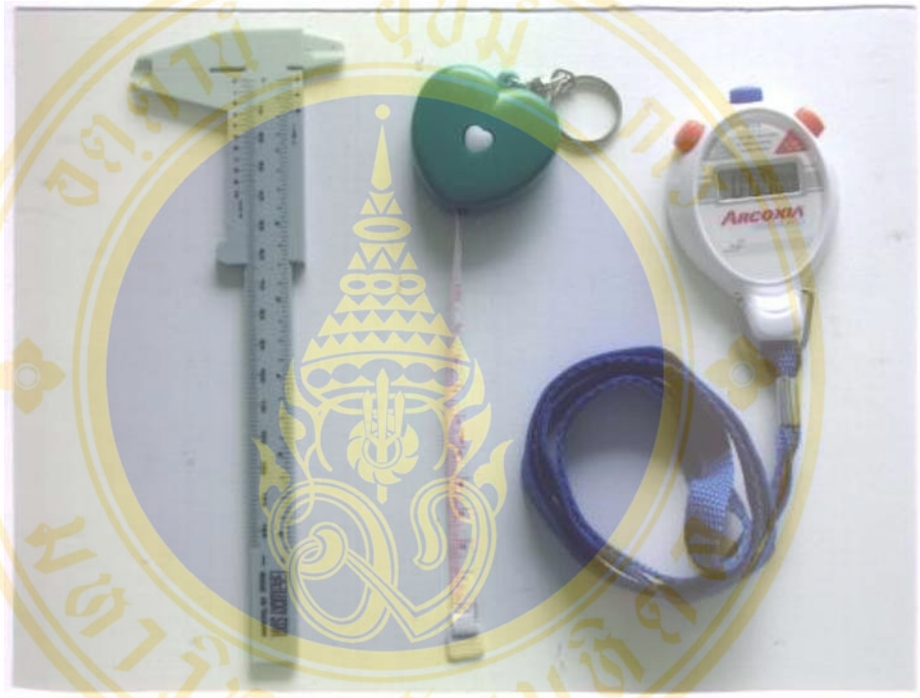

Figure 3.1: Calipers, measurement tape, digital stopwatch

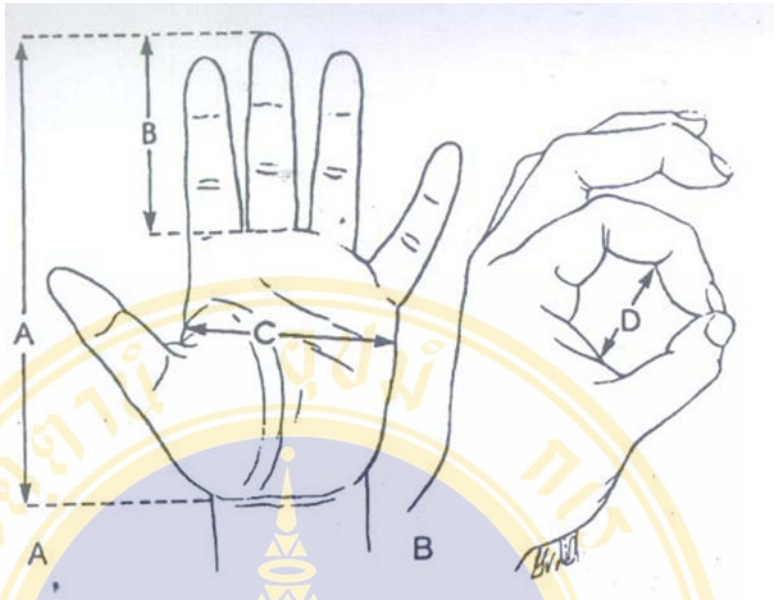

Figure 3.2: Measurement of hand size

In figure 3.2A, standard measurements of the hand that were collected for each subjects: A, from the wrist crease to the tip of the long finger; B, from the crease at the base of the long finger to its tip, and C, the span of the palm taken parallel to the wrist crease at the level shown. In figure 3.2B, the span of the first web space was measured for this study. Subjects were asked to create the "OK" sign, and the ruler was placed gently into the skin fold until resistance was reached. The distance, D, was measured to the crease at the distal phalangeal joint. It was considered that this would approximately correlate with grip size of the individual when gripping a dynamometer (12).

They were also being tested to confirm their hand dominance, using of specific devices (figure 3.3) (50). All subjects were consecutively examined on their hand functions tests, grip-strength, and pinch-strength.

Figure 3.3: Devices for testing handedness

Hand functions test

The combined versions of the JHFT and the SHFE were used to examine the abilities of hand-manipulation. These tests consisted of eight sub-tests:

- Grasp – release large pegs
- Grasp – release small pegs
- Picking up large light objects
- Picking up large heavy object
- Stacking checkers
- Grasp – release blocks
- Grasp – release nails
- Simulated eating

Moreover, the button-board test from SHFE was also performed in this study. Previous examinations in the performance of upper extremities among Thai elderly subjects living in Chiang Mai province had shown that wearing shirt and managing of buttons were yet one of the most important daily activities that most Thai elderly

people have to perform (42). Though, Jarus and co-workers (34) had opposed on the reliability of the test, the present investigator believed that it might be fruitful to perform this examination.

Materials and equipment

16 pegs:	8 large pegs (1/2" diameter, 1 – 1/2" long)
	8 small pegs (3/8" diameter, 1 – 1/2" long)
	Peg board (5" x 5" x 3/4")
10 cans:	5 empty cans
	5 full (1 pounds) cans
4 checkers:	4 standard sized checkers (1 – 1/4" diameter)
Three size blocks:	3 – 3/4" x 3 – 3/4" x 1 – 3/4"
	1 – 3/4" x 1 – 3/4" x 3/4"
	1/2" x 1/2" x 1/2"
Nails – length:	2 – 1/2", 1", 3/4", 1/4"
5 kidney beans:	length approximate 5/8"
Button board:	8 – 1/2" x 6 – 1/2" x 3/8" with three buttons
	(two – 1" diameter, one – 1/2" diameter)

Additional equipment:

5 inches diameter rubber grip disc

Water glass (2 – 1/2 inches diameter, 3 – 3/4 inches height)

Plastic sheets with pre-measured parallel marking of 12" from midline

Regular spoon

A wooden board (41 –1/2 inches X 11 – 1/4 inches x 3/4 inches) with a centerpiece of wood (20 inches x 2 inches x 1/2 inches) glue to the board (6 inches from the front and 4 – 5/8 inches from the right end of the board)

Providing a well-lighted room, each subject was seated in a chair of 18-inch height at a desk of 30-inch-height. Equipments and materials were properly placed in order to provide a suitable environment for hand function testing (figure 3.4 & 3.5).

Figure 3.4: Preparation for hand function tests

Figure 3.5: Preparation for hand function tests

Prior to the examination, a standard verbal instruction was given to the subject. Then, the subjects could ask question until they clearly understood the direction. The subjects performed the test with his/her non-dominant hand first. Digital stopwatch (figure 3.1) was used to record the number of seconds required to complete each test. Each hand was tested twice, and the average time was calculated

Subtest 1 and 2: Large and small pegs

Procedure – The top of pegboard was placed 12-inch from the edge of table, with the larger pegs closer to the subjects. All pegs were lined up to the left (or right) of the pegboard on a rubber grip disc, adjacent to and touching the pegboard (figure 3.6). Timing started from the word "go", the subject picked up the large peg from the NDH side of the board, one at a time, and placed them in the appropriated size of the hole then the watch was stopped (figure 3.7 & 3.8).

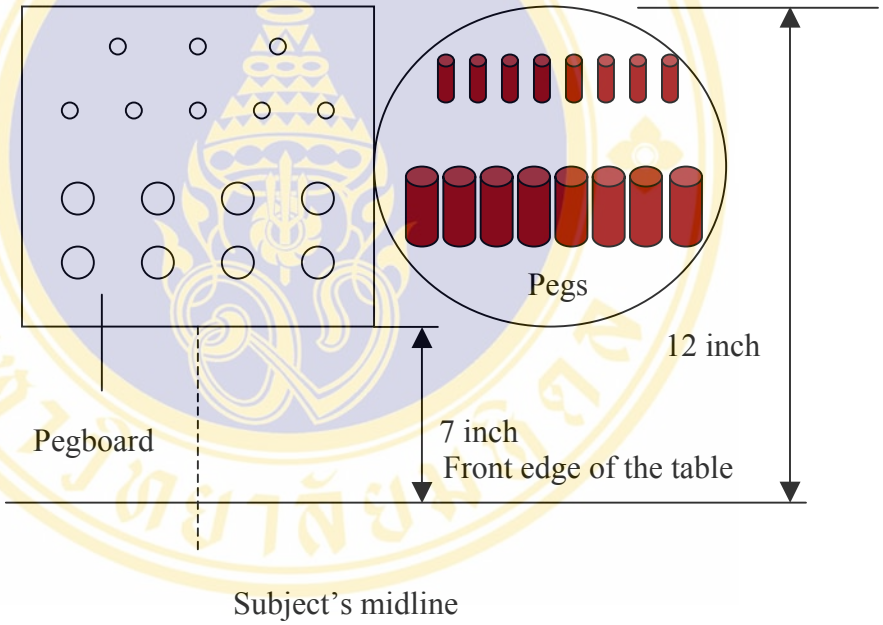

Figure 3.6: Preparation for large pegs test

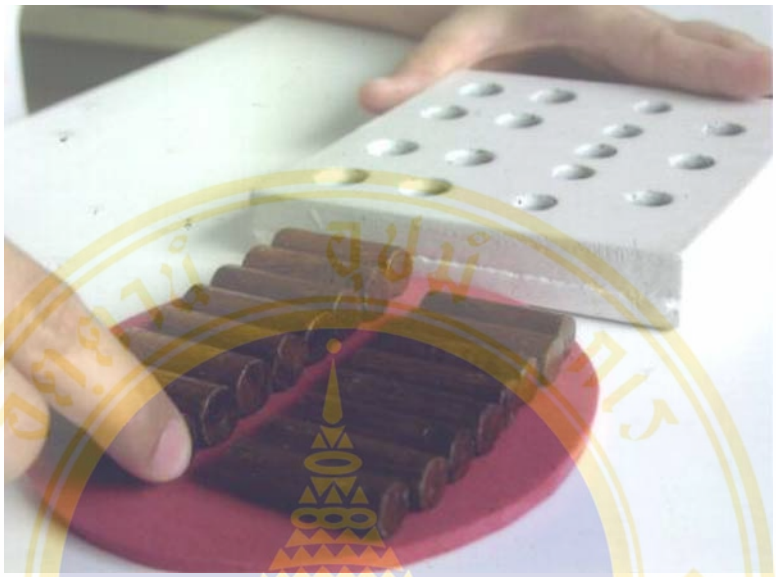

Figure 3.7: Large pegs test

Figure 3.8: Large pegs test

The board was turned, so the smaller holes were closer to the subject (figure 3.9).

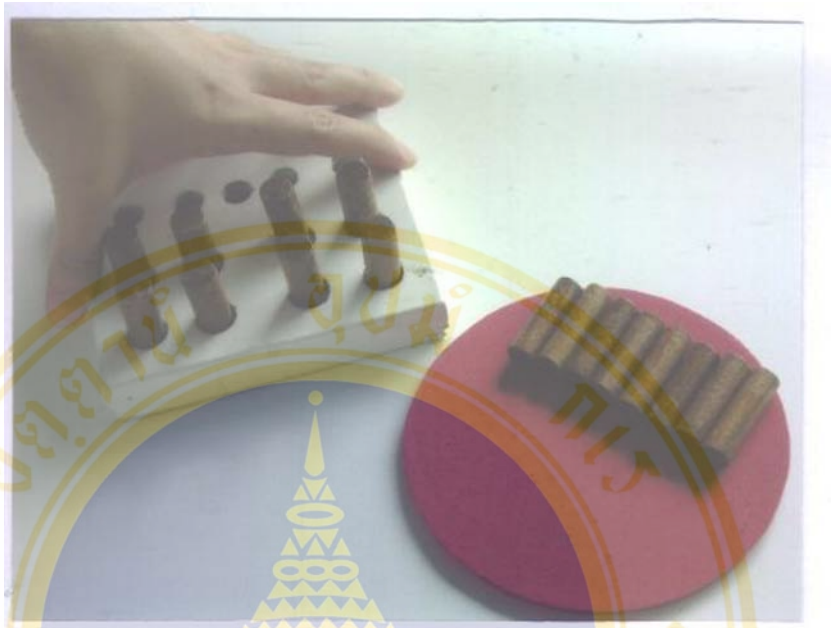

Figure 3.9: Small pegs test

Timing was begun again, the subject continued to use his same hand and placed the small pegs into the remaining holes, and then the watch was stopped (figure 3.10).

Figure 3.10: Small pegs test

The subject used a hand to stabilize the pegboard while the other hand is being tested (figure 3.11)

Figure 3.11: Small pegs test

Dominant hand – The board and pegs were rearranged with pegs lined up to the DH side of the pegboard for testing of the DH.

Subtest 3 and 4: Large heavy and light objects

Procedure – Five–full (1 pound) cans were placed in front of a wooden board that clamped to the table. They were placed 5 inches apart from the edge of the table in front of the subject. These cans were placed at 2 inches apart (figure 3.12). Timing was from the word "go"; subjects, then, grasped the can on the NDH side starting from the far most one and lined up them on the board. The time was stopped when the last can had been released on the board (figure 3.13 & 3.14).

For large light objects subtest, five empty cans with open end placing down were placed instead of five – full cans and subjects followed the same procedure.

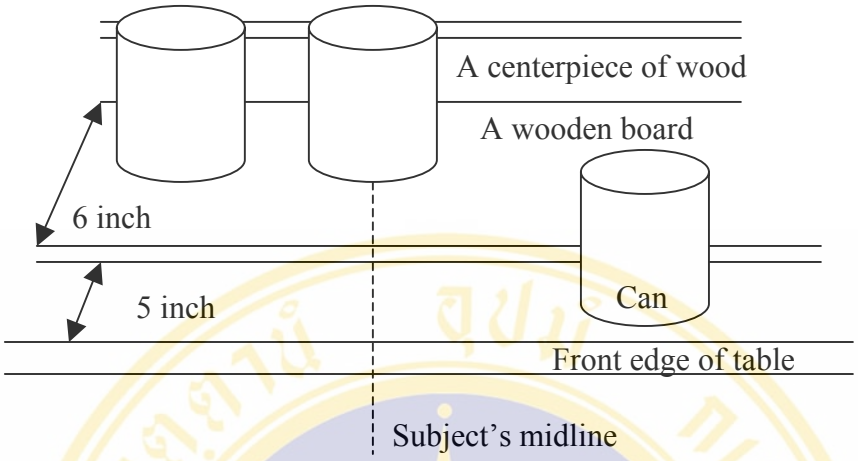

Figure 3.12: Preparation of large light & heavy objects test

Figure 3.13: Large light & heavy objects test

Figure 3.14: Large light & heavy objects test

Dominant hand – Subject began to grasp the can on the extreme DH side

Subtest 5: Checkers

Procedure – Four standard sized checkers were placed on a wooden board that clamped to the table, 5 inches apart from the edge of table in front of the subject. The checkers were lined up, two on each side of the center as a "0000" configuration (figure 3.16). Timing was from the word "go", subject began to move any checker with the NDH and stacked them on the board, one on the top of the other (figure 3.17). Time was stopped when the forth checker had made contact with the third checker.

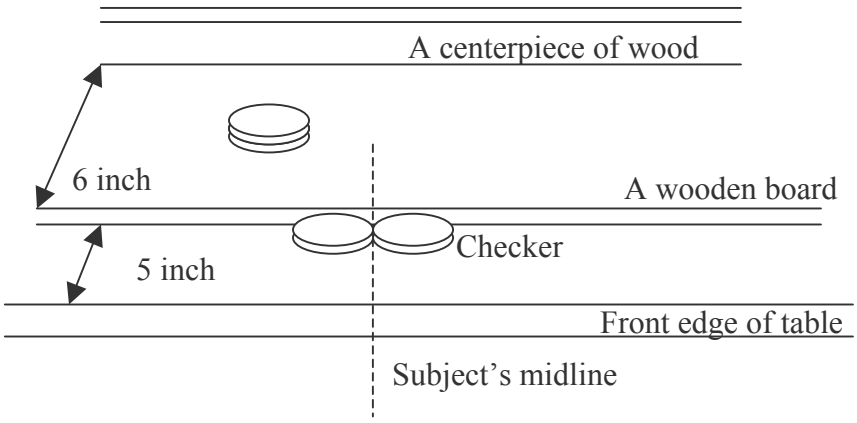

Figure 3.15: Preparation of checkers test

Figure 3.16: Checkers test

Figure 3.17: Checkers test

Dominant hand – Subject repeated the same procedure with the DH

Subtest 6: Blocks

Procedure - Large sized block was placed 12 inches apart from the edge of table and medium sized block was placed 1/2 inches below the large one. The small sized block was placed 5 inches apart from the edge of the table. The plastic sheet was placed 12 inches apart from the right or left side of the blocks (figure 3.18). Time was from the word "go", subject, then, picked up the three blocks, one at a time, and placed them in the outline of the appropriate square on the provided plastic sheet. Time was stopped when the smallest block had been placed in its square (figure 3.19 & 3.20).

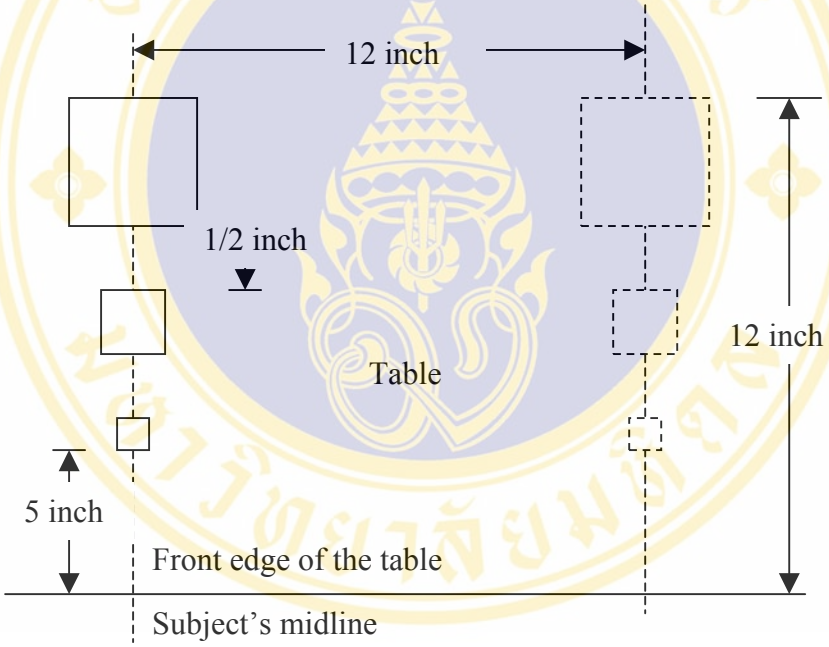

Figure 3.18: Preparation of blocks test

Figure 3.19: Blocks test

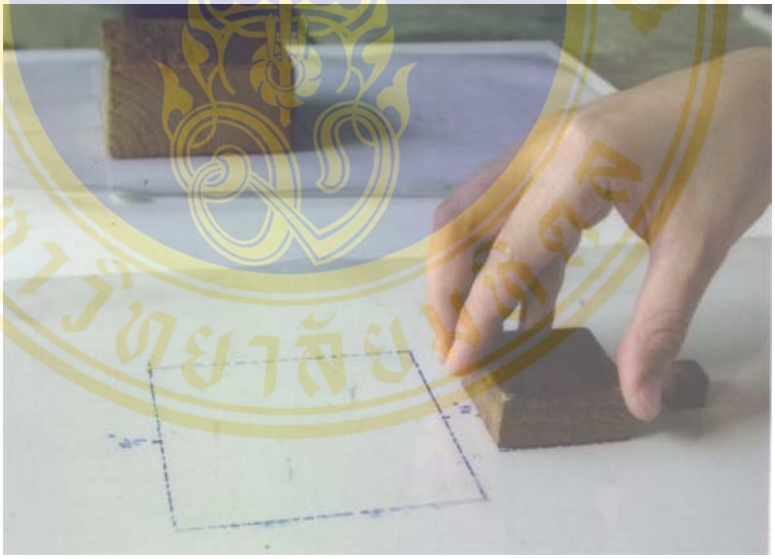

Figure 3.20: Blocks test

Dominant hand – The plastic sheet was placed 12 inches apart from the DH side of the blocks. The subject repeated the same procedure with the DH.

Subtest 7: Nails

Procedure – Nails were placed in a vertical column 1 inch apart with the nail heads to the DH side. The longest nail was place on the far most – 12 inches apart from the edge of the table. A rubber grip disc was used to keep the nails from rolling. An empty-glass was placed 12 inches closed to the NDH side of a mid line and parallel to the longest nail (figure 3.21). Timing was from the word "go", the subject, then, picked up four nails, one at a time starting with the longest nail, and placed them in the provided glass. Time was stopped when the sound of the smallest nail striking the inside of the glass had been heard (figure 3.22 & 3.23).

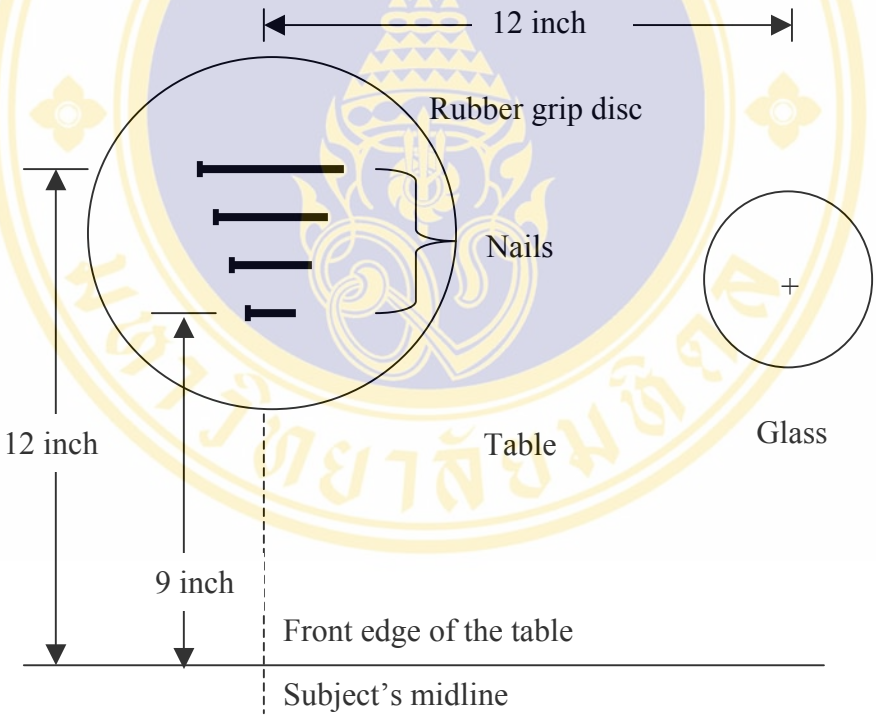

Figure 3.21: Preparation for nails test

Figure 3.22: Nails test

Figure 3.23: Nails test

Dominant hand – The nails were placed with nail heads to the NDH side and the glass was placed to the DH side of a midline. The subject followed the same procedure with the DH.

Subtest 8: Simulated feeding

Procedure – Five kidney beans were placed on a wooden board that clamped to the table 5 inches apart from the edge of the table in front of the subject. The bean were placed on the NDH side of a midline, parallel to and touching the upright portion of the board at 2 inches apart. An empty one-pound-can was placed centrally in front of the board (figure 3.24). Timing is from the word "go", the subject used a regular spoon to pick up the a bean, one at a time starting with the extreme NDH side, and placed them in the can. The time wais stopped when the sound of the last bean striking the inside of the can had been heard (figure 3.25 & 3.26).

Dominant hand – The bean were placed on the DH side of a midline. Subject picked up the bean on the extreme DH side first and followed the same procedure with the DH.

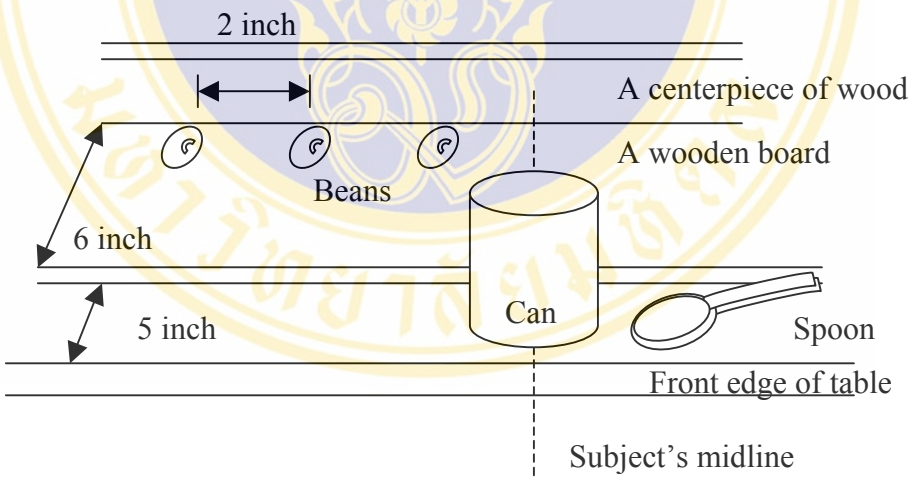

Figure 3.24: Preparation of simulated feeding test

Figure 3.25: Simulated feeding test

Figure 3.26: Simulated feeding test

Subtest 9: Button board

Procedure – These buttons sewn to a cloth board were unbuttoned and re-buttoned. Buttons were positioned directly under the other in a vertical column 1-inch apart; 1/2-inch button was undermost button. The board was placed 12 inches apart from the edge of the table (figure 3.27). Timing was from the word "go"; the subject unbuttoned all three in a sequence (figure 3.28 & 3.29), starting with the uppermost button, and re-buttoned them without pausing (figure 3.30 & 3.31). Time was stopped when the last button had been re-buttoned (figure 3.32).

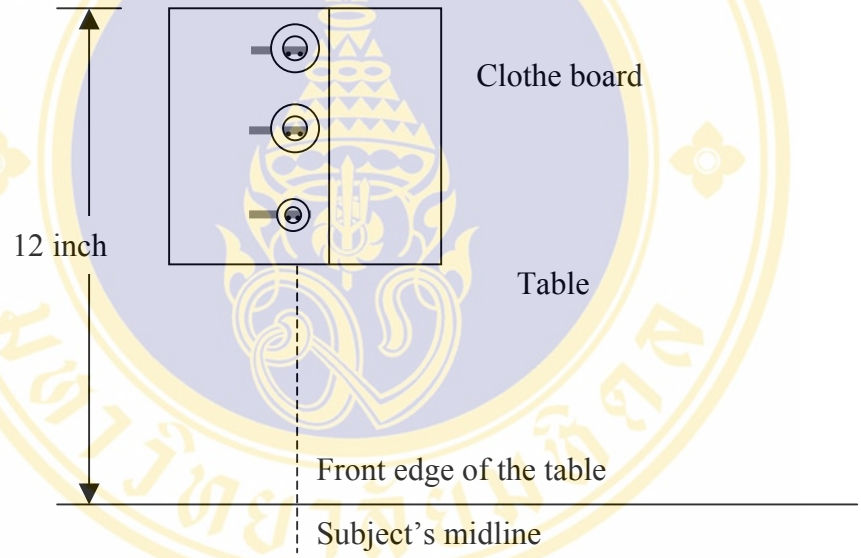

Figure 3.27: Preparation of button board test

Figure 3.28: Button board test

Figure 3.29: Button board test: Unbuttoned

Figure 3.30: Button board test: Rebuttoned

Figure 3.31: Button board test: Rebuttoned

Figure 3.32: Button board test: Rebuttoned

Grip strength test

The grip strength test was secondly be carried out. An adjustable-handle Jamar dynamometer was used (figure 3.33).

Figure 3.33: An adjustable-handle Jamar dynamometer

This dynamometer was reset to zero-position prior to each examination and read to the nearest increment of the two-scale division. The second handle position on the dynamometer was utilized as recommended by Mathiowetz and colleagues.

Participant's testing position was adapted and followed through the recommendation of the American Society of Hand Therapists (ASHT). He/she comfortably seated on a chair without armrest. The shoulder was adducted and neutrally rotated. The elbow was flexed at 90 degree. The forearm was in neutral position. The wrist was put in place between 0 and 30-degree dorsiflexion and between 0 and 15-degree ulnar deviation (figure 3.34).

Figure 3.34: Grip-strength measurement. This standard arm and hand positioning was used for all hand strength measurement

Initially, the examiner carefully performed a grip strength test to demonstrate its correct technique. Subjects, then, were allowed to practice once with his/her dominant hand. The well-prepared verbal instruction was given without variation to each subject. This protocol was repeatedly instructed during each test. The dynamometer was held around the readout dial by the examiner to prevent inadvertent dropping. The reading scores of the three successive trials were recorded

for each hand. The dominant hand was examined first. A minimum of 30 seconds rest was allowed between each test.

Pinch strength test

The B&L pinch gauge was used to measure palmar (three-jaw chuck) pinch, key (lateral) pinch and tip (two-point) pinch (figure 3.35). Palmar pinch was defined as the approximation of thumb pad to pads of the index and middle fingers (figure 3.36). Key pinch was defined as the approximation of thumb pad against the radial side of the middle phalanx of the index finger (figure 3.37). And tip pinch was defined as the approximation of thumb tip to the index finger tip (figure 3.38).

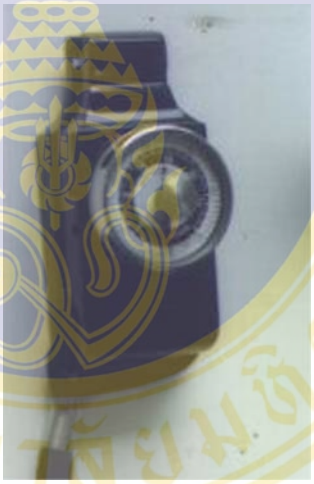

Figure 3.35: B & L pinch gauge

Figure 3.36: Palmar pinch: thumb pad to pads of index and long fingers

Figure 3.37: Key pinch: thumb pad to lateral aspect of middle phalanx of the index finger

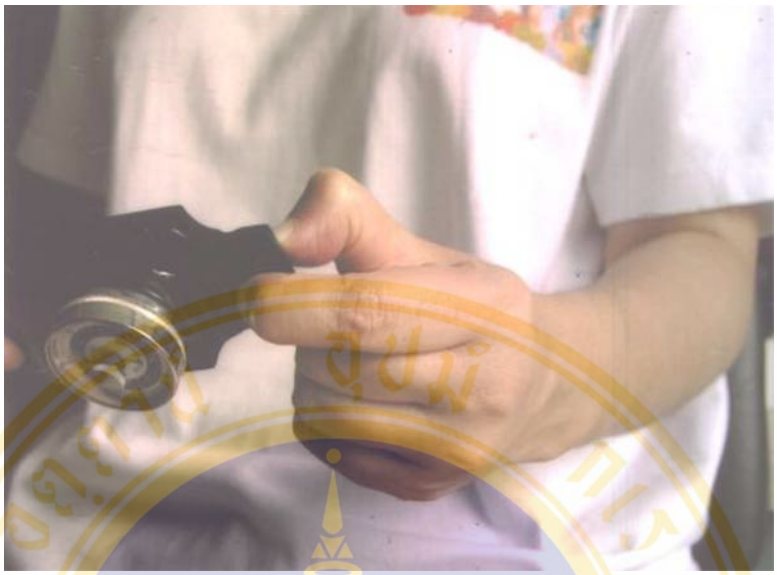

Figure 3.38: Tip pinch: thumb tip to index finger tip

Testing positions were also followed through the recommendation of the ASHT. The examiner demonstrated the correct position of the subjects' fingers before each test. All subjects were allowed to practice once.

Subjects were examined on his/her palmar pinch, key pinch, and tip pinch strength, respectively. During the examinations, a standard verbal instruction was given to each subject. This protocol was repeatedly instructed during each test. The pinch gauge was loosely held by the examiner at distal end to prevent dropping. The reading scores of the three successive trials were recorded for each hand. The scores were read on the needle side of the readout marker. The dominant hand was tested first. A minimum of 30 seconds rest was allowed between each test. The accuracy of the Jamar dynamometer and the B&L pinch gauge were checked and calibrated prior to this study.

Statistical analyses

To evaluate intra-tester reliability of hand strength and hand function test, the intraclass correlation coefficient ($ICC_{3,1}$) was used to assess the correlation of the two separate observations. These tests were administered a week or less apart.

Kologorov-Smirnov Goodness of Fit-test was used to examine the distributing pattern of the obtained data. Mean and standard deviation were calculated. For all of the reading scores on the hand strength test and hand functions test, statistical analyses were performed using Statistical Packages for Social Sciences version 10.0. Student's t-test was used to compare the continuous data between two groups. A p-value of less than 0.05 was considered statistically significant.

Subject

⇓

Questionnaires & consent form

⇓

Record: occupation, gender, age, height, weight

hand size, hand dominance

⇓

First test: hand function test

Non-dominant hand, first

Dominant hand

⇓

Second test: grip strength test

Dominant hand 3 trials

Non-dominant hand 3 trials

⇓

Third test: pinch strength test

Palmar, key, and tip pinch

Dominant hand 3 trials

Non-dominant hand 3 trials

⇓

Data analyses of three tests

testing procedure for this study was mandatory.

Figure 3.39 Schematic of the study procedure

CHAPTER 4
RESULTS

4.1 General Description of the Subjects

Sixty-seven male and 102 female healthy volunteers with ages of 21 to 60 years old participated in this study. Ninety-four of them were married (55.6 %). Only eight participants were found to be left handed (4.7 %). Altogether, one hundred and sixty-nine participants had a mean age of 39.1 $\pm$11.3 years, body weight of 60.4 $\pm$10.7 kg, height of 160.7 $\pm$7.8 cm, and BMI of 23.4 $\pm$4.0 kg/m^2 (table 4.1).

Most participants were graduated with a bachelor degree (52 cases, 30.8%). Twenty-three participants had education higher than the master degree (13.6%). Thirty-nine participants came from elementary school (23.1%). Thirty-two cases were from high school (18.9%). And, twenty-three cases had diploma degree (13.6%). Most of the present participants were government employees (79 cases, 46.7%). Fifty-three cases employed in the private business (31.4%). Eighteen cases were students (10.7%). Lastly, 19 cases unemployed and worked at home (11.2%). Therefore, most of them were light manual workers (160 cases, 94.7%) while the rest had moderate to heavy manual works (5.3%). Furthermore, most of them did not exercise (112 cases, 66.3%) regularly.

Upon survey, eighty-five participants had not reported of any associated clinical conditions (50.2%). However, some concurrent clinical conditions were observed. Most of them had hypertension (38 cases, 22.5%). Eighteen participants had history of osteoarthritis of their knees (10.7%). Eleven participants had history of allergy (6.5%). Nine participants had history of controlled diabetes mellitus (5.3%). Lastly, eight cases had history of treated dyslipidemia (4.7%).

Usually, participants did not report of any coexisting family history (71 cases, 42%). If they did report, most of them were diabetes mellitus (39 cases, 23.1%) and

hypertension (38 cases, 22.5%). The rest were cerebrovascular disease in 4.7% (8 cases), cardiovascular disease in 3.0% (5 cases), carcinomas in 3.6% (6 cases), and inflammatory arthritis in 1.2% (2 cases).

Among male participants, 18 subjects categorized under 21 – 30 years of age had a mean age of 25.5 ± 2.2 years, body weight of 62.5 ± 8.1 kg, height of 170.1 ± 5.9 cm, and BMI of 21.7 ± 2.3 kg/m^2 (table 4.1). Sixteen males categorized under 31 – 40 years of age had a mean age of 34.7 ± 3.5 years, body weight of 67.8 ± 10.0 kg, height of 168.9 ± 7.1 cm, and BMI of 23.9 ± 3.9 kg/m^2. Seventeen males categorized under 41 – 50 years of age had a mean age of 44.1 ± 2.8 years, body weight of 63.9 ± 8.8 kg, height of 165.0 ± 5.3 cm, and BMI of 23.4 ± 2.9 kg/m^2. Lastly, 16 males categorized under 51 – 60 years of age had a mean age of 53.8 ± 3.3 years, body weight of 68.5 ± 13.0 kg, height of 162.0 ± 5.2 cm, and BMI of 26.1 ± 4.5 kg/m^2. There was a significant increase in BMI and decrease in height among males participated in each decade of life (p = 0.0006, and 0.006, respectively). However, there was no significant difference in body weight among participants in each decade of life (p = 0.24).

Among female participants, 28 subjects categorized under 21 – 30 years of age had a mean age of 24.4 ± 1.8 years, body weight of 50.8 ± 5.6 kg, height of 158.3 ± 5.2 cm, and BMI of 20.3 ± 2.1 kg/m^2. Twenty-six females categorized under 31 – 40 years of age had a mean age of 35.7 ± 3.6 years, body weight of 56.0 ± 10.3 kg, height of 157.2 ± 4.3 cm, and BMI of 22.6 ± 4.0 kg/m^2. Twenty-five females categorized under 41 – 50 years of age had a mean age of 45.2 ± 3.2 years, body weight of 58.2 ± 6.9 kg, height of 155.7 ± 6.9 cm, and BMI of 24.1 ± 3.9 kg/m^2. Lastly, 23 females categorized under 51 – 60 years of age had a mean age of 54.3 ± 3.0 years, body weight of 64.6 ± 8.3 kg, height of 155.9 ± 5.5 cm, and BMI of 26.6 ± 3.5 kg/m^2. There was a significant increase in body weight and BMI among females participated in each decade of life (p < 0.0001 for both categories). However, there was no significant difference in height among participants in each decade of life (p = 0.29).

Table 4.1 General characteristics of all healthy volunteers

Sex	Age group		Marriage	Age	Weight	Height	BMI
	years	number	(number)	(years)	(kg.)	(cm.)	(kg/m^2)
M	21 – 30	18	2	25.5 ±2.2	62.5 ±8.1	170.1 ±5.9	21.7 ±2.3
	31 – 40	16	9	34.7 ±3.5	67.8 ±10.0	168.9 ±7.1	23.9 ±3.9
	41 – 50	17	16	44.1 ±2.8	63.9 ±8.8	165.0 ±5.3	23.4 ±2.9
	51 – 60	16	16	53.8 ±3.3	68.5 ±13.0	162.0 ±5.2	26.1 ±4.5
	Total	67	43	39.2 ±11.1	65.5 ±10.2	166.7 ±7.0	23.7 ±3.8
F	21 – 30	28	2	24.4 ±1.8	50.8 ±5.6	158.3 ±5.2	20.3 ±2.1
	31 – 40	26	14	35.7 ±3.6	56.0 ±10.3	157.2 ±4.3	22.6 ±4.0
	41 – 50	25	16	45.2 ±3.2	58.2 ±8.7	155.7 ±6.8	24.1 ±3.9
	51 – 60	23	19	54.3 ±3.0	64.6 ±8.3	155.9 ±5.5	26.6 ±3.5
	Total	102	51	39.1 ±11.6	57.1 ±9.6	156.8 ±5.6	23.3 ±4.1
Over all		169	97	39.1±11.3	60.4±10.7	160.7±7.8	23.4±4.0

BMI = body mass index, F = female, M = male

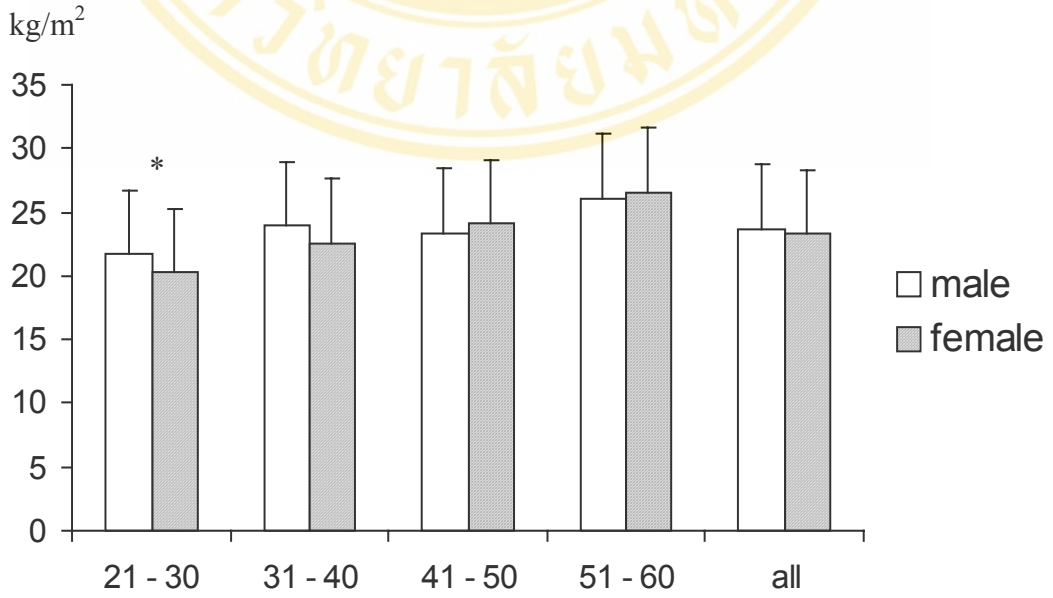

Figure 4.1 Bar chart comparing BMI between male and female groups in each decade of life.

There was significantly lower in female-BMI as compared to that of male-BMI, considered within the same age-categories during the 2nd decade of life (21.7 ± 2.3 *vs*. 20.3 ± 2.1 years, $p = 0.039$). After 30 years of age, male-BMI was not significantly higher than that of the female counterpart (23.9 ± 3.9 *vs*. 22.6 ± 4.0 years, $p = 0.31$, 23.4 ± 2.9 *vs*. 24.1 ± 3.9 years, $p = 0.53$ and 26.1 ± 4.5 *vs*. 26.6 ± 3.5 years, $p = 0.70$ during the 3rd, 4th and 5th decades of life, respectively).

4.2 Hand Measurement

Hand measurement was preformed as previously described (table 4.2). There was no significant difference in each pair of measurement i.e. A, B, C and D lines between both hands except considering in line C during the 2nd, 5th decades of life of female and all recruited female-group as well as in all recruited male-group (table 4.3).

Table 4.2 Hand measurement

Sex	Age group		LH	Hand	Measured Lines			
	Years	N	(n)	side	A (cm.)	B (cm.)	C (cm.)	D(cm.)
M	21-30	18	2	DH	18.1 ±2.5	7.9 ±0.5	8.5 ±0.4	4.4 ±0.4
				NDH	18.1 ±2.6	7.9 ±0.5	8.3 ±0.5	4.4 ±0.4
	31-40	16	0	DH	18.8 ±1.4	7.9 ±0.6	8.6 ±0.4	4.2 ±0.5
				NDH	18.9 ±1.4	7.9 ±0.5	8.5 ±0.5	4.2 ±0.5
	41-50	17	0	DH	17.7 ±2.6	7.6 ±0.6	8.5 ±0.4	4.3 ±0.5
				NDH	17.9 ±2.5	7.6 ±0.5	8.4 ±0.4	4.3 ±0.5
	51-60	16	1	DH	18.2 ±1.1	7.6 ±0.5	8.6 ±0.3	4.0 ±0.5
				NDH	18.3 ±1.0	7.6 ±0.5	8.5 ±0.4	4.0 ±0.5
	Total	67	3	DH	18.2 ±2.0	7.8 ±0.5	8.6 ±0.4	4.2 ±0.5
				NDH	18.3 ±2.1	7.8 ±0.5	8.4 ±0.5	4.2 ±0.5

M = male, F = female, N = number, LH = left handedness,

DH = dominant hand, NDH = Non-dominant hand

Table 4.2 (continued) Hand measurement

Sex	Age group		LH	Hand	Measured Lines			
	Years	N	(n)	side	A (cm.)	B (cm.)	C (cm.)	D(cm.)
F	21-30	28	0	DH	17.2 ±0.6	7.3 ±0.5	7.5 ±0.3	4.2 ±0.4
				NDH	17.2 ±0.7	7.3 ±0.4	7.3 ±0.3	4.2 ±0.4
	31-40	26	1	DH	17.3 ±0.9	7.4 ±0.4	7.7 ±0.5	4.1 ±0.3
				NDH	17.3 ±0.8	7.3 ±0.4	7.5 ±0.4	4.1 ±0.4
	41-50	25	3	DH	17.0 ±1.0	7.2 ±0.5	7.8 ±0.4	4.0 ±0.4
				NDH	16.9 ±1.1	7.1 ±0.6	7.6 ±0.4	4.0 ±0.4
	51-60	23	0	DH	17.2 ±0.7	7.2 ±0.5	7.9 ±0.3	3.9 ±0.3
				NDH	17.2 ±1.0	7.3 ±0.5	7.7 ±0.3	3.9 ±0.3
	Total	102	4	DH	17.1 ±0.8	7.3 ±0.5	7.7 ±0.4	4.0 ±0.4
				NDH	17.2 ±0.9	7.3 ±0.5	7.6 ±0.4	4.1 ±0.4
Over all		169	7	DH	17.6 ±1.5	7.5 ±0.5	8.1 ±0.6	4.1 ±0.4
				NDH	17.6 ±1.6	7.5 ±0.5	7.9 ±0.6	4.1 ±0.4

M = male, F = female, N = number, LH = left handedness,
DH = dominant hand, NDH = Non-dominant hand

Considering on all participants, there was significantly longer measured line C of the dominant hand compared to that of the non-dominant hand (p = 0.007). A significantly longer measured line C of the dominant hands could be observed among male subjects considering as a whole group (p = 0.01) and among female subjects during the 2nd and 5th decades of life (p = 0.02). However, there was only a trend observed among female subjects considering as a whole group (p = 0.08).

Table 4.3 Comparative studies in the different measured lines between DH and NDH hands under the different age categories

Sex	Age group (years)	*p*-value[1] considered between DH and NDH hands			
		Line A	Line B	Line C	Line D
M	21-30	0.99	1.0	0.19	1.0
	31-40	0.84	0.99	0.54	1.0
	41-50	0.82	0.99	0.31	1.0
	51-60	0.79	1.0	0.43	1.0
	Total	0.78	0.99	0.01*	1.0
F	21-30	0.99	0.99	0.02*	1.0
	31-40	1.0	0.37	0.12	0.99
	41-50	0.74	0.52	0.08	1.0
	51-60	0.99	0.50	0.03*	1.0
	Total	0.37	0.99	0.08	0.08
Over all	Total	0.99	0.98	0.007*	0.89

*p-value considered significant at < 0.05,

[1]p-value, independent sample t-test; M = male, F = female,

DH = dominant hand, NDH = Non-dominant hand

Generally, male subjects had longer length of the measured lines A, B, and C for both DH and NDH and the measured lined D only for the DH compared to those of females. Considering on the length of each line between male and female subjects, there was no significant difference in the length of measured line D in all age categories except during the 4th decade of life (p = 0.04) for both the DH and the NDH. The difference of the measured line D of the dominant hand between male and female subjects considering on all cases was also achieved statistical significance (p = 0.005). There were significantly longer length of measured line B, and C in male subjects in all age categories except for the NDH during the 5th decade of life (p = 0.07). Significantly longer length of measured line A and B were also observed in male subjects especially during the 3rd and 5th decades of life. However, at the 2nd and 4th decades of life, there was no significant difference in the length of both lines except

longer in length for the measured line A of both hands in male subjects during the 4th decade of life (table 4.4).

Table 4.4 Comparative studies between male and female in the different measured lines under different age-categories

Age group (years)	Hand side	*p*-value[1] considered between male and female			
		Line A	Line B	Line C	Line D
21-30	DH	0.07	0.0003*	<0.0001*	0.11
	NDH	0.07	<0.0001*	<0.0001*	0.11
31-40	DH	0.0001*	0.002*	<0.0001*	0.42
	NDH	<0.0001*	0.0001*	<0.0001*	0.48
41-50	DH	0.23	0.02*	<0.0001*	0.04*
	NDH	0.08	0.007*	<0.0001*	0.04*
51-60	DH	0.001*	0.019*	<0.0001*	0.44
	NDH	0.001*	0.07	<0.0001*	0.44
Total	DH	<0.0001*	<0.0001*	<0.0001*	0.005*
	NDH	<0.0001*	<0.0001*	<0.0001*	0.15

**p*-value considered significant at < 0.05,

[1]*p*-values, independent sample t-test;

DH = dominant hand, NDH = Non-dominant hand

4.3 Hand Functions Test

Subtest 1 and 2: large and small pegs

Large pegs test performed by the DH was significantly faster in rate than that of the NDH in all female participants or during each decades of life. Also, large pegs test performed by the DH was faster in rate than that of the NDH in all male participants and in male group during the 3rd and 4th decades of life. Moreover, large pegs test performed by the DH in female participants was faster in rate than that of male group if considering on all recruited cases as well as that of the male group during the 2nd and 3rd decades of life (table 4.5). Sporadically finding on the large

pegs test, there was a significantly faster in rate of the NDH of female participants as compared to that of the male counterpart during the 3rd decade of life (table 4.5).

Table 4.5 Large pegs test (second)

Age group (years)	Male			Female			*p*-value[2]	
	DH	NDH	*p*-value[1]	DH	NDH	*p*-value[1]	DH	NDH
21-30	9.8 ±1.0	10.3 ±0.9	0.15	8.6 ±0.7	9.9 ±1.1	<0.01*	<0.01*	0.20
31-40	10.2 ±1.2	11.6 ±1.6	0.008*	9.3 ±1.1	10.4 ±1.2	<0.01*	0.02*	<0.01*
41-50	9.8 ±1.4	11.0 ±1.6	0.02*	9.9 ±1.0	10.8 ±1.2	<0.01*	0.79	0.65
51-60	10.9 ±1.9	12.2 ±2.1	0.15	10.6 ±1.1	12.3 ±1.3	<0.01*	0.54	0.86
Total	10.1 ±1.4	11.2 ±1.6	<0.01*	9.5 ±1.2	10.8 ±1.5	<0.01*	<0.01*	0.10

**p*-value considered significant at < 0.05, NDH = Non-dominant hand

[1]*p*-value, dependent sample t-test; between dominant hand and non-dominant hand,

[2]*p*-value, independent sample t-test; between males and females, DH = dominant hand,

There were significant correlations between large pegs test and the measured lines A, B, C, D in both hands of all recruited cases. In female cases, there were significant correlations between the large pegs test rate and the length of the measured lines A, B, C of both hands as well as the measured line D of the DH in all recruited females. Significant correlations between the large pegs test rate of both hands and the length of measured line A during the 3rd decade and the measure line C in the female group during the 2nd decade of life. There was also a significant correlation between the large pegs test rate of the NDH and the length of the measured line B in the female group during the 5th decade of life. In male cases, there were significant correlations between the large pegs test rate of both hands and the length of the measured lines B, C in all recruited male cases as well as in male group during the 4th decade of life (table 4.6).

Table 4.6 Correlations between hand measurement and large peg test

Sex	Age group (years)	Hand side	*r* and *p*-values between large pegs test and measured lines							
			Line A		Line B		Line C		Line D	
			r	*p*	*r*	*p*	*r*	*p*	*r*	*p*
M	21-30	DH	-0.23	0.381	-0.25	0.34	0.43	0.09	-0.17	0.51
		NDH	-0.14	0.64	0.20	0.49	0.46	0.06	-0.20	0.44
	31-40	DH	0.27	0.33	0.08	0.77	-0.04	0.88	-0.17	0.55
		NDH	0.31	0.27	0.15	0.60	0.09	0.77	-0.03	0.92
	41-50	DH	0.18	0.51	0.66	<0.01*	0.72	0.002*	0.33	024
		NDH	0.17	0.55	0.64	0.01*	0.79	<0.01*	0.29	0.30
	51-60	DH	0.08	0.83	-0.09	0.80	-0.10	0.76	0.24	0.50
		NDH	0.12	0.72	-0.10	0.78	-0.26	0.43	0.23	0.52
	Total	DH	0.02	0.91	0.29	0.03*	0.35	0.007*	0.05	0.70
		NDH	0.001	0.99	0.31	0.02*	0.38	0.003*	0.07	0.57
F	21-30	DH	0.09	0.67	0.36	0.08	0.74	<0.01*	-0.68	0.09
		NDH	0.19	0.36	0.31	0.14	0.76	<0.01*	0.12	0.56
	31-40	DH	0.41	0.046*	0.27	0.21	0.35	0.10	0.24	0.25
		NDH	0.44	0.03*	0.28	0.19	0.33	0.11	0.29	0.17
	41-50	DH	0.03	0.94	0.09	0.80	0.19	0.59	-0.21	0.56
		NDH	0.07	0.85	0.21	0.55	0.22	0.55	0.19	0.60
	51-60	DH	0.37	0.09	0.40	0.06	0.34	0.12	0.12	0.58
		NDH	0.35	0.12	0.47	0.027*	0.37	0.09	-0.02	0.95
	Total	DH	0.35	<0.01*	0.40	<0.01*	0.43	<0.01*	0.21	0.04*
		NDH	0.39	<0.01*	0.40	<0.01*	0.46	<0.01*	0.17	0.10
Over all		DH	0.33	<0.01*	0.54	<0.01*	0.73	<0.01*	0.22	<0.01*
		NDH	0.35	<0.01*	0.56	<0.01*	0.74	<0.01*	0.23	<0.01*

*p-value considered significant at < 0.05,

Pearson's correlation studies, r = r-value, p = p-value,

M = male; F = female; DH = dominant hand, NDH = Non-dominant hand

Small pegs test performed by the DH was significantly faster in rate as compared to that of the NDH in all age groups of female subjects. Significantly faster test rate performed by the DH compared to that of the NDH was also observed in male group during the 3rd decade of life. Female participants could perform a faster small peg test as compared to male group during the 2nd and 3rd decades of life (table 4.7).

Table 4.7 Small pegs test

Age group (years)	Male			Female			*p*-value[2]	
	DH (second)	NDH (second)	*p*-value[1]	DH (second)	NDH (second)	*p*-value[1]	DH	NDH
21-30	9.5 ±0.8	10.1 ±1.0	0.09	8.8 ±0.8	10.0 ±1.0	<0.01*	<0.01*	<0.01*
31-40	10.1 ±1.0	11.7 ±1.6	<0.01*	9.3 ±1.0	10.5 ±1.5	<0.01*	0.02*	0.02*
41-50	10.4 ±1.6	11.3 ±1.9	0.13	9.7 ±1.1	10.9 ±1.1	<0.01*	0.10	0.39
51-60	11.1 ±1.3	12.4 ±1.9	0.06	10.8 ±1.3	12.2 ±1.2	<0.01*	0.48	0.68
Total	10.2 ±1.3	11.2 ±1.8	<0.01*	9.6 ±1.3	10.8 ±1.4	<0.01*	<0.01*	0.11

*p-value considered significant at < 0.05,

[1]p-value, dependent sample t-test; between dominant hand and non-dominant hand,

[2]p-value, independent sample t-test; between males and females,

DH = dominant hand, NDH = Non-dominant hand

Significant associations between the measured line C and small pegs test rate was observed in all recruited participants as well as in all female participants. There was also significant correlation between small pegs test and the measured line D in all female participants (table 4.8).

Table 4.8 Correlations between hand measurement and small pegs test

Sex	Age group (years)	Hand side	*r* and *p*-values between small pegs test and measured lines							
			Line A		Line B		Line C		Line D	
			r	*p*	*r*	*p*	*r*	*p*	*r*	*p*
M	21-30	DH	0.25	0.33	0.33	0.18	-0.15	0.55	0.33	0.18
		NDH	0.21	0.41	0.21	0.42	-0.07	0.79	0.26	0.29
	31-40	DH	0.20	0.49	0.37	0.18	0.09	0.75	-0.28	0.92
		NDH	0.20	0.46	0.30	0.28	0.19	0.50	0.08	0.79
	41-50	DH	-0.38	0.15	0.01	0.98	0.07	0.80	0.13	0.14
		NDH	-0.40	0.14	0.07	0.80	0.05	0.85	0.62	0.61
	51-60	DH	0.39	0.23	0.24	0.49	0.21	0.54	-0.18	0.62
		NH	0.45	0.16	0.25	0.47	0.47	0.15	-0.19	0.61
	Total	DH	-0.06	0.65	0.04	0.75	0.04	0.77	-0.07	0.59
		NDH	-0.06	.068	0.01	0.96	0.13	0.34	-0.06	0.63
F	21-30	DH	-0.19	0.36	-0.30	0.15	-0.02	0.94	-0.19	0.37
		NDH	-0.21	0.31	-0.39	0.06	0.10	0.64	-0.16	0.45
	31-40	DH	0.03	0.87	0.05	0.80	0.13	0.53	-0.13	0.52
		NDH	0.01	0.99	0.80	0.56	0.16	0.44	-0.13	0.53
	41-50	DH	-0.10	0.64	-0.09	0.67	0.23	0.26	0.04	0.85
		NDH	-0.06	0.76	0.03	0.90	0.33	0.11	-0.01	0.99
	51-60	DH	-0.16	0.48	-0.08	0.72	-0.01	0.99	-0.11	0.26
		NDH	-0.04	0.86	-0.18	0.44	0.01	0.98	-0.26	0.25
	Total	DH	-0.10	0.35	-0.14	0.18	0.25	0.01*	-0.20	0.045*
		NDH	-0.08	0.41	-0.10	0.31	0.29	<0.01*	-0.23	0.025*
Over all		DH	0.01	0.89	0.04	0.59	0.27	<0.01*	-0.10	0.20
		NDH	0.02	0.80	0.05	0.53	0.31	<0.01*	-0.11	0.16

**p*-value considered significant at < 0.05,

Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,

M = male; F = female; DH = dominant hand, NDH = Non-dominant hand

Subtest 3 and 4: Large heavy and light objects

There were significant faster in the rates of large heavy objects test performed by the DH as compared to that of the NDH when considering all recruited male or female participants as well as in female groups during their 3rd, and 5th decades of life (table 4.9).

Table 4.9 Large heavy objects test

Age group (years)	Male			Female			*p*-value[2]	
	DH (second)	NDH (second)	*p*-value[1]	DH (second)	NDH (second)	*p*-value[1]	DH	NDH
21-30	3.3 ±0.4	3.5 ±0.4	0.19	3.4 ±0.5	3.6 ±0.5	0.11	0.48	0.48
31-40	3.5 ±0.6	3.8 ±0.7	0.06	3.6 ±0.5	3.8 ±0.5	0.003*	0.56	0.99
41-50	3.6 ±0.7	3.8 ±0.5	0.12	3.6 ±0.4	3.7 ±0.4	0.13	0.99	0.48
51-60	4.1 ±0.6	4.4 ±0.6	0.14	4.1 ±0.5	4.4 ±0.6	0.037*	0.99	0.99
Total	3.6 ±0.6	3.8 ±0.6	0.02*	3.6 ±0.5	3.9 ±0.6	0.001*	1.0	0.29

**p*-value considered significant at < 0.05,

[1]*p*-value, dependent sample t-test; between dominant hand and non-dominant hand,

[2]*p*-value, independent sample t-test; between males and females,

DH = dominant hand, NDH = Non-dominant hand

Significant associations were found between large heavy objects test rate performed by the NDH and the measured line D in all recruited participants (table 4.10).

Table 4.10 Correlations between hand measurement and large heavy objects test

Sex	Age group (years)	Hand side	*r* and *p*-values between large heavy objects test and measured lines							
			Line A		Line B		Line C		Line D	
			r	*p*	*r*	*p*	*r*	*p*	*r*	*p*
M	21-30	DH	-0.04	0.92	-0.30	0.23	-0.28	0.26	0.07	0.78
		NDH	-0.30	0.87	-0.32	0.20	-0.25	0.31	-0.05	0.84
	31-40	DH	-0.15	0.60	-0.17	0.56	-0.36	0.18	-0.09	0.76
		NDH	-0.11	0.56	-0.18	0.52	-0.13	0.63	0.07	0.80
	41-50	DH	-0.25	0.35	0.08	0.77	0.48	0.06	0.11	0.68
		NDH	-0.27	0.31	0.08	0.77	0.42	0.11	0.06	0.84
	51-60	DH	-0.02	0.96	0.04	0.91	-0.07	0.84	0.14	0.69
		NDH	0.04	0.91	0.07	0.83	0.11	0.76	0.05	0.89
	Total	DH	-0.14	0.29	0.17	0.20	-0.01	0.92	-0.12	0.36
		NDH	-0.13	0.32	-0.18	0.18	0.05	0.68	-0.18	0.18
F	21-30	DH	-0.09	0.66	-0.13	0.53	0.07	0.74	-0.02	0.94
		NDH	0.09	0.68	-0.24	0.26	0.08	0.71	-0.04	0.87
	31-40	DH	-0.08	0.69	0.13	0.54	0.12	0.57	-0.05	0.81
		NDH	-0.13	0.53	0.09	0.67	0.07	0.73	-0.10	0.64
	41-50	DH	-0.33	0.10	-0.17	0.42	-0.26	0.22	-0.19	0.37
		NDH	-0.33	0.11	0.14	0.52	-0.19	0.36	-0.16	0.42
	51-60	DH	-0.09	0.68	0.02	0.93	0.20	0.38	0.08	0.73
		NDH	-0.20	0.36	0.05	0.84	0.21	0.35	-0.13	0.56
	Total	DH	-0.13	0.20	-0.08	0.46	0.17	0.10	-0.14	0.18
		NDH	-0.17	0.09	-0.06	0.54	0.17	0.11	-0.19	0.07
Over all		DH	-0.13	0.10	-0.12	0.12	0.03	0.68	-0.13	0.10
		NDH	-0.14	0.07	-0.12	0.13	0.05	0.54	-0.16	0.04*

*p-value considered significant at < 0.05,

Pearson's correlation studies, r = r-value, p = p-value,

M = male; F = female; DH = dominant hand, NDH = Non-dominant hand

There was a significant faster in rate of large light objects test performed by the DH than the NDH in all recruited female participants as well as in female group during the 3rd, 4th, and 5th decades of life. Significant faster in rate of large light objects test performed by the DH in male group also observed in all recruited male participants as well as in male group during the 2nd, 3rd, 4th decades of life (table 4.11).

Table 4.11 Large light objects test

Age group (years)	Male			Female			*p*-value[2]	
	DH (second)	NDH (second)	*p*-value[1]	DH (second)	NDH (second)	*p*-value[1]	DH	NDH
21-30	3.3 ±0.4	3.6 ±0.4	0.04*	3.3 ±0.5	3.5 ±0.4	0.06	0.59	1.0
31-40	3.5 ±0.6	4.0 ±0.6	0.04*	3.5 ±0.5	3.8 ±0.6	0.02*	1.0	0.75
41-50	3.6 ±0.5	4.0 ±0.5	0.03*	3.5 ±0.3	3.8 ±0.5	0.01*	0.59	0.55
51-60	4.2 ±0.6	4.6 ±0.7	0.19	4.1 ±0.6	4.6 ±0.6	0.01*	0.06	0.71
Total	3.6 ±0.6	4.0 ±0.5	0.001*	3.6 ±0.6	3.9 ±0.7	0.01*	0.37	1.0

*p-value considered significant at < 0.05,

[1]p-value, dependent sample t-test; between dominant hand and non-dominant hand,

[2]p-value, independent sample t-test; between males and females,

DH = dominant hand, NDH = Non-dominant hand

There were significant positive-associations between the measured line C and large light objects test rate performed by all recruited female participants (table 4.12).

Table 4.12 Correlations between hand measurement and large light objects test

Sex	Age group (years)	Hand side	*r* and *p*-values between large light objects test and measured lines							
			Line A		Line B		Line C		Line D	
			r	*p*	*r*	*p*	*r*	*p*	*r*	*p*
M	21-30	DH	-0.09	0.72	-0.28	0.26	-0.18	0.48	0.08	0.77
		NDH	-0.10	0.69	-0.32	0.20	-0.12	0.65	-0.01	0.97
	31-40	DH	-0.04	0.89	-0.22	0.43	-0.37	0.17	-0.08	0.77
		NDH	-0.02	0.96	-0.22	0.44	-0.21	0.44	-0.08	0.77
	41-50	DH	-0.34	0.20	-0.06	0.83	0.23	0.39	0.01	0.98
		NDH	-0.36	0.18	-0.02	0.94	0.16	0.55	-0.02	0.95
	51-60	DH	0.47	0.14	0.50	0.12	0.27	0.42	0.18	0.75
		NDH	0.42	0.20	0.50	0.12	0.54	0.09	0.02	0.96
	Total	DH	-0.10	0.45	-0.15	0.27	-0.03	0.81	-0.19	0.16
		NDH	-0.10	0.45	-0.15	0.26	0.06	0.65	-0.21	0.11
F	21-30	DH	-0.01	0.99	-0.01	0.97	0.25	0.22	0.17	0.42
		NDH	0.05	0.83	-0.16	0.45	0.33	0.11	0.08	0.69
	31-40	DH	0.01	0.99	0.18	0.38	0.22	0.28	-0.03	0.87
		NDH	-0.01	0.96	0.38	0.60	0.13	0.52	-0.02	0.92
	41-50	DH	-0.08	0.69	0.01	0.96	0.01	0.96	-0.01	0.96
		NDH	-0.09	0.68	0.07	0.74	0.002	0.99	0.08	0.69
	51-60	DH	-0.08	0.71	0.05	0.84	0.16	0.48	-0.03	0.90
		NDH	-0.29	0.20	0.10	0.65	0.12	0.61	-0.11	0.64
	Total	DH	-0.04	0.73	-0.004	0.97	0.28	<0.01*	-0.08	0.41
		NDH	-0.10	0.34	0.009	0.93	0.26	<0.01*	-0.10	0.33
Over all		DH	-0.06	0.45	-0.05	0.50	0.12	0.15	-0.13	-0.14
		NDH	-0.08	0.32	-0.05	0.57	0.13	0.10	0.11	0.07

**p*-value considered significant at < 0.05,

Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,

M = male; F = female; DH = dominant hand, NDH = Non-dominant hand

Subtest 5: Checkers

There were significant faster in rate of checkers tests performed by the DH as compared to that of the NDH in all recruited males, all recruited females, in male group during their 2nd 3rd, and 4th decades of life, including female participants in each age group. Moreover, the rate of checkers test performed by the DH appeared to be faster in female group as compared to that of the male group during the 2nd decade of life (table 4.13).

Table 4.13 Checkers test

Age group (years)	Male			Female			*p*-value[2]	
	DH (second)	NDH (second)	*p*-value[1]	DH (second)	NDH (second)	*p*-value[1]	DH	NDH
21-30	3.9 ±0.5	4.5 ±0.8	0.01*	3.4 ±0.6	4.0 ±0.5	<0.01*	0.01*	0.01*
31-40	3.8 ±0.8	4.7 ±1.1	<0.01*	3.7 ±0.6	4.2 ±0.6	<0.01*	0.65	0.06
41-50	4.1 ±0.8	5.0 ±1.2	0.01*	3.9 ±0.8	4.9 ±0.7	<0.01*	0.12	0.74
51-60	4.5 ±0.7	4.8 ±0.9	0.41	4.5 ±0.8	5.2 ±0.9	0.01*	0.69	0.18
Total	4.0 ±0.7	4.7 ±1.0	<0.01*	3.8 ±0.8	4.5 ±0.8	<0.01*	0.04*	0.15

**p*-value considered significant at < 0.05,

[1]*p*-value, dependent sample t-test; between dominant hand and non-dominant hand,

[2]*p*-value, independent sample t-test; between males and females,

DH = dominant hand, NDH = Non-dominant hand

There were significant positive associations between checkers test rate and the length of the measured line C in all recruited participants and all recruited female participants (table 4.14). Significant correlation between checkers test rate and the length of the measured line D of the DH in all recruited female participants was also observed.

Table 4.14 Correlations between hand measurement and checkers test

Sex	Age group (years)	Hand side	*r* and *p*-values between checker test and measured lines							
			Line A		Line B		Line C		Line D	
			r	*p*	*r*	*p*	*r*	*p*	*r*	*p*
M	21-30	DH	-0.06	0.83	-0.40	0.10	-0.51	0.03*	0.09	0.74
		NDH	-0.09	0.74	-0.38	0.12	-0.40	0.10	0.12	0.64
	31-40	DH	0.16	0.57	0.29	0.30	0.08	0.78	0.06	0.84
		NDH	0.15	0.59	0.15	0.59	0.24	0.40	0.18	0.51
	41-50	DH	-0.33	0.22	0.04	0.88	0.33	0.21	0.05	0.85
		NDH	-0.35	0.18	0.03	0.91	0.19	0.47	-0.07	0.80
	51-60	DH	0.05	0.99	0.10	0.78	0.04	0.92	-0.25	0.49
		NDH	-0.09	0.80	0.09	0.80	0.04	0.31	-0.35	0.32
	Total	DH	-0.13	0.32	-0.05	0.72	0.01	0.94	-0.10	0.44
		NDH	-0.15	0.25	-0.11	0.43	0.08	.055	0.11	0.40
F	21-30	DH	-0.19	0.37	-0.16	0.44	0.10	0.65	-0.02	0.93
		NDH	-0.20	0.33	-0.21	0.33	0.25	0.23	-0.07	0.74
	31-40	DH	-0.03	0.99	0.11	0.58	0.35	0.08	-0.36	0.07
		NDH	0.04	0.85	0.04	0.83	0.30	0.13	-0.09	0.66
	41-50	DH	-0.19	0.35	-0.19	0.37	-0.15	0.78	-0.08	0.69
		NDH	-0.19	0.36	-0.02	0.95	-0.06	0.69	-0.02	0.92
	51-60	DH	-0.05	0.84	0.03	0.90	0.27	0.23	-0.09	0.69
		NDH	-0.16	0.48	0.05	0.82	0.35	0.11	-0.14	0.53
	Total	DH	-0.11	0.27	-0.11	0.30	0.25	0.01*	-0.22	0.03*
		NDH	-0.14	0.17	-0.05	0.65	0.29	<0.01*	-0.17	0.09
Over all		DH	-0.06	0.44	-0.02	0.82	-0.20	0.01*	-0.14	0.08
		NDH	-0.08	0.33	-0.004	0.96	0.30	<0.01*	-0.12	0.14

*p-value considered significant at < 0.05,

Pearson's correlation studies, r = r-value, p = p-value,

M = male; F = female; DH = dominant hand, NDH = Non-dominant hand

Subtest 6: Blocks

There were significant faster in rate of blocks tests performed by the DH than the NDH in all recruited participants from both genders as well as in female of all age groups. There were significant faster in rate of blocks test performed by both hands in female as compared to male groups during the 3rd decade of life as well as by the DH in all recruited participants (table 4.15).

Table 4.15 Blocks test

Age group (years)	Male			Female			*p*-value[2]	
	DH (second)	NDH (second)	*p*-value[1]	DH (second)	NHD (second)	*p*-value[1]	DH	NDH
21-30	3.4 ±0.7	3.8 ±0.6	0.05	3.2 ±0.4	3.8 ±0.5	<0.01*	0.22	1.0
31-40	4.1 ±1.0	4.7 ±1.0	0.13	3.5 ±0.5	4.0 ±0.7	<0.01*	0.01*	0.01*
41-50	3.8 ±0.6	4.2 ±0.8	0.06	3.6 ±0.7	4.0 ±0.8	0.02*	0.34	0.22
51-60	4.3 ±0.6	4.7 ±0.5	0.09	4.3 ±0.7	4.8 ±0.9	0.04*	1.0	0.69
Total	3.9 ±0.8	4.3 ±0.8	<0.01*	3.6 ±0.7	4.1 ±0.8	<0.01*	0.01*	0.11

**p*-value considered significant at < 0.05,

[1]*p*-value, dependent sample t-test; between the DH and the NDH,

[2]*p*-value, independent sample t-test; between males and females,

DH = dominant hand, NDH = Non-dominant hand

There was significant correlation between the rate of blocks test performed by both hands and the length of the measured lines A in male group during the 4th decade of life, the length of the measured line D of the DH in all recruited female participants, as well as the length of the measured line C of the NDH in all recruited cases (table 4.16).

Table 4.16 Correlations between hand measurement and blocks test

Sex	Age group (yrs.)	Hand side	*r* and *p*-values between blocks test and measured lines							
			Line A		Line B		Line C		Line D	
			r	*p*	*r*	*p*	*r*	*p*	*r*	*p*
M	21-30	DH	-0.002	0.99	0.001	0.99	-0.30	0.21	0.11	0.67
		NDH	-0.03	0.91	-0.06	0.82	-0.30	0.41	0.03	0.92
	31-40	DH	0.28	0.31	0.14	0.63	-0.005	0.99	-0.05	0.85
		NDH	0.26	0.34	0.04	0.90	0.21	0.45	0.10	0.73
	41-50	DH	-0.55	0.03*	0.03	0.90	0.03	0.91	0.14	0.61
		NDH	-0.56	0.03*	0.02	0.93	0.04	0.89	0.12	0.65
	51-60	DH	-0.22	0.51	-0.07	0.85	-0.21	0.54	-0.23	0.53
		NDH	-0.27	0.42	0.005	0.99	0.06	0.86	-0.24	0.51
	Total	DH	-0.07	0.58	-0.02	0.90	-0.07	0.59	-0.14	0.31
		NDH	-0.08	0.56	-0.06	0.64	0.06	0.65	-0.11	0.40
F	21-30	DH	-0.10	0.62	-0.06	0.79	-0.05	0.80	0.01	0.95
		NDH	-0.05	0.82	-0.18	0.39	-0.04	0.85	0.03	0.87
	31-40	DH	-0.15	0.48	-0.11	0.58	0.13	0.53	-0.19	0.35
		NDH	-0.10	0.63	-0.10	0.64	0.05	0.81	-0.11	0.96
	41-50	DH	-0.36	0.08	-0.15	0.47	-0.22	0.28	-0.08	0.70
		NDH	-0.35	0.09	-0.14	0.52	-0.18	0.40	-0.08	0.70
	51-60	DH	-0.25	0.26	-0.20	0.41	0.19	0.40	-0.35	0.11
		NDH	-0.24	0.29	0.19	0.40	0.13	0.57	-0.35	0.11
	Total	DH	-0.21	0.04	-0.17	0.10	0.16	0.13	-0.24	0.02*
		NDH	-0.20	0.05	-0.15	0.15	0.13	0.19	-0.20	0.05
Over all		DH	-0.05	0.51	-0.02	0.81	0.15	0.06	-0.16	0.05
		NDH	-0.05	0.51	-0.02	0.78	0.18	0.02*	-0.12	0.12

*p-value considered significant at < 0.05,

Pearson's correlation studies, r = r-value, p = p-value,

M = male; F = female; DH = dominant hand, NDH = Non-dominant hand

Subtest 7: Nails

There were significant faster in rate of nails tests performed by the DH as compared to the NDH among all recruited participants in each gender as well as among female at each age group except during the 3rd decade of life. There were significant faster in rate of nails test performed by the DH in female as compared to that of male at each age group except during the 5th decade of life. There were also significant faster in rate of nails test performed by the NDH in female as compared to male considering on all recruited participants and considering on group during the 3rd decade of life (table 4.17).

Table 4.17 Nails test

Age group (years)	Male			Female			*p*-value[2]	
	DH (second)	NDH (second)	*p*-value[1]	DH (second)	NDH (second)	*p*-value[1]	DH	NDH
21-30	4.4 ±0.8	5.0 ±0.9	0.05	4.0 ±0.4	4.6 ±0.6	<0.01*	0.03*	0.08
31-40	4.7 ±0.8	5.3 ±1.0	0.08	4.2 ±0.7	4.6 ±0.8	0.08	0.04*	0.02*
41-50	4.7 ±0.6	5.2 ±1.0	0.05	4.3 ±0.5	4.9 ±0.7	<0.01*	0.02*	0.26
51-60	5.0 ±0.8	5.5 ±1.0	0.20	4.9 ±0.6	5.5 ±0.6	<0.01*	0.65	1.0
Total	4.7 ±0.8	5.2 ±1.0	<0.01*	4.3 ±0.7	4.9 ±0.8	<0.01*	<0.01*	0.03*

**p*-value considered significant at < 0.05,

[1]*p*-value, dependent sample t-test; between the DH and the NDH,

[2]*p*-value, independent sample t-test; between males and females,

DH = dominant hand, NDH = Non-dominant hand

There were significant associations between the rate of nails test and the length of measured line C of both hands among all recruited participants, all female participants as well as in female group during the 3rd decade of life. Also, there were significant negative associations between the measured line B and the rate of nails test performed by the NDH in female group during the 2nd decade of life (table 4.18).

Table 4.18 Correlations between hand measurement and nails test

Sex	Age group (years)	Hand side	*r* and *p*-values between nails test and measured lines							
			Line A		Line B		Line C		Line D	
			r	*p*	*r*	*p*	*r*	*p*	*r*	*p*
M	21-30	DH	0.16	0.53	0.01	0.98	0.10	0.69	0.27	0.28
		NDH	0.15	0.56	0.01	0.97	0.12	0.64	0.34	0.17
	31-40	DH	0.13	0.64	0.04	0.88	-0.22	0.43	0.11	0.69
		NDH	0.12	0.67	0.12	0.68	-0.16	0.58	0.20	0.47
	41-50	DH	-0.27	0.30	-0.02	0.95	0.11	0.69	0.08	0.77
		NDH	-0.28	0.30	0.05	0.85	0.03	0.92	0.14	0.60
	51-60	DH	-0.07	0.84	-0.05	0.89	-0.03	0.93	-0.31	-0.50
		NDH	-0.14	0.68	-0.02	0.95	0.14	0.69	0.38	.014
	Total	DH	0.01	0.99	-0.06	0.64	0.01	0.97	-0.04	0.75
		NDH	-0.01	0.99	-0.04	0.79	0.05	0.70	-0.04	0.77
F	21-30	DH	-0.37	0.07	-0.35	0.08	0.15	0.47	-0.07	0.72
		NDH	-0.28	0.17	-0.47	0.02*	0.19	0.36	-0.09	0.66
	31-40	DH	0.08	0.70	0.38	0.05	0.51	0.01*	-0.13	0.53
		NDH	0.08	0.70	0.29	0.15	0.46	0.02*	-003	0.87
	41-50	DH	-0.13	0.54	-0.09	0.69	0.001	0.99	-0.01	0.95
		NDH	-0.15	0.49	-0.05	0.81	0.04	0.86	0.12	0.58
	51-60	DH	-0.06	0.80	0.09	0.69	0.37	0.09	0.08	0.73
		NDH	-0.13	0.57	0.10	0.66	0.37	0.09	0.18	0.43
	Total	DH	-0.07	0.52	-0.001	0.99	0.39	<0.01*	-0.14	0.17
		NDH	-0.09	0.38	-0.009	0.93	0.37	<0.01*	-0.07	0.50
Over all		DH	0.06	0.46	0.08	0.33	0.32	<0.01*	-0.05	0.55
		NDH	0.05	0.52	0.09	0.25	0.32	<0.01*	-0.01	0.94

*p-value considered significant at < 0.05,

Pearson's correlation studies, r = r-value, p = p-value,

M = male; F = female; DH = dominant hand, NDH = Non-dominant hand

Subtest 8: Simulated feeding

There were significant faster in rate of simulated feeding tests performed by the DH in both genders at all age groups as compared to that of the NDH (table 38). There was significantly faster in rate of simulated feeding test performed by both hands in female compared to that of male groups when considering in all recruited cases, in cases during the 3rd decade of life. The rate of simulated feeding test performed by the DH group during the 4th decade of life was also significantly faster in female as compared to that of male groups (table 4.19).

Table 4.19 Simulated feeding test

Age group (years)	Males			Females			*p*-value[2]	
	DH (second)	NDH (second)	*p*-value[1]	DH (second)	NDH (second)	*p*-value[1]	DH	NDH
21-30	6.1 ±0.8	7.4 ±1.3	<0.01*	5.9 ±0.6	7.1 ±0.7	<0.01*	0.34	0.32
31-40	6.4 ±0.9	7.8 ±1.0	<0.01*	5.8 ±0.5	7.1 ±1.0	<0.01*	<0.01*	0.03*
41-50	6.7 ±0.8	8.0 ±1.0	<0.01*	5.6 ±0.8	7.4 ±1.2	<0.01*	<0.01*	0.10
51-60	7.0 ±0.8	8.6 ±1.4	<0.01*	6.5 ±0.8	8.2 ±1.2	<0.01*	0.06	0.35
Total	6.5 ±0.9	7.9 ±1.2	<0.01*	6.0 ±0.3	7.4 ±0.5	<0.01*	<0.01*	<0.01*

**p*-value considered significant at < 0.05,

[1]*p*-value, dependent sample t-test; between dominant hand and non-dominant hand,

[2]*p*-value, independent sample t-test; between males and females,

DH = dominant hand, NDH = Non-dominant hand

There were significant correlations between the rate of simulated feeding test and the length of measured lines A, B of the DH as well as the length of measured lines B, D of the NDH in the female group during the 4th decade of life (table 4.20).

Table 4.20 Correlations between hand measurement and simulated feeding test

Sex	Age group (years)	Hand side	*r* and *p*-values between simulated feeding test and measured lines							
			Line A		Line B		Line C		Line D	
			r	*p*	*r*	*p*	*r*	*p*	*r*	*p*
M	21-30	DH	0.22	0.38	-0.22	0.38	-0.30	0.23	-0.03	0.89
		NDH	0.19	0.45	-.025	0.31	-0.26	0.30	-0.07	0.78
	31-40	DH	0.02	0.95	-0.06	0.83	-0.09	-0.03	0.06	0.83
		NH	0.002	0.99	-0.11	0.69	0.74	.092	0.12	0.67
	41-50	DH	-0.46	0.07	-0.08	0.78	-0.25	0.34	-0.01	0.96
		NDH	-0.50	0.048*	-0.24	0.38	-.029	.027	-0.06	0.82
	51-60	DH	0.33	0.32	0.14	0.68	0.23	0.49	-0.28	0.43
		NDH	0.35	0.29	0.04	0.90	0.48	0.13	-0.28	0.43
	All	DH	-0.05	0.70	-0.16	0.23	-0.14	0.28	-0.14	0.28
		NDH	-0.06	.064	-0.24	0.06	-0.06	0.64	-0.14	0.29
F	21-30	DH	0.23	0.28	0.17	0.17	0.24	0.25	0.16	0.44
		NDH	0.27	0.19	0.24	0.42	0.20	0.33	0.20	0.33
	31-40	DH	-0.05	0.80	0.18	0.37	0.17	0.07	-0.02	0.92
		NH	-0.01	0.94	0.03	0.89	0.41	0.72	0.02	0.93
	41-50	DH	-0.63	<0.01*	-0.46	0.02*	-0.28	0.17	-0.40	0.05
		NDH	-0.61	<0.01	-0.47	0.02*	-0.22	0.28	-0.43	0.03*
	51-60	DH	0.15	0.51	0.23	0.31	0.40	0.06	0.10	0.65
		NDH	-0.21	0.34	0.31	0.16	0.47	0.03*	-0.04	0.85
	Total	DH	-0.13	0.21	-0.02	0.84	0.16	0.13	-0.10	0.32
		NDH	-0.18	0.07	-0.01	0.90	0.15	0.13	-0.11	0.26
Over all		DH	0.05	0.54	0.08	0.31	0.26	<0.01*	-0.05	0.51
		NDH	0.03	0.69	0.06	0.43	0.28	<0.01*	-0.05	0.52

*p-value considered significant at < 0.05,

Pearson's correlation studies, r = r-value, p = p-value,

M = male; F = female; DH = dominant hand, NDH = Non-dominant hand

Subtest 9: Button board

There was significantly faster in rate of button board test in female as compared to that of male groups during the 2nd and 3rd decades of life (table 4.21).

Table 4.21 Button board test

Age group (years)	Male (seconds)	Female (seconds)	*p*-value[1]
21-30	13.9 ±2.3	12.3 ±1.6	<0.01*
31-40	15.2 ±2.3	12.7 ±1.8	<0.01*
41-50	15.1 ±3.3	13.9 ±1.9	0.14
51-60	16.4 ±3.0	16.9 ±9.9	0.85
Total	15.0 ±2.8	13.8 ±5.1	0.09

**p*-value considered significant at < 0.05,

[1]*p*-value, independent sample t-test; between males and female groups

4.4 Grip-Strength Test

Using of an adjustable-handle Jamar dynamometer, reset to zero-position at each reading, grip-strength of the DH considering on a total number of all participants, male participants, as well as female participants were stronger than that of the NDH (33.0±9.2 *vs*. 29.3±8.1 kg, $p < 0.001$, 42.3±6.3 *vs*. 37.2±6.2 kg, $p < 0.001$, and 27.4±5.2 *vs*. 24.7±4.7 kg, $p < 0.001$, respectively). Grip-strength of the DH was also stronger than that of the NDH during the 2nd, 3rd, and 5th decades of life and had a trend to be stronger than that of NDH during the 4th decade of life in male subjects (table 4.22). In female subjects, grip-strength of the DH was stronger than that of the NDH during the 2nd decade of life and had a trend to be stronger than that of the NDH during the 4th decade of life. Moreover, there was a significantly stronger in male grip-strength as compared to that of female in all age groups.

Table 4.22 Grip-strength

Age group (years)	Male			Female			*p*-value[2]	
	DH	NDH	*p*-value[1]	DH	NDH	*p*-value[1]	DH	NDH
21-30	42.9 ±8.2	36.7 ±7.4	0.02*	27.7 ±4.4	24.8 ±4.0	0.01*	<0.01*	<0.01*
31-40	43.3 ±5.4	38.5 ±5.7	0.02*	26.8 ±6.3	24.1 ±4.8	0.11	<0.01*	<0.01*
41-50	41.6 ±6.2	37.3 ±6.5	0.06	28.4 ±4.8	25.8 ±5.0	0.07	<0.01*	<0.01*
51-60	40.9 ±4.1	36.3 ±5.1	0.009*	26.5 ±5.4	24.1 ±5.1	0.13	<0.01*	<0.01*
Total	42.3 ±6.3	37.2 ±6.2	<0.01*	27.4 ±5.2	24.7 ±4.7	0.002*	<0.01*	<0.01*

**p*-value considered significant at < 0.05,

[1]*p*-value, dependent sample t-test; between dominant hand and non-dominant hand,

[2]*p*-value, independent sample t-test; between males and females,

DH = dominant hand, NDH = Non-dominant hand

In male subjects, a significant positive correlation between the grip strength and the length of measured lines C from both hands as well as the length of the measured line B of the DH were observed during the 4th decade of life. Among females, there were significant positive associations between the length of the different measured lines and grip-strength (i.e. the measured lines A from both hands during the 3rd and 4th decades of life, the length of the measured line B from both hands during the 4th decade of life, the length of the measured lines C from both hands during the 2nd and 4th decades of life and from the NDH during the 3rd decade of life). Significant positive correlations on the NDH between grip strength and the length of both measured line C was also found in female group during the 2nd decades of life (table 4.23).

Table 4.23 Correlations between hand measurement and grip-strength

Sex	Age group (yrs.)	Side	*r* and *p*-values between grip strength and measured lines							
			Line A		Line B		Line C		Line D	
			r	*p*	*r*	*p*	*r*	*p*	*r*	*p*
M	21-30	DH	-0.23	0.38	0.25	0.34	0.43	0.09	-0.17	.051
		NDH	-0.32	0.21	0.30	0.25	0.36	0.16	-0.14	0.60
	31-40	DH	0.27	0.33	0.08	0.77	-0.04	0.88	-0.17	0.55
		NDH	0.44	0.10	0.19	0.50	0.25	0.37	-0.08	0.78
	41-50	DH	0.18	0.51	0.66	0.01*	0.72	<0.01*	0.32	0.24
		NDH	-0.12	0.67	0.34	0.22	0.75	<0.01*	-0.09	.075
	51-60	DH	0.08	0.83	-0.09	0.80	-0.10	0.76	0.24	0.50
		NDH	0.19	0.58	-0.02	0.95	0.19	0.57	0.06	0.88
	All	DH	0.02	0.91	0.29	0.03*	0.35	<0.01*	0.05	0.70
		NDH	-0.07	0.58	0.22	0.09	0.42	<0.01*	-0.05	0.69
F	21-30	DH	0.09	0.67	0.36	0.08	0.74	<0.01*	0.12	.056
		NDH	0.14	0.50	0.23	0.28	0.68	<0.01*	-0.07	0.72
	31-40	DH	0.41	0.046*	0.27	0.21	0.35	0.10	0.24	0.25
		NDH	0.50	0.01*	0.37	0.07	0.43	0.029*	0.09	0.68
	41-50	DH	0.59	<0.01*	0.60	<0.01*	0.63	<0.01*	0.35	0.09
		NDH	0.52	<0.01*	0.50	0.01*	0.62	<0.01*	0.24	0.25
	51-60	DH	0.37	0.09	0.40	0.06	0.34	0.12	0.31	0.58
		NDH	0.22	0.33	0.32	0.15	0.37	0.09	-0.03	0.89
	All	DH	0.36	<0.01*	0.40	<0.01*	0.43	<0.01*	0.21	0.04*
		NDH	0.34	<0.01*	0.34	0.001*	0.48	<0.01*	0.07	0.48
Over all		DH	0.33	<0.01*	0.54	<0.01*	0.73	<0.01*	0.22	<0.01*
		NDH	0.30	<0.01*	0.51	<0.01*	0.74	<0.01*	0.15	0.07

**p*-value considered significant at < 0.05,

Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,

M = male; F = female; DH = dominant hand, NDH = Non-dominant hand

4.5 Pinch Strength Test

After examining of palmar pinch, key pinch, and tip pinch strength by using of the B&L pinch gauge in the healthy volunteers, there were significantly stronger

palmar pinch-, key pinch- and tips pinch-strength in male as compared to that of female participants. Considering on all recruited male and female participants, this study found a significantly stronger palmar pinch-strength of the DH as compared to that of the NDH. But, there was no significant difference in the palmar pinch-strength between the DH and NDH when each decade of life was considered (except in female group during their 20 to 40 years of age) (table 4.24).

Table 4.24 Palmar pinch-strength

Age group (years)	Male			Female			*p*-value[2]	
	DH	NDH	*p*-value[1]	DH	NDH	*p*-value[1]	DH	NDH
21-30	7.9 ±1.4	7.1 ±1.5	0.11	6.3 ±1.3	5.6 ±1.0	0.01*	<0.01*	<0.01*
31-40	8.1 ±1.3	7.3 ±1.1	0.10	6.5 ±1.5	5.6 ±1.1	0.02*	<0.01*	<0.01*
41-50	8.0 ±1.6	7.4 ±1.4	0.24	6.7 ±1.3	6.3 ±1.1	0.16	<0.01*	<0.01*
51-60	7.6 ±0.9	7.2 ±0.9	0.35	6.3 ±1.3	5.7 ±1.2	0.11	<0.01*	<0.01*
Total	7.9 ±1.3	7.3 ±1.2	<0.01*	6.5 ±1.3	5.8 ±1.1	<0.01*	<0.01*	<0.01*

*p-value considered significant at < 0.05,

[1] p-value, dependent sample t-test; between dominant hand and non-dominant hand,

[2] p-value, independent sample t-test; between males and females,

DH = dominant hand, NDH = Non-dominant hand

There was significant correlation between the length of the measured lines A, B, C and the palmar pinch-strength in all of the recruited participants. There were also significant correlations between the length of the measured lines C and palmar pinch-strength in all participants from each gender. Significant sporadic positive associations were found between the measured line C and palmar pinch-strength in female group during the 2nd decade of life and in male group during the 4th decade of life. Positive correlations between palmar pinch-strength of the DH and the measured line A in male group during the 3rd decade of life as well as the measured line B of the NDH in male group during the 5th decade of life were also significantly shown (table 4.25).

Table 4.25 Correlations between hand measurement and palmar pinch-strength

Sex	Age group (years)	Hand side	*r* and *p*-values between palmar pinch strength and measured lines							
			Line A		Line B		Line C		Line D	
			r	*p*	*r*	*p*	*r*	*p*	*r*	*p*
M	21-30	DH	-0.19	0.47	0.34	0.19	0.20	0.44	-0.12	0.65
		NDH	-0.29	0.26	0.17	0.51	0.23	0.37	-0.19	0.47
	31-40	DH	0.56	0.03*	0.24	0.39	0.23	0.40	0.07	0.81
		NDH	0.33	0.24	0.20	0.47	0.24	0.40	0.20	0.47
	41-50	DH	0.26	0.25	0.48	0.07	0.59	0.02*	0.33	0.23
		NDH	0.46	0.09	0.47	0.08	0.62	0.01*	0.29	0.30
	51-60	DH	-0.10	0.78	-0.38	0.25	0.10	0.78	-0.34	0.34
		NDH	-0.28	0.40	-0.62	0.04*	-0.07	0.83	-0.56	0.09
	Total	DH	0.12	0.36	0.26	0.05	0.32	0.01*	0.09	0.52
		NDH	0.06	0.67	0.11	0.42	0.32	0.02*	0.01	0.95

*p-value considered significant at < 0.05,

Pearson's correlation studies, r = r-value, p = p-value,

M = male; F = female; DH = dominant hand, NDH = Non-dominant hand

Table 4.25 (continued) Correlations between hand measurement and palmar pinch-strength

Sex	Age group (years)	Hand side	*r* and *p*-values between palmar pinch strength and measured lines							
			Line A		Line B		Line C		Line D	
			r	*p*	*r*	*p*	*r*	*p*	*r*	*p*
F	21-30	DH	-0.13	0.53	0.14	0.51	0.76	<0.01*	-0.07	0.74
		NDH	-0.15	0.46	-0.14	0.52	0.43	0.03*	-0.29	0.16
	31-40	DH	0.25	0.24	0.13	0.53	0.26	0.21	0.04	0.87
		NDH	0.29	0.15	0.19	0.38	0.22	0.29	0.26	0.22
	41-50	DH	-0.19	0.36	-0.27	0.20	0.05	0.80	-0.01	0.99
		NDH	0.02	0.91	0.11	0.59	0.34	0.10	0.12	0.58
	51-60	DH	0.15	0.51	0.26	0.25	0.05	0.81	0.28	0.21
		NDH	0.18	0.41	0.24	0.29	0.15	0.52	0.10	0.67
	Total	DH	-0.01	.098	0.05	0.63	0.26	0.01*	0.04	0.68
		NDH	0.05	0.62	0.06	0.57	0.28	0.005*	0.001	0.90
Over all		DH	0.20	0.01*	0.31	<0.01*	0.50	<0.01*	0.13	0.09
		NDH	0.22	0.006*	0.30	<0.01*	0.55	<0.01*	0.11	0.18

*p-value considered significant at < 0.05,

Pearson's correlation studies, r = r-value, p = p-value,

M = male; F = female; DH = dominant hand, NDH = Non-dominant hand

For the key pinch-strength, statistical significances between DH and NDH were observed in all recruited subjects from both genders, in male participants during the 4th decade of life, and in female participants during the 2nd to 3rd decades of life. There was a significant stronger key pinch-strength of both hands in male as compared to that of female in all age groups (table 4.26).

Table 4.26 Key pinch-strength

Age group (years)	Male			Female			*p*-value[2]	
	DH	NDH	*p*-value[1]	DH	NDH	*p*-value[1]	DH	NDH
21-30	9.2 ±1.4	8.5 ±1.9	0.26	6.4 ±0.9	5.5 ±1.0	0.008*	<0.01*	<0.01*
31-40	9.3 ±0.8	8.9 ±1.2	0.26	6.6 ±1.1	5.9 ±0.9	0.03*	<0.01*	<0.01*
41-50	9.4 ±1.6	8.2 ±1.2	0.02*	6.9 ±1.1	6.5 ±1.0	0.19	<0.01*	<0.01*
51-60	8.6 ±0.6	8.3 ±1.0	0.49	6.8 ±0.9	6.2 ±1.0	0.15	<0.01*	<0.01*
Total	9.2 ±1.2	8.5 ±1.4	0.005*	6.5 ±1.0	5.9 ±1.1	0.04*	<0.01*	<0.01*

**p*-value considered significant at < 0.05,

[1]*p*-value, dependent sample t-test; between dominant hand and non-dominant hand,

[2]*p*-value, independent sample t-test; between males and females,

DH = dominant hand, NDH = Non-dominant hand.

There were significant correlations between key pinch-strength and the length of the measured lines C in all recruited participants as well as participants in each genders. Among male subjects, there were significant correlations between key pinch-strength during the 4th decade of life and the length of the measured line C of both hands as well as the length of the measured line B of the DH. Among females, there were significantly positive associations between key pinch-strength and the length of the measured line C and of both hands during the 2nd, 3rd, and 4th decades of life as well as the length of the measured line A of the NDH during the 3rd decade of life (table 4.27).

Table 4.27 Correlations between hand measurement and key pinch-strength

Sex	Age group (years)	Hand side	*r* and *p*-values between key pinch-strength and measured lines							
			Line A		Line B		Line C		Line D	
			r	*p*	*r*	*p*	*r*	*p*	*r*	*p*
M	21-30	DH	-0.06	0.81	-0.33	0.20	0.36	0.16	-0.01	0.99
		NDH	-0.23	0.37	0.23	0.39	0.28	0.28	-0.04	0.88
	31-40	DH	-0.04	0.89	0.24	0.38	-0.07	0.80	0.09	0.75
		NDH	0.01	0.97	0.37	0.18	0.18	0.65	0.12	0.66
	41-50	DH	0.18	0.51	0.66	0.007*	0.72	0.002*	0.32	0.84
		NDH	-0.12	0.67	0.34	0.22	0.75	0.001*	-0.09	0.75
	51-60	DH	-0.27	.042	-0.43	0.19	0.10	0.77	-0.29	0.42
		NDH	-0.13	0.70	-0.55	0.08	0.27	0.42	-0.43	0.22
	Total	DH	0.06	0.65	0.18	0.19	0.33	0.01*	0.03	0.83
		NDH	0.01	0.99	0.18	0.19	0.31	0.02*	0.01	0.93
F	21-30	DH	-0.07	0.76	0.07	0.73	0.56	0.003*	0.06	0.78
		NDH	-0.16	0.80	-0.13	0.53	0.57	0.003*	-0.17	0.40
	31-40	DH	0.27	0.20	0.25	0.23	0.57	0.003*	0.12	0.28
		NDH	0.51	0.01*	0.38	0.07	0.58	0.003*	0.12	0.58
	41-50	DH	0.08	0.74	0.06	0.79	0.47	0.02*	0.09	0.66
		NDH	0.25	0.24	0.20	0.34	0.57	0.003*	0.14	0.50
	51-60	DH	0.11	0.63	0.20	0.39	0.37	0.09	0.15	0.51
		NDH	0.08	0.72	-0.06	0.80	0.30	0.17	-0.13	0.56
	Total	DH	0.08	0.42	0.12	0.25	0.51	<0.01*	0.06	0.53
		NDH	0.11	0.29	0.03	0.77	0.53	<0.01*	-0.08	0.41
Over all		DH	0.28	<0.01*	0.42	<0.01*	0.73	<0.01*	0.17	0.04*
		NDH	0.27	<0.01*	0.39	<0.01*	0.72	<0.01*	0.11	0.17

*p-value considered significant at < 0.05,

Pearson's correlation studies, r = r-value, p = p-value,

M = male; F = female; DH = dominant hand, NDH = Non-dominant hand

Among females, tip pinch-strength of the DH was stronger than that of the NDH in all recruited participants of both genders and in female subjects during each decade of life. Tip pinch-strength performed by the DH was found to be stronger than

that of the NDH in male subjects during the 4th decade of life. Altogether, there was stronger tip pinch strength of both hands in male as compared to that of female in all age groups (table 4.28).

Table 4.28 Tip pinch-strength

Age group (years)	Male			Female			*p*-value[2]	
	DH	NDH	*p*-value[1]	DH	NDH	*p*-value[1]	DH	NDH
21-30	5.1 ±1.2	4.6 ±1.3	0.23	4.1 ±1.0	3.3 ±0.9	0.003*	<0.01*	<0.01*
31-40	5.7 ±0.8	5.2 ±0.7	0.06	4.0 ±0.9	3.2 ±0.7	0.001*	<0.01*	<0.01*
41-50	5.5 ±1.0	4.8 ±1.0	0.045*	4.5 ±0.9	3.8 ±0.8	0.005*	<0.01*	<0.01*
51-60	5.8 ±1.0	5.2 ±1.2	0.20	4.2 ±1.0	3.5 ±0.9	0.008*	<0.01*	<0.01*
Total	5.5 ±1.0	4.9 ±1.1	0.002*	4.2 ±0.9	3.4 ±0.9	<0.01*	<0.01*	<0.01*

**p*-value considered significant at < 0.05,

[1]*p*-value, dependent sample t-test; between dominant hand and non-dominant hand,

[2]*p*-value, independent sample t-test; between males and females,

DH = dominant hand, NDH = Non-dominant hand

There were significant correlations between the lengths of the measured lines A, B, and C and tip pinch-strength of all cases obtained from the recruited participants. Among male subjects, there was a significant positive correlation between the measured line C and tip pinch-strength of both hands in all male participants as well as during the 4th decade of life. Among female subjects, significant positive associations between tip pinch-strength and the length of the measured line C of both hands during the 2nd decade of life, the DH during the 3rd decade of life, and the NDH during the 4th decade of life. Significant positive associations between tip pinch-strength of the NDH and the length of the measured line A during the 3rd decade of life were also noted in this study (table 4.29).

Table 4.29 Correlations between hand measurement and tip pinch-strength

Sex	Age group (years)	Hand side	*r* and *p*-values between tip pinch-strength and measured lines							
			Line A		Line B		Line C		Line D	
			r	*p*	*r*	*p*	*r*	*p*	*r*	*p*
M	21-30	DH	0.20	0.44	0.28	0.27	0.15	0.56	0.41	0.10
		NDH	0.03	0.93	-0.07	0.80	0.30	0.24	0.06	0.83
	31-40	DH	-0.09	0.74	-0.18	0.52	-0.17	0.55	-0.16	0.58
		NDH	0.44	0.10	0.33	0.24	0.44	0.10	-0.15	0.59
	41-50	DH	.041	0.13	0.41	013	0.84	<0.01*	0.29	0.30
		NDH	0.15	0.58	0.09	0.76	0.75	<0.01*	0.03	0.92
	51-60	DH	-0.28	0.40	-0.52	0.10	0.30	0.37	-0.29	0.42
		NDH	-0.07	-0.54	-0.54	0.09	0.45	0.17	-0.58	0.08
	Total	DH	0.18	0.17	0.01	0.94	0.29	0.03*	0.05	.072
		NDH	0.13	0.33	-0.08	0.55	0.46	<0.01*	-0.16	0.23
F	21-30	DH	-0.04	0.86	0.19	0.38	0.68	<0.01*	0.15	0.46
		NDH	0.04	0.84	0.04	0.85	0.61	0.001*	-0.01	0.99
	31-40	DH	0.21	0.32	0.23	0.26	0.55	0.004*	0.12	0.57
		NDH	0.44	0.03*	0.28	0.18	0.38	0.06	0.11	.060
	41-50	DH	-0.16	0.44	-0.16	0.45	0.32	0.12	-0.01	0.96
		NDH	-0.02	0.92	-0.04	0.86	0.44	0.03*	-003	0.88
	51-60	DH	0.20	0.37	0.12	0.59	0.12	0.59	0.08	0.72
		NDH	0.30	0.18	-0.03	0.90	0.40	0.07	-0.14	0.52
	Total	DH	0.003	0.98	0.07	0.52	0.43	<0.01*	0.06	0.57
		NDH	0.12	0.26	-0.004	0.97	0.46	<0.01*	-0.06	0.56
Over all		DH	0.27	<0.01*	0.28	<0.01*	0.62	<0.01*	0.15	0.07
		NDH	0.30	<0.01*	0.26	<0.01*	0.69	<0.01*	0.03	0.70

*p-value considered significant at < 0.05, M = male; F = female;

DH = dominant hand, NDH = Non-dominant hand,

Pearson's correlation studies, r = r-value, p = p-value

Table 4.30 Correlations between age and various hand-strength/hand-function tests in male group during the 2nd decade of life.

Variables	Hand side	*r*-value	*p*-value
Grip-strength	DH	-0.13	0.62
	NDH	0.02	0.94
Palmar pinch-strength	DH	0.03	0.92
	NDH	-0.08	0.76
Key pinch-strength	DH	-0.09	0.73
	NDH	-0.01	0.97
Tip pinch-strength	DH	-0.07	0.80
	NDH	0.05	0.85
Large pegs test	DH	-0.11	0.67
	NDH	0.14	0.59
Small pegs test	DH	0.03	0.91
	NDH	0.06	0.82
Large heavy objects test	DH	0.56	0.02*
	NDH	0.60	0.01*
Large light objects test	DH	0.49	0.04*
	NDH	0.62	0.01*
Checkers test	DH	0.20	0.44
	NDH	0.31	0.21
Blocks test	DH	0.26	0.30
	NDH	0.11	0.65
Nails test	DH	-0.08	0.76
	NDH	0.13	0.62
Simulated feeding test	DH	0.20	0.43
	NDH	0.19	0.44
Button board test	B	0.33	0.19

**p*-value considered significant at < 0.05, M = male; F = female; B = both hands, Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value

DH = dominant hand, NDH = non-dominant hand

There were significant correlations between age and the rates of large heavy & light objects test performed by both hands in male group during the 2nd decade of life (table 4.30).

Table 4.31 Correlations between age and various hand-strength/hand-function tests in male group during the 3rd decade of life.

Variables	Hand side	*r*-values	*p*-value
Grip-strength	DH	0.15	0.57
	NDH	0.13	0.64
Palmar pinch-strength	DH	0.14	0.62
	NDH	0.10	0.71
Key pinch-strength	DH	0.02	0.93
	NDH	-0.24	0.37
Tip pinch-strength	DH	0.13	0.65
	NDH	0.12	0.67
Large pegs test	DH	0.13	0.61
	NDH	0.12	0.65
Small pegs test	DH	0.18	0.50
	NDH	0.26	0.31
Large heavy objects test	DH	-0.09	0.71
	NDH	-0.05	0.84
Large light objects test	DH	-0.15	0.58
	NDH	0.35	0.17
Checkers test	DH	-0.12	0.64
	NDH	0.25	0.34
Blocks test	DH	0.16	0.53
	NDH	0.28	0.27

**p*-value considered significant at < 0.05, M = male; F = female; B = both hands, Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value

DH = dominant hand, NDH = non-dominant hand

Table 4.31 (continued) Correlations between age and various hand-strength/ hand-function tests in male group during the 3rd decade of life.

Variables	Hand side	*r*-values	*p*-value
Nails test	DH	0.003	0.99
	NDH	0.19	0.46
Simulated feeding test	DH	0.02	0.93
	NDH	0.07	0.79
Button board test	B	-0.05	0.86

*p-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, r = r-value, p = p-value
DH = dominant hand, NDH = non-dominant hand

There was no significant correlation between age and grip-/ pinch-strength, or any kind of the hand function test rate in male group during their 3rd decade of life (table 4.31).

Table 4.32 Correlations between age and various hand-strength/hand-function tests in male group during the 4th decade of life.

Variables	Hand side	*r*-values	*p*-value
Grip-strength	DH	0.16	0.57
	NDH	0.13	0.64
Palmar pinch-strength	DH	0.14	0.62
	NDH	0.10	0.71
Key pinch-strength	DH	0.02	0.93
	NDH	-0.24	0.37
Tip pinch-strength	DH	0.13	0.65
	NDH	0.12	0.67

*p-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, r = r-value, p = p-value,
DH = dominant hand, NDH = non-dominant hand

Table 4.32 (Continued) Correlations between age and various hand-strength/hand-function tests in male group during the 4th decade of life.

Variables	Hand side	*r*-values	*p*-value
Large pegs test	DH	0.13	0.61
	NDH	0.12	0.65
Small pegs test	DH	0.18	0.50
	NDH	0.26	0.31
Large heavy objects test	DH	-0.09	0.73
	NDH	-0.05	0.84
Large light objects test	DH	-0.15	0.58
	NDH	0.35	0.17
Checkers test	DH	-0.12	0.64
	NDH	0.25	0.34
Blocks test	DH	0.16	0.53
	NDH	0.28	0.27
Nails test	DH	0.003	0.99
	NDH	0.19	0.46
Simulated feeding test	DH	0.02	0.93
	NDH	0.07	0.79
Button board test	B	-0.05	0.86

*p-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, r = r-value, p = p-value,
DH = dominant hand, NDH = non-dominant hand

There was no significant correlation between age and hand grip-strength / hand function tests in male group during their 4th decade of life (table 4.32).

Table 4.33 Correlations between age and various hand-strength/hand-function tests in male group during the 5th decade of life.

Variables	Hand side	*r*-values	*p*-value
Grip-strength	DH	-0.63	0.04*
	NDH	0.001	0.99
Palmar pinch-strength	DH	-0.32	0.34
	NDH	-0.28	0.41
Key pinch-strength	DH	0.18	0.59
	NDH	0.21	0.53
Tip pinch-strength	DH	0.13	0.71
	NDH	0.37	0.27
Large pegs test	DH	0.03	0.94
	NDH	0.26	0.44
Small pegs test	DH	-0.01	0.98
	NDH	0.17	0.63
Large heavy objects test	DH	0.33	0.32
	NDH	0.74	0.009*
Large light objects test	DH	0.64	0.03*
	NDH	0.52	0.10
Checkers test	DH	0.49	0.13
	NDH	0.34	0.30
Blocks test	DH	-0.17	0.61
	NDH	0.20	0.45
Nails test	DH	0.34	0.31
	NDH	0.17	0.62
Simulated feeding test	DH	0.63	0.04*
	NDH	0.56	0.07
Button board test	B	0.43	0.19

*p-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, r = r-value, p = p-value,
DH = dominant hand, NDH = non-dominant hand

There were significant correlations between age and grip-strength of the DH, the rate of large heavy objects test performed by the NDH, the rate of large light objects performed by the DH, as well as between age and the rate of simulated feeding test performed by the DH in male group during their 5th decade of life (table 4.33).

Table 4.34 Correlations between age and various hand-strength/hand-function tests in all male participants.

Variables	Hand side	*r*-values	*p*-value
Grip-strength	DH	-0.15	0.25
	NDH	-0.03	0.84
Palmar pinch-strength	DH	-0.05	0.69
	NDH	0.05	0.69
Key pinch-strength	DH	-0.11	0.39
	NDH	-0.11	0.40
Tip pinch-strength	DH	0.22	0.09
	NDH	0.18	0.17
Large pegs test	DH	0.22	0.09
	NDH	0.38	0.003*
Small pegs test	DH	0.42	0.001*
	NDH	0.42	0.001*
Large heavy objects test	DH	0.39	0.002*
	NDH	0.48	<0.01*
Large light objects test	DH	0.51	<0.01*
	NDH	0.56	<0.01*
Checkers test	DH	0.33	0.01*
	NDH	0.22	0.08

**p*-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,
DH = dominant hand, NDH = non-dominant hand

Table 4.34 (continued) Correlations between age and various hand-strength/ hand-function tests in all male participants.

Variables	Hand side	*r*-values	*p*-value
Blocks test	DH	0.28	0.03*
	NDH	0.26	0.04*
Nails test	DH	0.24	0.07
	NDH	0.22	0.09
Simulated feeding test	DH	0.38	0.002*
	NDH	0.37	0.003*
Button board test	B	0.30	0.02*

**p*-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,
DH = dominant hand, NDH = non-dominant hand

There were significant correlations between the rates of various hand function tests such as large light & heavy objects test, small pegs test, simulated feeding test, blocks test, button board test performed by both hands; checkers test performed by the DH; large pegs test performed by the NDH and age in all male participants (table 4.34).

Table 4.35 Correlations between age and various hand-strength/hand-function tests in female group during the 2nd decade of life.

Variables	Hand side	*r*-values	*p*-value
Grip-strength	DH	-0.004	0.98
	NDH	-0.009	0.96
Palmar pinch-strength	DH	0.05	0.79
	NDH	0.17	0.39

**p*-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,
DH = dominant hand, NDH = non-dominant hand

Table 4.35 (continued) Correlations between age and various hand-strength/hand-function tests in female group during the 2nd decade of life.

Variables	Hand side	*r*-values	*p*-value
Key pinch-strength	DH	0.28	0.15
	NDH	-0.10	0.63
Tip pinch-strength	DH	-0.04	0.84
	NDH	-0.08	0.68
Large pegs test	DH	0.21	0.29
	NDH	0.35	0.07
Small pegs test	DH	0.28	0.15
	NDH	0.23	0.23
Large heavy objects test	DH	0.11	0.58
	NDH	0.009	0.96
Large light objects test	DH	0.08	0.69
	NDH	0.07	0.71
Checkers test	DH	0.10	0.62
	NDH	0.11	0.58
Blocks test	DH	0.07	0.72
	NDH	-0.04	0.84
Nails test	DH	-0.20	0.30
	NDH	-0.16	0.43
Simulated feeding test	DH	0.25	0.20
	NDH	0.13	0.51
Button board test	B	-0.15	0.15

**p*-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,
DH = dominant hand, NDH = non-dominant hand

There was no significant correlation between age and hand-strength/hand function tests in female group during their 2nd decade of life (table 4.35).

Table 4.36 Correlations between age and various hand-strength/hand-function tests in female group during the 3rd decade of life.

Variables	Hand side	*r*-values	*p*-value
Grip-strength	DH	-0.20	0.36
	NDH	-0.13	0.53
Palmar pinch-strength	DH	-0.22	0.28
	NDH	-0.41	0.04*
Key pinch-strength	DH	-0.27	0.20
	NDH	-0.12	0.56
Tip pinch-strength	DH	-0.05	0.82
	NDH	-0.02	0.93
Large pegs test	DH	0.35	0.08
	NDH	0.28	0.16
Small pegs test	DH	0.48	0.01*
	NDH	0.27	0.18
Large heavy objects test	DH	0.26	0.20
	NDH	0.31	0.13
Large light objects test	DH	0.15	0.45
	NDH	0.20	0.32
Checkers test	DH	0.22	0.29
	NDH	0.24	0.23
Blocks test	DH	-0.04	0.85
	NDH	0.15	0.46
Nails test	DH	0.11	0.60
	NDH	0.15	0.46
Simulated feeding test	DH	0.13	0.53
	NDH	0.02	0.93
Button board test	B	0.26	0.20

*p-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, r = r-value, p = p-value,
DH = dominant hand, NDH = non-dominant hand

There was significant correlation between age and palmar pinch-strength of the NDH, the rate of small pegs test performed by the DH in female group during their 3rd decade of life (table 4.36).

Table 4.37 Correlations between age and various hand-strength/hand-function tests in female group during the 4th decade of life.

Variables	Hand side	*r*-values	*p*-value
Grip-strength	DH	-0.45	0.02*
	NDH	-0.29	0.15
Palmar pinch-strength	DH	-0.01	0.95
	NDH	0.07	0.75
Key pinch-strength	DH	-0.13	0.55
	NDH	-0.27	0.19
Tip pinch-strength	DH	-0.13	0.53
	NDH	-0.12	0.58
Large pegs test	DH	0.37	0.07
	NDH	0.05	0.80
Small pegs test	DH	0.07	0.74
	NDH	0.02	0.93
Large heavy objects test	DH	0.30	0.14
	NDH	-0.03	0.87
Large light objects test	DH	0.06	0.79
	NDH	0.08	0.71
Checkers test	DH	0.12	0.56
	NDH	-0.10	0.64

*p-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, r = r-value, p = p-value,
DH = dominant hand, NDH = non-dominant hand

Table 4.37 (continued) Correlations between age and various hand-strength/ hand-function tests in female group during the 4th decade of life.

Variables	Hand side	*r*-values	*p*-value
Blocks test	DH	0.31	0.13
	NDH	0.15	0.46
Nails test	DH	0.07	0.73
	NDH	0.04	0.86
Simulated feeding test	DH	0.37	0.07
	NDH	0.13	0.54
Button board test	B	0.35	0.09

*p-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, r = r-value, p = p-value,
DH = dominant hand, NDH = non-dominant hand

There was a significant correlation between age and grip-strength of the DH in female group during the 4th decade of life (table 4.37).

Table 4.38 Correlations between age and various hand-strength/hand-function tests in female group during the 5th decade of life.

Variables	Hand side	*r*-values	*p*-value
Grip-strength	DH	-0.01	0.96
	NDH	-0.10	0.66
Palmar pinch-strength	DH	-0.07	0.76
	NDH	-0.19	0.38
Key pinch-strength	DH	0.10	0.64
	NDH	0.06	0.79

*p-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, r = r-value, p = p-value,
DH = dominant hand, NDH = non-dominant hand

Table 4.38 (Continued) Correlations between age and various hand-strength/hand-function tests in female group during the 5th decade of life.

Variables	Hand side	*r*-values	*p*-value
Tip pinch-strength	DH	-0.05	0.83
	NDH	-0.30	0.16
Large pegs test	DH	0.22	0.33
	NDH	0.43	0.045*
Small pegs test	DH	0.17	0.44
	NDH	0.18	0.43
Large heavy objects test	DH	0.40	0.06
	NDH	0.48	0.02*
Large light objects test	DH	0.25	0.27
	NDH	0.26	0.26
Checkers test	DH	0.16	0.47
	NDH	0.19	0.19
Blocks test	DH	0.34	0.12
	NDH	0.48	0.02*
Nails test	DH	0.30	0.18
	NDH	0.57	0.006*
Simulated feeding test	DH	0.18	0.43
	NDH	0.03	0.90
Button board test	B	0.18	0.09

*p-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, r = r-value, p = p-value,
DH = dominant hand, NDH = non-dominant hand

There were significant correlations between the rates of large pegs, large heavy objects, blocks, and nails tests performed by the NDH and age in female group during their 5th decade of life (table 4.38).

Table 4.39 Correlations between age and various hand-strength/hand-function tests in all female participants.

Variables	Hand side	*r*-values	*p*-value
Grip-strength	DH	-0.09	0.39
	NDH	-0.04	0.69
Palmar pinch-strength	DH	-0.004	0.97
	NDH	0.09	0.40
Key pinch-strength	DH	0.16	0.12
	NDH	0.27	0.006*
Tip pinch-strength	DH	0.11	0.30
	NDH	0.13	0.20
Large pegs test	DH	0.64	<0.01*
	NDH	0.59	<0.01*
Small pegs test	DH	0.60	<0.01*
	NDH	0.53	<0.01*
Large heavy objects test	DH	0.49	<0.01*
	NDH	0.49	<0.01*
Large light objects test	DH	0.50	<0.01*
	NDH	0.56	<0.01*
Checkers test	DH	0.51	<0.01*
	NDH	0.57	<0.01*
Blocks test	DH	0.52	<0.01*
	NDH	0.43	<0.01*
Nails test	DH	0.46	<0.01*
	NDH	0.46	<0.01*
Simulated feeding test	DH	0.26	0.008*
	NDH	0.33	0.001*
Button board test	B	0.32	0.001*

**p*-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,
DH = dominant hand, NDH = non-dominant hand

There were significant correlations between the rates of various hand functions test such as large light & heavy objects test, large & small pegs test, checkers test, blocks test, nails test, simulated feeding test, button board test performed by both hands, key pinch-strength of the NDH, and age in all female participants (table 4.39).

Table 4.40 Correlations between age and various hand-strength/hand-function tests in all participants (both genders).

Variables	Hand side	*r*-values	*p*-value
Grip-strength	DH	-0.11	0.18
	NDH	-0.05	0.49
Palmar pinch-strength	DH	-0.04	0.62
	NDH	0.04	0.65
Key pinch-strength	DH	-0.01	0.99
	NDH	0.05	0.57
Tip pinch-strength	DH	0.10	0.21
	NDH	0.09	0.25
Large pegs test	DH	0.45	<0.01*
	NDH	0.50	<0.01*
Small pegs test	DH	0.51	<0.01*
	NDH	0.47	<0.01*
Large heavy objects test	DH	0.45	<0.01*
	NDH	0.48	<0.01*
Large light objects test	DH	0.56	<0.01*
	NDH	0.45	<0.01*
Checkers test	DH	0.44	<0.01*
	NDH	0.42	<0.01*
Blocks test	DH	0.41	<0.01*
	NDH	0.36	<0.01*

**p*-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,
DH = dominant hand, NDH = non-dominant hand

Table 4.40 (continued) Correlations between age and various hand-strength/ hand-function tests in all participants (both genders).

Variables	Hand side	*r*-values	*p*-value
Nails test	DH	0.35	<0.01*
	NDH	0.34	<0.01*
Simulated feeding test	DH	0.27	<0.01*
	NDH	0.33	<0.01*
Button board test	B	0.30	<0.01*

**p*-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,
DH = dominant hand, NDH = non-dominant hand

There were significant correlations between the rates of all hand functions tests performed by both hands and age of all participants considering in both genders (table 4.40)

Table 4.41 Correlations between BMI and various hand-strength/hand-function tests in male group during the 2nd decade of life.

Variables	Hand side	*r*-values	*p*-value
Grip-strength	DH	0.56	0.02*
	NDH	0.45	0.07
Palmar pinch-strength	DH	0.59	0.01*
	NDH	0.31	0.23
Key pinch-strength	DH	0.51	0.035*
	NDH	0.37	0.14
Tip pinch-strength	DH	0.51	0.036*
	NDH	0.43	0.09

**p*-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,
DH = dominant hand, NDH = non-dominant hand

Table 4.41 (continued) Correlations between BMI and various hand-strength/ hand-function tests in male group during the 2nd decade of life.

Variables	Hand side	*r*-values	*p*-value
Large pegs test	DH	0.10	0.70
	NDH	0.01	0.96
Small peg test	DH	-0.10	0.71
	NDH	-0.05	0.86
Large heavy objects test	DH	0.24	0.34
	NDH	0.05	0.84
Large light objects test	DH	0.29	0.26
	NDH	0.07	0.78
Checkers test	DH	-0.23	0.36
	NDH	0.02	0.94
Blocks test	DH	0.08	0.76
	NDH	-0.03	0.90
Nails test	DH	0.19	0.45
	NDH	0.26	0.30
Simulated feeding test	DH	-0.12	0.63
	NDH	-0.39	0.11
Button board test	B	-0.19	0.46

*p-value considered significant at < 0.05, M = male; F = female; B = both hands, Pearson's correlation studies, r = r-value, p = p-value,
DH = dominant hand, NDH = non-dominant hand

There were significant correlations between BMI and the hand strength of the DH in male group during the 2nd decade of life (table 4.41).

Table 4.42 Correlations between BMI and various hand-strength/hand-function tests in male group during the 3rd decade of life.

Variables	Hand side	*r*-values	*p*-value
Grip-strength	DH	-0.20	0.47
	NDH	-0.25	0.36
Palmar pinch-strength	DH	-0.34	0.20
	NDH	-0.35	0.18
Key pinch-strength	DH	-0.08	0.77
	NDH	-0.03	0.92
Tip pinch-strength	DH	0.06	0.82
	NDH	0.15	0.59
Large pegs test	DH	0.36	0.17
	NDH	0.29	0.28
Small pegs test	DH	0.47	0.07
	NDH	0.33	0.22
Large heavy objects test	DH	0.03	0.92
	NDH	0.08	0.77
Large light objects test	DH	0.05	0.86
	NDH	0.04	0.88
Checkers test	DH	0.26	0.33
	NDH	0.15	0.57
Blocks test	DH	0.10	0.71
	NDH	-0.11	0.69
Nails test	DH	-0.06	0.82
	NDH	0.30	0.27
Simulated feeding test	DH	-0.05	0.86
	NDH	-0.05	0.85
Button board test	B	0.08	0.76

**p*-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,
DH = dominant hand, NDH = non-dominant hand

There was no significant correlation between BMI and hand strength / hand function tests in male group during their 3rd decade of life (table 4.42).

Table 4.43 Correlations between BMI and various hand-strength/hand-function tests in male group during the 4th decade of life.

Variables	Hand side	*r*-values	*p*-value
Grip-strength	DH	0.51	0.045*
	NDH	0.47	0.07
Palmar pinch-strength	DH	0.51	0.043*
	NDH	0.50	0.047*
Key pinch-strength	DH	0.49	0.05
	NDH	0.15	0.57
Tip pinch-strength	DH	0.53	0.034*
	NDH	0.58	0.02*
Large pegs test	DH	-0.22	0.40
	NDH	-0.003	0.99
Small pegs test	DH	-0.21	0.42
	NDH	0.05	0.84
Large heavy objects test	DH	0.03	0.90
	NDH	0.26	0.32
Large light objects test	DH	0.02	0.94
	NDH	0.27	0.29
Checkers test	DH	0.24	0.35
	NDH	0.10	0.72
Blocks test	DH	-0.002	0.99
	NDH	0.10	0.71
Nails test	DH	-0.19	0.47
	NDH	-0.06	0.82

*p-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, r = r-value, p = p-value,
DH = dominant hand, NDH = non-dominant hand

Table 4.43 (continued) Correlations between BMI and various hand-strength/ hand-function tests in male group during the 4th decade of life.

Variables	Hand side	*r*-values	*p*-value
Simulated feeding test	DH	-0.38	0.13
	NDH	0.10	0.70
Button board test	B	-0.08	0.77

**p*-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,
DH = dominant hand, NDH = non-dominant hand

There were significant correlations between BMI and palmar- & tip pinch-strength of both hands, and grip-strength test of the DH in male group during the 4th decade of life (table 4.43).

Table 4.44 Correlations between BMI and various hand-strength/hand-function tests in male group during the 5th decade of life.

Variables	Hand side	*r*-values	*p*-value
Grip-strength	DH	0.003	0.99
	NDH	0.07	0.85
Palmar pinch-strength	DH	0.29	0.39
	NDH	0.48	0.14
Key pinch-strength	DH	0.35	0.29
	NDH	0.65	0.03*
Tip pinch-strength	DH	0.81	0.11
	NDH	0.79	0.004*
Large pegs test	DH	0.36	0.28
	NDH	0.33	0.33

**p*-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,
DH = dominant hand, NDH = non-dominant hand

Table 4.44 (continued) Correlations between BMI and various hand-strength/ hand-function tests in male group during the 5th decade of life.

Variables	Hand side	*r*-values	*p*-value
Small pegs test	DH	0.20	0.56
	NDH	0.17	0.61
Large heavy objects test	DH	0.04	0.92
	NDH	0.07	0.84
Large light objects test	DH	-0.04	0.90
	NDH	0.11	0.75
Checkers test	DH	0.02	0.96
	NDH	-0.04	0.92
Blocks test	DH	-0.09	0.79
	NDH	-0.12	0.72
Nails test	DH	0.01	0.97
	NDH	0.19	0.58
Simulated feeding test	DH	0.31	0.36
	NDH	-0.36	0.27
Button board test	B	-0.34	0.31

*p-value considered significant at < 0.05, M = male; F = female; B = both hands, Pearson's correlation studies, r = r-value, p = p-value,
DH = dominant hand, NDH = non-dominant hand

There were significant correlations between BMI and tip & key pinch-strength of the NDH in male group during the 5th decade of life (table 4.44).

Table 4.45 Correlations between BMI and various hand-strength/hand-function tests in all male participants.

Variables	Hand side	*r*-values	*p*-value
Grip-strength	DH	0.18	0.17
	NDH	0.16	0.21
Palmar pinch-strength	DH	0.18	0.16
	NDH	0.19	0.15
Key pinch-strength	DH	0.24	0.06
	NDH	0.19	0.14
Tip pinch-strength	DH	0.42	0.001*
	NDH	0.47	0.001*
Large pegs test	DH	0.21	0.11
	NDH	0.29	0.02*
Small pegs test	DH	0.20	0.12
	NDH	0.29	0.02*
Large heavy objects test	DH	0.17	0.18
	NDH	0.25	0.049*
Large light objects test	DH	0.20	0.12
	NDH	0.29	0.04*
Checkers test	DH	0.19	0.14
	NDH	0.13	0.33
Blocks test	DH	0.18	0.16
	NDH	0.10	0.43
Nails test	DH	0.08	0.53
	NDH	0.22	0.09
Simulated feeding test	DH	0.04	0.78
	NDH	-0.02	0.91
Button board test	B	0.02	0.91

**p*-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,
DH = dominant hand, NDH = non-dominant hand

There were significant correlations between tip pinch-strength of both hands, the rates of large heavy & light objects test, the rates of large & small pegs test performed by the NDH and BMI in all male participants (table 4.45).

Table 4.46 Multivariate, linear regression, study between age, and various hand-strength/hand-function tests adjusted for BMI in all male participants.

Parameter	Handed	Age		BMI	
		Beta	*p*-value	Beta	*p*-value
Tip-pinch strength	DH	ND	0.48	ND	0.001*
	NDH	ND	0.84	ND	<0.001*
Simulated feeding test	DH	ND	0.002*	ND	0.38
	NDH	ND	0.003*	ND	0.20
Checkers test	DH	ND	0.01*	ND	0.52
Large light objects test	DH	ND	<0.001*	ND	0.84
	NDH	ND	<0.001*	ND	0.53
Large heavy objects test	DH	ND	0.002*	ND	0.76
	NDH	ND	<0.001*	ND	0.46
Blocks test	DH	ND	0.025*	ND	0.50
	NDH	ND	0.044*	ND	0.93
Large pegs test	NDH	ND	0.003*	ND	0.16
Small pegs test	DH	ND	0.001*	ND	0.65
	NDH	ND	0.001*	ND	0.22
Buttons board test	Both	ND	0.017*	ND	0.87

**p*-value considered significant at < 0.05, Beta =Standardized Coefficients Beta, ND = Not determined, DH = dominant hand, NDH = non-dominant hand

After multivariate, linear regression, stepwise analyses were performed. The statistical significances could exist only in some aspects. There were significant associations between BMI and tip-pinch strength, between the rates of various hand functions test and age such as simulated feeding, large light & heavy objects, small

pegs, blocks, button board tests performed by both hands, checkers test performed by the DH, and large pegs test performed by the NDH (table 4.46).

Table 4.47 Correlations between BMI and various hand-strength / hand-function tests in female group during the 2nd decade of life.

Variables	Hand side	*r*-values	*p*-value
Grip-strength	DH	0.36	0.06
	NDH	0.51	0.006*
Palmar pinch-strength	DH	0.25	0.20
	NDH	0.43	0.02*
Key pinch-strength	DH	0.54	0.003*
	NDH	0.51	0.006*
Tip pinch-strength	DH	0.48	0.009*
	NDH	0.53	0.003*
Large pegs test	DH	0.22	0.25
	NDH	0.17	0.40
Small pegs test	DH	0.24	0.23
	NDH	0.31	0.11
Large heavy objects test	DH	0.15	0.45
	NDH	0.03	0.86
Large light objects test	DH	0.32	0.10
	NDH	0.17	0.39
Checkers test	DH	0.30	0.13
	NDH	0.05	0.79
Blocks test	DH	0.18	0.36
	NDH	0.14	0.49
Nails test	DH	0.32	0.10
	NDH	0.11	0.59

*p-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, r = r-value, p = p-value,
DH = dominant hand, NDH = non-dominant hand

Table 4.47 (Continued) Correlations between BMI and various hand-strength / hand-function tests in female group during the 2nd decade of life.

Variables	Hand side	*r*-values	*p*-value
Simulated feeding test	DH	0.14	0.48
	NDH	0.11	0.58
Button board test	B	0.24	0.22

**p*-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,
DH = dominant hand, NDH = non-dominant hand

There were significant correlations between BMI and key and tip pinch-strength of both hands during the 2nd decade of life. Moreover, there were significant correlations between BMI and grip-strength, palmar pinch-strength of the NDH in female group during the 2nd decade of life (table 4.47).

Table 4.48 Correlations between BMI and various hand-strength/hand-function tests in female group during the 3rd decade of life.

Variables	Hand side	*r*-values	*p*-value
Grip-strength	DH	0.06	0.77
	NDH	0.04	0.84
Palmar pinch-strength	DH	-0.06	0.79
	NDH	-0.10	0.64
Key pinch-strength	DH	0.26	0.21
	NDH	0.29	0.16
Tip pinch-strength	DH	0.23	0.26
	NDH	0.23	0.26
Large pegs test	DH	0.44	0.02*
	NDH	0.48	0.01*

**p*-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,
DH = dominant hand, NDH = non-dominant hand

Table 4.48 (continued) Correlations between BMI and various hand-strength/ hand-function tests in female group during the 3rd decade of life.

Variables	Hand side	*r*-values	*p*-value
Small pegs test	DH	0.36	0.07
	NDH	0.46	0.02*
Large heavy objects test	DH	0.35	0.08
	NDH	0.33	0.10
Large light objects test	DH	0.35	0.08
	NDH	0.34	0.09
Checkers test	DH	0.49	0.01*
	NDH	0.48	0.01*
Blocks test	DH	0.21	0.31
	NDH	0.31	0.12
Nails test	DH	0.57	0.002*
	NDH	0.50	0.009*
Simulated feeding test	DH	0.22	0.07
	NDH	0.07	0.75
Button board test	B	0.20	0.32

**p*-value considered significant at < 0.05, M = male; F = female; B = both hands, Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,
DH = dominant hand, NDH = non-dominant hand

There were significant correlations between BMI and the rates of large pegs, checkers, nails test performed by both hands as well as the rate of small pegs tests performed by the NDH in female group during their 3rd decade of life (table 4.48).

Table 4.49 Correlations between BMI and various hand-strength/hand-function tests in female group during the 4th decade of life.

Variables	Hand side	*r*-values	*p*-value
Grip-strength	DH	0.23	0.27
	NDH	0.23	0.28
Palmar pinch-strength	DH	0.05	0.83
	NDH	-0.13	0.53
Key pinch-strength	DH	0.45	0.03
	NDH	0.28	0.17
Tip pinch-strength	DH	0.23	0.28
	NDH	0.06	0.78
Large pegs test	DH	0.13	0.53
	NDH	0.02	0.93
Small pegs test	DH	-0.19	0.37
	NDH	-0.17	0.42
Large heavy objects test	DH	-0.29	0.16
	NDH	-0.46	0.02*
Large light objects test	DH	-0.11	0.61
	NDH	-0.29	0.17
Checkers test	DH	0.14	0.50
	NDH	-0.08	0.71
Blocks test	DH	-0.13	0.53
	NDH	-0.06	0.77
Nails test	DH	-0.05	0.80
	NDH	0.13	0.55
Simulated feeding test	DH	0.19	0.38
	NDH	0.001	0.99
Button board test	B	-0.16	0.43

*p-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, r = r-value, p = p-value,
DH = dominant hand, NDH = non-dominant hand

There was a significant correlation between BMI and the rate of large heavy objects test performed by the NDH in female group during their 4th decade of life (table 4.49).

Table 4.50 Correlations between BMI and various hand-strength/hand-function tests in female group during the 5th decade of life.

Variables	Hand side	*r*-values	*p*-value
Grip-strength	DH	-0.03	0.91
	NDH	0.11	0.62
Palmar pinch-strength	DH	-0.22	0.32
	NDH	-0.18	0.40
Key pinch-strength	DH	0.07	0.75
	NDH	0.14	0.52
Tip pinch-strength	DH	0.10	0.64
	NDH	0.23	0.30
Large pegs test	DH	0.37	0.09
	NDH	0.43	0.046*
Small pegs test	DH	0.13	0.55
	NDH	0.30	0.18
Large heavy objects test	DH	0.06	0.81
	NDH	-0.02	0.93
Large light objects test	DH	0.09	0.69
	NDH	0.11	0.63
Checkers test	DH	0.28	0.21
	NDH	0.14	0.54
Blocks test	DH	0.27	0.21
	NDH	0.28	0.20

*p-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, r = r-value, p = p-value,
DH = dominant hand, NDH = non-dominant hand

Table 4.50 (continued) Correlations between BMI and various hand-strength/ hand-function tests in female group during the 5th decade of life.

Variables	Hand side	*r*-values	*p*-value
Nails test	DH	0.37	0.09
	NDH	0.48	0.02*
Simulated feeding test	DH	0.07	0.76
	NDH	-0.18	0.42
Button board test	B	0.34	0.12

**p*-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,
DH = dominant hand, NDH = non-dominant hand

There were significant correlations between BMI and the rates of nails and large pegs tests performed by the NDH in female group during the 5th decade of life (table 4.50).

Table 4.51 Correlations between BMI and various hand-strength/hand-function tests in all female participants.

Variables	Hand side	*r*-values	*p*-value
Grip-strength	DH	0.07	0.49
	NDH	0.14	0.17
Palmar pinch-strength	DH	-0.01	0.94
	NDH	0.02	0.87
Key pinch-strength	DH	0.35	<0.01*
	NDH	0.37	<0.01*
Tip pinch-strength	DH	0.25	0.01*
	NDH	0.26	0.008*

**p*-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,
DH = dominant hand, NDH = non-dominant hand

Table 4.51 (continued) Correlations between BMI and various hand-strength/ hand-function tests in all female participants.

Variables	Hand side	*r*-values	*p*-value
Large pegs test	DH	0.54	<0.01*
	NDH	0.51	<0.01*
Small pegs test	DH	0.40	<0.01*
	NDH	0.46	<0.01*
Large heavy objects test	DH	0.33	0.001*
	NDH	0.28	0.005*
Large light objects test	DH	0.40	<0.01*
	NDH	0.39	<0.01*
Checkers test	DH	0.49	<0.01*
	NDH	0.42	<0.01*
Blocks test	DH	0.37	<0.01*
	NDH	0.36	<0.01*
Nails test	DH	0.50	<0.01*
	NDH	0.49	<0.01*
Simulated feeding test	DH	0.26	0.01*
	NDH	0.18	0.07
Button board test	B	0.32	0.001*

**p*-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,
DH = dominant hand, NDH = non-dominant hand

There were significant correlations between BMI and key & tip pinch-strength of both hands in all recruited female participants. There were also significant positive associations between BMI and the rates of various hand functions test such as large & small pegs test, large light & heavy objects test, checkers test, blocks test, nails test button board test performed by both hands, the rate of simulated feeding test performed by the DH in all female participants (table 4.51).

Table 4.52 Multivariate, linear regression, study between age, and various hand-strength/hand-function tests adjusted for BMI in all female participants.

Parameter	Handed	Age		BMI	
		Beta	*p*-value	Beta	*p*-value
Key-pinch strength	DH	ND	0.48	ND	<0.001*
	NDH	ND	0.58	ND	<0.001*
Tip-pinch strength	DH	ND	0.53	ND	0.011*
	NDH	ND	0.69	ND	0.008*
Simulated feeding test	DH	ND	0.008*	ND	0.22
	NDH	ND	0.001*	ND	0.76
Checkers test	DH	0.332	0.002*	0.286	0.009*
	NDH	ND	<0.001*	ND	0.33
Large light objects test	DH	ND	<0.001*	ND	0.18
	NDH	ND	<0.001*	ND	0.54
Large heavy objects test	DH	ND	<0.001*	ND	0.75
	NDH	ND	<0.001*	ND	0.74
Blocks test	DH	ND	<0.001*	ND	0.47
	NDH	ND	<0.001*	ND	0.20
Nails test	DH	0.242	0.026*	0.353	0.002*
	NDH	0.248	0.025*	0.34	0.002*
Large pegs test	DH	0.486	<0.001*	0.24	0.012*
	NDH	0.44	<0.001*	0.24	0.019*
Small pegs test	DH	ND	<0.001*	ND	0.059
	NDH	0.404	<0.001*	0.21	0.050
Buttons board test	Both	ND	0.001*	ND	0.115

**p*-value considered significant at < 0.05, Beta =Standardized Coefficients Beta,
ND = Not determined, DH = dominant hand, NDH = non-dominant hand

After multivariate, linear regression, stepwise analyses were performed. The statistical significances could exist only in some aspects. There were significant associations between BMI and key- & tip-pinch strength test of both hands, between

the rates of various hand functions test and age such as simulated feeding, large light & heavy objects, blocks, small pegs test performed by both hands and the rate of checkers test performed by the NDH. Moreover, both statistical significances between the rates of some aspects of hand function tests and age as well as BMI could exist such as large pegs, nails tests performed by both hands, the rate of checkers test performed by the DH (table 4.52).

Table 4.53 Correlations between BMI and various hand-strength/hand-function tests in all participants (both genders).

Variables	Hand side	*r*-values	*p*-value
Grip-strength	DH	0.07	0.37
	NDH	0.11	0.18
Palmar pinch-strength	DH	0.05	0.52
	NDH	0.07	0.39
Key pinch-strength	DH	0.21	0.007*
	NDH	0.22	0.006*
Tip pinch-strength	DH	0.26	0.001*
	NDH	0.27	0.001*
Large peg test	DH	0.41	<0.01*
	NDH	0.43	<0.01*
Small peg test	DH	0.33	<0.01*
	NDH	0.38	<0.01*
Large heavy object test	DH	0.27	0.001*
	NDH	0.27	0.001*
Large light object test	DH	0.33	<0.01*
	NDH	0.35	<0.01*

**p*-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,
DH = dominant hand, NDH = non-dominant hand

Table 4.53 (continued) Correlations between BMI and various hand-strength/ hand-function tests in all participants (both genders).

Variables	Hand side	*r*-values	*p*-value
Checker test	DH	0.40	<0.01*
	NDH	0.30	<0.01*
Blocks test	DH	0.29	0.001*
	NDH	0.27	0.01*
Nail test	DH	0.34	<0.01*
	NDH	0.37	<0.01*
Simulated feeding test	DH	0.16	0.04*
	NDH	0.11	0.16
Button test	B	0.30	<0.01*

**p*-value considered significant at < 0.05, M = male; F = female; B = both hands,
Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,
DH = dominant hand, NDH = non-dominant hand

There were significant correlations between BMI and tip & key pinch strength, the rates of checkers, blocks, nails, large & small pegs, large light & heavy objects, button board test performed by both hands, the rate of simulated feeding test performed by the DH in all participants of both genders (table 4.53).

Table 4.54 Multivariate, linear regression, study between age and various hand-strength/hand-function tests adjusted for BMI in all participants (both genders).

Parameter	Handed	Age		BMI	
		Beta	*p*-value	Beta	*p*-value
Key-pinch strength	DH	ND	0.086	ND	0.007*
	NDH	ND	0.29	ND	0.006*
Tip-pinch strength	DH	ND	0.56	ND	0.001*
	NDH	ND	0.44	ND	0.001*

**p*-value considered significant at < 0.05, Beta =Standardized Coefficients Beta,
ND = Not determined, DH = dominant hand, NDH = non-dominant hand

Table 4.54 (continued) Multivariate, linear regression, study between age and various hand-strength/hand-function tests adjusted for BMI in all participants (both genders).

Parameter	Handed	Age		BMI	
		Beta	*p*-value	Beta	*p*-value
Simulated feeding	DH	ND	<0.001*	ND	0.77
	NDH	ND	<0.001*	ND	0.30
Checkers	DH	0.31	<0.001*	0.227	0.006*
	NDH	ND	<0.001*	ND	0.21
Large light objects	DH	ND	<0.001*	ND	0.29
	NDH	ND	<0.001*	ND	0.40
Large heavy objects	DH	ND	<0.001*	ND	0.68
	NDH	ND	<0.001*	ND	0.91
Blocks	DH	ND	<0.001*	ND	0.22
	NDH	ND	<0.001*	ND	0.21
Nails	DH	0.232	0.008*	0.216	0.013*
	NDH	0.272	0.026*	0.192	0.002*
Large pegs	DH	0.321	<0.001*	0.235	0.004*
	NDH	0.376	<0.001*	0.229	0.004*
Small pegs	DH	ND	<0.001*	ND	0.35
	NDH	0.376	<0.001*	0.182	0.027*
Buttons	Both	ND	<0.001*	ND	0.16

**p*-value considered significant at < 0.05, Beta =Standardized Coefficients Beta,
ND = Not determined, DH = dominant hand, NDH = non-dominant hand

After multivariate, linear regression, stepwise analyses were performed. The statistical significances could exist only in some aspects. There were significant associations between BMI and key- & tip-pinch strength, between age and the rates of various hand function tests and such as simulated feeding, large light & heavy objects, blocks tests performed by both hands, the rate of small pegs test performed by the DH, and the rate of checkers test performed by the NDH. Moreover, both statistical

significances between the rates of some aspects of hand function tests and age as well as BMI could exist such as large pegs, nails tests performed by both hands, the rate of small pegs test performed by the NDH, and the rate of checkers test performed by the DH (table 4.54).

Table 4.55 Correlations between grip- and pinch-strength

Sex	Age group (years)	Hand side	Correlation study between grip- and pinch-strength tests					
			Palmar pinch-		Key pinch-		Tip pinch-	
			r	*p*	*r*	*p*	*r*	*p*
M	21-30	DH	0.87	<0.001*	0.49	0.048*	0.37	0.15
		NDH	0.72	0.001*	0.63	0.007*	0.54	0.026*
	31-40	DH	0.54	0.03*	0.13	0.64	0.31	0.25
		NDH	0.79	<0.001*	0.38	0.15	0.60	0.014*
	41-50	DH	0.67	0.005*	0.56	0.024*	0.60	0.015*
		NDH	0.47	0.07	0.54	0.029*	0.38	0.15
	51-60	DH	0.50	0.12	-0.04	0.91	0.05	0.88
		NDH	0.11	0.75	0.17	0.62	-0.15	0.67
	All	DH	0.63	<0.001*	0.42	<0.001*	0.35	0.007*
		NDH	0.59	<0.001*	0.52	<0.001*	0.39	0.002*
F	21-30	DH	0.74	<0.001*	0.73	0.001*	0.63	<0.001*
		NDH	0.63	<0.001*	0.71	<0.001*	0.56	0.002*
	31-40	DH	0.58	<0.001*	0.76	<0.001*	0.67	<0.001*
		NDH	0.81	0.004*	0.78	<0.001*	0.55	0.007*
	41-50	DH	0.76	0.10*	0.47	0.019*	0.23	0.26
		NDH	0.18	0.38	0.63	0.001*	0.39	0.05
	51-60	DH	0.31	0.15	0.62	0.002*	0.35	0.11
		NDH	0.64	0.001*	0.49	0.017*	0.46	0.028*

*p-value considered significant at < 0.05, M = male; F = female;

Pearson's correlation studies, r = r-value, p = p-value,

DH = dominant hand, NDH = non-dominant hand.

Table 4.55 (continued) Correlation between grip- and pinch-strength

Sex	Age group (years)	Hand side	Correlation study between grip- and pinch-strength tests					
			Palmar pinch-		Key pinch-		Tip pinch-	
			r	*p*	*r*	*P*	*r*	*p*
F	All	DH	0.45	<0.001*	0.63	<0.001*	0.48	<0.001*
		NDH	0.58	<0.001*	0.61	<0.001*	0.48	<0.001*
Overall		DH	0.66	<0.001*	0.81	<0.001*	0.65	<0.001*
		NDH	0.72	<0.001*	0.81	<0.001*	0.69	<0.001*

**p*-value considered significant at < 0.05, M = male; F = female;
Pearson's correlation studies, *r* = *r*-value, *p* = *p*-value,
DH = dominant hand, NDH = non-dominant hand.

There were significant correlations between grip-strength and palmar, key, tip pinch-strength tests of both hands in all recruited participants as well as in each gender. In male, there were significant correlations between grip-strength and palmar pinch-strength of both hands during the 2nd and 3rd decades of life and the DH during the 4th decade of life. There were significant correlations between grip-strength and the key pinch-strength during the 2nd and 4th decades of life as well as the tip pinch strength of the NDH during the 2nd, 3rd decades of life and the DH during the 4th decade of life. In female, there were significant correlations between grip-strength and palmar, tip pinch-strength of both hands during the 2nd and 3rd decades of life as well as the strength of the NDH during the 5th decade of life. There were significant correlations between key pinch-strength and grip-strength for both hands in female groups during each decade of life. Significant correlation between grip-strength and palmar pinch-strength of the DH during the 4th decade of life was also observed (table 4.55).

Table 4.56 Correlations between grip-strength and various hand-function tests in all male participants.

Test	Correlation with	Grip-strength	
		r-value	*p*-value
Checkers	DH	-0.16	0.21
	NDH	0.10	.045
Simulated feeding	DH	-0.23	0.07
	NDH	-0.03	0.82
Large light objects	DH	-0.07	0.62
	NDH	0.03	0.85
Large heavy objects	DH	-0.01	0.96
	NDH	0.05	0.73
Blocks	DH	-0.01	0.93
	NDH	0.18	0.17
Nails	DH	0.09	0.48
	NDH	0.19	0.14
Large pegs	DH	-0.02	0.87
	NDH	0.11	0.42
Small pegs	DH	-0.14	0.28
	NDH	0.09	.051
Buttons	DH	0.10	0.46
	NDH	0.16	0.22

**p*-value considered significant at < 0.05, DH = dominant hand, NDH = non-dominant hand

There was no significant correlation between grip-strength of both hands and various hand function tests (table 4.56).

Table 4.57 Correlations between pinch-strength and various hand-function tests in all male participants.

Tests	Correlation with	Pinch-strength					
		Palmar		Key		Tip	
		r-value	*p*-value	*r*-value	*p*-value	*r*-value	*p*-value
Checkers	DH	-0.21	0.11	-0.10	0.46	0.11	0.42
	NDH	-0.15	0.27	-0.07	0.61	0.01	0.92
Simulated feeding	DH	-0.18	0.17	-0.20	0.13	-0.01	0.94
	NDH	-0.07	0.60	-0.14	0.27	-0.05	0.69
Large light objects	DH	-0.14	0.29	-0.23	0.07	0.11	0.39
	NDH	-0.09	0.50	-0.06	0.67	0.15	.024
Large heavy objects	DH	-0.13	0.33	-0.07	0.61	0.19	0.14
	NDH	-0.08	0.54	-0.02	0.91	0.16	0.23
Blocks	DH	0.06	0.66	-0.14	0.28	0.09	0.51
	NDH	0.13	0.32	0.04	0.79	0.11	0.42
Nails	DH	-0.12	0.36	-0.05	0.71	0.19	0.16
	NDH	0.11	0.41	0.25	0.06	0.36	0.004*
Large pegs	DH	0.04	0.74	-0.14	0.30	0.05	0.71
	NDH	0.11	0.39	0.17	0.20	0.28	0.03*
Small pegs	DH	-0.14	0.28	0.18	0.17	-0.02	0.90
	NDH	-0.02	0.88	0.02	0.91	0.07	0.62
Buttons	DH	-0.20	0.13	-0.07	0.59	0.08	0.56
	NDH	-0.12	0.37	0.07	0.61	0.17	0.18

*p-value considered significant at < 0.05, DH = dominant hand, NDH = non-dominant hand

There were significant correlations between nails test, large pegs tests and tip pinch-strength of the NDH (table 4.57).

Table 4.58 Correlations between grip-strength and various hand-function tests in all female participants.

Tests	Correlation with	Grip-strength	
		r-value	*p*-value
Checkers	DH	0.04	0.69
	NDH	-0.05	0.59
Simulated feeding	DH	-0.12	0.26
	NDH	-0.12	0.22
Large light objects	DH	-0.03	0.74
	NDH	-0.12	0.25
Large heavy objects	DH	-0.12	0.25
	NDH	-0.17	0.09
Blocks	DH	-0.10	0.35
	NDH	-0.12	0.24
Nails	DH	-0.09	0.38
	NDH	-0.01	0.89
Large pegs	DH	-0.14	0.17
	NDH	-0.03	0.77
Small pegs	DH	-0.12	0.24
	NDH	-0.10	0.32
Buttons	DH	-0.07	0.51
	NDH	0.03	0.76

*p-value considered significant at < 0.05, DH = dominant hand, NDH = non-dominant hand

There was no significant correlation between grip-strength of both hands and various hand function tests (table 4.58).

Table 4.59 Correlations between pinch-strength and various hand-function tests in all female participants.

Parameter	Correlation with	Pinch-strength					
		Palmar		Key		Tip	
		r-value	*p*-value	*r*-value	*p*-value	*r*-value	*p*-value
Checkers	DH	0.11	0.26	0.22	0.03*	0.18	0.08
	NDH	0.04	0.71	0.21	0.04*	0.13	0.21
Simulated feeding	DH	-0.07	0.51	0.05	0.65	0.05	0.62
	NDH	0.01	0.94	0.04	0.68	0.03	0.78
Large light objects	DH	-0.01	0.91	0.17	0.08	0.13	0.20
	NDH	-0.03	0.80	0.08	0.40	-0.003	0.97
Large heavy objects	DH	-0.09	0.39	0.08	0.44	0.03	0.75
	NDH	-0.09	.037	0.02	0.82	-0.03	0.75
Blocks	DH	-0.04	0.73	0.15	0.13	0.11	0.26
	NDH	-0.01	0.94	0.09	0.37	0.001	0.99
Nails	DH	-0.04	0.70	0.22	0.03*	0.19	0.06
	NDH	0.08	0.42	0.23	0.02*	0.11	0.28
Large pegs	DH	-0.01	0.91	0.19	0.06	0.08	0.46
	NDH	0.12	0.24	0.17	0.09	0.03	0.75
Small pegs	DH	0.03	0.76	0.12	0.25	0.18	0.08
	NDH	0.01	0.91	0.16	0.12	0.06	0.57
Buttons	DH	-0.14	0.15	0.04	0.66	-0.07	0.48
	NDH	0.18	0.86	0.04	0.69	-0.05	0.64

*p-value considered significant at < 0.05, DH = dominant hand, NDH = non-dominant hand

There were significant correlations between nails test, checkers test and key pinch-strength of both hands (table 4.59).

Table 4.60 Correlations between grip-strength and various hand-function tests in all participants (both genders).

Tests	Correlation with	Grip-strength	
		r-value	*p*-value
Checkers	DH	0.06	0.44
	NDH	0.10	0.23
Simulated feeding	DH	0.18	0.03*
	NDH	0.09	0.28
Large light objects	DH	-0.025	0.75
	NDH	0.004	0.96
Large heavy objects	DH	-0.09	0.26
	NDH	-0.07	0.41
Blocks	DH	0.10	0.18
	NDH	0.09	0.25
Nails	DH	0.18	0.02*
	NDH	0.20	0.01*
Large pegs	DH	0.11	0.19
	NDH	0.10	0.20
Small pegs	DH	0.09	0.27
	NDH	0.09	0.24
Buttons	DH	0.08	0.33
	NDH	0.13	0.09

*p-value considered significant at < 0.05, DH = dominant hand, NDH = non-dominant hand

There were significant correlations between nails test and grip-strength of both hands as well as between simulated feeding test and grip-strength of the DH (table 4.60).

Table 4.61 Correlations between pinch-strength and various hand-function tests in all participants (both genders).

Parameter	Correlation with	Pinch-strength					
		Palmar		Key		Tip	
		r-value	*p*-value	*r*-value	*p*-value	*r*-value	*p*-value
Checkers	DH	0.06	0.46	0.15	0.05	0.19	0.02*
	NDH	0.02	0.80	0.13	0.11	0.12	0.12
Simulated feeding	DH	0.07	0.37	0.22	0.01*	0.21	0.01*
	NDH	0.08	0.35	0.10	0.22	0.10	0.20
Large light objects	DH	-0.04	0.58	0.01	0.88	0.11	0.16
	NDH	-0.01	0.89	0.06	0.47	0.09	0.28
Large heavy objects	DH	-0.11	0.16	-0.02	0.76	0.06	0.45
	NDH	-0.08	0.29	-0.10	0.90	0.03	0.73
Blocks	DH	0.09	0.27	0.15	0.06	0.19	0.02*
	NDH	0.10	0.21	0.13	0.12	0.10	0.19
Nails	DH	0.06	0.49	0.25	0.002*	0.29	<0.01*
	NDH	0.19	0.02*	0.30	<0.01*	0.29	<0.01*
Large pegs	DH	0.11	0.19	0.18	0.02*	0.17	0.04*
	NDH	0.17	0.04*	0.22	0.01*	0.19	0.02*
Small pegs	DH	0.07	0.36	0.16	0.048*	0.20	0.01*
	NDH	0.07	0.40	0.15	0.05	0.13	0.11
Buttons	DH	-0.07	0.35	0.10	0.21	0.04	0.62
	NDH	0.05	0.51	0.12	0.14	0.08	0.30

*p-value considered significant at < 0.05, DH = dominant hand, NDH = non-dominant hand

There were significant correlations between nails test, large pegs test and key & tip pinch-strength of both hands, between nails test, large pegs test of the NDH and palmar pinch-strength, between simulated feeding test and key & tip pinch-strength of the DH as well as between tip pinch-strength of the DH and checkers test (table 4.61).

CHAPTER 5
DISCUSSION

5.1 General Description of Subjects

In the 4th National Nutrition Survey of Thailand in 1995, there were 580 studied participants (170 male and 410 females) dwelling in Bangkok with ages of 13 to 59 years (61). The average body mass index (BMI) was 23.0 $\pm$ 4.8 kg/m^2 of which conformed to that of the present study (23.4 $\pm$ 4.0 kg/m^2, $p = 0.32$).

Progressive increase in BMI could be observed from 20- to 60 years of age in both genders ($p = 0.0006$ for male and $p < 0.001$ for female). During the 2nd decade of life, male participants in this study had a higher average BMI as compared to that of female participants ($p = 0.039$). The higher average BMI in male as compared to that of female in this age group was comparable to the high prevalence of overweight in young male participants reported from a number of well developed Asian countries such as: the National Health Survey of Singapore in 1998 and the National Nutrition Survey of Japan in 2000 (62-63).

5.2 Comparative study between grip-strength observed in the present study and other reports

It was found that the average grip-strength in the present study, when converted grip-strength data into pounds, was not as strong as that previously reported in western countries (table 5.1). This could be due to less muscle mass, smaller in hand size, which could be demonstrated as a lower BMI compared to that of population in Philadelphia or in Milwaukee regions (15). The results in this present study had been compared to other studies. For example, Tantibhaedhyangkul et al in 2001 had studied 744 participants aged 8 to 96 years of whom 78.9% were males and 87.7% were females, classified under the category of 20 to 59 year-old-group (44),

Imrhan et al in 1989 had examined 70 participants aged 18 to 40 years (48), as well as Astin et al in 1999 had also examined 100 participants aged 20 to 65 years (53).

5.3 Comparative study of grip-strength observed in each gender

Grip-strength in male subjects in the present study was weaker as compared to that reported by Tantibhaedhyangkul and colleagues ($p = 0.007$) (table 5.2) (44). They were also weaker compared to the studies performed by Imrhan and colleagues ($p < 0.01$) (48) as well as by Astin and co-workers ($p < 0.001$) (53). The observed grip-strength performed by female subjects in the present study was also weaker as compared to the reports from those of the western countries ($p < 0.01$). Nevertheless, the observed grip-strength performed by female in this study was not different from that observed by Tantibhaedhyangkul and colleagues' study considering on all recruited female participants ($p = 0.07$) (44).

Since, little doubt exists about the positive relationship between muscular strength and BMI. Furthermore, with the given BMI, some authors had even calculated maximum grip-strength (22, 54, 64). Therefore, these might be partially explained by the differences in BMI. The male participated in the present study were relatively smaller in body size (weight = 65.5$\pm$10.2 kg, height = 166.7$\pm$7.0 cm) as compared to that reported by Tantibhaedhyangkul and colleagues in 2001 (weight = 67.0$\pm$11.5 kg., height = 166.6$\pm$6.6 cm.) ($p = 0.01$ for weight), whereas the female participated in this study were, more or less, equal in body size to the female subjects studied by Tantibhaedhyangkul and colleagues in 2001 (57.1$\pm$9.6 *vs*. 55.6$\pm$10.3 kg. for weight and 156.8$\pm$5.6 *vs*. 155.0$\pm$6.0 cm. for height) ($p = 0.78$ for weight) (44). Furthermore, the grip-strength studied by Rantanen and colleagues in 1999 among the male Japanese American ancestry living in Hawaii during the 5th decade of life was relatively not different from the male data observed in this study (table 5.3) (57).

Table 5.1 Comparative findings of grip-strength on dominant and non-dominant hands in each gender between the present results and other reports

Reports	Male		Female	
	DH (lbs.)	NDH (lbs.)	DH (lbs.)	NDH (lbs.)
Mathiowetz et al. 1985	104.3±28.3	93.1±27.6	62.8±17.0	53.9±15.7
Crosby et al. 1994	137.0±24.0	129.0±22.0	81.0±16.0	75.0±16.0
The present study	93.1±13.9	81.8±13.6	60.3±11.4	54.3±10.3
p-value*	<0.0001[1]	<0.0001[2]	<0.0001[1]	<0.0001[2]

[1]*p*-value, One-Way ANOVA performed on the DH among different studied groups,

[2]*p*-value, One-Way ANOVA performed on the NDH among different studied groups,

**p*-value considered significant at < 0.05;

DH = dominant hand, NDH = non-dominant hand.

Table 5.2 Comparative findings of grip-strength (kg.) among the different studied groups considering in each gender.

Reports	Male	Female
Tantibhaedhyangkul et al. 2001	45.2±8.2	28.5±5.6
Imrhan et al. 1989	49.4±1.9	31.4±2.5
Astin et al. 1999	46.2±2.3	29.5±2.2
This present study	42.3±6.3	27.4±5.2
p-value*	<0.01[1]	<0.01[2]

[1]*p*-value, One-Way ANOVA performed on the Male group among different studied groups,

[2]*p*-value, One-Way ANOVA performed on the Female group among different studied groups,

**p*-value considered significant at < 0.05.

Table 5.3 Comparative findings on the dominant hand-grip-strength (kg.) of the male subjects between the Japanese American ancestry in Hawaii and the present study

Age groups	Rantanen et al.			The present study		
	N	BMI ($kg./m^2$)	Grip-strength (kg.)	N	BMI ($kg./m^2$)	Grip-strength (kg.)
50-54	2792	24.0±0.06	40.1±0.11	16	26.1±4.5	40.9±4.1
55-59	1590	23.7±0.08	37.9±0.14			

Grip-strength peaked within 31 to 40 age group in the male subjects observed in the present study which was similar to that previously demonstrated by Mathiowetz and coworkers in 1985 (table 5.4) (15) as well as by Tantibhaedhyangkul and colleagues in 2001 (44). Grip-strength in the female volunteers participated in the present study was noted to occur later than that previously reported from both studies mentioned above. However, grip-strength in the female participated in the present study was found to reach their peak during the 41 to 50 years of age and gradually declined thereafter which is consistent with that observed by Schmidt and Toews in 1970 (54).

Table 5.4 Distribution of grip-strength of the dominant hand in male subjects and its peak in this study as compared to that of Mathiowetz and coworkers in 1985

The present study		Mathiowetz et al. in 1985	
Age group (years)	Grip-strength (kg.)	Age group (years)	Grip-strength (lbs.)
21-30	42.9±8.2	20-24	121.0±20.6
		25-29	120.8±23.0
31-40	43.3±5.4	30-34	121.8±22.4
		35-39	119.7±24.0
41-50	41.6±6.2	40-44	116.8±20.7
		45-49	109.9±23.0
51-60	40.9±4.1	50-54	113.6±18.1

		55-59	101.1±26.7

Considering on a total number of participants as well as on a total number of male or female participants, grip-strength of the dominant hand was stronger than that of non-dominant hand ($p < 0.001$ for all categories). The present finding was conformed to those previously reported (15, 24, 54) (table 5.5 and 5.6).

Table 5.5 Comparative findings on the mean grip-strength (lbs.), percent differences between the dominant and non-dominant hands in all participants with other reports

Reports	Dominant hand	Non-dominant hand	Percent differences
Schmidt et al. 1970	113.0	109.5	3.2
Petersen et al. 1989	88.9	79.9	12.7
Crosby et al. 1994	109.0	101.0	8.0
The present study	72.6	64.5	11.2

DH = dominant hand, NDH = non-dominant hand,

Table 5.6 Comparative findings on the mean grip-strength, percent differences between the dominant and non-dominant hands in each gender with other reports

Reports	Male			Female		
	DH	NDH	%	DH	NDH	%
Mathiowetz et al. 1985	104.3±28.3 lbs.	93.1±27.6 lbs.	10.7	62.8±17.0 lbs.	53.9±15.7 lbs.	14.2
Young et al 1989	43.7±6.5 kg.	41.8±7.3 kg.	4.4	24.5±4.4 kg.	21.9±4.3 kg.	10.6
Crosby et al. 1994	137.0±24.0 lbs.	129.0±22.0 lbs.	5.8	81.0±16.0 lbs.	75.0±16.0 lbs.	7.4

DH = dominant hand, NDH = non-dominant hand, ND = not done

% = percent difference between the DH and the NDH groups

Table 5.6 (continued) Comparative findings on the mean grip-strength, percent differences between the dominant and non-dominant hands in each gender with other reports

Reports	Male			Female		
	DH	NDH	%	DH	NDH	%
Richards et al. 1997	49.1±7.5 kg.	46.7±7.2 kg.	4.9	29.5±6.2 kg.	27.8±5.7 kg.	5.8
Josty et al. 1997	46.1 kg.	41.9 kg.	9.1	ND	ND	ND
The present study	42.3±6.3 kg.	37.2±6.2 kg.	12.1	27.4±5.2 kg.	24.7±4.7 kg.	9.9

DH = dominant hand, NDH = non-dominant hand, ND = not done

% = percent difference between the DH and the NDH groups

5.4 Grip-strength difference between the DH and the NDH, the 10%-Rule

Many studies had supported these observations. Mathiowetz and colleagues in 1985 (15) demonstrated that the dominant grip-strength was stronger than the non-dominant one. Furthermore, Schmidt and Toews in 1970 (54) found out that the dominant hand had to be stronger by a factor dominant/non-dominant hands of 1.03, which was in accordance with the ratio 1.07± 0.11 observed in the study performed by Thorngren and Werner in 1979 (55). Some authors had even suggested the calculated methods to predict the values (24). Josty et al. in 1997 had also shown the difference existed between the dominant and the non-dominant grip- and pinch-strength (56). He confirmed a 10% rule to predict hand strength for non-manual and light manual workers. Crosby and colleagues in 1994 had also shown the 10% stronger in grip-strength on the dominant hand among the majority of the right-handed subjects (22). Grip-strength of an uninjured hand is, therefore, supposed to be a very useful determinant of the other hand function following injury, since percentage differences can be calculated and used to determine the degree of rehabilitation required.

However, some authors believed that the 10% rule was valid for right handed persons only; for left handed persons, grip strength should be considered equivalent in both hands (16, 24).

5.5 Grip-strength differences and hand size

One may suspect that the hand size can affect on the hand strength. Considering on all participants recruited in this study or on each gender, there were significant correlations between grip-strength and the length of many measured lines (table 4.23), especially for the measured line C. Though, these considering effects could not be consistently demonstrated by the correlation study between the dominant/non-dominant hands and the differences in length of other measured lines. The measured line C of the DH was persistently longer than that of NDH in all participants (p = 0.007), in male participants (p = 0.01) and possibly in female participants (p = 0.08). Therefore, the length of the measured line C may be useful in predicting grip-strength among patients in the future.

Gender-differences in this study had been expected. The stronger grip- and pinch-strength in males was observed. A number of the possibilities were anticipated. Larger in the male hand-size was one of the possibilities. Considering on the comparative studies between all males' and all females' different measured lines, male had a larger dominant hand size (p< 0.0001 for most dimensions). Particularly, the significant differences in length of the lines measured from both genders were persistently observed from the measured line B and C when considered in each age group (a trend of the measured line B was observed during the 5th decade of life for the NDH group, p = 0.07). The significant differences in length of the measured line A were observed only during the 3rd and 5th decades of life (a trend was observed in the rest subgroups except for the DH group during the 4th decade of life). The longer in the measured line C of both hands in male as compared to that of female in all age group showed in this study may be able to explain the possibility of the stronger grip-strength in male participants.

However, considering the grip-strength during each decade of life, only the positive association between grip-strength and measured line C in male during their 4th decade of life and in female during the 2nd, 3rd (except for the DH group) and 4th decades of life were found. The positive associations between the measured line A to the grip-strength during their 3rd and 4th decades of life in female without significant gender-differences in the length of the measured lines A during the 4th decade of life were also observed. Moreover, grip-strength of the dominant hand in all male subjects was stronger than that of the non-dominant hand (42.3±6.3 *vs*. 37.2±6.2 kg, $p < 0.01$) without significantly larger in other dimensions of the dominant hand ($p = 0.78$, 0.99, and 1.0 in line A, B, and D, respectively). Therefore, the merely longer in the measured lines may not explain all of these observations.

5.6 Comparative study between pinch-strength in this study and other reports

The average palmar pinch-, tip pinch-, and key pinch-strength in the present study, when converted the pinch-strength data into pounds, were also not as strong as that previously reported (table 5.7, 5.8, and 5.9). Again, this could be due to less muscle mass, smaller in hand size, which could be demonstrated as a lower BMI compared to that of population in Philadelphia or in Milwaukee regions (15, 22).

Table 5.7 Comparative findings of palmar pinch-strength on dominant and non-dominant hands among different studies in each gender with other reports

Reports	Male		Female	
	DH (lbs.)	NDH (lbs.)	DH (lbs.)	NDH (lbs.)
Mathiowetz et al. 1985	23.4±5.0	23.0±5.3	16.3±3.8	15.7±3.6
The present study	17.4±2.9	16.1±2.6	14.3±2.9	12.8±2.4
p-value	< 0.001*	< 0.001*	< 0.001*	< 0.001*

**p*-value considered significant at < 0.05,

DH = dominant hand, NDH = non-dominant hand

Table 5.8 Comparative findings of key pinch-strength on the dominant and non-dominant hands in each gender with other reports

Reports	Male		Female	
	DH (lbs.)	NDH (lbs.)	DH (lbs.)	NDH (lbs.)
Mathiowetz et al. 1985	24.5±4.6	23.6±4.6	16.2±3.0	15.3±3.1
Young et al. 1989	25.4±3.7	24.3±3.6	16.0±2.5	14.8±2.1
Crosby et al. 1994	27.0±5.0	26.0±5.0	20.0±5.0	19.0±4.0
The present study	20.0±0.7	18.7±0.2	14.3±2.2	13.0±2.4
p-value	< 0.001*	< 0.001*	< 0.001*	< 0.001*

**p*-value considered significant at < 0.05,

DH = dominant hand, NDH = non-dominant hand

Table 5.9 Comparative findings of tip pinch-strength on the dominant and non-dominant hands in each gender with other reports

Reports	Male		Female	
	DH (lbs.)	NDH (lbs.)	DH (lbs.)	NDH (lbs.)
Mathiowetz et al. 1985	17.0±4.1	16.4±4.0	11.3±2.6	10.8±2.4
The preent study	12.5±0.7	10.8±1.1	9.0±2.0	7.3±1.8
p-value	< 0.001*	< 0.001*	< 0.001*	< 0.001*

**p*-value considered significant at < 0.05,

DH = dominant hand, NDH = non-dominant hand

Palmar pinch-strength peaked within 21 to 40 age group in male which was also similar to that previously demonstrated by Mathiowetz and coworkers in 1985 (table 5.10) (15). Palmar pinch-strength in the female participated in the present study was also observed to occur later than that reported by Mathiowetz et al in 1985 (15) and that of the mean of three trials obtained from multiple trials by Mathiowetz et al. in 1991, 1984, and 1985 (39). Though, palmar pinch-strength in the female participated in this study was found to reach their peak during the 4th decade of age. This was consistent with the study for normative data among healthy Taiwanese by Su

and colleagues in 1995, which peaked with the 40- to 59-year-old group for Chinese female subjects (65).

Table 5.10 Distribution of palmar pinch-strength of the dominant hand in male subjects and its peak in this study compared to that of Mathiowetz and coworkers in 1985

The present study		Mathiowetz et al. in 1985	
Age group (years)	Palmar pinch-strength (lbs.)	Age group (years)	Palmar pinch-strength (lbs.)
21-30	17.4 ±3.1	20-24	26.6±5.5
		25-29	26.0±4.3
31-40	17.8 ±2.9	30-34	24.7±4.7
		35-39	26.2±4.1
41-50	17.6 ±3.5	40-44	24.5±4.3
		45-49	24.0±3.3
51-60	16.7 ±2.0	50-54	23.8±5.4
		55-59	23.7±4.8

Table 5.11 Distribution of palmar pinch-strength of the dominant hand in male subjects and its peak in this study compared to that of mean of three trials*

Age group (years)	Mean of the present study (lbs.)		Mean of three trials* (lbs.)	
	Male	Female	Male	Female
21-30	17.4	13.9	27	17
31-40	17.8	14.3	25	19
41-50	17.6	14.7	24	17
51-60	16.7	13.9	24	17

*Trials obtained from multiple trials by Mathiowetz et al. in 1991, 1984, and 1985

Key pinch-strength peaked within 41 to 50 age groups in both genders, which occurred later than that of the study conducted by Mathiowetz and coworkers in 1985 (table 5.12) (15). Key pinch-strength in the male participated in this study observed to occur later than that reported by Mathiowetz et al in 1985. This seems to occur earlier than that of the mean of three trials obtained from multiple trials by Mathiowetz et al. in 1991, 1984, and 1985 (39). However, key pinch-strength in the female participated in the present study, of which found to reach their peak during the 4th to 5th decades of life, was possibly concordant with that reported by Su and colleagues in 1995 (65).

Table 5.12 Distribution of key pinch-strength of the dominant hand in male subjects and its peak in this study compared to that of Mathiowetz et al. in 1985

The present study		Mathiowetz et al. in 1985	
Age group (years)	Key pinch-strength (lbs.)	Age group (years)	Key pinch-strength (lbs.)
21-30	20.2 ±3.1	20-24	26.0±3.5
		25-29	26.7±4.9
31-40	20.5 ±1.8	30-34	26.4±4.8
		35-39	26.1±3.2
41-50	20.7 ±3.5	40-44	25.6±2.6
		45-49	25.8±3.9
51-60	18.9 ±1.3	50-54	26.7±4.4
		55-59	24.2±4.2

Table 5.13 Distribution of key pinch-strength of the dominant hand and its peak in this study compared to that of mean of three trials*

Age group (years)	Mean of the present study (lbs.)		Mean of three trials* (lbs.)	
	Male	Female	Male	Female
21-30	20.2	14.1	26	18
31-40	20.5	14.5	26	19
41-50	20.7	15.2	26	17
51-60	18.9	15.0	27	17

*Trials obtained from multiple trials by Mathiowetz et al. in 1991, 1984, and 1985

The peaks of tip pinch-strength examined in both genders were not strikingly seen. This was also conformed to that of Mathiowetz et al (table 5.14) (15).

Table 5.14 Distribution of tip pinch-strength of the dominant hand in male subjects and its peak in this study compared to that of Mathiowetz and coworkers in 1985

The present study		Mathiowetz et al. in 1985	
Age group (years)	Tip pinch-strength (lbs.)	Age group (years)	Tip pinch-strength (lbs.)
21-30	11.2±2.6	20-24	18.0±3.0
		25-29	18.3±4.4
31-40	12.5±1.8	30-34	17.6±6.7
		35-39	18.0±3.6
41-50	12.1±2.2	40-44	17.8±4.0
		45-49	18.7±4.9
51-60	12.8±2.2	50-54	18.3±4.0
		55-59	16.6±3.3

Table 5.15 Distribution of tip pinch-strength of the dominant hand in male subjects and its peak in this study compared to that of mean of three trials*

Age group (years)	Mean of the present study (lbs.)		Mean of three trials* (lbs.)	
	Male	Female	Male	Female
21-30	11.2	9.0	18	11
31-40	12.5	8.8	18	13
41-50	12.1	9.9	18	11
51-60	12.8	9.2	18	12

*Trials obtained from multiple trials by Mathiowetz et al. in 1991, 1984, and 1985

Palmar pinch-, key pinch- and tip pinch-strength of the dominant hand were stronger than that of the non-dominant hand in all participants (table 5.16). the present findings were not different from those previously reported (22, 56) i.e. Su and associates in 1995 of which had claimed an overall 13% pinch strength difference between the dominant and non-dominant hands for the total Taiwanese sample (15).

Table 5.16 Comparative finding on tip pinch-strength, percent differences between dominant and non-dominant hands in all participants with other reports

Reports	Dominant hand	Non-dominant hand	Percent differences
Crosby et al. 1994	17.0±5.0 lbs.	15.0±4.0 lbs.	11.8
The present study	7.0±1.5 kg.	6.3±1.4 kg.	8.5

DH = dominant hand, NDH = non-dominant hand

Table 5.17 Comparative finding on key pinch-strength, percent differences between dominant and non-dominant hands in all participants with other reports

Reports	Dominant hand	Non-dominant hand	Percent differences
Crosby et al. 1994	24.0±6.0 lbs.	22.0±6.0 lbs.	8.3
Josty et al. 1997	10.5 kg.	9.7 kg.	7.6
The present study	7.6±1.6 kg.	6.9±1.7 kg.	9.2

DH = dominant hand, NDH = non-dominant hand,

Considering separately in each gender, palmar pinch-, tip pinch- and key pinch-strength of the dominant hand were stronger than that of the non-dominant hand in both genders (table 5.18). The dominant hand strength in the female subjects was statistically significant difference from that of the non-dominant hand as actually seen in the tables except during the 4^{th} and 5^{th} decades of life for palmar and key pinch-strength.

Table 5.18 Comparative study on the mean palmar pinch-strength, percent differences between dominant and non-dominant hands in each gender with other reports

Reports	Male			Female		
	DH	NDH	%	DH	NDH	%
Mathiowetz et al. 1985	23.4±5.0 lbs.	23.0±5.3 lbs.	1.7	16.3±3.8 lbs.	15.7±3.6 lbs.	3.7
Crosby et al. 1994	19.0±4.0 lbs.	18.0±4.0 lbs.	5.3	14.0±4.0 lbs.	13.0±3.0 lbs.	7.1
The present study	7.9±1.3 kg.	7.3 ±1.2 kg.	7.6	6.5±1.3 kg.	5.8±1.1 kg.	10.8

DH = dominant hand, NDH = non-dominant hand,

% = percent difference between the DH and the NDH groups

Table 5.19 Comparative study on the mean key pinch-strength, percent differences between dominant and non-dominant hands in each gender with other reports

Reports	Male			Female		
	DH	NDH	%	DH	NDH	%
Mathiowetz et al. 1985	24.5±4.6 lbs.	23.6±4.6 lbs.	3.7	16.2±3.0 lbs.	15.3±3.1 lbs.	5.6
Crosby et al.	27.0±5.0 lbs.	26.0±5.0 lbs.	3.7	20.0±5.0 lbs.	19.0±4.0 lbs.	5.0
Young et al	25.4±3.7 lbs.	24.3±3.6 lbs.	4.3	16.0±2.5 lbs.	14.8±2.1 lbs.	7.5
The present study	9.2±1.2 kg.	8.5±1.4 kg.	7.6	6.5±1.0 kg.	5.9±1.1 kg.	9.2

DH = dominant hand, NDH = non-dominant hand,

% = percent difference between the DH and the NDH groups

Table 5.20 Comparative study on tip pinch-strength, percent differences between dominant and non-dominant hands in each gender with other reports

Reports	Male			Female		
	DH	NDH	%	DH	NDH	%
Mathiowetz et al. 1985	17.0±4.1 lbs.	16.4±4.0 lbs.	3.5	11.3±2.6 lbs.	10.8±2.4 lbs.	4.4
The present study	5.5±1.0 kg.	4.9±1.1 kg.	10.9	4.2±0.9 kg.	3.4±0.9 kg.	19.1

DH = dominant hand, NDH = non-dominant hand,

% = percent difference between the DH and the NDH groups

Gender difference in the study on pinch-strength was noted. There were stronger in palmar pinch-, key pinch-, and tip pinch-strength in male compared to that of female. Dominant hand-strength in male was stronger than that of non-dominant hand (7.9 ±1.3 *vs*. 7.3 ±1.2 kg, $p < 0.01$ for palmar pinch-strength; 9.2 ±1.2 *vs*. 8.5 ±1.4 kg, $p < 0.01$ for key pinch strength; and 5.5 ±1.0 *vs*. 4.9 ±1.1 kg, $p < 0.01$ for tip pinch strength). Again, the longer of measured line C in male compared to that of

female was presumed to have a causal relationship of which could be demonstrated by the significant correlations within all recruited cases as well as within each genders. However, significant correlation could be sporadically observed in the study on palmar pinch-strength (the 4th decade of life in male and the 2nd decade of life in female), on key pinch-strength (the 4th decade of life in male and the 2nd, 3rd, 4th decades of life in female), and on tip pinch-strength of both hands (the 4th decade of life in male, 2nd decade of life in female). And, some of the positive associations between tip pinch-strength and the length of the other measured lines were not consistently observed in each age group (table 4.29).

A number of reports on the gender-differences in the study of grip- and pinch-strength were previously described. The reports confirmed the present results. In that study which examined by Wattanavitawat P. and co-workers on 360 adults aged 20-40 years in Chiang Mai also showed a moderate associations ($r = 0.5$, $p < 0.001$) between the observed grip- and palmar pinch-strength. Generally, the positive associations between grip- and palmar pinch-strength observed in the studied adult aged 20-40 years old in the present study were similar to their results (18).

Table 5.21 Comparing findings on grip-, palmar pinch-strength (kg.) of the dominant hand between Wattanavittawat et al. and the present study

Age group (years)	Wattanavittawat et al				The present study			
	Male		Female		Male		Female	
	Grip-	Pinch-	Grip-	Pinch-	Grip-	Pinch-	Grip-	Pinch-
20-30	42.8 ±7.3	8.2 ±1.7	29.3 ±4.8	6.4 ±1.2	42.9 ±8.2	7.9 ±1.4	27.7 ±4.4	6.3 ±1.3
31-40	43.3 ±6.3	8.2 ±1.3	28.9 ±5.3	6.7 ±1.3	43.3 ±5.4	8.1 ±1.3	26.8 ±6.3	6.5 ±1.5

Table 5.22 Comparing the correlations study between grip-strength, palmar pinch-strength of the DH from Wattanvittanawat et al and the present results obtained from all participants

Reports	Hand strength	*r*-value	*p*-value
Wattanvittanawat et al	- palmar pinch-strength	0.5	<0.01*
The present study	- palmar pinch-strength	0.66	<0.001*
	- key pinch-strength	0.81	<0.001*
	- tip pinch-strength	0.65	<0.001*

**p*-value considered significant at < 0.05

5.7 Correlation study between hand strength and age

Previous study had shown that there was a relationship between hand strength and age. Schmidt et al. had also claimed that hand strength decreased as age increased over 32 years in 1,128 men and over 40 years in 80 women (1208 participants, age 18 – 62 years) who were applicants for employment at the Kaiser Steel Manufacturing division in Fontana, USA (54). Thorngren and colleagues in 1979 had examined 450 ambulatory persons (age 21 – 65 years) without history of pain or trauma in the upper extremity at the orthopedic clinic and demonstrated that the grip strength determined with Martin vigorometer decreased steadily with increasing age (55). Moreover, Mathiowetz had proposed a curvilinear relationship, with hand strength peaking between 25 to 50 years of age and decreasing thereafter in 628 volunteers (age 20 – 94 years). Kellor and coworkers had developed normative data from the examined 250 individuals based on a linear inverse relationship, that the maximal value achieved at 20 years and decreased with increasing age (66). The presence of peak strength of the dominant handgrip in the 3rd decade of life in male and in the 4th decade of life in female subjects from the present examination were conformed to those previous reports. Nevertheless, the present data did not show any significant negative association between the strength of the dominant handgrip and age during the 2nd to 5th decades of life in all cases (r = -0.11, p = 0.18). Further investigation on the degree of correlation between grip-strength and age in each age group was performed; moderately negative association could be elicited only from the DH of female during

the 4th decade (r = -0.45, p = 0.02), and the DH of male during the 5th decade (r = -0.63, p = 0.04) of life. These could be due to many possibilities. Inadequate sample size could be one of them. However, a study of grip-strength in 720 adults dwelling in Chiang Mai by Wattanavittawat and coworkers showed no significant differences between 20- to 30-year age group and 30- to 40- year age group. And, Tantibhaedhyangkul and associates claimed that the grip-strength on the dominant hand side did not have significant differences between each decade of life in her studied groups (44). They also demonstrated that grip-strength did significantly decrease after the age of 60 years and rapidly declined after the age of 70 years. This could be a result of a decrease in muscle mass that correlated with a decrease in muscle strength occurring with aging grip-strength, especially after the age of 60 years (67-69). Muscles that are most frequently used have loss in strength (70-72). Therefore, good correlation coefficient might be able to obtain if we collected more cases and recruited more older age groups.

Therapists are usually concerned with the ability and capacity of a person to perform activities independently. Though, some authors proposed a measure of grip-strength often used as sole criteria for hand function (54). Many aspects in the clinical assessment of patients' daily living skill provided information useful in evaluation of the individual are developed and accepted in determining patients' hand functions which are suitable to their populations. The investigator also collected a number of data from the recruited populations on the hand functions tests and compared them with the results that were previously reported.

5.8 Comparative study on the hand functions test between the present study and other reports

Jebsen and colleagues have published normative values on many aspects of the hand function tests for adults for ages 20 to 59 years in 1969 (59). Two hundred and forty American participants (120 males and 120 females) aged 20 to 59 years could perform faster checker, large heavy & light objects tests as compared to the present study. No significant difference between the rates of simulated feeding test between

American and Thai. Nevertheless, the female participated in this study had a faster rate of simulated feeding test as compared to that of Jebsen and colleagues (table 5.23).

Table 5.23 Mean times and standard deviations (seconds) for normal subjects: Comparative study between the present study and the Jebsen Hand Function Test (JHFT) on American populations.

Tests	Hand side	Male			Female		
		JHFT	The present results	*p*-values[1]	JHFT	The present results	*p*-values[1]
Simulated feedings	DH	6.4±0.9	6.5±0.9	0.47	6.7±1.1	6.0±0.3	<0.01*
	NDH	7.9±1.3	7.9±1.2	1.0	8.0±1.6	7.4±0.5	<0.01*
Checkers	DH	3.3±0.7	4.0±0.7	<0.01*	3.3±0.6	3.8±0.8	<0.01*
	NDH	3.8±0.6	4.7±1.0	<0.01*	3.8±0.7	4.5±0.8	<0.01*
Large-light objects	DH	3.0±0.4	3.6±0.6	<0.01*	3.1±0.5	3.6±0.6	<0.01*
	NDH	3.2±0.6	4.0±0.5	<0.01*	3.3±0.6	3.9±0.7	<0.01*
Large-heavy objects	DH	3.0±0.5	3.6±0.6	<0.01*	3.2±0.5	3.6±0.5	<0.01*
	NDH	3.1±0.4	3.8±0.6	<0.01*	3.3±0.5	3.9±0.6	<0.01*

[1]*p*-value, independent sample t-test; between the JHFT study and the present study,

**p*-value considered significant at < 0.05, DH = dominant hand, NDH = Non-dominant hand.

The female participated in the present study could perform the test at relatively faster rates of the hand functions tests than that reported by Smith and colleagues according to blocks, nails, large & small peg test of both hands and button board test at all age group except for large peg test performed by the NDH (60). In male, the rates of nails test, small peg test, performed by both hands as well as the blocks test performed by the DH were relatively faster than that reported by Smith and colleagues (table 5.24).

Table 5.24 Mean times and standard deviations (seconds) for normal subjects-: Comparative study between the present study and the Smith Hand Function Evaluation (SHFE).

Tests	Hand side	Males			Females		
		SHFE	The present results	*p*-values[1]	SHFE	The present results	*p*-values[1]
Blocks	DH	5.1±1.7	3.9±0.8	<0.01*	4.8±1.3	3.6±0.7	<0.01*
	NDH	4.4±1.2	4.3±0.8	0.61	4.8±1.1	4.1±0.8	<0.01*
Nails	DH	6.3±1.4	4.7±0.8	<0.01*	5.5±1.2	4.3±0.7	<0.01*
	NDH	6.4±1.6	5.2±1.0	<0.01*	5.4±1.2	4.9±0.8	<0.01*
Large pegs	DH	10.4±1.7	10.1±1.4	0.34	10.4±1.2	9.5±1.2	<0.01*
	NDH	10.7±2.0	11.2±1.6	0.16	11.2±1.7	10.8±1.5	0.14
Small pegs	DH	12.9±2.6	10.2±1.3	<0.01*	13.3±2.9	9.6±1.3	<0.01*
	NDH	13.7±3.1	11.2±1.8	<0.01*	13.7±2.6	10.8±1.4	<0.01*
Buttons	B	14.9±4.0	15.0±2.8	0.88	12.1±2.5	13.8±5.1	0.03*

**p*-value considered significant at < 0.05,

[1]*p*-value, independent sample t-test; between the SHFE and the present study,

DH = dominant hand, NDH = Non-dominant hand, B = both hands

Considering on the hand function related to age, Agnew and colleagues had established normative data on the hand function by using an interim Australian version of the original Jebsen Hand Function Test (JHFT) and reported in 1982 (58). The test was administered to 383 Australian subjects of both sexes aged 16 to 60 years. The time consumed during each type of the test was relatively increased as the participants getting old. These findings were conformed to that of Agnew and colleagues.

Table 5.25 Mean times and standard deviations (seconds) for normal subjects: Comparative study of the dominant hand between the present study and the simulated feeding test on Australian populations*.

The present study			Agnew et al. in 1982		
Age group (years)	Simulated feeding (sec.)		Age group (years)	Simulated feeding (sec.)	
	Male	Female		Male	Female
21-30	6.1±0.8	5.8±0.6	16-25	6.54±1.35	6.9±1.6
			26-35	6.51±1.76	6.26+1.76
31-40	6.4±1.0	5.8±0.5			
			36-45	6.53±1.83	5.89±0.95
41-50	6.7±0.8	5.8±0.7			
			46-55	6.64±1.96	6.03±1.06
51-60	6.9±0.9	6.4±0.9			
			56-65	6.88±0.09	7.21±1.98

*Using of the Jebsen Hand Function Test (JHFT)

Table 5.26 Mean times and standard deviations (seconds) for normal subjects: Comparative study of the dominant hand between the present study and the checkers test on Australian populations*.

The present study			Agnew et al. in 1982		
Age group (years)	Checkers (sec.)		Age group (years)	Checkers (sec.)	
	Male	Female		Male	Female
21-30	3.8±0.5	3.3±0.4	16-25	3.78±0.8	3.48±0.78
			26-35	4.11±0.69	3.68±0.53
31-40	3.8±0.9	3.9±0.8			
			36-45	3.91±0.71	3.73±0.72
41-50	3.7±0.7	3.9±0.6			
			46-55	3.82±0.66	4.01±0.67
51-60	4.6±0.7	4.3±0.7			
			56-65	4.47±0.72	4.72±2.08

*Using of the Jebsen Hand Function Test (JHFT)

Table 5.27 Mean times and standard deviations (seconds) for normal subjects: Comparative study of the dominant hand between the present study and the large heavy objects test on Australian populations*.

The present study			Agnew et al. in 1982		
Age group (years)	Large heavy objects (sec.)		Age group (years)	Large heavy objects (sec.)	
	Male	Female		Male	Female
21-30	3.3±0.5	3.3±0.4	16-25	2.91±0.55	3.39±0.62
			26-35	3.06±0.64	3.08±0.41
31-40	3.5±0.8	3.7±0.4			
			36-45	2.89±0.49	3.21±0.50
41-50	3.4±0.4	3.6±0.2			
			46-55	3.26±0.61	3.44±0.49
51-60	4.2±0.5	3.9±0.4			
			56-65	3.27±0.48	4.01±0.59

*Using of the Jebsen Hand Function Test (JHFT)

Table 5.28 Mean times and standard deviations (seconds) for normal subjects: Comparative study of the dominant hand between the present study and the large light objects test on Australian populations*.

The persent study			Agnew et al. in 1982		
Age group (years)	Large light objects (sec.)		Age group (years)	Large light objects (sec.)	
	Male	Female		Male	Female
21-30	3.2±0.4	3.2±0.4	16-25	2.90±0.55	3.27±0.74
			26-35	3.13±0.54	3.13±0.57
31-40	3.6±0.8	3.6±0.5			
			36-45	3.00±0.43	2.99±0.41
41-50	3.5±0.4	3.6±0.4			
			46-55	3.19±0.63	3.4±0.54
51-60	4.3±0.4	3.9±0.5			
			56-65	3.41±0.51	3.92±0.77

*Using of the Jebsen Hand Function Test (JHFT)

5.9 Clinical implications

Grip and pinch-strength are reliable clinical measures of human strength and are used widely with other clinical observations to plot the course of hand function. Usually, physical therapists use grip-strength and pinch-strength measurements as means of evaluating patients' hand functions. This information may be used to determine the degree of disability and to document changes or improvement resulting from specific treatment methods. Grip and pinch-strength data could also be used to monitor specific hands disabilities such as rheumatoid arthritis, which causes progressive hand weakness. Grip strength assessment could even serve to predict all causes of mortality with different levels of BMI in initial disease free men and also serve to predict old age disability, hence, providing a greater safety margin above the threshold of disability (75-76).

As our physical therapists and occupational therapists have become progressively more responsible for providing rehabilitation care in the treatment of hand problems, objective evaluation of hand strength as well as other hand functions had become increasingly important. Accurate and appropriate assessment is viewed as an important precursor to therapy, helping to establish baselines upon which to develop and prioritize treatment procedures and as a determinant of the efficacy of the treatment program itself. It also serves as a potent source of patient motivation and provides a method for precise communication between professionals, and among our therapists, patients, and their family members. In some instances, adequate assessment of a dysfunctional hand can be accomplished by comparing it with the normal one; in others instances, comparison with objective measures is essential. The treatment of adults living in the developing country who have hand problems have been facilitated by the availability of the objective data concerning their normal hand strength. However, normative data concerning the hand strength in Thai are, unfortunately, less readily available and are less well documented. These preliminary data should provide our therapists who treat Thai patients with hand problems with a valid basis for determining “normal” and “dysfunctional,” and for establishing sound treatment goals. They should also give the therapists a means for preparing a patient’s score with the scores of normal individuals of the same age and sex. In addition, the present preliminary data should help the therapists in documenting their treatments to the patient, the family, and the third party.

It is also important to recognize that either hand strength or a particular aspect of hand function measurement is not an isolated aspect of patient’s function but is dependent upon the ability of proximal portion of the upper extremity to position the hand for function and also upon mental status and other factors. Therefore, the collection of reliable and valid evaluation data depends on the use of the accurate test instruments that have standardized procedures for their administration. In addition, normative data assist in interpreting evaluation results and in setting realistic treatment goals. To improve the reliability and validity of hand strength evaluations the

following recommendations had been made to follow: (A) standardized positioning and instruction should be followed; (B) the average of three trials should be used; (C) the dynamometer and pinch gauge described should be used for data collection; (D) scores obtained should be compared to the appropriate age and sex categories for interpretation; (E) the calibration of the dynamometer and pinch gauges should be checked regularly; (F) the same test instrument should be used for pre- and post-testing (17).

5.10 Recommendations for further study

Establishing a normative data on hand strength and hand function performances in healthy Thai adults are possible. However, further study should be considered on many aspects. Unquestionably, a larger sample size is desirable. Enrolling more participants from different occupations, and various parts of our country especially male group as well as recruiting more participants from different age categories including young and elderly participants could be beneficial and identified which test is acceptably and practically performed. Moreover, a better test that could be designed and practically used is looking forward to come out. Lastly, revision of the normative data should be performed i.e. every 10 years to update the data, and ensure its reliability when therapists employ it in their clinical practice.

CHAPTER 6
CONCLUSION

The subjects in this study comprised of 169 volunteers (age 21-60 years), who were workers or subjects without evidences of abnormality of upper extremity structure or functions. Most of them were right-handed and usually healthy without any associated illness. The assessment of hand strength/hand function test was based on standard protocols of measurement and the combined versions of the JHFT and the SHFE.

The purpose of this study was partially set to establish preliminary data concerning grip strength, pinch-strength, and many aspects of hand function performances for use by our clinicians who were treating Thai patients with hand problems. It was shown that the grip strength of persons aged 20 to 60 years was not significantly related with age or BMI. The results revealed that male subjects had longer in length of the measured lines A, B, and C for both hands and the measured lined D only for the dominant hand as compared to those of females. Grip-strength and pinch-strength of the dominant hand was generally stronger than that of the non-dominant hand. Grip-strength and pinch-strength in male was also generally stronger than that of female. Regarding the hand function tests, dominant hand usually performed at a faster rate as compared to those of the non-dominant hand in both genders. There were significant correlations between grip-strength and pinch-strength of both hands derived from the total numbers of each gender as well as from all recruited participants. There were significant correlations between their age and the rate of almost all aspects of the hand functions derived from the total numbers of each gender as well as from all recruited participants. There were also significant correlations between their BMI and almost all aspects of hand function derived from all female participants as well as from all recruited participants. The significant correlations between males' BMI and various hand functions were less noticeable.

However, the significant correlations in male could be observed only between subjects' BMI and large & small pegs tests as well as large heavy & light objects tests performed by their non-dominant hands. Significance but rather small correlations between hand strength and some hand functions performance had been observed. Lastly, the 10% rule of hand strength in this study is applicable.

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APPENDIX

APPENDIX A

แบบยินยอมเข้าร่วมการวิจัย

เรื่อง ขอความร่วมมือในการเก็บข้อมูลวิจัย

เรียน ผู้เข้าร่วมวิจัย

เนื่องด้วย ข้าพเจ้า นางเหรียญพร ผู้เจริญชนะชัย นักศึกษาหลักสูตรวิทยาศาสตรมหาบัณฑิตสาขากายภาพบำบัด โครงการจัดตั้งคณะกายภาพบำบัดและวิทยาศาสตร์การเคลื่อนไหวประยุกต์ มหาวิทยาลัยมหิดล อยู่ในระหว่างดำเนินการวิจัยเพื่อเสนอวิทยานิพนธ์ เรื่อง "ความแข็งแรงของมือ และ ความสามารถในการใช้งานของมือในผู้ใหญ่ไทยที่มีสุขภาพดี" ซึ่งผลการวิจัยนี้จะเป็นประโยชน์ต่อผู้ป่วยที่ได้รับบาดเจ็บทางมือ หรือมีโรคของมือ เพื่อประเมินสภาพของผู้ป่วยก่อนและหลังการรักษา รวมทั้งการวางแผนการรักษาที่เหมาะสมและมีประสิทธิภาพมากยิ่งขึ้น

การดำเนินการเก็บข้อมูลมีขั้นตอนดังนี้

1. ดำเนินการซักประวัติ, วัดขนาดและความถนัดของมือทั้ง 2 ข้าง
2. ทดสอบแรงบีบของมือข้างที่ถนัด 3 ครั้ง และมือข้างไม่ถนัด 3 ครั้ง
3. ทดสอบแรงบีบของนิ้วมือข้างที่ถนัด 3 ครั้ง และมือข้างไม่ถนัด 3 ครั้ง
4. ทดสอบการใช้งานของมือทั้ง 2 ข้าง โดยมีการทดสอบ 9 อย่าง

จึงเรียนมาเพื่อขอความร่วมมือในการเก็บรวบรวมข้อมูล เพื่อการทำวิทยานิพนธ์ดังกล่าว ทั้งนี้ในการเก็บข้อมูลจะไม่เกิดอันตรายแก่ผู้เข้าร่วมวิจัยแต่อย่างใด

ขอขอบพระคุณอย่างสูงมา ณ โอกาสนี้

ขอแสดงความนับถือ

(นาง เหรียญพร ผู้เจริญชนะชัย)
วันที่……..ผู้วิจัย

ข้าพเจ้า……..อายุ…….ปี
ได้รับทราบขั้นตอนการเก็บข้อมูลการวิจัยเรื่อง "ความแข็งแรงของมือ และ ความสามารถในการใช้งานของมือในผู้ใหญ่ไทยที่มีสุขภาพดี" และยินยอมเข้าร่วมการวิจัยครั้งนี้ด้วยความเต็มใจ

ลงชื่อ…….
วันที่……..ผู้เข้าร่วมวิจัย

APPENDIX B

1. ชื่อ _____ นามสกุล _____
2. ที่อยู่ _____ โทร. _____
3. วัน เดือน ปีเกิด _____ อายุ _____ ปี _____ เดือน เพศ _____
4. ความถนัดของมือ _____
5. น้ำหนัก _____ kg. ส่วนสูง _____ cm.
6. การศึกษา

   ___ ประถมศึกษา ___ ปวช / ปวส ___ มัธยมศึกษา

   ___ ปริญญาตรี ___ สูงกว่าปริญญาตรี
7. สถานภาพการสมรส

   ___ โสด ___ แต่งงาน ___หม้าย
8. อาชีพ _____ ลักษณะของงานที่ทำ _____
9. การออกกำลังกาย

   ___ ออกกำลังกายเป็นประจำ _____ วันต่ออาทิตย์

   ___ ไม่ออกกำลังกาย
10. ประวัติครอบครัว

    ___ มีประวัติโรคในครอบครัว

    ___ โรคหัวใจ ___ มะเร็ง ___ ความดันโลหิตสูง

    ___ โรคข้อ ___ อัมพาต / อัมพฤกษ์ ___ โรคกระดูกพรุน

    ___ เบาหวาน ___ โรคทางจิตเวช ___ อื่นๆ _____

    ___ ไม่มีประวัติโรคในครอบครัว
11. ประวัติปัจจุบัน

    ท่านมีอาการ หรือ กำลังมีอาการของโรคดังต่อไปนี้

    ___ โรคข้อ ___ อุบัติเหตุของศรีษะและทางสมอง

    ___ กระดูกหัก ___ โรคภูมิแพ้

    ___ โรคกระดูกพรุน ___ โรคของต่อมธัยรอยด์

    ___ โรคความดันโลหิตสูง ___ โรคเบาหวาน

    ___ อื่นๆ _____

___ ไม่มีอาการของโรคใดๆ

12. ในช่วง 6 เดือนที่ผ่านมา ท่านเคยรักษาอาการของโรคข้อหรือมีกระดูกหัก หรือไม่

___ เคย คือ _____

___ ไม่เคย

13. ประวัติทางการแพทย์

ท่านรับประทานยาเป็นประจำ หรือไม่

___ รับประทานยา คือ _____

___ ไม่เคยรับประทาน

A. cm

B. cm

C. cm

D. cm

APPENDIX C

	RIGHT				LEFT			
STRENGTH (kg.)	1	2	3	average	1	2	3	average
Grip strength								
Palmar pinch strength								
Key pinch strength								
Tip pinch strength								

HAND FUNCTION TESTS (sec.)	RIGHT	LEFT
1. Large pegs		
2. Small pegs		
3. Large light objects		
4. Large heavy objects		
5. Checkers		
6. Blocks		
7. Nails		
8. Eating		
9. Buttons (both hands)		

Name

Date Sex Age

แบบทดสอบความถนัดของมือในคนไทย

ชื่อ _____ นามสกุล _____ เพศ _____ อายุ _____ ปี

ข้อทดสอบ		มือซ้าย	มือขวา
1.	เขียน ชื่อและนามสกุล ในใบยินยอม		
2.	วาดรูปตามตัวอย่าง		
3.	โยนของลงในกล่อง		
4.	ใช้กรรไกรตัดกระดาษ		
5.	แปรงฟัน		
6.	ใช้มีดหั่นของ		
7.	ใช้ช้อนตักของ		
8.	จับไม้กวาด		
9.	จุดไม้ขีด		
10.	เปิดฝากล่อง		

APPENDIX D

Intraclass correlation coefficient [ICC $_{(3, 1)}$]

The intraclass correlation coefficient is defined as the agreements between any two measurements in the same object using randomly chosen methods. Another situation where the method may be useful is where a characteristic that cannot be measured objectively is assessed by two or more raters and the level of agreement between the raters, which may be referred to the reliability of the ratings, is critical to the way the data are used (73-74). The principle objective of this examination, to assess the validity of the measurements, was pursued through comparisons of the prediction.

The investigator, thereby, performed intraclass correlation studies to determine the reliability of the ratings on each clinical parameter prior to conducting the main study. Ten healthy volunteers were included. Hand function and hand strength tests were sequentially performed as previously described in the study-methodology. The averages of each test were then calculated. Making an attempt to perform the tests in the same subject at the same time of the day, both of the hand strength and hand functions performance were repeated at one week after. The ICC $_{(3, 1)}$, two-way mixed effect model (consistency definition), was reported as follow.

Table 47 Reliability analyses

Measures	Hand side	ICCs	95% limits of agreement
Grip-strength	DH	0.97	0.89 to 0.99
	NDH	0.97	0.88 to 0.99
Palmar pinch-strength	DH	0.81	0.40 to 0.95
	NDH	0.90	0.64 to 0.97
Key pinch-strength	DH	0.97	088 to 0.99
	NDH	0.95	0.80 to 0.99
Tip pinch-strength	DH	0.77	0.31 to 0.94
	NDH	0.91	0.68 to 0.98
Simulated feeding	DH	0.92	0.72 to 0.98
	NDH	0.95	0.83 to 0.99
Checkers	DH	0.88	0.61 to 0.97
	NDH	0.70	0.16 to 0.92
Large light objects	DH	0.85	0.50 to 0.96
	NDH	0.86	0.54 to 0.96
Large heavy objects	DH	0.86	0.53 to 0.96
	NDH	0.87	0.57 to 0.97
Blocks	DH	0.85	0.50 to 0.96
	NDH	0.83	0.46 to 0.96
Nails	DH	0.86	0.55 to 0.96
	NDH	0.60	0.01 to 0.89
Large pegs	DH	0.79	036 to 0.94
	NDH	0.91	0.67 to 0.98
Small pegs	DH	0.91	0.68 to 0.98
	NDH	0.90	0.64 to 0.97
Button board	B	0.75	0.28 to 0.93

DH =Dominant hand, NDH = Non-dominant hand, B = both hands

APPENDIX E: Raw data of the general characteristics

Case No.	Sex	Age (year)	Marriage	Educational level	Occupation	Manual work type	Exercise	Co-existing disease	Family history	Handed	Weight (kg.)	Height (cm.)	BMI (kg/m^2)
1	F	21.75	No	B.Sc.	Student	Light	No	None	None	Right	56.30	161.00	21.72
2	F	22.50	No	M.Sc.	Student	Light	No	None	HT	Right	40.50	153.00	17.30
3	F	23.25	No	B.Sc.	Student	Light	No	None	DM	Right	47.00	150.00	20.89
4	F	23.67	No	M.Sc.	Student	Light	No	None	None	Right	47.00	157.00	19.07
5	F	24.42	No	M.Sc.	Student	Light	No	None	None	Right	43.00	155.00	17.90
6	F	24.42	No	M.Sc.	Student	Light	No	Arthropathy	None	Right	44.00	152.00	19.04
7	F	22.25	No	B.Sc.	Student	Light	Yes	Arthropathy	CAD	Right	47.00	160.00	18.36
8	F	24.00	No	B.Sc.	Student	Light	No	None	DM	Right	54.00	153.00	23.07
9	F	25.00	No	M.Sc.	Student	Light	No	None	None	Right	48.00	159.00	18.99
10	F	24.17	No	M.Sc.	Student	Light	Yes	Arthropathy	DM	Right	60.00	170.00	20.76
11	F	22.58	No	B.Sc.	Gov. employ	Light	No	None	Arthritis	Right	47.00	164.00	17.47
12	F	29.00	No	M.Sc.	Gov. employ	Light	No	Allergy	Cancer	Right	49.00	161.00	18.90
13	F	21.00	No	High school	Gov. employ	Light	No	None	HT	Right	54.00	155.00	22.48
14	F	23.33	No	B.Sc.	Gov. employ	Light	No	None	DM	Right	50.00	155.00	20.81
15	F	26.00	No	B.Sc.	Priv. employ	Light	No	None	HT	Right	50.00	163.00	18.82
16	F	27.17	No	B.Sc.	Priv. employ	Light	No	None	HT	Right	56.00	165.00	20.57
17	F	24.08	No	B.Sc.	Priv. employ	Light	No	None	DM	Right	53.00	165.00	19.47
18	F	22.67	No	Diploma	Gov. employ	Light	No	None	CAD	Right	52.00	150.00	23.11
19	F	26.08	No	B.Sc.	Priv. employ	Light	No	None	DM	Right	54.00	164.00	20.08
20	F	24.75	No	B.Sc.	Priv. employ	Light	Yes	None	None	Right	60.00	160.00	23.44
21	F	24.42	No	B.Sc.	Priv. employ	Light	Yes	None	DM	Right	55.00	162.00	20.96
22	F	24.75	No	B.Sc.	Gov. employ	Light	No	Allergy	None	Right	44.00	154.00	18.55
23	F	23.92	No	B.Sc.	Priv. employ	Light	Yes	None	HT	Right	41.00	155.00	17.07
24	F	27.33	No	B.Sc.	Priv. employ	Light	No	None	None	Right	58.00	153.00	24.78
25	F	22.83	No	B.Sc.	Gov. employ	Light	No	None	None	Right	53.00	162.00	20.20
26	F	25.08	No	B.Sc.	Priv. employ	Light	No	None	None	Right	48.00	158.00	19.23
27	F	25.58	No	M.Sc.	Student	Light	No	None	DM	Right	60.00	162.00	22.86
28	F	26.00	No	M.Sc.	Student	Light	No	None	None	Right	52.00	153.00	22.21
29	F	38.83	No	B.Sc.	Priv. employ	Light	No	None	DM	Right	60.00	158.00	24.03
30	F	32.50	No	B.Sc.	Priv. employ	Light	Yes	Allergy	None	Right	54.00	160.00	21.09

APPENDIX E: Raw data of the general characteristics (continued)

Case No.	Sex	Age (year)	Marriage	Educational level	Occupation	Manual work type	Exercise	Co-existing disease	Family history	Handed	Weight (kg.)	Height (cm.)	BMI (kg/m^2)
31	F	31.00	No	M.Sc.	Priv. employ	Light	Yes	Arthropathy	HT	Right	49.00	157.00	19.88
32	F	39.75	Yes	Elementary	Priv. employ	Light	No	HT	None	Right	78.00	154.00	32.89
33	F	35.83	Yes	B.Sc.	Priv. employ	Light	No	None	HT	Right	50.00	158.00	20.03
34	F	32.17	Yes	B.Sc.	Priv. employ	Light	No	None	DM	Right	52.00	155.00	21.64
35	F	39.58	Yes	Elementary	Gov. employ	Light	No	None	None	Right	62.50	157.00	25.36
36	F	39.50	Yes	Elementary	Priv. employ	Light	Yes	Arthropathy	CAD	Right	49.00	150.00	21.78
37	F	38.00	Yes	B.Sc.	Gov. employ	Light	No	None	HT	Right	42.00	149.00	18.92
38	F	35.08	Yes	B.Sc.	Priv. employ	Light	No	None	CVA	Right	47.00	157.00	19.07
39	F	33.33	Yes	B.Sc.	Priv. employ	Light	No	None	None	Right	52.00	162.00	19.81
40	F	39.75	No	Diploma	Priv. employ	Light	No	HT	DM	Right	84.00	160.00	32.81
41	F	39.58	Yes	M.Sc.	Priv. employ	Light	No	None	Cancer	Right	52.00	157.00	21.10
42	F	37.67	Yes	Elementary	Gov. employ	Light	No	None	None	Right	61.00	160.00	23.83
43	F	37.75	No	B.Sc.	Gov. employ	Light	No	None	None	Right	55.00	150.00	24.44
44	F	39.42	No	M.Sc.	Gov. employ	Light	Yes	Arthropathy	None	Right	59.00	168.00	20.90
45	F	38.08	No	M.Sc.	Gov. employ	Light	Yes	None	HT	Right	55.00	162.00	20.96
46	F	34.50	No	B.Sc.	Student	Light	Yes	None	HT	Right	48.00	153.00	20.50
47	F	32.08	No	High school	Gov. employ	Light	Yes	None	None	Right	46.00	155.00	19.15
48	F	38.83	No	B.Sc.	Gov. employ	Light	No	None	HT	Right	78.00	160.00	30.47
49	F	34.17	Yes	B.Sc.	Priv. employ	Light	Yes	None	HT	Right	46.00	156.00	18.90
50	F	31.42	Yes	B.Sc.	Gov. employ	Light	No	None	None	Right	54.00	158.00	21.63
51	F	30.08	No	B.Sc.	Priv. employ	Light	No	None	None	Right	53.00	160.00	20.70
52	F	30.08	Yes	High school	Gov. employ	Light	Yes	Arthropathy	CVA	Right	50.00	156.00	20.55
53	F	30.33	Yes	High school	Gov. employ	Light	No	Arthropathy	DM	Right	58.00	153.00	24.78
54	F	38.50	No	Diploma	Gov. employ	Light	Yes	Dyslipidemia	None	Left	60.50	163.00	22.77
55	F	48.25	Yes	Elementary	Priv. employ	Light	No	None	None	Right	60.50	158.50	24.08
56	F	48.42	Yes	Diploma	Priv. employ	Light	No	HT	DM	Right	64.00	150.00	28.44
57	F	45.50	No	Elementary	Priv. employ	Light	No	None	None	Right	56.00	156.00	23.01
58	F	44.58	Yes	Elementary	House work	Light	No	HT	DM	Right	47.50	177.50	15.08
59	F	44.83	No	High school	Priv. employ	Light	No	HT	None	Right	45.70	155.00	19.02
60	F	49.58	No	B.Sc.	Gov. employ	Light	No	Arthropathy	DM	Right	56.00	150.00	24.89

APPENDIX E: Raw data of the general characteristics (continued)

Case No.	Sex	Age (year)	Marriage	Educational level	Occupation	Manual work type	Exercise	Co-existing disease	Family history	Handed	Weight (kg.)	Height (cm.)	BMI (kg/m^2)
61	F	45.17	No	B.Sc.	Gov. employ	Light	Yes	Arthropathy	HT	Right	55.00	157.00	22.31
62	F	49.42	No	High school	Gov. employ	Light	No	Arthropathy	HT	Right	68.00	155.00	28.30
63	F	49.33	Yes	High school	Priv. employ	Light	No	None	CAD	Right	61.00	145.00	29.01
64	F	41.67	Yes	High school	Priv. employ	Light	No	HT, DM	DM	Right	47.00	145.00	22.35
65	F	41.83	Yes	Elementary	Priv. employ	Light	No	HT	HT	Right	60.00	155.00	24.97
66	F	47.08	Yes	Elementary	Priv. employ	Light	No	HT	HT	Right	59.10	150.00	26.27
67	F	49.92	No	M.Sc.	Gov. employ	Light	Yes	HT	DM	Right	51.00	147.00	23.60
68	F	46.92	Yes	High school	Priv. employ	Light	No	HT, allergy	DM	Right	68.00	160.00	26.56
69	F	45.00	Yes	High school	Gov. employ	Light	Yes	Arthropathy	None	Right	66.70	159.50	26.22
70	F	49.67	Yes	Elementary	Gov. employ	Light	No	None	None	Right	57.00	153.00	24.35
71	F	41.00	No	High school	Priv. employ	Light	No	None	DM	Right	80.60	160.00	31.48
72	F	45.33	No	Elementary	Gov. employ	Light	No	None	None	Right	48.70	148.50	22.08
73	F	43.67	Yes	Elementary	House work	Light	Yes	None	None	Right	68.50	158.00	27.44
74	F	41.17	No	M.Sc.	Gov. employ	Light	No	None	DM	Right	62.00	156.00	25.48
75	F	40.08	Yes	Diploma	Gov. employ	Light	No	None	DM	Right	52.00	161.00	20.06
76	F	40.33	Yes	B.Sc.	Gov. employ	Light	No	None	None	Right	43.50	160.00	16.99
77	F	43.58	Yes	High school	Gov. employ	Light	No	None	None	Left	63.00	153.00	26.91
78	F	41.92	Yes	Elementary	Gov. employ	Light	No	None	DM	Left	62.20	162.00	23.70
79	F	46.58	Yes	High school	House work	Light	Yes	None	None	Left	52.00	161.00	20.06
80	F	59.50	Yes	High school	House work	Light	No	HT	None	Right	72.30	147.50	33.23
81	F	51.75	Yes	M.Sc.	Gov. employ	Light	Yes	Arthropathy	None	Right	56.30	161.00	21.72
82	F	55.33	Yes	High school	House work	Light	No	HT	DM	Right	69.50	155.50	28.74
83	F	54.50	Yes	High school	House work	Light	No	HT	HT	Right	76.40	156.00	31.39
84	F	54.33	Yes	Elementary	House work	Light	No	Allergy	DM	Right	61.00	153.50	25.89
85	F	57.17	Yes	Elementary	House work	Light	No	HT	DM	Right	52.70	148.50	23.90
86	F	52.08	Yes	Elementary	House work	Light	Yes	DM	None	Right	52.00	152.00	22.51
87	F	59.00	Yes	High school	Priv. employ	Light	Yes	None	DM	Right	67.00	161.00	25.85
88	F	53.33	No	B.Sc.	Gov. employ	Light	No	None	None	Right	52.70	158.00	21.11
89	F	59.33	Yes	Elementary	House work	Light	No	Arthropathy	Cancer	Right	71.00	156.50	28.99
90	F	51.00	No	B.Sc.	Gov. employ	Light	Yes	None	None	Right	75.00	165.00	27.55

APPENDIX E: Raw data of the general characteristics (continued)

Case No.	Sex	Age (year)	Marriage	Educational level	Occupation	Manual work type	Exercise	Co-existing disease	Family history	Handed	Weight (kg.)	Height (cm.)	BMI (kg/m^2)
91	F	53.33	Yes	High school	Gov. employ	Light	Yes	None	None	Right	57.50	167.00	20.62
92	F	57.17	Yes	Elementary	Gov. employ	Light	No	None	DM	Right	64.50	150.00	28.67
93	F	51.00	Yes	Elementary	Priv. employ	Moderate	No	HT, dyslipid	HT	Right	67.50	156.00	27.74
94	F	55.00	Yes	Diploma	House work	Light	Yes	None	None	Right	71.00	164.00	26.40
95	F	57.00	No	Diploma	House work	Light	Yes	HT, dyslipid	HT	Right	50.00	148.00	22.83
96	F	54.00	Yes	Elementary	House work	Light	Yes	Allergy	HT	Right	65.00	156.00	26.71
97	F	50.33	Yes	Elementary	House work	Light	No	DM	DM	Right	60.00	151.00	26.31
98	F	57.08	Yes	Elementary	Gov. employ	Light	No	Dyslipidemia	HT	Right	80.00	154.00	33.73
99	F	50.75	Yes	Diploma	House work	Light	Yes	HT, dyslipid	None	Right	70.00	158.00	28.04
100	F	53.58	Yes	Elementary	Gov. employ	Moderate	No	HT, dyslipid	DM	Right	63.00	149.00	28.38
101	F	52.00	Yes	Elementary	House work	Light	No	None	None	Right	63.00	158.00	25.24
102	F	50.08	No	Elementary	Priv. employ	Light	No	HT	HT	Right	69.30	160.00	27.07
103	M	22.20	No	Diploma	Gov. employ	Light	No	None	None	Right	67.00	171.00	22.91
104	M	21.20	No	B.Sc.	Student	Light	Yes	None	None	Right	58.00	172.00	19.61
105	M	24.40	No	B.Sc.	Student	Light	No	None	None	Right	71.00	170.00	24.57
106	M	28.10	No	High school	Gov. employ	Light	Yes	None	None	Right	53.00	159.00	20.96
107	M	27.90	No	B.Sc.	Gov. employ	Light	No	None	None	Right	70.00	176.00	22.60
108	M	27.00	No	High school	Gov. employ	Light	No	None	HT	Right	78.00	170.00	26.99
109	M	21.50	No	B.Sc.	Student	Light	No	None	DM	Right	74.00	181.00	22.59
110	M	26.90	No	B.Sc.	Priv. employ	Light	No	None	None	Right	60.00	175.00	19.59
111	M	28.60	No	M.Sc.	Priv. employ	Light	No	None	HT	Right	61.00	163.00	22.96
112	M	23.90	No	M.Sc.	Student	Light	No	Allergy	None	Right	60.00	178.00	18.94
113	M	25.50	No	M.Sc.	Student	Light	Yes	None	None	Right	68.00	176.00	21.95
114	M	25.11	No	High school	Gov. employ	Light	Yes	None	None	Right	52.00	168.00	18.42
115	M	26.67	No	B.Sc.	Gov. employ	Light	No	None	HT	Right	55.00	162.00	20.96
116	M	25.58	No	B.Sc.	Priv. employ	Light	Yes	None	None	Right	65.50	167.00	23.49
117	M	26.50	Yes	High school	Gov. employ	Light	No	None	Cancer	Right	65.00	163.00	24.11
118	M	27.75	Yes	Diploma	Gov. employ	Light	No	None	None	Left	56.00	170.00	19.38
119	M	24.17	No	B.Sc.	Gov. employ	Light	Yes	None	None	Left	48.00	170.00	19.38
120	M	25.50	No	Diploma	Gov. employ	Light	Yes	None	HT	Left	63.00	171.00	21.55

APPENDIX E: Raw data of the general characteristics (continued)

Case No.	Sex	Age (year)	Marriage	Educational level	Occupation	Manual work type	Exercise	Co-existing disease	Family history	Handed	Weight (kg.)	Height (cm.)	BMI (kg/m^2)
121	M	31.92	No	Diploma	Priv. employ	Moderate	Yes	None	HT	Right	62.00	173.00	20.72
122	M	39.50	No	Diploma	Priv. employ	Light	No	HT	CAD	Right	93.00	168.00	32.95
123	M	38.50	Yes	Diploma	Gov. employ	Light	No	Allergy	DM	Right	80.00	172.50	26.89
124	M	33.08	Yes	Diploma	Gov. employ	Light	Yes	None	None	Right	62.00	171.00	21.20
125	M	38.08	Yes	High school	Gov. employ	Light	Yes	None	HT	Right	72.00	172.00	24.34
126	M	32.08	Yes	B.Sc.	Gov. employ	Light	Yes	None	HT	Right	57.00	178.00	17.99
127	M	39.42	Yes	M.Sc.	Gov. employ	Light	No	None	DM	Right	61.00	165.00	22.41
128	M	34.58	Yes	Elementary	Gov. employ	Light	Yes	None	None	Right	60.00	170.00	20.76
129	M	34.08	Yes	Diploma	Gov. employ	Light	Yes	None	DM	Right	65.00	160.00	25.39
130	M	31.00	No	Elementary	Priv. employ	Heavy	Yes	None	HT	Right	51.00	160.00	19.92
131	M	34.58	Yes	Elementary	Gov. employ	Moderate	Yes	None	DM	Right	75.00	182.00	22.64
132	M	31.50	Yes	Elementary	Gov. employ	Light	Yes	None	None	Right	75.00	165.00	27.55
133	M	36.67	Yes	Diploma	Gov. employ	Light	Yes	None	None	Right	65.00	150.00	28.89
134	M	30.10	No	B.Sc.	Gov. employ	Light	No	None	HT	Right	70.00	171.00	23.94
135	M	30.17	No	B.Sc.	Priv. employ	Light	No	None	Arthritis	Right	68.00	180.00	20.99
136	M	40.10	No	B.Sc.	Gov. employ	Light	Yes	Allergy	DM	Right	69.00	165.00	25.34
137	M	41.17	Yes	Diploma	Gov. employ	Light	Yes	None	HT	Right	68.00	169.00	23.81
138	M	43.50	Yes	M.Sc.	Gov. employ	Light	Yes	None	Cancer	Right	62.00	170.00	21.45
139	M	47.00	Yes	Elementary	Priv. employ	Light	No	None	HT	Right	63.50	164.00	23.61
140	M	41.25	Yes	M.Sc.	Gov. employ	Light	Yes	None	None	Right	50.00	164.00	18.59
141	M	41.17	Yes	Elementary	Gov. employ	Light	No	None	None	Right	62.00	161.00	23.92
142	M	42.67	Yes	High school	Gov. employ	Light	No	None	HT	Right	47.50	158.00	19.03
143	M	48.25	Yes	High school	Gov. employ	Light	No	None	Cancer	Right	59.00	158.00	23.63
144	M	47.67	Yes	High school	Priv. employ	Light	No	None	HT	Right	66.00	162.00	25.15
145	M	43.67	Yes	B.Sc.	Gov. employ	Light	Yes	None	HT	Right	68.00	164.00	25.28
146	M	47.42	Yes	Diploma	Gov. employ	Moderate	No	None	None	Right	78.00	176.50	25.04
147	M	49.08	Yes	Elementary	Gov. employ	Moderate	Yes	None	None	Right	60.00	170.00	20.76
148	M	42.75	Yes	Diploma	Priv. employ	Light	Yes	None	HT	Right	74.00	175.00	24.16
149	M	42.67	Yes	High school	Priv. employ	Light	No	None	None	Right	62.00	162.00	23.62
150	M	41.67	Yes	B.Sc.	Gov. employ	Light	No	None	None	Right	63.50	163.00	23.90

APPENDIX E: Raw data of the general characteristics (continued)

Case No.	Sex	Age (year)	Marriage	Educational level	Occupation	Manual work type	Exercise	Co-existing disease	Family history	Handed	Weight (kg.)	Height (cm.)	BMI (kg/m^2)
151	M	45.25	Yes	B.Sc.	Gov. employ	Light	No	None	None	Right	64.00	165.00	23.51
152	M	44.00	Yes	Elementary	Gov. employ	Moderate	No	HT, DM	HT	Right	82.10	162.00	31.28
153	M	40.75	No	Elementary	Gov. employ	Moderate	No	None	CVA	Right	56.00	162.00	21.34
154	M	57.33	Yes	Elementary	Priv. employ	Light	Yes	HT	None	Right	74.60	167.00	26.75
155	M	51.92	Yes	Diploma	Priv. employ	Light	No	HT, DM	DM	Right	56.00	160.00	21.88
156	M	57.42	Yes	High school	Priv. employ	Light	Yes	HT, DM	None	Right	66.10	160.00	25.82
157	M	60.00	Yes	Elementary	House work	Light	No	HT	CVA	Right	63.20	161.00	24.38
158	M	52.25	Yes	High school	Priv. employ	Light	No	HT	CVA	Right	57.00	161.00	21.99
159	M	51.75	Yes	B.Sc.	Priv. employ	Light	No	HT, dyslipid	None	Right	69.50	159.50	27.32
160	M	51.08	Yes	Diploma	House work	Light	Yes	HT	CVA	Right	64.70	166.00	23.48
161	M	51.33	Yes	Elementary	Gov. employ	Light	No	None	CVA	Right	85.00	165.00	31.22
162	M	55.50	Yes	High school	Gov. employ	Light	No	None	None	Right	60.00	165.00	22.04
163	M	51.08	Yes	Elementary	Priv. employ	Light	No	Arthropathy	None	Right	52.00	150.00	23.11
164	M	50.33	Yes	Diploma	Gov. employ	Light	Yes	None	CVA	Right	67.00	170.00	23.18
165	M	59.50	Yes	B.Sc.	House work	Light	No	HT, DM	None	Right	71.30	167.00	25.57
166	M	51.67	Yes	High school	Gov. employ	Light	No	None	DM	Right	56.00	155.00	23.31
167	M	51.83	Yes	B.Sc.	Gov. employ	Light	No	HT	None	Right	83.70	156.00	34.39
168	M	55.75	Yes	Elementary	Gov. employ	Light	No	HT, DM	DM	Right	102.50	166.00	37.20
169	M	51.42	Yes	High school	Priv. employ	Light	No	HT, DM	DM	Left	67.30	163.00	25.33

M = Male, F = Female, HT = Hypertension, DM = Diabetes mellitus, CAD =Cardiovascular disease, CVA =cerebrovascular disease,
Dyslipid = Dyslipidemia, Arthropathy = Osteoarthritis of knee joint, Arthritis = Inflammatory arthritic disease
Gov. employ. = Government employee, Priv. Employ = Private employee,
B.S c. = Educational level of bachelor's degree, M.Sc. = Educational level of master's degree or higher,
Diploma = Educational level of diploma's degree, High school = Educational level of high school's degree,
Elementary = Educational level of elementary school's degree,
Right = Right handed, L = Left handed.

APPENDIX E: Raw data of the measured line (cm.) & grip-strength (kg.)

Case	Line A		Line B		Line C		Line D		Dominant hand (DH)			Non-dominant hand (NDH)		
no.	DH	NDH	DH	NDH	DH	NDH	DH	NDH	Grip 1	Grip 2	Grip 3	Grip 1	Grip 2	Grip 3
1	17.20	17.60	7.00	7.26	7.60	7.30	3.55	3.75	29.00	25.00	29.00	26.00	26.00	22.00
2	16.00	16.00	6.50	6.58	7.26	7.07	3.60	3.52	22.00	22.00	20.00	22.00	23.00	19.00
3	17.80	18.20	7.94	8.13	7.57	7.24	4.74	4.80	23.00	21.00	22.00	25.00	24.00	24.00
4	16.70	16.70	7.10	7.10	7.66	7.56	4.08	4.19	25.00	24.00	24.00	22.10	22.00	20.00
5	17.70	17.50	7.50	7.50	7.30	7.10	4.53	4.68	27.00	28.90	25.80	22.00	22.00	22.00
6	16.80	16.80	7.20	6.90	7.70	7.36	3.90	4.24	23.00	22.10	25.90	16.00	20.00	22.00
7	18.30	18.10	7.60	7.70	7.07	6.96	4.30	4.10	23.00	24.00	25.00	18.00	22.00	22.00
8	16.20	16.20	6.60	6.76	7.20	7.20	3.40	3.57	26.00	26.00	24.00	23.00	23.20	25.00
9	17.50	17.50	7.50	7.35	7.70	7.60	4.33	4.47	26.00	25.50	26.00	26.00	26.00	21.80
10	18.50	18.60	7.95	8.00	8.00	7.90	4.80	4.60	34.00	34.50	36.00	32.00	32.00	31.00
11	17.30	17.30	7.40	7.55	7.90	8.00	4.18	4.20	28.00	29.00	30.00	26.50	26.00	23.00
12	17.60	17.80	7.70	7.60	7.74	7.40	4.64	4.80	28.40	29.00	26.00	23.00	23.00	29.00
13	17.00	17.80	7.70	7.40	8.06	7.97	4.78	4.57	36.90	36.90	39.50	30.50	32.00	31.00
14	17.50	17.40	7.90	7.78	7.57	7.40	4.24	4.20	33.00	32.00	32.00	29.00	32.00	31.00
15	17.50	17.80	7.50	7.76	7.80	7.60	4.30	4.47	30.50	33.20	31.50	26.00	24.40	28.00
16	17.20	17.10	7.10	7.00	7.40	7.30	4.00	4.10	24.80	27.00	24.00	24.40	24.00	21.60
17	16.70	16.70	7.10	7.10	7.70	7.56	4.04	4.19	24.80	25.40	25.90	21.00	23.60	21.70
18	15.80	15.60	6.90	6.83	7.60	7.30	3.20	3.40	30.20	31.50	30.90	30.00	30.00	30.00
19	17.70	17.70	7.35	7.40	7.36	7.25	4.26	4.20	28.00	26.00	24.00	25.00	22.60	26.00
20	16.70	16.70	6.87	6.68	7.70	7.40	3.70	3.70	21.90	23.00	25.00	22.00	24.00	19.80
21	17.30	17.30	7.30	7.20	7.50	7.50	3.90	3.80	33.50	32.00	30.00	38.50	29.50	30.00
22	18.30	18.10	7.60	7.70	7.07	6.96	4.30	4.25	23.00	21.80	24.00	20.00	17.00	16.90
23	16.60	16.50	7.20	7.37	7.30	7.06	4.16	4.27	25.90	28.50	28.00	20.00	19.00	21.00
24	16.80	16.80	7.10	6.96	7.74	7.70	4.40	4.30	29.50	29.70	32.00	28.80	25.90	28.00
25	17.20	17.30	7.17	7.10	7.30	7.00	4.46	4.65	23.80	24.90	25.00	22.00	21.00	20.50
26	16.80	16.80	7.20	6.90	7.70	7.36	3.90	4.20	29.70	29.00	30.00	26.50	25.00	27.00
27	17.00	17.10	7.25	7.57	8.36	8.24	3.60	3.70	37.50	37.50	38.00	28.50	31.00	32.50
28	17.00	16.90	6.60	7.00	7.28	7.20	3.86	3.85	28.50	24.25	26.50	24.00	24.00	23.00
29	16.50	16.80	6.66	6.60	7.80	7.50	3.83	3.99	21.70	19.50	24.00	20.00	20.50	20.30
30	17.60	17.50	7.50	7.30	7.50	7.20	4.50	5.00	33.00	31.80	31.00	26.00	22.00	23.40
31	17.30	17.30	6.77	6.96	7.30	7.00	4.06	3.97	22.60	23.60	24.00	20.40	19.00	20.50

APPENDIX E: Raw data of the measured line (cm.) & grip-strength (kg.) (continued)

Case	Line A		Line B		Line C		Line D		Dominant hand (DH)			Non-dominant hand (NDH)		
no.	DH	NDH	DH	NDH	DH	NDH	DH	NDH	Grip 1	Grip 2	Grip 3	Grip 1	Grip 2	Grip 3
32	17.00	17.20	7.30	7.20	8.47	8.09	3.35	3.46	35.00	34.20	34.60	28.00	25.80	29.00
33	18.00	18.00	7.50	7.20	7.88	7.50	3.65	3.54	24.00	23.00	24.00	26.00	30.00	26.00
34	16.90	17.00	7.66	7.60	8.00	7.75	3.89	4.10	34.00	31.40	35.00	24.90	33.60	33.70
35	18.00	17.90	7.47	7.40	8.27	7.90	4.30	4.20	34.00	33.90	35.00	25.00	31.00	30.00
36	16.30	16.20	6.70	7.00	7.35	7.27	3.80	3.60	25.50	25.80	23.00	28.00	25.00	27.30
37	15.50	15.50	6.80	6.60	6.90	6.90	3.85	3.65	14.00	15.80	16.00	14.00	15.00	12.00
38	17.50	17.40	7.55	7.55	7.40	7.35	4.20	4.20	25.00	23.00	16.50	18.20	20.00	24.00
39	17.80	17.80	7.66	7.40	7.56	7.40	4.44	4.30	38.50	41.00	39.00	28.00	34.00	31.00
40	18.60	18.40	8.20	7.80	8.70	8.40	4.20	3.37	24.00	23.00	22.50	19.50	24.00	22.30
41	17.40	17.20	6.97	7.00	7.67	7.37	4.10	4.30	28.80	30.00	31.50	24.00	23.00	24.00
42	18.30	18.00	7.60	7.50	7.50	7.40	4.65	4.50	26.00	28.30	26.00	22.00	19.50	24.00
43	17.20	16.80	7.30	7.10	7.39	7.15	3.70	4.00	25.00	26.00	26.00	26.00	26.00	26.00
44	18.80	18.80	8.00	8.10	7.90	7.80	4.80	4.58	28.00	30.00	29.00	30.00	30.00	29.00
45	16.70	16.50	6.90	7.10	7.00	7.00	3.90	3.85	20.50	20.00	18.50	20.00	18.00	21.50
46	16.10	16.10	7.30	7.30	7.20	6.90	4.20	4.30	18.90	22.00	22.00	17.60	18.30	20.00
47	16.10	16.40	7.07	7.17	7.07	7.00	4.16	4.30	22.00	22.00	21.50	16.00	18.00	19.00
48	17.70	17.60	7.79	7.70	8.30	8.00	4.20	4.10	18.00	18.00	16.00	16.00	18.00	16.00
49	17.00	17.40	7.05	7.30	7.56	7.40	4.25	4.08	25.00	25.00	24.00	21.40	20.00	22.00
50	17.40	17.50	7.35	7.10	7.80	7.50	3.95	3.80	30.50	32.00	30.00	27.00	27.80	27.00
51	17.00	17.00	7.05	7.10	7.50	7.30	4.20	4.00	36.00	36.00	36.20	30.00	30.50	29.30
52	17.00	17.00	7.37	7.40	7.90	7.70	4.10	4.30	26.00	26.00	24.00	25.00	27.00	26.00
53	17.70	17.70	7.30	7.40	8.00	7.74	4.40	4.20	30.00	29.90	30.00	26.00	27.50	26.00
54	18.90	18.60	7.70	7.86	7.85	8.00	4.50	4.35	35.00	30.00	33.00	30.00	30.00	29.00
55	17.50	17.50	7.30	7.30	7.30	7.07	4.70	4.65	23.00	23.40	24.00	22.00	20.00	20.50
56	15.60	15.60	6.60	6.40	7.70	7.80	3.84	3.98	27.50	29.80	29.50	26.00	24.00	23.00
57	16.00	16.00	6.80	6.50	7.50	7.25	3.25	3.10	25.80	26.20	25.70	21.80	24.00	23.00
58	17.80	17.70	7.80	7.70	8.00	7.90	4.20	4.00	26.00	28.00	30.00	26.00	28.80	27.00
59	16.60	16.70	7.27	7.20	7.20	7.00	4.08	4.10	23.80	24.00	25.00	20.80	20.70	22.00
60	17.00	16.80	7.70	7.07	7.70	7.25	3.70	3.80	26.30	26.20	29.80	22.00	26.00	27.40
61	17.60	17.80	7.46	7.55	8.10	8.14	4.24	4.10	34.30	36.00	36.00	33.60	34.00	33.60
62	15.50	15.40	6.36	6.08	7.77	7.50	3.80	3.70	20.00	24.40	23.00	25.80	25.90	25.40

APPENDIX E: Raw data of the measured line (cm.) & grip-strength (kg.) (continued)

Case	Line A		Line B		Line C		Line D		Dominant hand (DH)			Non-dominant hand (NDH)		
no.	DH	NDH	DH	NDH	DH	NDH	DH	NDH	Grip 1	Grip 2	Grip 3	Grip 1	Grip 2	Grip 3
63	15.40	15.40	6.90	6.94	7.70	7.50	3.66	3.60	30.20	32.00	32.60	25.00	26.80	27.00
64	15.50	15.50	6.45	6.40	7.30	7.24	3.66	3.46	22.00	22.30	22.00	19.30	20.60	23.00
65	16.70	16.50	7.10	6.90	8.00	7.50	3.65	3.60	28.60	27.40	29.00	21.00	20.00	18.00
66	16.80	16.70	7.20	7.30	7.68	7.70	3.66	3.50	25.90	26.00	26.00	20.00	23.00	21.80
67	15.00	14.60	6.20	5.97	7.00	6.70	3.40	3.50	22.00	21.00	20.00	18.00	21.30	22.00
68	17.30	17.40	7.46	7.30	7.70	7.50	4.03	4.08	24.00	27.90	27.50	21.50	21.00	24.00
69	18.20	18.20	8.00	7.80	8.40	8.16	4.30	4.36	26.00	25.00	26.00	24.20	25.50	25.00
70	17.40	17.30	7.45	7.50	7.76	7.70	4.10	4.50	24.00	28.90	25.00	21.90	26.00	26.00
71	18.70	18.70	8.36	8.20	8.10	8.20	4.50	4.25	39.90	42.00	44.00	42.20	45.00	38.20
72	16.00	16.20	6.80	6.85	7.70	7.60	4.20	4.00	24.00	25.90	25.90	24.00	25.00	27.00
73	18.30	18.30	7.44	7.60	8.54	8.30	4.36	4.70	32.20	35.00	33.00	28.00	26.00	28.00
74	17.00	16.80	7.00	6.80	8.07	7.80	3.96	3.80	30.50	32.00	32.20	29.00	30.50	29.00
75	18.00	17.90	7.87	7.70	7.96	7.68	4.00	4.20	33.00	35.00	35.50	30.60	30.00	30.00
76	17.70	17.50	7.30	7.40	7.20	7.00	4.60	4.56	28.00	27.50	27.70	21.00	24.30	24.00
77	17.30	17.40	7.16	7.17	7.74	7.36	3.94	3.80	28.50	29.00	32.20	28.80	33.00	30.50
78	17.80	17.80	7.30	7.46	8.20	7.86	4.20	4.10	29.50	30.90	28.00	21.00	24.20	24.00
79	17.20	17.50	7.26	7.24	8.09	7.88	4.08	4.14	33.30	32.00	31.50	31.00	30.20	32.00
80	16.60	17.00	6.88	6.80	7.90	7.50	3.70	4.00	22.50	25.00	25.00	21.00	23.70	24.00
81	17.20	17.60	7.00	7.26	7.60	7.30	3.55	3.75	27.80	28.00	30.80	24.40	26.00	22.00
82	16.90	16.90	6.86	6.90	7.60	7.47	4.00	4.00	22.00	22.00	23.30	18.20	22.30	21.90
83	16.70	17.00	7.10	7.26	7.80	7.60	4.00	4.00	24.00	27.70	26.00	29.00	26.40	26.00
84	17.30	17.30	7.00	7.10	8.00	7.75	3.60	3.60	34.00	36.00	37.00	28.80	31.20	32.00
85	16.00	16.00	6.80	6.76	7.60	7.30	3.50	3.60	24.00	21.00	23.80	21.00	19.80	21.00
86	17.00	16.80	7.00	7.10	7.90	7.95	3.60	3.60	16.80	20.30	22.00	15.00	19.80	21.80
87	17.70	17.60	7.90	7.90	8.20	8.00	3.96	3.90	33.00	35.00	35.30	28.00	26.20	28.50
88	17.00	17.40	7.46	7.46	7.57	7.30	4.16	4.14	28.80	30.30	29.00	24.60	25.00	23.70
89	18.60	18.80	8.30	8.30	8.60	8.30	4.30	4.60	26.00	26.90	27.00	21.00	21.80	23.70
90	18.20	18.20	8.00	7.90	8.70	8.20	4.30	4.30	25.50	28.20	28.00	22.40	23.00	24.00
91	17.90	17.80	7.50	7.50	7.60	7.50	4.60	4.60	22.00	25.40	24.50	18.00	19.50	18.00
92	16.90	16.90	6.80	6.70	8.05	7.60	4.20	4.20	16.50	18.00	18.00	16.00	18.00	19.00
93	16.90	17.10	7.00	7.20	7.90	7.88	3.90	4.00	27.00	31.00	31.00	33.00	30.20	32.00

APPENDIX E: Raw data of the measured line (cm.) & grip-strength (kg.) (continued)

Case	Line A		Line B		Line C		Line D		Dominant hand (DH)			Non-dominant hand (NDH)		
no.	DH	NDH	DH	NDH	DH	NDH	DH	NDH	Grip 1	Grip 2	Grip 3	Grip 1	Grip 2	Grip 3
94	17.00	17.30	7.00	7.08	8.05	8.10	4.10	3.90	33.00	32.00	31.00	33.00	33.90	32.00
95	16.30	13.70	6.80	7.20	7.87	7.50	4.20	4.10	24.00	23.90	24.00	22.00	21.90	24.00
96	17.50	17.60	7.44	7.50	8.10	7.93	4.00	3.55	33.00	36.00	32.00	29.00	26.00	32.00
97	17.00	17.10	6.60	6.70	7.60	7.60	3.60	3.80	15.00	18.00	18.00	14.00	15.00	14.00
98	16.50	16.80	6.30	6.40	7.70	7.70	3.50	3.40	28.00	29.00	27.90	22.00	24.50	26.00
99	17.70	17.80	7.60	7.90	7.95	8.00	3.85	4.10	30.00	34.00	36.00	28.00	30.00	32.00
100	16.30	16.40	6.90	7.00	7.53	7.60	3.30	3.32	18.00	18.00	19.00	16.00	18.00	16.00
101	17.70	17.60	7.90	7.90	8.20	8.00	3.96	3.80	31.00	28.00	26.00	28.00	28.00	28.00
102	18.20	18.10	7.60	7.50	7.80	7.60	4.00	4.10	24.00	28.00	27.80	25.80	28.40	25.80
103	19.50	19.50	8.70	8.67	9.09	9.08	4.30	4.48	49.00	50.90	50.50	43.50	43.00	45.00
104	18.80	19.10	8.18	8.26	8.65	8.40	4.08	4.20	54.00	49.00	46.00	45.00	38.00	44.20
105	18.30	18.30	7.60	7.60	8.50	8.40	4.00	4.00	40.00	32.00	34.50	33.00	30.50	29.00
106	18.40	18.40	8.40	8.20	8.40	8.00	4.60	4.44	36.00	34.00	38.00	34.90	33.40	36.00
107	18.30	18.30	7.65	7.85	8.70	8.46	3.80	4.00	50.00	46.00	47.40	45.00	41.70	44.00
108	19.40	19.50	8.20	8.40	9.10	9.10	4.20	4.17	56.00	57.00	54.00	46.00	44.00	46.00
109	21.00	21.30	8.60	8.70	8.80	8.87	5.60	5.40	41.00	39.00	42.00	30.00	30.00	27.00
110	19.10	19.20	8.10	8.16	8.10	7.80	5.08	5.00	28.00	33.00	30.00	32.40	35.90	32.50
111	18.00	18.00	7.70	7.55	8.00	7.54	4.36	4.17	49.00	52.50	50.00	39.00	44.00	43.00
112	19.30	18.80	8.20	8.28	8.30	8.07	4.70	4.50	48.00	46.00	46.00	38.00	36.00	34.00
113	18.50	18.90	7.73	7.80	8.96	8.48	4.14	4.26	37.00	37.90	38.00	32.00	28.00	26.00
114	18.00	17.90	7.40	7.40	8.54	8.40	4.10	4.20	54.00	49.00	46.00	45.00	38.00	44.20
115	17.10	17.10	7.00	6.90	7.70	7.45	3.90	3.90	34.00	35.80	33.70	20.40	25.00	24.80
116	8.80	8.30	8.25	8.10	8.50	8.40	4.60	4.30	52.00	49.80	52.80	46.00	44.00	48.00
117	17.80	17.80	7.45	7.45	8.98	8.80	4.30	4.45	54.00	56.00	50.50	46.00	48.00	48.00
118	19.00	19.20	7.90	7.80	8.80	8.50	4.36	4.30	32.40	31.00	31.70	30.50	26.00	27.80
119	18.30	18.60	7.28	7.53	7.70	7.44	4.30	4.60	35.90	37.20	37.50	35.40	36.30	34.00
120	19.00	18.80	7.96	7.90	8.65	8.55	4.40	4.40	43.30	40.20	39.00	35.50	33.70	30.80
121	19.00	19.40	7.60	7.90	8.60	8.60	4.30	4.70	49.60	50.00	49.70	37.60	38.50	43.00
122	18.00	18.00	7.60	7.36	8.60	8.50	4.30	4.10	34.90	30.00	38.00	32.50	32.40	27.00
123	19.60	19.80	8.50	8.45	9.20	9.05	4.30	4.60	47.00	47.70	49.00	39.40	44.00	40.30
124	17.80	17.50	7.20	7.00	8.00	7.60	4.90	4.60	49.00	49.30	44.50	40.00	42.00	46.00

APPENDIX E: Raw data of the measured line (cm.) & grip-strength (kg.) (continued)

Case no.	Line A		Line B		Line C		Line D		Dominant hand (DH)			Non-dominant hand (NDH)		
	DH	NDH	DH	NDH	DH	NDH	DH	NDH	Grip 1	Grip 2	Grip 3	Grip 1	Grip 2	Grip 3
125	19.50	19.10	8.15	8.00	8.80	8.20	4.86	4.30	39.50	42.00	38.00	32.00	31.80	27.00
126	18.90	19.40	7.90	7.90	8.76	8.60	4.50	4.60	46.00	46.00	46.00	46.20	41.50	45.00
127	18.00	18.30	7.73	7.66	8.65	8.38	3.80	3.96	37.00	39.00	36.00	36.00	30.00	30.00
128	18.50	19.00	7.80	7.80	8.90	8.70	4.15	3.96	40.00	44.00	45.50	38.00	39.50	45.00
129	17.10	17.60	7.00	7.94	7.96	7.86	3.30	3.48	43.00	47.00	46.30	35.00	35.00	39.00
130	17.80	17.80	7.80	7.80	8.50	8.45	4.00	4.20	44.00	42.00	44.00	36.00	40.00	40.00
131	23.00	23.00	9.00	8.60	9.35	9.40	4.10	4.00	49.00	51.00	50.00	50.00	50.00	47.00
132	19.60	19.80	8.50	8.45	9.20	9.05	4.30	4.66	48.00	50.00	47.00	41.00	41.00	44.00
133	17.30	17.20	6.95	7.10	7.85	7.80	3.10	3.00	42.00	44.00	46.00	41.00	41.00	41.50
134	19.00	18.80	8.00	7.96	8.69	8.40	4.46	4.50	35.40	35.80	36.00	33.80	29.90	29.80
135	19.30	19.60	8.20	8.36	8.90	8.80	4.66	4.67	34.00	33.70	34.30	30.00	32.40	36.00
136	19.30	19.50	8.70	8.45	8.30	8.40	3.80	4.00	42.00	47.00	48.00	44.00	44.00	42.00
137	18.10	18.10	7.95	7.95	8.70	8.60	3.75	3.70	50.00	51.50	57.00	49.30	49.00	47.60
138	19.40	19.50	8.20	8.10	8.80	8.70	4.85	4.90	46.00	48.00	48.00	36.00	36.00	40.00
139	17.00	17.60	7.00	7.00	9.16	9.16	3.70	3.95	42.50	43.70	44.40	37.60	41.00	41.00
140	18.00	18.00	7.40	7.40	7.80	7.70	4.20	4.50	32.40	32.00	32.40	21.80	23.80	24.00
141	18.00	18.00	7.20	7.00	8.90	8.60	4.18	4.17	40.00	40.30	42.00	32.40	39.50	38.00
142	17.70	18.00	7.10	7.30	8.02	7.90	4.00	4.00	32.00	31.80	30.00	31.80	27.00	24.00
143	17.50	18.00	7.00	7.16	8.08	8.20	3.70	4.00	40.00	37.90	40.30	35.00	33.40	36.00
144	18.60	18.60	7.90	7.70	8.15	8.26	4.60	4.50	38.00	42.00	39.50	35.00	35.90	34.00
145	18.00	18.00	7.50	7.50	8.50	8.30	4.50	4.30	36.00	38.20	38.00	33.00	30.00	35.00
146	21.10	21.10	9.20	9.00	8.90	8.95	5.40	5.60	52.20	54.00	50.00	40.00	38.00	43.00
147	8.80	9.00	7.50	7.10	8.50	8.40	4.50	4.30	42.00	41.80	43.00	38.00	45.00	42.00
148	17.30	17.70	6.96	7.05	7.95	7.75	4.08	4.14	43.00	42.00	42.00	40.00	41.00	42.00
149	18.30	18.00	7.90	7.80	9.00	8.80	4.40	4.20	42.00	42.00	44.50	46.00	48.00	46.00
150	17.30	17.70	6.96	7.05	7.95	7.75	4.08	4.04	38.70	34.50	37.80	35.00	33.30	32.00
151	18.00	18.20	7.50	7.60	8.34	8.10	4.00	4.10	37.50	37.80	35.40	32.00	36.90	38.00
152	18.50	18.60	7.58	7.80	8.76	8.80	4.20	4.10	47.00	49.80	47.70	39.40	41.30	44.00
153	18.80	19.20	7.55	8.00	9.00	8.74	4.20	4.60	37.40	40.80	39.80	38.10	34.80	35.30
154	18.00	18.00	7.35	7.40	8.97	8.87	3.13	3.30	37.00	38.60	37.40	40.00	41.50	44.00
155	17.20	17.70	7.56	7.76	8.29	8.29	4.00	4.30	37.40	40.80	39.80	38.00	34.80	35.40

APPENDIX E: Raw data of the measured line (cm.) & grip-strength (kg.) (continued)

Case no.	Line A		Line B		Line C		Line D		Dominant hand (DH)			Non-dominant hand (NDH)		
	DH	NDH	DH	NDH	DH	NDH	DH	NDH	Grip 1	Grip 2	Grip 3	Grip 1	Grip 2	Grip 3
156	17.90	17.50	7.46	7.30	8.70	8.36	3.90	3.40	35.40	35.00	33.00	25.80	27.00	28.00
157	18.90	19.00	7.97	7.80	8.46	8.55	3.80	4.07	35.40	38.00	40.30	38.00	40.00	38.00
158	17.90	18.00	7.50	7.60	8.40	8.00	4.16	4.00	48.00	47.00	50.00	43.60	46.00	44.00
159	17.00	17.90	7.00	7.20	8.68	8.40	3.97	4.20	39.00	37.00	40.00	29.50	30.30	34.90
160	17.40	17.20	7.50	7.50	8.40	8.30	4.00	4.05	40.00	46.00	43.00	33.00	35.50	40.00
161	19.00	19.40	7.20	7.00	9.00	8.80	4.65	4.50	46.00	46.50	48.00	41.80	40.00	41.60
162	21.20	21.00	9.20	9.20	8.80	8.90	4.50	4.45	38.00	42.00	41.00	34.00	34.00	36.00
163	17.10	17.30	7.15	7.30	8.20	8.20	2.95	2.95	38.00	42.00	42.00	34.00	36.00	36.00
164	18.00	17.90	7.59	7.46	8.36	7.95	3.78	3.80	44.00	42.00	43.00	27.80	35.00	33.90
165	17.10	17.30	7.15	7.30	8.20	8.20	2.95	3.00	36.50	39.90	36.50	34.00	35.00	35.80
166	18.00	18.00	7.57	7.50	8.43	8.00	4.40	4.20	35.00	38.00	38.00	35.70	34.00	32.50
167	18.50	18.30	7.47	7.50	8.40	8.30	4.65	4.50	37.40	37.80	38.00	33.80	31.60	34.30
168	19.00	19.40	7.88	8.10	9.40	9.45	4.70	4.50	40.80	42.00	42.00	32.00	32.40	35.90
169	17.20	17.30	7.46	7.46	8.70	8.60	4.20	4.35	36.00	42.00	40.30	33.20	34.80	39.00

APPENDIX E: Raw data of pinch strength (kg.)

Case No.	Dominant hand (DH)			Non-dominant hand (NDH)			Dominant hand (DH)			Non-dominant hand (NDH)		
	Palmar 1	Palmar 2	Palmar 3	Palmar 1	Palmar 2	Palmar 3	Key 1	Key 2	Key 3	Key 1	Key 2	Key 3
1	5.90	5.50	5.50	6.00	5.50	5.50	6.50	6.50	6.50	5.50	5.90	5.50
2	5.10	5.50	5.20	4.00	4.00	4.50	5.90	5.50	5.00	5.00	5.60	5.00
3	5.40	5.10	4.50	3.50	4.50	4.00	5.00	5.50	5.20	4.70	4.50	4.50
4	6.50	6.00	5.90	6.00	6.30	6.20	5.60	6.00	6.10	5.00	4.90	4.80
5	5.40	5.50	5.40	4.80	4.00	5.20	6.50	6.40	6.20	5.30	5.20	5.10
6	5.70	6.00	5.70	4.20	5.00	5.50	6.00	5.80	5.40	5.60	5.80	5.50
7	6.50	6.50	6.00	5.10	4.60	5.10	5.90	5.00	4.60	4.70	5.20	4.90
8	5.00	4.50	3.90	5.00	4.90	5.50	5.70	5.30	6.20	5.40	5.00	5.20
9	5.10	4.50	4.30	3.70	4.10	4.10	6.50	6.50	4.60	5.00	4.30	3.60
10	6.70	7.60	7.90	6.80	5.90	6.00	6.70	6.70	7.00	5.50	5.50	6.00
11	7.70	8.00	7.40	4.70	5.00	5.00	4.70	6.00	6.00	5.00	4.50	4.50
12	6.20	7.00	7.20	7.80	6.50	5.50	7.90	7.90	6.50	6.50	5.50	5.80
13	8.90	8.30	8.50	6.40	7.00	7.20	8.50	8.50	8.90	8.30	8.50	8.50
14	5.00	6.30	5.90	6.50	5.50	5.60	5.00	5.90	5.90	5.00	4.50	5.00
15	6.50	6.30	6.30	4.50	5.60	5.40	5.90	6.60	6.20	5.00	5.00	5.50
16	7.50	6.00	7.50	5.70	6.50	5.80	6.70	7.00	6.80	4.50	4.50	4.50
17	6.80	6.50	7.50	6.00	5.90	5.60	6.00	6.00	5.50	6.50	6.00	6.50
18	7.00	8.60	8.30	7.00	7.00	6.80	7.10	7.00	6.80	6.70	7.00	6.60
19	5.00	5.50	5.50	5.50	4.40	4.60	5.90	5.50	5.90	5.00	5.00	5.50
20	6.20	6.00	6.10	6.50	6.00	6.60	6.20	6.20	6.50	5.20	5.00	5.00
21	6.80	7.20	6.60	7.20	7.60	7.10	7.50	7.10	7.50	7.20	6.50	6.50
22	6.10	4.70	5.40	6.00	4.50	4.00	6.20	6.20	5.80	3.00	4.10	4.00
23	7.50	7.50	5.50	6.00	6.00	5.00	5.80	5.90	6.00	5.20	4.80	5.00
24	7.00	7.20	7.50	5.80	6.20	5.80	8.00	8.00	8.00	6.50	6.50	6.10
25	4.50	4.20	4.50	3.80	3.90	3.30	6.80	6.90	5.00	5.20	4.80	5.50
26	6.50	7.00	6.50	7.00	7.00	6.50	7.00	7.30	6.90	5.50	5.50	5.40
27	9.00	11.00	10.80	6.50	6.50	7.00	8.80	7.80	8.30	7.70	8.00	7.50
28	5.65	5.35	5.30	5.95	5.00	5.25	6.60	6.45	6.25	5.50	5.50	5.35
29	6.60	6.60	6.80	5.00	5.00	4.80	6.30	6.00	6.00	5.00	5.50	5.70
30	6.80	6.40	6.90	5.70	5.70	7.00	7.00	6.80	6.80	5.70	5.30	5.50
31	5.20	5.00	4.80	5.60	5.50	5.40	5.50	4.80	5.00	5.70	5.70	5.60

APPENDIX E: Raw data of pinch strength (kg.) (contiued)

Case No.	Dominant hand (DH)			Non-dominant hand (NDH)			Dominant hand (DH)			Non-dominant hand (NDH)		
	Palmar 1	Palmar 2	Palmar 3	Palmar 1	Palmar 2	Palmar 3	Key 1	Key 2	Key 3	Key 1	Key 2	Key 3
32	7.60	8.00	8.30	4.70	5.60	6.70	8.50	9.00	8.00	7.80	7.80	7.30
33	6.00	8.70	8.00	4.00	4.50	6.70	6.30	6.00	6.60	6.40	5.80	5.50
34	7.00	7.70	7.50	7.00	7.50	7.00	8.00	8.60	7.00	6.80	6.60	8.00
35	5.50	7.00	6.00	7.20	7.00	6.20	7.90	7.90	9.00	7.70	8.00	7.10
36	5.00	5.50	5.00	5.00	4.70	5.00	6.00	6.10	6.00	5.20	6.00	5.30
37	3.00	4.00	4.00	2.00	3.90	3.20	4.50	4.70	5.00	3.80	3.80	3.50
38	9.10	9.00	9.10	5.00	5.30	5.00	6.50	6.00	6.00	5.40	4.80	5.50
39	7.00	7.40	7.60	7.00	6.00	5.90	7.00	6.50	7.00	6.00	6.50	7.30
40	6.00	6.50	6.60	5.30	5.90	5.50	5.50	6.00	5.90	6.00	6.00	5.50
41	9.20	9.50	9.20	6.70	6.50	7.00	6.50	6.50	6.50	6.50	6.60	6.00
42	6.00	5.50	6.00	4.20	5.50	6.00	6.60	5.30	6.20	6.50	6.00	5.50
43	5.90	5.00	5.00	5.40	4.70	4.50	5.40	5.50	4.90	4.60	6.00	5.80
44	5.70	5.20	6.00	5.80	4.00	4.50	6.50	6.50	6.50	7.00	6.20	7.00
45	4.50	4.20	4.50	4.50	4.30	4.90	4.60	5.20	5.40	3.70	4.00	4.00
46	6.00	6.00	7.00	4.70	5.30	6.00	5.80	6.00	6.30	5.00	5.50	5.50
47	5.60	5.50	5.10	6.00	6.80	6.00	6.70	6.70	6.60	7.10	5.50	5.60
48	3.60	4.50	4.40	3.50	3.50	4.00	6.20	6.30	6.50	5.50	5.00	6.00
49	7.00	7.80	6.50	5.00	6.00	6.00	6.50	6.60	6.80	6.20	6.80	6.50
50	7.40	7.00	7.00	5.50	5.90	6.80	7.40	7.00	7.00	6.00	6.70	6.00
51	9.00	7.40	8.30	8.50	7.80	8.50	8.50	7.60	8.20	6.60	6.20	6.50
52	5.60	5.50	5.10	6.00	6.80	6.00	6.70	6.70	6.60	7.10	5.50	5.60
53	7.00	8.50	8.00	5.50	6.20	4.50	8.90	8.70	8.20	6.60	6.50	6.50
54	7.00	7.00	7.60	7.20	7.00	6.80	7.80	7.00	7.00	5.50	5.90	5.60
55	5.50	5.50	5.50	4.00	4.50	4.60	6.20	5.80	5.90	5.50	5.00	5.50
56	9.00	8.80	7.80	7.20	6.00	7.50	7.20	7.60	8.00	6.00	6.50	6.00
57	4.50	4.90	4.40	6.00	5.00	6.00	5.10	4.80	5.10	5.20	5.30	5.30
58	6.90	6.50	5.50	8.30	8.50	8.00	6.00	5.50	5.30	6.40	5.90	5.60
59	6.00	6.30	6.20	6.00	6.00	6.40	6.40	6.00	6.10	6.00	5.80	6.00
60	5.50	5.50	5.60	4.60	5.00	4.60	6.80	6.50	6.20	5.30	5.20	6.30
61	9.00	8.80	8.60	8.20	7.50	6.00	8.20	8.30	7.50	7.00	8.70	8.30
62	6.80	6.80	6.40	6.70	6.00	6.80	6.90	8.00	7.80	7.00	7.10	6.80

APPENDIX E: Raw data of pinch strength (kg.) (continued)

Case No.	Dominant hand (DH)			Non-dominant hand (NDH)			Dominant hand (DH)			Non-dominant hand (NDH)		
	Palmar 1	Palmar 2	Palmar 3	Palmar 1	Palmar 2	Palmar 3	Key 1	Key 2	Key 3	Key 1	Key 2	Key 3
63	7.40	8.60	7.50	7.10	8.00	7.50	8.00	6.90	7.80	7.50	7.30	7.00
64	7.30	7.50	7.50	6.20	6.30	6.00	7.30	6.50	6.80	6.90	6.30	6.50
65	9.20	10.50	9.50	6.50	7.00	6.50	9.00	9.20	8.70	6.50	7.00	6.20
66	4.50	4.60	4.50	5.00	5.00	5.60	5.10	5.00	4.50	5.00	5.50	5.40
67	6.20	7.10	7.50	6.80	6.00	6.00	6.10	6.00	6.00	5.00	5.50	5.00
68	6.40	6.70	6.00	4.50	4.50	4.50	6.00	6.30	6.40	5.00	5.90	5.90
69	5.90	6.20	5.00	6.00	6.50	6.30	6.50	6.60	6.50	6.30	5.50	6.40
70	7.00	8.60	7.00	7.80	8.20	8.70	7.80	8.30	8.20	6.50	7.40	6.50
71	6.20	5.60	5.60	7.00	6.00	5.70	8.00	8.30	8.50	8.20	8.00	8.50
72	6.80	6.60	7.80	6.00	5.30	6.00	7.60	7.40	8.20	7.70	7.60	7.50
73	6.90	7.40	6.70	6.00	7.20	8.20	7.70	8.00	7.90	7.30	7.40	7.00
74	5.50	5.00	5.00	4.50	5.20	5.00	6.50	7.50	7.50	8.00	7.60	8.50
75	5.50	5.80	5.50	5.50	5.10	5.00	7.30	7.50	7.50	6.00	6.00	6.30
76	7.00	7.80	7.20	6.50	6.50	6.30	5.10	5.00	5.30	5.50	5.30	6.00
77	8.50	8.10	8.50	7.00	6.20	6.60	9.00	8.00	8.20	7.30	8.00	7.90
78	7.00	6.80	6.50	6.70	6.40	6.60	7.50	6.00	6.80	6.60	7.00	6.00
79	6.80	7.50	7.10	6.80	7.00	7.30	7.10	7.30	7.00	7.80	7.90	8.00
80	5.50	5.00	5.00	4.00	4.50	5.00	6.00	6.40	6.30	6.20	6.00	6.00
81	4.50	4.50	4.50	5.00	4.60	6.50	6.20	6.00	6.20	5.10	5.60	6.00
82	4.00	5.00	5.00	4.60	6.00	4.80	6.00	5.00	5.80	6.40	7.50	7.40
83	5.00	5.50	5.60	4.60	6.30	6.50	7.00	7.00	7.00	7.00	6.20	6.10
84	5.00	5.50	5.60	6.50	6.30	6.60	7.00	7.90	8.50	7.30	7.40	8.00
85	7.80	8.00	8.00	5.10	6.00	6.50	7.50	7.50	7.40	6.30	6.50	6.50
86	6.00	6.00	6.50	4.50	5.30	5.50	6.00	6.50	6.40	6.80	6.20	5.50
87	6.50	6.20	6.20	7.90	7.90	7.00	7.40	7.40	6.50	8.00	6.80	7.50
88	8.30	10.00	10.00	6.00	6.70	7.00	6.60	7.30	6.30	5.80	5.50	5.00
89	6.00	6.50	7.00	4.00	4.50	4.50	6.50	7.90	7.20	5.00	5.00	5.50
90	6.50	6.80	6.00	4.20	4.80	4.90	6.40	7.50	7.00	5.50	5.50	6.00
91	6.80	7.80	7.60	6.00	6.00	6.60	7.00	7.00	6.80	5.50	6.00	5.90
92	6.00	6.30	6.40	4.50	5.00	5.00	6.90	7.00	6.80	5.80	6.00	5.50
93	7.20	6.90	7.00	7.10	7.50	7.50	8.20	8.60	8.20	8.00	7.00	8.00

APPENDIX E: Raw data of pinch strength (kg.) (continued)

Case No.	Dominant hand (DH)			Non-dominant hand (NDH)			Dominant hand (DH)			Non-dominant hand (NDH)		
	Palmar 1	Palmar 2	Palmar 3	Palmar 1	Palmar 2	Palmar 3	Key 1	Key 2	Key 3	Key 1	Key 2	Key 3
94	6.40	6.70	6.00	6.50	7.20	7.30	7.20	6.80	7.50	7.80	8.00	8.20
95	5.80	4.60	5.10	4.70	4.50	4.90	6.20	6.50	6.00	4.60	5.00	5.50
96	7.30	7.50	6.50	4.20	4.50	5.00	6.70	8.00	7.90	5.50	5.70	6.50
97	6.00	6.10	5.50	4.40	5.00	4.50	5.50	5.50	5.70	6.00	6.00	5.80
98	7.50	7.00	7.50	5.50	5.40	6.00	7.50	7.30	7.00	6.00	6.50	6.30
99	8.40	8.10	8.50	8.50	8.30	8.30	8.80	8.50	8.20	7.50	7.90	8.00
100	4.00	4.30	4.50	3.50	4.00	4.00	5.10	5.50	5.50	4.50	5.00	4.60
101	6.50	6.00	6.00	6.50	7.50	6.50	6.50	6.50	7.30	6.20	5.80	5.50
102	5.10	5.80	5.90	6.00	4.50	5.80	5.20	4.60	5.20	4.30	4.40	4.10
103	8.80	9.50	9.20	9.00	9.00	9.20	9.80	9.80	9.50	8.40	10.50	10.20
104	8.00	7.30	8.50	8.00	9.50	9.40	9.80	10.00	9.50	9.00	9.40	8.70
105	9.70	8.60	6.70	6.00	5.00	5.40	11.50	10.50	10.50	8.80	8.30	8.60
106	7.50	7.40	6.90	7.00	6.80	6.80	8.20	7.50	8.60	8.60	9.00	9.00
107	7.50	7.20	9.50	6.00	5.30	5.00	8.20	7.50	7.50	5.70	6.00	6.50
108	9.80	11.50	10.00	8.90	7.50	9.00	12.00	12.50	11.90	11.50	11.50	10.00
109	6.80	7.20	7.40	5.30	4.80	4.20	8.00	8.20	7.60	5.40	6.00	6.20
110	6.70	6.40	7.10	6.30	6.70	6.70	9.50	10.00	10.00	8.20	7.50	8.30
111	11.00	9.80	11.40	9.00	7.00	9.50	10.40	11.00	9.70	10.00	9.50	9.50
112	8.00	9.00	8.00	5.50	6.50	7.50	9.50	9.60	9.80	9.50	10.00	9.00
113	7.40	7.40	7.00	7.60	6.60	5.90	9.50	9.60	9.90	8.70	7.20	8.00
114	8.00	9.00	8.00	5.50	6.50	7.50	9.50	9.60	9.80	9.50	10.00	9.00
115	6.40	5.80	6.20	6.50	5.00	6.30	6.00	5.50	6.20	5.00	4.20	4.50
116	9.90	9.50	8.20	9.10	8.50	8.00	10.00	10.00	10.00	11.00	10.00	9.50
117	7.00	6.50	6.80	9.00	9.50	8.00	7.80	10.50	9.50	11.80	12.00	11.30
118	6.70	5.30	6.00	4.80	5.40	5.20	8.40	7.70	7.50	7.20	6.70	7.50
119	6.30	7.20	6.90	6.20	6.50	6.40	9.00	8.50	8.00	9.50	9.10	8.40
120	7.60	8.00	7.00	7.50	8.00	8.30	8.50	9.80	8.00	8.00	7.90	8.50
121	10.00	12.50	8.70	8.50	9.50	9.00	8.60	8.50	8.00	9.50	9.50	9.60
122	6.80	7.00	6.50	5.60	5.30	5.00	8.00	8.40	7.90	8.00	8.00	7.40
123	8.00	7.10	8.10	8.30	7.90	8.70	10.50	9.60	11.00	10.40	10.40	9.90
124	8.70	8.90	9.00	7.90	7.70	7.60	9.50	9.20	9.50	8.00	7.90	8.00

APPENDIX E: Raw data of pinch strength (kg.) (continued)

Case No.	Dominant hand (DH)			Non-dominant hand (NDH)			Dominant hand (DH)			Non-dominant hand (NDH)		
	Palmar 1	Palmar 2	Palmar 3	Palmar 1	Palmar 2	Palmar 3	Key 1	Key 2	Key 3	Key 1	Key 2	Key 3
125	7.80	7.50	7.00	6.00	6.00	6.50	9.20	9.10	9.00	6.50	7.00	6.80
126	8.00	7.50	9.00	8.50	8.00	8.50	10.30	10.00	9.00	10.50	10.00	9.00
127	8.00	7.60	8.00	7.80	6.90	6.90	9.10	8.50	9.00	9.00	8.50	8.50
128	8.50	8.00	8.20	8.20	8.10	8.00	8.00	7.60	8.30	7.70	8.00	7.90
129	6.70	8.50	7.70	5.50	6.50	6.50	9.00	9.60	9.30	9.50	9.00	8.80
130	6.50	6.20	6.20	6.00	7.00	7.50	10.50	10.10	9.50	9.20	9.50	9.50
131	10.50	11.00	11.00	8.00	7.50	7.50	8.50	9.00	8.50	8.00	7.50	7.30
132	7.60	7.50	7.60	8.50	8.40	8.40	9.80	8.90	9.50	10.50	10.50	10.50
133	8.00	8.00	8.00	7.00	7.20	7.50	9.70	9.80	9.40	8.50	8.50	8.50
134	6.80	5.80	5.70	6.20	6.00	6.50	8.60	9.00	9.50	7.90	8.10	7.80
135	8.50	8.80	9.00	6.30	6.20	6.00	10.40	10.20	10.00	8.00	10.00	9.60
136	8.00	8.00	8.50	8.00	8.50	9.00	10.80	10.50	10.80	11.00	11.00	12.00
137	9.20	8.00	8.20	6.00	7.50	8.00	11.00	10.50	10.80	9.50	10.10	9.80
138	10.00	10.00	9.50	9.30	8.70	8.20	9.00	8.50	8.50	8.50	9.00	8.80
139	7.30	7.60	7.90	7.50	6.50	9.00	10.00	10.50	11.40	8.10	9.10	9.00
140	4.30	5.50	6.20	6.00	4.50	5.00	7.80	7.60	7.30	7.10	7.00	7.00
141	7.00	7.40	7.40	7.70	8.00	7.50	10.50	11.00	9.60	10.40	9.80	10.40
142	6.50	6.50	7.30	6.70	7.20	7.50	8.00	7.80	7.60	8.00	8.00	7.40
143	8.70	9.00	9.50	7.50	8.40	8.50	11.00	10.90	10.80	8.30	7.50	9.00
144	6.20	5.30	5.50	5.50	6.50	6.50	5.60	7.50	6.70	6.00	5.50	6.60
145	9.50	9.80	9.40	9.80	9.70	9.50	11.00	10.20	9.80	8.50	9.00	8.50
146	10.00	10.50	10.00	8.50	9.50	9.40	11.50	11.00	11.30	10.00	10.00	9.00
147	7.40	7.60	7.40	6.00	5.60	5.40	7.90	8.40	8.00	7.00	7.50	6.60
148	9.30	9.20	9.30	8.20	7.50	7.50	8.70	8.00	7.80	7.00	7.50	7.50
149	8.00	9.00	8.00	7.00	7.50	8.00	12.00	11.00	11.00	8.00	9.00	9.40
150	6.00	6.50	6.50	5.00	5.00	5.00	8.20	8.40	8.00	7.00	7.00	7.00
151	6.80	7.00	8.00	6.70	6.90	7.00	8.80	9.30	9.20	7.60	7.80	7.50
152	10.10	10.00	9.90	9.00	9.10	8.70	11.00	11.00	10.70	8.00	8.00	7.90
153	7.80	7.80	7.30	7.70	7.20	6.50	8.50	8.90	9.00	7.90	7.50	7.50
154	8.00	7.20	8.50	8.20	8.00	9.00	8.30	8.80	9.00	9.20	10.00	9.50
155	7.80	7.80	7.30	7.70	7.20	6.60	8.50	8.90	9.00	7.90	7.50	7.60

APPENDIX E: Raw data of pinch strength (kg.) (continued)

Case No.	Dominant hand (DH)			Non-dominant hand (NDH)			Dominant hand (DH)			Non-dominant hand (NDH)		
	Palmar 1	Palmar 2	Palmar 3	Palmar 1	Palmar 2	Palmar 3	Key 1	Key 2	Key 3	Key 1	Key 2	Key 3
156	6.50	8.00	8.50	7.00	6.70	7.50	10.00	9.20	9.30	9.20	9.00	9.00
157	6.50	6.40	7.50	6.00	6.50	7.00	8.50	8.70	8.70	8.00	9.00	8.60
158	8.20	8.58	8.70	7.00	6.50	6.30	8.50	8.50	9.00	8.30	8.60	8.50
159	6.60	6.50	6.80	6.90	7.00	7.20	7.80	7.30	8.30	7.80	7.50	6.40
160	6.50	6.60	6.00	6.00	6.60	6.70	8.10	8.70	9.40	8.30	9.00	9.10
161	10.00	9.30	8.00	7.50	9.00	8.50	9.20	9.50	9.00	10.30	9.70	10.50
162	6.80	6.50	6.50	6.00	5.50	6.00	7.50	7.50	8.00	7.00	6.50	7.00
163	7.50	8.00	8.00	7.50	7.90	7.00	8.80	8.50	8.50	7.50	7.50	7.40
164	9.10	8.70	8.50	8.20	9.20	9.00	8.30	7.80	8.00	8.10	8.50	7.00
165	5.90	6.50	6.20	5.50	6.20	6.00	6.10	6.50	6.80	5.50	6.00	5.00
166	7.80	8.40	7.90	7.00	6.70	7.70	8.20	8.30	8.70	7.70	7.50	8.00
167	8.50	9.50	9.50	6.30	7.50	7.00	8.00	8.40	8.20	6.90	8.50	7.70
168	10.10	10.00	9.80	8.60	9.20	9.50	11.20	11.20	10.60	11.50	11.00	10.00
169	9.10	7.50	8.00	8.50	7.80	8.30	11.00	11.50	10.00	8.70	9.30	8.90

APPENDIX E: Raw data of pinch strength (kg.) & the rates of various hand function performances (second)

Case No.	Dominant hand (DH)			Non-dominant hand (NDH)			Dominant hand (DH)		Non-dominant hand (NDH)	
	Tip 1	Tip 2	Tip 3	Tip 1	Tip 2	Tip 3	Feeding 1	Feeding 2	Feeding 1	Feeding 2
1	4.30	4.50	4.40	4.00	4.00	4.30	5.88	5.22	6.82	6.47
2	2.50	2.50	2.50	2.00	2.10	2.10	4.95	4.63	7.06	6.26
3	4.10	3.70	3.50	3.00	3.20	3.00	6.86	5.91	7.51	7.21
4	4.10	3.90	4.00	3.00	3.50	2.10	5.60	5.02	5.92	5.52
5	3.50	3.00	3.20	2.60	2.70	2.90	5.84	5.66	6.89	7.50
6	4.50	5.20	5.30	3.80	3.70	3.50	5.83	5.14	6.72	6.48
7	4.70	5.00	5.10	4.60	5.00	4.50	6.16	6.26	6.63	6.86
8	3.50	3.00	4.00	3.10	2.80	2.60	6.74	6.06	8.18	8.70
9	3.50	3.50	3.50	2.60	2.60	2.60	6.41	7.66	6.94	7.33
10	6.40	6.00	5.50	4.00	4.50	4.30	5.92	6.05	7.40	7.60
11	3.20	4.00	4.20	2.50	3.00	3.30	5.70	5.34	9.02	7.69
12	4.90	4.50	4.50	3.90	3.70	3.60	6.13	5.66	8.31	6.63
13	6.10	6.50	5.80	4.00	5.50	5.00	7.02	5.63	7.11	6.49
14	3.90	3.50	3.50	3.00	2.80	2.80	5.81	5.33	8.13	6.28
15	3.30	4.10	3.50	3.00	3.00	3.00	6.70	5.78	7.84	7.75
16	4.40	3.00	4.00	2.50	2.00	2.20	6.72	5.54	8.03	7.01
17	3.40	3.60	3.40	2.00	2.60	2.70	4.77	5.47	6.85	5.66
18	5.50	4.80	4.50	2.80	4.20	4.50	5.34	5.66	7.96	7.61
19	3.00	3.50	3.20	2.00	2.90	3.00	5.68	7.98	7.98	6.37
20	3.50	3.20	4.10	3.50	3.50	3.20	6.37	6.59	8.92	7.24
21	5.00	4.60	5.00	3.30	3.10	3.00	5.82	4.97	7.38	7.78
22	1.40	1.60	1.50	1.00	1.10	1.10	5.46	5.85	6.77	6.76
23	3.00	3.70	3.20	2.70	3.00	3.00	6.08	5.35	7.33	6.44
24	6.00	5.50	5.10	4.70	5.00	4.70	5.91	5.43	7.62	6.19
25	3.50	3.50	3.60	2.80	3.50	3.50	4.80	4.77	6.21	5.63
26	4.20	4.20	4.00	3.00	3.00	3.00	5.85	7.89	7.25	8.36
27	4.90	4.40	5.00	4.50	5.50	4.50	5.64	6.23	6.39	6.77
28	4.15	4.25	4.35	3.55	3.80	4.15	5.55	5.28	6.65	5.34
29	4.70	3.80	5.10	3.00	3.10	3.50	6.34	5.13	6.27	6.63
30	4.30	4.20	4.50	3.00	3.70	3.50	6.06	5.55	7.63	6.53
31	2.50	3.50	3.00	2.80	3.00	3.10	6.03	5.31	6.84	5.57

APPENDIX E: Raw data of pinch strength (kg.) & the rates of various hand function performances (second)

Case No.	Dominant hand (DH)			Non-dominant hand (NDH)			Dominant hand (DH)		Non-dominant hand (NDH)	
	Tip 1	Tip 2	Tip 3	Tip 1	Tip 2	Tip 3	Feeding 1	Feeding 2	Feeding 1	Feeding 2
32	5.00	6.00	5.50	4.60	3.00	4.00	5.55	6.57	7.50	6.31
33	4.30	4.20	3.50	3.00	2.80	2.50	6.63	5.88	8.63	8.20
34	3.80	4.60	4.60	2.50	3.00	2.80	6.20	6.19	8.34	7.16
35	5.70	5.60	5.60	4.70	3.90	3.00	6.77	6.38	8.22	9.16
36	3.00	3.00	4.00	3.00	2.20	2.80	4.74	5.23	5.75	5.06
37	2.30	2.50	2.00	1.60	1.80	1.70	6.56	6.01	9.50	7.49
38	3.00	3.10	3.10	2.50	2.00	2.00	6.02	5.77	9.21	8.09
39	5.50	5.40	5.00	3.50	4.50	4.50	6.20	5.84	8.09	6.97
40	3.90	4.20	4.10	3.90	4.00	4.50	5.33	5.56	7.49	7.03
41	4.50	5.00	5.10	3.30	4.20	3.00	6.15	5.34	7.77	6.34
42	3.50	4.00	3.50	3.00	3.00	3.50	5.88	6.39	6.58	5.95
43	3.00	2.90	3.00	2.60	3.00	2.80	5.18	5.06	7.38	6.38
44	4.40	4.20	4.50	4.00	4.50	4.00	5.81	5.21	7.18	6.33
45	2.50	2.40	2.10	2.40	2.50	2.50	5.73	5.51	6.55	6.74
46	4.50	4.50	5.00	2.90	3.00	3.00	5.48	6.50	9.16	8.13
47	5.50	5.40	5.00	3.50	4.50	4.40	6.34	5.99	7.00	6.30
48	3.30	3.60	4.00	3.20	3.50	3.20	7.79	6.88	7.44	9.26
49	4.50	5.00	5.20	4.50	4.90	5.50	5.78	5.27	6.70	5.96
50	4.20	4.30	4.80	3.50	3.50	3.40	6.24	5.21	6.81	5.90
51	4.00	4.40	4.20	4.00	3.50	4.20	5.43	5.09	6.68	7.14
52	4.20	4.00	3.90	3.00	3.40	3.80	4.99	5.00	6.57	6.02
53	4.40	4.10	4.00	2.50	2.60	2.60	5.30	6.18	8.94	6.81
54	3.50	3.50	3.00	2.50	2.50	2.20	4.54	5.35	4.92	6.19
55	3.30	3.90	3.50	2.60	2.90	3.50	5.68	5.26	9.03	6.88
56	4.90	6.00	6.50	4.50	5.00	4.60	5.87	5.75	9.06	8.64
57	3.10	4.50	3.50	3.30	4.00	3.00	6.61	5.98	6.59	6.41
58	3.50	2.80	3.20	3.80	3.20	3.70	5.89	5.41	8.49	6.88
59	4.20	3.80	3.30	3.50	4.20	3.80	5.70	5.22	7.99	6.67
60	4.00	4.00	3.90	2.80	3.30	3.20	5.27	5.45	7.89	6.16
61	4.70	4.30	3.80	3.50	4.30	4.50	5.51	5.03	8.40	6.41
62	4.50	4.60	4.30	3.60	4.00	3.20	7.20	6.34	7.66	6.34

APPENDIX E: Raw data of pinch strength (kg.) & the rates of various hand function performances (second)

Case No.	Dominant hand (DH)			Non-dominant hand (NDH)			Dominant hand (DH)		Non-dominant hand (NDH)	
	Tip 1	Tip 2	Tip 3	Tip 1	Tip 2	Tip 3	Feeding 1	Feeding 2	Feeding 1	Feeding 2
63	4.80	3.70	5.50	4.60	3.80	4.50	7.43	7.44	10.65	10.23
64	4.80	4.50	5.30	4.90	4.40	3.80	6.38	5.81	10.12	10.39
65	5.50	6.50	6.70	4.40	4.90	4.70	4.66	5.64	5.77	5.63
66	3.40	3.40	3.40	3.40	2.60	3.10	5.80	5.42	6.28	6.17
67	3.50	4.00	4.00	3.00	3.00	3.10	6.58	5.56	8.66	6.76
68	3.50	5.00	4.60	3.10	2.50	3.00	4.59	4.36	6.74	5.63
69	4.60	4.50	4.50	3.50	3.80	3.70	6.20	5.84	7.99	6.41
70	4.50	5.00	3.90	3.60	3.50	3.70	5.81	5.42	6.23	8.10
71	4.60	4.80	5.40	4.00	4.60	4.40	5.59	4.85	6.51	5.99
72	6.40	6.20	6.30	4.00	4.50	4.60	7.26	6.64	7.74	7.61
73	4.60	4.60	4.60	3.60	4.30	4.50	5.49	4.70	9.38	7.18
74	4.70	4.60	4.50	4.20	4.50	4.00	5.71	4.95	7.19	6.42
75	5.40	4.50	3.80	3.30	3.30	4.50	5.72	5.51	7.63	7.87
76	3.70	4.00	4.00	2.50	3.10	2.50	4.99	5.10	8.74	6.82
77	3.90	3.30	4.30	3.60	3.30	3.20	6.20	5.88	7.42	6.23
78	4.50	5.00	4.00	3.50	3.20	3.50	4.12	3.99	6.92	5.43
79	6.00	6.50	5.50	6.10	6.30	6.50	4.78	4.83	6.04	5.35
80	4.40	4.90	4.30	3.70	3.20	3.40	6.18	6.06	7.14	6.62
81	3.50	3.80	3.50	2.50	3.00	3.70	5.63	5.25	8.51	6.18
82	2.50	3.00	2.50	3.20	3.00	3.00	6.46	5.93	9.16	7.18
83	3.00	3.50	4.00	3.00	3.30	3.20	5.93	5.06	7.63	6.34
84	3.50	4.00	3.00	3.70	4.50	4.00	6.05	5.91	8.99	7.66
85	4.60	3.70	3.40	2.00	2.80	2.40	5.99	5.22	10.16	7.39
86	4.50	4.00	4.20	3.20	3.00	3.20	6.58	6.27	6.86	6.76
87	4.20	4.50	4.50	4.10	3.40	3.50	6.95	6.68	8.63	7.69
88	4.50	5.00	4.60	2.60	3.00	2.80	6.04	5.99	7.51	6.77
89	4.50	4.50	4.80	2.50	2.30	2.50	8.02	7.17	8.20	7.25
90	4.00	4.10	5.00	4.00	3.80	4.00	7.64	6.34	9.77	8.27
91	6.00	6.00	5.00	4.40	4.00	4.20	5.99	5.30	9.99	10.12
92	3.10	3.50	3.50	2.50	2.50	2.50	5.54	5.89	7.95	6.76
93	5.50	4.50	4.70	5.50	5.00	6.00	5.70	5.18	7.39	6.06

APPENDIX E: Raw data of pinch strength (kg.) & the rates of various hand function performances (second)

Case No.	Dominant hand (DH)			Non-dominant hand (NDH)			Dominant hand (DH)		Non-dominant hand (NDH)	
	Tip 1	Tip 2	Tip 3	Tip 1	Tip 2	Tip 3	Feeding 1	Feeding 2	Feeding 1	Feeding 2
94	5.00	5.40	5.00	4.50	4.70	5.00	6.81	6.50	8.44	8.75
95	3.10	2.20	2.50	1.80	2.20	2.00	8.65	8.03	9.91	9.07
96	5.00	4.50	4.00	3.50	3.70	4.00	7.74	7.94	9.40	10.06
97	4.00	4.40	4.90	3.00	4.00	4.00	7.29	6.53	10.12	8.94
98	6.30	6.20	6.20	4.50	4.50	5.00	6.75	6.62	9.25	7.63
99	5.50	5.80	6.00	4.50	4.30	4.90	7.37	6.72	9.16	8.53
100	3.20	3.40	3.30	3.50	3.00	3.30	7.28	7.08	10.06	9.57
101	4.80	5.00	4.50	3.50	3.50	3.50	6.95	6.68	8.63	7.70
102	2.50	2.60	3.40	2.50	2.50	2.30	6.28	5.71	6.06	5.30
103	5.30	5.20	6.00	4.50	4.50	5.40	7.15	6.11	6.03	6.50
104	4.00	3.60	3.00	4.50	4.80	5.00	5.17	4.77	7.56	6.07
105	5.30	6.30	5.50	4.40	3.70	4.20	7.31	7.27	7.88	8.04
106	5.00	5.70	6.00	4.70	3.60	4.50	5.37	5.05	6.16	5.66
107	3.60	4.00	3.50	3.50	3.70	4.00	5.53	5.72	7.56	6.27
108	7.00	6.00	7.20	6.00	5.50	5.00	5.68	6.02	7.49	6.24
109	6.50	6.50	6.50	3.00	4.20	4.50	5.58	4.94	6.05	6.02
110	5.30	5.00	4.80	4.50	4.10	4.20	7.72	7.23	10.71	8.20
111	6.00	7.00	6.50	5.90	4.60	6.00	6.47	6.16	8.26	6.99
112	6.10	4.80	5.50	3.50	4.00	3.50	7.66	6.30	9.55	9.56
113	4.50	4.40	3.60	5.10	4.90	5.00	5.63	5.32	7.16	7.09
114	6.00	6.00	6.50	5.00	5.00	5.10	6.14	5.40	9.08	6.98
115	3.50	3.00	3.00	3.00	2.50	2.80	7.45	6.65	11.95	8.89
116	5.00	4.30	4.70	4.00	4.20	4.50	5.49	4.98	6.49	5.91
117	6.50	6.00	6.80	9.00	8.50	8.50	5.79	6.06	6.86	6.89
118	3.00	3.00	3.00	3.50	3.00	3.00	7.47	6.55	8.28	7.00
119	5.50	5.50	5.30	5.00	4.70	5.10	5.71	5.95	6.98	6.80
120	6.00	6.00	6.50	5.00	5.00	5.00	7.22	5.55	7.84	6.06
121	6.00	6.50	6.00	5.30	5.50	5.40	8.78	8.55	10.99	9.51
122	6.60	6.70	6.90	4.70	5.50	5.60	7.23	6.25	8.67	8.88
123	6.00	5.50	6.50	6.00	7.00	7.50	4.88	4.86	7.01	5.87
124	6.50	6.50	7.00	4.50	5.00	4.90	6.13	6.22	8.34	7.16

APPENDIX E: Raw data of pinch strength (kg.) & the rates of various hand function performances (second)

Case No.	Dominant hand (DH)			Non-dominant hand (NDH)			Dominant hand (DH)		Non-dominant hand (NDH)	
	Tip 1	Tip 2	Tip 3	Tip 1	Tip 2	Tip 3	Feeding 1	Feeding 2	Feeding 1	Feeding 2
125	5.00	5.30	5.50	5.50	5.50	4.00	7.40	6.18	9.21	7.80
126	5.00	6.50	5.50	5.00	6.00	5.50	5.79	5.37	7.04	6.97
127	5.60	6.00	5.50	5.00	4.60	4.60	6.21	6.39	7.01	7.13
128	6.00	5.90	6.00	5.50	5.50	5.50	6.07	6.47	8.38	8.06
129	5.20	5.50	5.00	4.50	5.00	5.50	5.88	5.68	6.54	6.63
130	6.50	6.50	6.50	5.50	5.00	4.90	7.29	7.28	8.37	7.84
131	6.50	6.00	6.20	6.50	6.50	5.80	6.16	6.72	7.53	6.91
132	4.50	4.90	4.50	4.90	4.60	4.60	7.38	7.81	7.28	7.22
133	6.50	6.20	6.50	5.70	5.50	5.50	5.96	5.75	8.22	7.56
134	3.50	4.40	4.00	3.50	4.10	4.00	6.62	5.80	7.82	7.31
135	4.20	5.00	5.51	4.20	4.00	4.50	5.50	5.59	7.02	6.30
136	6.00	5.50	6.00	5.50	6.00	6.20	6.85	6.56	9.50	8.55
137	5.00	5.40	5.50	3.90	3.90	4.00	7.31	6.61	9.40	8.89
138	7.00	7.00	6.90	4.90	4.60	5.00	6.61	5.91	8.96	7.71
139	6.40	6.20	6.50	6.50	5.60	6.40	6.40	5.38	7.35	6.94
140	4.00	3.80	4.00	3.30	2.50	3.00	9.31	6.70	7.19	5.63
141	6.00	6.80	6.00	5.80	5.50	6.50	7.41	7.02	8.57	7.54
142	4.50	4.50	4.80	3.00	3.50	3.40	6.07	5.71	6.92	6.45
143	5.00	6.00	5.50	4.50	4.20	4.30	6.92	6.31	8.16	8.52
144	4.50	4.70	5.40	4.00	4.00	5.00	8.71	6.83	8.66	6.82
145	6.00	5.50	6.00	5.50	5.70	6.00	6.65	5.82	7.75	7.54
146	6.90	6.50	6.30	5.20	5.00	5.00	6.24	5.35	7.57	6.94
147	4.30	4.00	5.50	4.00	4.40	4.30	7.90	8.13	9.60	10.03
148	4.00	4.50	4.00	4.50	4.00	4.00	6.00	5.84	7.81	6.38
149	6.20	6.80	6.70	7.00	6.00	6.50	7.97	6.37	8.94	9.81
150	4.20	4.30	4.40	4.00	4.30	4.00	5.85	6.71	7.34	6.54
151	5.00	5.90	5.60	5.00	5.00	4.60	6.06	7.16	7.97	7.13
152	7.50	6.80	7.00	5.80	5.00	6.50	6.15	5.69	8.70	8.08
153	7.00	7.80	7.50	5.80	6.00	6.30	7.49	6.45	9.98	9.30
154	6.00	6.20	7.80	7.00	7.00	8.00	7.02	6.95	8.42	7.84
155	4.80	5.30	5.20	3.40	3.20	3.80	7.02	6.72	10.63	11.60

APPENDIX E: Raw data of pinch strength (kg.) & the rates of various hand function performances (second)

Case No.	Dominant hand (DH)			Non-dominant hand (NDH)			Dominant hand (DH)		Non-dominant hand (NDH)	
	Tip 1	Tip 2	Tip 3	Tip 1	Tip 2	Tip 3	Feeding 1	Feeding 2	Feeding 1	Feeding 2
156	7.00	7.80	7.50	5.80	6.00	6.40	9.00	6.35	10.63	8.39
157	5.50	5.50	5.50	5.30	5.50	6.00	8.70	8.24	11.25	10.95
158	6.30	6.50	5.70	4.00	4.70	4.20	6.21	6.16	8.56	8.15
159	5.00	4.50	5.30	4.90	5.00	4.80	6.71	6.23	7.38	7.03
160	6.00	6.00	6.70	4.50	6.00	5.00	5.85	5.85	7.69	6.20
161	7.00	6.60	7.00	6.40	7.00	7.00	7.65	7.77	7.72	7.06
162	4.00	4.00	4.00	4.00	4.00	3.50	7.38	7.00	8.97	8.21
163	5.00	5.50	4.90	4.50	5.00	4.50	7.72	7.66	8.56	8.37
164	6.10	5.60	6.00	4.00	5.20	5.80	6.46	5.61	8.47	6.94
165	4.00	5.50	5.60	5.00	5.00	4.60	8.27	7.39	10.13	7.77
166	5.00	6.30	5.50	4.50	4.60	4.80	5.81	5.70	7.09	6.02
167	5.40	5.30	5.00	3.70	4.20	4.40	6.70	6.54	9.43	8.00
168	6.50	6.00	5.90	6.00	7.60	6.50	7.05	6.80	9.37	8.41
169	4.20	4.50	4.50	3.00	4.00	4.40	5.85	5.395.88	7.09	6.70

APPENDIX E: Raw data of the rates of various hand function performances (second)

Case no.	Dominant hand (DH)		Non dominant hand (NDH)		DH, objects test		NDH, objects test		DH, objects test		NDH, objects test	
	Checker 1	Checker 2	Checker 1	Checker 2	Light 1	Light 2	Light 1	Light 2	Heavy 1	Heavy 2	Heavy 1	Heavy 2
1	2.95	2.69	3.80	3.24	2.80	2.75	3.13	2.94	3.02	2.96	3.35	2.89
2	3.91	3.06	4.52	3.37	2.95	2.88	3.41	2.99	3.12	2.92	3.30	3.30
3	3.24	2.91	3.36	3.27	2.83	3.12	4.06	2.99	3.20	3.06	3.83	3.60
4	2.76	2.70	4.12	4.27	3.09	3.09	3.26	3.16	3.11	3.19	3.09	3.18
5	3.56	2.90	3.89	3.07	3.12	2.98	3.67	3.27	3.31	2.95	3.95	3.34
6	3.70	3.93	4.68	4.58	2.96	2.66	3.53	3.41	2.84	2.86	3.03	3.13
7	3.16	3.46	3.90	4.06	3.74	4.03	4.26	4.29	4.10	4.27	4.69	4.54
8	4.56	5.19	4.32	4.32	3.79	3.78	3.70	3.68	3.54	3.63	3.85	3.75
9	4.24	4.14	4.04	4.54	3.27	3.31	3.77	3.37	3.62	3.57	3.37	3.31
10	4.09	3.41	3.83	3.82	3.63	3.51	3.74	3.36	3.20	3.20	3.91	3.27
11	4.06	3.77	3.83	4.27	3.34	3.43	3.47	3.32	2.96	2.98	4.28	3.52
12	2.71	2.74	5.09	3.06	3.02	2.60	3.14	2.99	2.62	2.82	3.18	3.02
13	3.39	3.43	5.00	5.10	3.66	4.00	4.09	3.88	3.50	3.37	4.06	3.38
14	3.41	3.16	3.38	3.65	3.12	3.27	3.41	3.03	3.28	3.10	3.34	3.12
15	3.66	3.24	4.94	4.78	3.70	3.53	4.49	4.31	3.90	3.84	4.56	3.94
16	3.18	3.60	4.07	3.98	3.61	3.30	3.78	3.40	3.83	3.68	3.88	3.68
17	2.89	2.99	3.50	3.12	3.43	3.47	3.57	3.46	3.63	3.40	3.50	3.49
18	2.93	3.31	4.18	3.60	2.50	2.41	2.82	2.92	2.63	2.68	2.93	2.70
19	3.24	3.25	4.14	4.13	3.34	2.89	3.72	3.22	3.45	3.17	3.14	3.11
20	3.38	4.13	4.31	4.15	4.68	4.53	4.61	4.15	4.94	4.43	4.82	4.39
21	2.84	2.60	3.49	4.05	2.75	2.99	3.34	3.35	3.19	3.14	3.33	3.34
22	3.38	3.20	4.24	4.49	3.06	3.57	3.24	3.32	3.37	3.31	3.66	3.79
23	3.59	3.32	4.66	3.93	2.77	3.27	3.26	2.95	3.86	3.61	3.72	3.53
24	5.02	5.05	5.68	3.92	4.16	4.41	4.24	4.01	3.91	3.70	4.45	3.84
25	3.49	3.25	3.95	3.59	3.25	3.02	3.59	3.25	3.27	3.06	3.24	3.28
26	3.03	3.26	4.02	3.31	3.27	3.36	3.91	3.70	3.62	3.33	3.67	3.50
27	3.74	3.35	3.24	4.22	3.27	3.00	3.34	3.45	3.30	3.34	3.49	3.27
28	2.86	2.77	3.52	3.03	2.78	2.85	3.04	2.88	2.99	2.98	3.12	2.98
29	3.99	3.67	4.03	3.09	2.70	2.62	3.13	3.16	2.81	2.84	2.97	3.06
30	3.51	4.09	4.34	3.96	3.67	3.75	3.62	3.93	3.39	3.72	4.01	3.99
31	3.68	3.28	4.64	4.20	3.02	3.25	3.30	3.21	3.25	3.16	3.72	3.62

APPENDIX E: Raw data of the rates of various hand function performances (second)

Case no.	Dominant hand (DH)		Non dominant hand (NDH)		DH, objects test		NDH, objects test		DH, objects test		NDH, objects test	
	Checker 1	Checker 2	Checker 1	Checker 2	Light 1	Light 2	Light 1	Light 2	Heavy 1	Heavy 2	Heavy 1	Heavy 2
32	5.91	5.90	5.90	5.20	4.16	3.64	4.20	4.34	3.68	4.03	4.49	3.88
33	4.08	3.69	4.51	3.98	3.80	3.55	4.27	3.95	3.78	3.77	4.89	4.45
34	4.12	3.98	4.59	3.66	3.68	4.16	4.86	4.55	3.93	3.78	4.32	4.05
35	4.01	3.81	5.63	4.91	4.50	4.74	5.11	5.68	4.63	4.29	5.43	5.03
36	3.17	3.20	4.35	3.18	3.56	3.56	4.02	3.71	3.84	3.82	3.91	4.16
37	3.03	3.16	4.70	3.95	3.39	3.56	3.88	3.52	4.06	3.92	4.16	3.80
38	2.99	2.66	3.41	4.32	2.97	2.76	2.86	2.93	2.94	2.92	3.51	3.37
39	3.97	3.54	5.42	5.00	3.52	3.25	3.63	3.39	3.26	3.01	3.37	3.45
40	3.44	3.45	5.95	4.56	3.74	3.67	4.03	4.05	4.02	3.50	4.05	4.02
41	3.40	3.52	4.39	3.60	3.48	3.49	3.98	3.83	3.42	3.13	3.88	3.74
42	4.23	3.33	4.00	4.41	3.71	3.95	3.88	4.07	4.15	3.77	4.27	4.16
43	3.81	4.02	4.49	4.01	3.97	3.34	3.95	3.70	3.59	3.99	3.94	3.95
44	3.45	3.21	3.91	4.47	3.31	3.08	3.66	3.52	3.51	3.47	3.95	3.96
45	3.24	3.39	3.12	4.04	3.36	3.32	3.95	3.66	3.18	3.85	3.45	3.74
46	3.44	3.83	3.95	3.65	3.51	3.49	3.52	3.39	3.72	3.85	4.02	3.64
47	4.60	4.34	4.69	4.61	4.23	4.16	4.99	4.65	4.18	4.04	4.33	4.10
48	3.98	3.86	4.38	4.06	3.66	3.89	4.34	3.91	3.91	4.07	4.49	4.34
49	3.09	3.36	4.13	3.76	3.32	3.34	4.06	3.39	3.11	3.14	3.14	3.13
50	3.06	2.96	3.70	3.23	3.11	2.81	3.36	2.94	2.71	2.66	3.22	3.02
51	3.63	3.18	3.70	3.09	3.02	3.09	3.11	3.42	3.37	3.18	3.45	3.46
52	3.44	3.76	4.56	4.33	2.91	2.81	3.34	3.14	2.98	2.92	3.47	3.03
53	2.91	3.11	4.06	3.70	4.14	3.82	4.43	4.34	4.29	4.00	4.16	3.67
54	3.39	4.69	4.13	3.88	2.73	2.80	3.93	2.90	3.13	2.83	3.01	2.94
55	4.38	3.80	6.24	7.05	3.57	3.40	4.84	3.56	3.78	3.33	3.39	3.24
56	3.84	3.45	5.06	4.34	3.52	3.28	3.78	3.53	3.40	3.78	3.43	3.33
57	3.76	3.71	5.35	4.06	3.55	2.84	3.31	3.10	3.56	3.31	3.31	3.07
58	3.16	3.38	4.98	4.04	3.65	3.45	3.96	4.12	3.87	4.02	4.23	3.93
59	3.66	3.14	4.54	4.34	3.63	3.59	4.49	4.12	3.88	3.62	4.56	4.25
60	2.91	2.91	3.48	2.95	3.58	3.66	4.00	4.34	3.72	3.70	4.13	4.15
61	4.43	3.74	6.03	4.01	3.49	3.27	4.19	3.74	3.25	3.57	3.77	3.72
62	2.86	2.91	4.46	3.73	2.84	2.80	3.34	2.94	3.09	3.20	3.24	3.02

APPENDIX E: Raw data of the rates of various hand function performances (second)

Case no.	Dominant hand (DH)		Non dominant hand (NDH)		DH, objects test		NDH, objects test		DH, objects test		NDH, objects test	
	Checker 1	Checker 2	Checker 1	Checker 2	Light 1	Light 2	Light 1	Light 2	Heavy 1	Heavy 2	Heavy 1	Heavy 2
63	5.59	6.18	7.16	6.02	3.88	3.95	4.45	4.10	4.01	4.02	4.35	3.89
64	4.44	4.02	5.85	5.00	3.59	3.40	4.19	4.17	3.28	3.33	4.41	3.78
65	3.56	2.95	4.68	4.81	3.80	3.89	3.65	3.33	3.36	3.24	4.21	3.51
66	4.81	4.77	5.33	5.06	3.81	3.38	4.02	3.56	4.09	3.93	3.89	3.83
67	4.57	4.08	4.45	4.44	4.01	3.61	4.69	4.24	3.88	4.10	4.13	4.50
68	2.66	2.75	3.95	4.34	2.88	2.76	2.74	2.81	3.02	2.66	2.80	2.94
69	3.26	4.13	5.41	3.99	4.02	3.37	3.63	3.93	3.27	3.59	4.06	3.64
70	4.62	5.20	5.74	4.63	4.08	3.67	4.03	3.84	3.84	3.66	3.95	3.73
71	3.59	3.20	4.80	4.15	3.41	3.34	3.20	3.28	3.17	3.08	3.27	3.06
72	4.34	4.74	5.15	5.10	4.01	4.59	3.83	3.07	4.56	4.54	3.66	3.51
73	4.68	4.46	4.61	4.30	4.09	3.60	4.20	3.96	3.41	3.16	3.88	3.70
74	3.58	3.90	5.11	4.48	3.58	3.40	3.63	3.34	3.54	3.49	3.77	3.48
75	3.22	5.25	4.99	5.12	3.67	3.57	3.47	3.85	4.00	3.66	4.01	3.91
76	3.85	4.15	6.50	4.82	3.45	3.31	4.94	3.93	3.29	3.37	3.97	3.95
77	4.74	3.89	4.92	4.45	3.57	3.60	4.81	4.34	3.63	3.41	3.64	3.48
78	2.95	3.04	5.91	5.31	3.05	2.98	3.62	3.34	3.25	2.96	3.66	3.61
79	2.95	3.12	4.52	4.92	3.42	3.70	3.60	3.40	3.78	3.32	3.60	3.67
80	4.12	3.70	5.87	4.31	3.89	3.86	4.49	4.36	3.69	3.70	3.97	4.09
81	2.83	3.01	3.91	3.16	4.03	3.70	4.74	3.99	3.63	3.60	4.10	3.90
82	3.61	3.70	4.33	3.22	3.44	3.64	4.10	3.82	3.55	3.59	3.95	3.55
83	3.84	4.06	4.20	3.99	3.63	3.31	4.79	3.82	3.54	3.41	3.99	3.72
84	4.06	4.15	5.12	5.44	3.66	4.09	4.25	4.12	4.04	4.09	4.88	4.69
85	4.67	4.10	6.99	5.44	3.48	3.51	4.71	4.50	3.53	3.65	4.89	5.11
86	5.09	3.84	5.49	4.05	3.76	3.32	3.93	4.06	3.58	3.74	3.76	3.55
87	5.95	4.42	5.71	4.64	4.17	4.45	4.31	4.41	4.42	4.24	4.57	4.34
88	4.99	4.93	5.04	4.53	4.04	4.32	5.49	4.58	4.58	4.20	4.52	4.20
89	5.23	4.81	6.99	6.91	4.57	4.52	5.68	5.27	4.84	4.20	4.91	4.74
90	4.75	5.16	6.95	5.81	4.16	4.24	5.52	4.41	3.65	4.05	4.31	4.36
91	3.20	3.53	4.16	3.75	3.44	3.86	3.79	4.20	3.84	3.91	4.13	4.17
92	5.28	4.74	5.69	5.04	4.71	4.96	4.99	4.64	4.76	4.74	5.59	4.76
93	4.67	3.77	4.73	4.95	3.36	3.34	4.18	4.06	3.61	3.56	3.66	3.81

APPENDIX E: Raw data of the rates of various hand function performances (second)

Case no.	Dominant hand (DH)		Non dominant hand (NDH)		DH, objects test		NDH, objects test		DH, objects test		NDH, objects test	
	Checker 1	Checker 2	Checker 1	Checker 2	Light 1	Light 2	Light 1	Light 2	Heavy 1	Heavy 2	Heavy 1	Heavy 2
94	3.87	3.95	4.66	3.84	3.91	3.59	4.01	3.77	3.83	4.63	4.25	3.98
95	5.07	5.34	6.23	6.78	5.38	4.99	6.20	6.09	5.23	4.06	6.32	5.26
96	4.96	4.58	6.45	5.07	4.72	4.38	4.56	4.20	4.77	4.66	4.92	4.88
97	5.19	5.34	6.03	6.43	4.06	4.03	5.09	4.18	3.97	3.68	4.06	4.59
98	5.74	6.19	5.29	5.37	4.37	4.31	5.91	4.60	4.38	4.65	4.88	4.88
99	5.40	5.66	6.41	5.08	4.66	4.34	5.19	5.03	4.09	3.99	4.60	4.09
100	5.00	4.93	5.63	4.72	5.85	5.37	6.09	5.47	4.75	5.13	5.13	5.10
101	5.95	4.42	5.71	4.64	4.17	4.45	4.31	4.41	4.42	4.24	4.57	4.40
102	4.36	3.52	5.48	4.83	3.76	3.34	4.48	3.47	3.18	3.36	3.66	3.02
103	3.84	3.40	3.76	3.54	2.73	2.58	2.95	2.70	2.43	2.40	2.52	2.64
104	3.11	3.11	4.06	3.40	2.74	2.63	2.88	2.86	2.89	2.77	3.18	2.74
105	4.24	3.97	4.58	4.66	3.59	3.46	4.04	3.99	3.39	3.95	3.81	3.52
106	3.37	3.35	4.79	4.90	3.00	3.05	3.59	3.34	2.81	3.28	3.20	3.44
107	4.27	3.56	5.85	5.02	3.41	3.54	3.65	3.56	3.49	3.69	3.62	3.81
108	3.62	3.38	5.11	4.05	3.36	3.41	3.45	3.13	3.57	3.52	3.56	3.24
109	3.31	3.66	4.49	3.00	3.34	3.29	3.14	3.47	3.04	3.43	4.03	3.24
110	4.54	5.06	4.12	6.17	3.55	3.86	4.47	3.99	3.84	4.04	4.17	3.91
111	3.74	3.41	4.32	3.59	3.38	3.46	4.17	3.88	3.81	3.80	3.91	3.97
112	4.69	3.99	4.96	5.33	3.03	2.67	3.75	3.41	3.51	2.88	3.62	3.41
113	3.06	2.93	3.88	3.27	2.76	2.89	3.02	3.08	2.76	2.99	3.68	3.05
114	3.84	3.84	3.77	3.09	2.97	2.78	3.67	2.99	2.76	2.95	3.22	3.15
115	5.20	3.63	6.90	4.49	3.63	3.67	3.83	3.92	3.56	3.59	3.99	3.70
116	3.84	3.81	4.03	4.09	3.42	3.28	3.79	3.45	3.16	3.39	3.49	3.32
117	4.56	3.99	5.36	5.08	3.74	3.29	4.60	3.74	3.56	3.52	3.73	3.76
118	3.79	3.95	3.83	3.25	3.50	3.35	4.14	3.64	3.53	3.35	3.77	3.81
119	4.55	4.16	5.34	5.83	3.19	2.91	3.37	3.31	3.28	2.88	3.21	3.20
120	4.38	4.24	4.38	3.81	4.33	3.94	3.59	3.54	4.21	3.85	4.01	3.45
121	5.12	4.65	5.40	5.66	4.54	4.35	4.97	4.05	4.16	4.63	4.60	5.37
122	5.52	4.60	5.45	5.59	3.49	3.54	4.56	3.92	3.75	3.90	4.41	4.66
123	3.23	3.13	4.15	3.09	2.56	2.70	2.67	2.64	2.70	2.65	2.81	2.73
124	3.51	3.02	6.84	5.48	3.88	4.30	4.56	4.29	3.90	3.76	4.60	4.56

APPENDIX E: Raw data of the rates of various hand function performances (second)

Case no.	Dominant hand (DH)		Non dominant hand (NDH)		DH, objects test		NDH, objects test		DH, objects test		NDH, objects test	
	Checker 1	Checker 2	Checker 1	Checker 2	Light 1	Light 2	Light 1	Light 2	Heavy 1	Heavy 2	Heavy 1	Heavy 2
125	3.46	2.99	4.60	4.42	2.88	2.72	3.93	3.35	2.28	2.69	3.16	3.16
126	3.26	2.77	3.57	3.24	3.24	3.28	3.89	3.40	3.49	3.36	3.33	3.21
127	3.25	3.56	3.97	3.41	2.63	2.53	2.97	2.68	2.98	2.53	3.03	3.06
128	3.50	3.95	4.05	3.99	4.24	3.93	4.58	4.44	3.63	3.52	3.83	3.63
129	3.15	2.88	3.84	3.53	3.71	3.35	4.16	4.16	3.44	3.40	3.74	3.50
130	3.82	4.47	3.81	4.66	2.84	2.82	3.97	4.00	3.59	3.78	4.35	4.00
131	3.85	4.00	4.56	4.39	3.81	3.28	3.81	3.50	3.47	3.13	3.38	3.47
132	4.56	4.37	4.91	4.75	4.22	4.06	4.98	4.63	4.25	4.31	4.66	4.44
133	2.62	3.28	4.25	3.56	3.84	3.63	3.82	3.88	3.16	3.28	3.39	3.37
134	4.70	4.29	5.74	4.84	3.66	3.48	3.93	3.54	3.40	3.47	3.65	3.44
135	3.26	3.40	4.41	5.21	3.17	3.13	4.05	3.84	2.91	3.12	3.41	3.81
136	5.57	4.75	8.41	7.15	3.97	4.29	4.84	4.40	4.19	4.25	4.91	4.53
137	4.44	4.24	5.91	4.27	3.66	3.62	3.66	3.70	3.52	3.34	3.78	3.89
138	3.53	3.27	4.81	4.33	3.41	3.32	3.69	3.53	3.45	3.30	3.52	3.45
139	3.65	3.09	4.17	4.41	3.42	3.34	4.56	3.68	3.54	3.48	4.35	3.93
140	3.68	3.36	3.18	3.04	4.07	3.66	3.52	3.38	3.52	3.32	3.32	3.22
141	5.94	4.16	5.52	4.27	3.97	3.85	4.06	3.85	4.02	3.84	4.31	4.64
142	3.48	3.17	4.21	3.86	3.23	3.34	3.95	3.74	3.30	3.06	3.45	3.18
143	2.99	3.00	5.42	4.06	3.00	2.95	4.20	3.51	2.88	2.89	3.72	3.42
144	4.31	3.96	4.78	4.90	4.02	3.92	4.36	4.04	4.02	3.82	4.24	3.86
145	3.75	3.72	4.47	3.53	3.56	3.12	3.84	3.50	2.91	2.91	3.12	3.19
146	3.84	3.84	5.00	3.97	3.22	3.00	4.00	3.53	3.03	3.46	3.47	3.28
147	6.04	4.57	8.36	6.06	4.44	4.45	5.57	4.60	4.26	4.53	4.28	4.24
148	3.40	3.25	4.78	4.54	2.94	2.81	3.56	3.32	2.53	2.69	3.44	3.37
149	4.31	4.31	4.60	4.32	3.66	3.66	4.06	4.55	4.65	4.56	4.00	4.05
150	4.27	4.06	7.35	5.39	3.44	3.34	3.77	3.58	3.23	3.31	3.69	3.34
151	4.98	4.72	7.95	8.02	3.44	3.37	4.83	4.01	2.97	3.02	3.07	3.39
152	5.31	4.88	4.90	5.16	4.27	4.47	5.04	4.86	4.31	4.10	4.75	4.39
153	5.63	4.92	5.16	5.60	5.12	4.59	4.43	4.81	4.99	4.80	5.00	4.88
154	4.82	4.34	4.74	4.59	4.31	4.24	4.55	4.03	3.70	2.99	4.84	4.71
155	4.86	4.39	3.91	4.13	3.48	3.54	3.90	3.82	3.80	4.02	4.34	4.06

APPENDIX E: Raw data of the rates of various hand function performances (second)

Case no.	Dominant hand (DH)		Non dominant hand (NDH)		DH, objects test		NDH, objects test		DH, objects test		NDH, objects test	
	Checker 1	Checker 2	Checker 1	Checker 2	Light 1	Light 2	Light 1	Light 2	Heavy 1	Heavy 2	Heavy 1	Heavy 2
156	5.75	5.63	4.54	4.49	5.15	4.12	6.08	5.29	4.90	4.55	4.94	4.64
157	4.84	4.93	7.01	6.19	4.95	4.70	5.20	4.84	4.59	4.64	5.18	4.99
158	3.47	3.32	4.27	3.72	4.22	3.66	4.71	3.82	4.15	3.66	4.31	3.72
159	4.38	4.00	4.39	5.00	4.39	4.34	4.45	5.00	4.53	4.92	4.81	4.40
160	5.20	4.39	4.63	5.14	4.24	4.30	5.06	3.69	4.16	3.87	4.24	3.63
161	4.15	4.09	4.44	4.29	3.75	3.81	4.75	4.28	3.84	3.78	4.16	4.19
162	4.43	5.04	5.06	4.00	5.50	4.93	5.93	5.00	4.41	4.08	5.35	5.16
163	5.53	5.00	6.62	6.69	4.75	4.18	5.78	4.69	4.37	4.59	4.84	4.50
164	3.39	3.23	4.29	3.67	3.10	3.08	3.27	3.18	2.90	3.06	3.29	3.40
165	5.95	5.77	7.70	8.85	4.71	4.12	5.94	5.47	3.96	4.04	4.74	4.56
166	4.77	4.40	6.56	4.78	3.95	3.81	4.07	3.72	3.81	3.59	3.81	3.59
167	3.45	3.55	5.76	4.34	4.58	4.05	5.27	4.53	4.07	4.23	4.83	4.31
168	5.14	4.56	5.57	4.52	3.38	3.36	4.31	4.10	3.25	3.48	3.45	3.96
169	3.59	3.41	5.18	4.09	3.61	3.55	4.76	4.08	3.80	3.78	4.38	3.75

APPENDIX E: Raw data of the rates of various hand function performances (second)

Case	Dominant hand (DH)		Non dominant hand (NDH)		Dominant hand (DH)		Non dominant hand (NDH)		DH, pegs test		NDH, pegs test	
no.	Block 1	Block 2	Block 1	Block 2	Nail 1	Nail 2	Nail 1	Nail 2	Large 1	Large 2	Large 1	Large 2
1	3.34	3.04	3.58	3.34	4.28	4.10	3.58	3.45	9.30	7.84	9.09	8.70
2	3.16	2.78	4.77	3.06	3.79	3.72	5.37	4.16	8.33	8.92	9.24	9.41
3	3.41	3.18	4.96	4.22	3.61	3.86	5.18	4.73	7.82	8.24	9.24	8.27
4	3.07	2.95	2.98	3.20	4.37	4.41	4.69	4.58	8.95	10.02	11.18	12.19
5	3.09	2.93	3.98	3.61	3.99	4.69	3.95	4.06	7.48	8.07	10.24	9.01
6	3.48	3.68	3.25	3.72	3.55	3.48	4.32	4.74	7.91	8.23	8.60	8.17
7	3.42	3.69	3.74	3.81	4.66	4.54	5.72	5.38	9.38	8.91	9.19	9.83
8	3.79	3.77	4.60	4.45	4.25	4.14	4.69	4.71	10.12	10.02	11.54	12.09
9	3.74	3.66	4.16	3.82	3.99	4.09	4.78	4.32	9.27	9.16	10.86	10.70
10	2.51	2.81	3.57	3.08	3.71	3.75	4.56	4.33	8.42	7.81	8.87	8.64
11	3.20	2.10	3.43	2.99	3.73	4.00	5.22	5.04	8.21	8.44	9.85	8.52
12	2.91	2.74	3.55	3.21	3.25	3.50	4.65	4.38	8.52	7.63	9.91	9.03
13	3.80	3.71	5.00	4.30	4.63	4.68	5.44	6.30	8.56	8.21	10.83	8.91
14	3.13	3.23	4.32	3.66	3.34	3.80	3.59	3.84	8.15	8.36	8.66	9.63
15	3.44	3.09	4.45	4.05	3.34	3.25	4.21	3.77	9.64	8.77	11.82	10.31
16	3.39	3.32	3.84	3.59	3.90	4.20	4.19	4.16	9.25	8.89	11.69	12.42
17	2.74	2.80	3.95	3.27	3.57	5.43	4.44	4.20	8.83	8.04	9.87	9.02
18	2.43	2.83	3.58	3.08	3.88	3.27	3.52	4.63	7.32	7.32	8.91	8.97
19	2.79	2.67	3.89	3.35	3.33	3.45	4.04	5.41	9.25	9.33	10.56	9.88
20	3.45	3.29	4.50	4.30	4.34	4.62	6.06	5.36	9.91	10.21	11.66	10.84
21	3.16	2.88	3.79	3.72	3.72	3.74	4.24	4.45	8.80	8.16	10.31	12.84
22	3.65	3.81	4.23	4.03	3.39	3.27	4.61	4.59	7.93	8.34	10.05	9.85
23	3.56	3.27	3.81	3.91	3.56	4.19	3.64	4.02	8.68	7.55	9.45	8.58
24	3.95	3.91	4.16	3.81	5.04	4.44	4.81	4.41	10.31	9.24	11.06	10.92
25	3.16	2.70	3.06	3.24	3.84	3.81	4.24	4.03	7.97	8.90	7.80	8.54
26	4.06	4.07	5.76	4.47	4.47	4.02	5.55	4.82	8.64	9.56	11.01	10.13
27	3.64	2.81	3.56	3.67	4.02	3.68	4.95	5.10	7.77	7.84	9.11	8.52
28	3.19	3.03	3.46	2.97	4.19	4.45	3.52	4.27	8.57	8.17	8.90	8.67
29	3.38	3.40	3.33	3.10	3.58	3.28	4.75	3.90	8.99	8.81	10.06	10.77
30	3.31	3.39	4.00	4.02	4.40	5.07	5.82	4.67	9.23	9.05	10.40	11.02
31	3.56	3.79	5.01	4.03	3.36	3.37	4.13	3.69	7.95	8.77	10.07	8.98

APPENDIX E: Raw data of the rates of various hand function performances (second)

Case	Dominant hand (DH)		Non dominant hand (NDH)		Dominant hand (DH)		Non dominant hand (NDH)		DH, pegs test		NDH, pegs test	
no.	Block 1	Block 2	Block 1	Block 2	Nail 1	Nail 2	Nail 1	Nail 2	Large 1	Large 2	Large 1	Large 2
32	4.38	4.67	5.45	4.80	5.60	5.47	6.46	5.97	13.05	10.34	14.04	13.51
33	4.10	3.13	4.91	4.47	4.66	4.05	6.01	4.83	10.28	8.95	10.31	10.78
34	4.06	3.35	3.98	3.87	5.06	5.16	5.39	5.49	11.21	9.74	12.06	12.39
35	3.75	3.92	5.12	4.55	5.25	5.20	6.56	5.58	11.81	11.11	12.51	14.10
36	3.57	3.35	4.34	3.67	3.89	4.18	4.86	4.45	9.20	9.43	10.10	9.49
37	3.03	2.96	3.80	3.34	3.76	3.77	4.22	4.41	8.76	8.31	10.31	9.58
38	3.01	2.95	3.01	3.09	3.70	3.16	4.55	3.88	8.95	9.99	11.83	8.77
39	3.13	2.95	3.26	3.21	4.08	4.03	4.22	4.08	9.04	7.77	9.88	9.19
40	3.21	3.05	4.45	3.38	4.41	5.14	4.72	4.53	9.16	8.89	10.91	10.19
41	3.44	3.26	3.74	3.38	3.63	3.66	4.78	4.20	7.70	8.56	9.65	8.99
42	4.84	4.51	6.31	5.37	4.09	5.06	4.93	6.09	9.34	9.75	11.92	11.37
43	3.27	3.19	4.74	3.83	3.85	4.06	4.24	4.08	8.49	8.32	9.32	10.01
44	3.06	3.00	3.49	3.46	3.89	3.69	3.63	3.57	7.92	8.63	11.84	9.85
45	3.03	3.34	3.34	3.36	4.12	4.55	3.92	3.98	11.49	11.91	9.56	10.22
46	3.23	3.06	4.16	3.71	3.92	3.57	4.28	3.86	8.53	9.10	10.06	9.45
47	4.31	4.09	4.57	4.13	5.09	4.38	4.86	4.31	9.13	9.06	10.30	10.78
48	3.56	3.52	4.06	4.22	5.03	5.99	5.49	5.97	10.08	9.96	11.47	10.34
49	3.87	3.41	4.86	4.06	3.30	3.42	3.41	3.45	8.05	8.24	8.60	9.17
50	2.93	2.69	3.77	3.20	3.04	3.83	3.64	4.31	8.87	8.47	10.09	9.34
51	3.52	3.70	3.77	3.54	3.29	3.52	3.64	3.53	7.18	7.38	9.52	8.62
52	4.00	4.23	4.07	3.51	5.38	5.08	5.40	5.56	8.77	9.20	11.79	11.56
53	2.77	3.22	3.59	3.41	3.80	5.01	5.12	4.38	8.38	10.83	9.50	8.69
54	2.42	2.80	3.58	3.62	3.49	3.23	3.44	3.20	9.16	10.56	9.38	10.17
55	3.72	3.27	4.87	4.21	4.19	4.32	4.39	4.20	8.38	9.74	9.26	10.76
56	3.77	3.68	3.77	4.07	4.06	5.05	5.50	4.93	10.09	10.29	10.57	10.30
57	2.84	3.49	3.32	3.34	3.59	3.88	4.50	7.52	10.35	9.36	10.08	9.13
58	4.24	3.96	4.82	4.28	4.85	4.67	5.31	5.79	11.51	11.42	11.46	11.24
59	3.78	3.13	3.86	3.31	5.24	4.71	5.74	5.12	9.31	9.74	12.13	10.59
60	3.76	3.39	4.39	3.65	3.86	3.63	4.41	4.12	10.08	8.77	9.78	8.70
61	2.91	3.23	1.06	3.76	3.50	4.13	4.33	3.73	9.02	9.95	9.92	9.79
62	3.01	3.25	3.30	3.73	3.50	4.16	4.87	4.02	10.45	10.33	11.67	11.51

APPENDIX E: Raw data of the rates of various hand function performances (second)

Case no.	Dominant hand (DH)		Non dominant hand (NDH)		Dominant hand (DH)		Non dominant hand (NDH)		DH, pegs test		NDH, pegs test	
	Block 1	Block 2	Block 1	Block 2	Nail 1	Nail 2	Nail 1	Nail 2	Large 1	Large 2	Large 1	Large 2
63	5.58	5.09	5.56	6.11	4.73	4.32	6.10	4.86	10.55	9.38	12.36	12.25
64	3.32	3.44	5.90	4.16	3.98	5.50	5.95	4.81	9.01	7.45	9.71	9.66
65	3.51	2.74	3.23	3.03	4.20	4.74	4.56	4.86	9.45	11.67	11.87	11.63
66	3.19	3.37	3.95	3.84	4.25	4.44	5.19	4.45	10.50	9.82	12.13	10.94
67	4.29	4.40	5.58	4.48	4.62	4.51	5.99	4.57	10.21	10.92	14.26	11.88
68	2.45	2.45	3.03	2.78	3.81	3.89	4.92	3.59	8.59	9.02	7.85	7.88
69	4.34	4.24	4.76	5.15	5.83	4.62	7.24	5.65	10.67	10.40	11.01	11.68
70	4.02	3.55	4.68	4.15	4.37	4.58	6.02	4.82	11.24	12.91	11.74	10.66
71	3.49	2.98	3.84	3.35	3.69	3.49	4.81	4.88	8.50	10.77	10.45	8.84
72	5.12	4.85	5.07	4.52	4.58	4.22	4.84	4.16	11.48	11.14	12.16	11.65
73	2.79	2.76	4.81	4.00	5.00	5.40	5.95	5.72	11.96	9.67	13.60	11.56
74	3.49	2.83	3.53	3.25	4.97	3.81	4.88	5.52	8.66	9.32	11.85	9.56
75	3.89	3.34	4.51	4.16	4.16	4.14	4.74	5.32	8.99	8.49	11.31	10.75
76	3.74	3.75	4.95	4.18	3.68	4.06	3.86	3.87	8.75	8.28	10.74	10.34
77	3.49	3.62	3.16	3.83	3.86	4.02	5.32	4.47	10.89	9.01	10.79	10.65
78	2.68	2.74	4.09	3.88	3.23	3.16	3.91	4.13	9.14	10.01	11.88	11.74
79	3.95	3.59	3.23	3.31	3.60	3.68	4.65	3.81	8.53	8.56	9.96	8.43
80	4.38	4.84	4.61	5.09	5.63	4.86	5.68	5.12	10.89	9.99	11.65	12.33
81	3.27	3.88	3.77	3.74	3.79	3.94	4.13	5.45	9.36	8.09	10.37	9.38
82	3.65	3.84	3.94	3.84	4.48	4.26	4.94	5.21	10.71	10.90	13.62	11.80
83	3.29	3.47	4.20	3.84	5.10	4.65	5.43	5.98	10.71	9.63	10.00	11.02
84	5.93	5.08	6.86	6.54	4.76	4.59	6.65	5.70	9.09	9.28	13.71	11.32
85	4.27	4.70	5.21	4.81	4.36	5.49	5.73	5.57	12.47	12.49	14.74	11.49
86	4.43	3.95	5.02	4.34	4.06	4.23	4.25	5.62	8.52	10.27	11.06	10.66
87	3.62	3.53	4.77	4.72	5.09	5.20	6.81	5.41	10.58	11.40	12.35	11.66
88	4.34	3.96	4.52	4.37	4.38	4.45	5.61	4.55	10.07	10.64	11.80	10.34
89	5.04	5.02	6.41	5.67	5.39	5.33	6.59	5.91	11.52	9.02	12.36	14.34
90	4.71	4.58	4.81	4.90	5.59	6.16	4.95	6.10	11.63	11.78	11.52	12.13
91	3.35	3.46	3.90	3.77	5.13	4.09	4.66	4.10	8.34	8.56	11.17	10.69
92	4.85	4.62	6.83	5.31	5.23	5.34	6.69	6.47	10.81	11.66	13.83	12.96
93	3.85	3.59	3.61	3.80	4.41	4.41	4.74	4.11	9.38	9.40	11.65	11.65

APPENDIX E: Raw data of the rates of various hand function performances (second)

Case	Dominant hand (DH)		Non dominant hand (NDH)		Dominant hand (DH)		Non dominant hand (NDH)		DH, pegs test		NDH, pegs test	
no.	Block 1	Block 2	Block 1	Block 2	Nail 1	Nail 2	Nail 1	Nail 2	Large 1	Large 2	Large 1	Large 2
94	3.51	3.81	4.06	4.72	5.51	5.69	5.99	5.75	12.56	10.22	12.99	13.65
95	4.49	4.85	5.29	4.84	6.04	4.74	5.64	5.64	10.81	9.84	14.78	12.13
96	4.24	4.66	5.03	4.92	3.66	3.79	4.91	4.58	11.88	10.48	12.53	13.05
97	4.00	4.06	4.38	4.00	4.91	4.88	5.58	5.12	12.83	11.50	13.94	12.81
98	5.00	5.25	6.34	5.59	5.09	5.25	6.97	6.15	11.97	11.19	14.87	15.75
99	4.14	4.12	5.69	4.81	6.25	5.54	5.81	5.78	11.16	10.50	14.28	12.12
100	5.88	5.65	6.09	5.75	5.56	5.84	6.03	5.37	12.81	10.81	13.62	12.09
101	3.62	3.53	4.77	4.72	5.09	5.20	6.81	5.41	10.58	11.40	12.35	11.56
102	3.11	3.01	3.25	3.00	3.95	4.05	5.77	4.08	9.98	9.43	10.80	9.98
103	3.24	3.03	3.61	3.96	4.41	3.37	5.02	4.70	9.97	11.06	11.03	10.21
104	3.03	2.99	4.91	3.72	4.96	4.69	4.57	3.74	9.49	9.41	10.31	9.11
105	3.68	3.50	4.10	4.06	4.71	4.23	4.88	5.19	10.63	9.24	10.52	10.41
106	3.96	3.52	4.22	4.60	4.87	4.05	4.81	4.55	9.76	8.54	12.14	10.13
107	3.94	3.08	4.00	3.80	3.91	3.88	5.26	4.68	9.83	10.26	10.16	11.59
108	3.52	3.72	4.54	3.53	4.15	3.89	5.06	4.83	9.58	8.56	9.52	10.45
109	3.81	2.58	3.74	3.35	5.31	4.46	5.16	5.81	11.35	12.40	9.39	10.16
110	4.33	4.74	5.46	4.89	5.08	4.69	5.66	4.91	12.30	11.05	11.20	10.31
111	3.18	3.40	3.63	3.47	4.62	4.41	4.98	4.63	11.91	10.37	11.24	10.24
112	3.12	3.08	3.30	4.37	4.01	4.88	5.85	4.70	9.00	9.50	12.39	11.03
113	2.45	2.37	3.07	2.79	3.64	3.66	3.95	3.77	9.34	9.10	9.90	9.45
114	2.61	3.06	3.59	2.71	3.53	3.49	3.99	4.35	9.02	9.57	8.74	8.74
115	4.67	4.03	4.65	5.20	3.98	3.64	5.19	4.33	9.90	10.56	11.23	10.76
116	3.57	3.20	3.34	3.09	3.95	3.81	3.96	4.49	9.81	8.98	9.20	8.27
117	3.13	2.84	4.09	3.57	5.92	8.02	7.96	8.20	8.38	9.99	11.29	10.78
118	2.70	3.02	2.91	3.52	3.60	3.49	5.99	4.47	9.52	8.48	8.10	9.91
119	3.02	2.88	3.60	3.27	4.55	4.02	4.95	4.77	8.56	8.53	11.71	10.25
120	5.66	4.62	4.25	3.84	5.33	5.33	4.16	5.56	10.31	9.95	10.80	9.47
121	6.27	6.41	7.02	6.93	6.56	6.44	6.86	5.58	12.01	10.72	15.87	12.38
122	4.61	4.44	3.37	5.02	4.16	3.95	4.71	5.02	10.91	11.18	11.46	12.67
123	2.91	3.36	3.53	4.09	3.89	3.60	6.59	6.14	9.41	9.17	10.88	10.39
124	3.57	4.21	4.49	4.37	5.23	4.21	4.14	4.23	8.28	8.68	9.28	10.74

APPENDIX E: Raw data of the rates of various hand function performances (second)

Case no.	Dominant hand (DH)		Non dominant hand (NDH)		Dominant hand (DH)		Non dominant hand (NDH)		DH, pegs test		NDH, pegs test	
	Block 1	Block 2	Block 1	Block 2	Nail 1	Nail 2	Nail 1	Nail 2	Large 1	Large 2	Large 1	Large 2
125	3.17	2.77	3.56	3.74	5.40	5.18	3.82	4.83	11.50	10.44	11.98	9.77
126	3.41	3.02	4.73	4.73	5.35	4.01	4.44	4.41	11.34	9.39	11.72	11.08
127	3.68	2.75	3.91	2.77	3.88	3.81	4.68	4.06	9.78	8.63	11.15	10.38
128	3.70	3.48	3.93	4.10	4.19	3.76	4.57	4.68	10.13	10.45	11.07	9.80
129	2.90	2.98	3.81	4.10	5.26	3.96	5.59	4.89	9.31	8.17	11.02	11.05
130	4.59	4.28	4.25	4.56	4.68	4.09	4.91	4.81	8.79	8.79	11.03	10.50
131	5.40	4.78	6.19	5.76	4.79	4.31	5.20	5.97	11.57	10.59	10.65	9.59
132	5.43	5.34	5.75	5.99	6.50	5.62	7.44	6.12	9.66	11.91	13.16	11.81
133	4.31	4.31	4.30	4.47	4.41	4.38	5.06	4.91	11.67	11.19	13.16	12.47
134	4.49	4.56	4.57	4.89	4.70	4.58	5.42	4.41	10.66	9.24	11.43	11.15
135	3.81	3.52	4.84	3.93	4.14	4.18	5.45	4.74	9.19	7.74	10.53	10.30
136	4.78	4.84	6.18	5.69	5.47	5.88	7.47	7.25	14.25	10.60	17.25	14.34
137	3.49	3.62	3.49	3.61	4.20	4.11	5.52	4.56	9.05	9.96	10.75	10.31
138	3.18	3.11	3.42	3.23	4.07	4.23	6.04	4.41	8.04	9.89	11.40	10.20
139	3.00	3.13	3.49	3.47	4.34	4.09	5.30	4.07	9.01	8.51	10.58	9.43
140	4.02	3.70	3.20	2.99	5.03	4.47	5.33	4.22	10.07	10.08	9.96	9.13
141	3.45	3.46	5.05	3.91	4.77	4.49	4.31	4.11	8.13	7.69	11.15	9.42
142	3.37	3.06	3.55	3.00	4.53	4.36	3.99	4.14	9.56	9.40	10.52	9.74
143	4.35	4.09	5.20	4.97	4.49	4.27	5.48	4.45	10.13	9.56	11.01	9.94
144	3.77	3.49	4.28	3.70	5.21	5.07	5.73	5.03	10.50	9.67	12.58	10.93
145	3.87	3.44	3.62	4.53	4.31	4.22	5.49	4.50	10.35	12.16	12.37	12.31
146	4.06	3.69	4.75	4.22	4.59	4.19	5.45	5.72	9.44	8.86	10.84	9.09
147	5.09	5.49	5.98	5.85	5.07	5.75	6.81	6.84	12.00	13.55	14.20	13.10
148	4.31	4.47	4.94	4.97	4.50	3.97	4.22	4.06	8.93	8.75	10.41	9.60
149	4.07	4.10	4.15	4.03	4.97	5.00	4.68	5.09	10.84	10.39	13.04	12.09
150	4.05	3.49	4.66	3.81	4.27	4.44	4.70	4.28	8.50	8.35	8.66	8.50
151	3.28	3.13	4.13	3.73	5.21	4.62	5.90	6.29	8.37	7.99	10.77	10.58
152	4.20	4.09	4.16	4.20	4.74	4.61	5.80	5.08	9.80	9.48	12.02	10.87
153	4.85	4.73	5.86	5.49	5.74	6.73	7.83	8.38	12.68	12.94	15.57	13.70
154	4.08	3.96	4.41	4.29	4.84	4.95	5.56	5.23	10.23	11.62	11.29	10.60
155	4.00	4.23	4.55	4.41	4.13	4.18	5.23	4.34	9.15	9.12	10.83	9.51

APPENDIX E: Raw data of the rates of various hand function performances (second)

Case no.	Dominant hand (DH)		Non dominant hand (NDH)		Dominant hand (DH)		Non dominant hand (NDH)		DH, pegs test		NDH, pegs test	
	Block 1	Block 2	Block 1	Block 2	Nail 1	Nail 2	Nail 1	Nail 2	Large 1	Large 2	Large 1	Large 2
156	4.41	4.38	5.42	4.89	6.27	6.03	6.78	6.41	12.13	9.91	15.24	14.14
157	3.94	3.89	4.96	4.74	5.63	4.88	5.63	5.47	10.20	10.09	13.55	12.02
158	3.62	3.29	4.28	3.58	4.71	4.78	5.26	4.76	10.18	8.91	11.37	11.38
159	4.40	4.46	4.48	5.41	5.04	5.23	6.08	5.93	11.39	10.49	11.30	10.70
160	5.07	5.48	5.26	4.77	5.63	4.78	5.45	4.44	9.81	9.55	11.64	9.16
161	4.09	3.75	4.44	3.91	4.56	4.43	5.59	5.38	13.21	13.30	15.07	14.28
162	4.71	4.12	5.28	5.08	5.50	4.87	5.63	5.09	13.34	12.15	12.91	13.75
163	5.35	4.97	5.78	5.12	6.50	6.41	7.37	8.03	15.15	13.72	15.94	14.69
164	3.84	3.41	3.89	3.81	3.51	3.57	4.05	4.02	8.56	7.78	9.31	9.46
165	6.61	5.45	7.24	7.04	7.74	6.64	7.79	6.74	11.59	11.34	13.84	11.38
166	3.27	3.93	5.18	4.38	4.61	4.56	6.16	4.84	8.74	8.91	10.35	10.81
167	4.68	4.87	6.32	5.34	5.02	5.32	6.63	5.82	11.14	11.30	15.12	12.56
168	3.18	2.76	4.38	4.02	4.95	4.49	4.38	4.45	9.38	9.94	11.01	11.26
169	3.44	3.71	3.35	3.81	6.52	4.94	6.60	5.13	10.81	10.40	11.73	10.08

APPENDIX E: Raw data of the rates of various hand function performances (second) (continued)

Case	Dominant hand, pegs test		Non-dominant hand, pegs test		Both hand	
no.	Small 1	Small 2	Small 1	Small 2	Button 1	Button 2
1	8.36	8.87	9.45	8.69	13.43	13.60
2	8.22	8.32	8.74	8.55	15.25	13.95
3	8.29	8.07	9.56	9.60	11.73	11.26
4	8.93	8.72	10.96	10.70	13.61	12.82
5	8.73	9.06	9.53	9.13	12.11	14.16
6	8.45	7.93	9.88	10.04	11.73	10.08
7	9.68	9.77	10.18	10.24	12.84	13.79
8	10.74	10.45	12.84	13.43	12.19	11.55
9	9.37	10.78	9.34	10.73	13.35	12.02
10	8.45	8.45	10.24	10.36	12.27	10.16
11	8.49	8.36	9.59	9.36	11.44	10.76
12	7.43	8.70	9.33	9.16	9.40	9.90
13	8.88	8.05	10.45	9.04	12.16	10.45
14	7.91	8.63	10.33	8.77	15.67	12.77
15	8.95	8.89	11.54	11.24	9.06	10.90
16	10.41	9.59	11.00	10.61	12.83	11.81
17	9.50	8.62	10.70	9.62	12.24	12.18
18	8.66	7.47	8.35	9.50	11.14	11.16
19	10.39	9.11	10.19	10.02	12.94	9.83
20	9.96	9.03	12.88	10.99	14.54	16.81
21	7.67	8.98	9.83	9.06	14.34	14.85
22	7.99	7.44	9.86	9.44	12.95	10.59
23	8.23	8.19	9.13	9.74	10.59	9.47
24	10.02	9.96	10.53	12.39	14.30	15.05
25	7.37	7.73	9.93	9.59	11.52	12.52
26	9.63	9.15	12.09	9.49	15.23	13.01
27	8.15	8.61	8.97	9.08	11.56	10.51
28	8.62	8.38	9.07	8.70	13.52	11.09
29	7.73	8.91	8.58	10.28	15.99	12.66
30	9.46	9.41	10.21	10.55	15.24	13.44
31	8.82	7.65	8.47	11.00	11.22	11.13
32	10.28	11.93	14.48	13.77	12.49	14.36
33	10.36	9.06	11.71	11.25	11.43	10.34
34	9.22	9.06	10.99	11.33	14.09	14.91
35	10.91	10.65	14.87	13.68	16.66	14.71
36	10.52	9.58	9.35	10.29	16.73	14.04
37	8.75	9.66	10.79	9.84	13.88	12.17
38	9.14	9.11	9.59	8.91	12.82	10.48
39	8.08	7.71	9.06	11.95	11.76	12.56
40	8.17	8.85	9.41	9.49	11.49	11.77
41	9.19	8.45	8.64	8.74	10.15	9.18
42	9.19	10.84	12.13	14.09	13.74	11.04
43	8.02	7.91	9.72	9.56	11.44	9.22
44	9.21	9.04	9.66	8.73	11.26	12.22
45	11.02	11.28	13.24	9.62	13.95	15.70
46	9.76	9.20	11.12	10.72	11.43	10.49
47	9.45	9.27	10.65	9.31	15.13	13.24
48	10.29	10.72	12.24	11.17	13.08	15.17
49	8.42	8.02	9.04	8.86	11.54	9.27
50	9.08	8.75	8.99	9.91	12.77	9.69

APPENDIX E: Raw data of the rates of various hand function performances (second) (continued)

Case	Dominant hand, pegs test		Non-dominant hand, pegs test		Both hand	
no.	Small 1	Small 2	Small 1	Small 2	Button 1	Button 2
51	7.81	8.62	9.86	9.31	11.62	10.53
52	7.37	7.73	9.13	9.81	12.62	11.04
53	9.13	9.66	11.84	9.74	12.79	12.31
54	9.36	9.90	10.77	9.63	16.71	14.50
55	9.17	7.79	9.87	10.85	11.44	11.81
56	10.99	8.56	10.24	11.83	15.74	12.96
57	8.37	8.70	9.24	9.52	16.06	20.00
58	11.24	10.70	11.72	12.41	15.32	13.24
59	10.21	8.91	12.71	10.40	13.31	14.48
60	8.77	8.47	11.83	11.49	15.27	11.68
61	10.83	10.00	10.29	11.61	12.88	13.19
62	8.66	9.11	10.29	8.97	17.24	13.56
63	9.84	9.66	12.10	11.99	16.59	14.64
64	9.85	8.27	9.02	9.95	12.44	10.64
65	9.70	10.60	14.11	12.50	14.92	11.40
66	12.13	11.00	10.50	9.99	14.53	14.60
67	10.04	10.32	11.72	11.99	17.20	13.63
68	9.61	8.65	9.58	8.63	14.85	11.61
69	9.98	10.52	12.96	10.29	14.30	10.75
70	9.40	9.12	11.13	10.78	13.74	14.95
71	9.66	7.96	9.45	9.86	11.60	11.29
72	13.44	13.07	12.37	10.87	16.37	14.56
73	11.33	10.04	13.24	10.61	15.49	11.92
74	10.30	9.17	11.77	12.47	13.63	14.90
75	9.95	7.93	9.52	9.93	16.71	16.35
76	8.77	9.23	11.69	11.48	12.58	12.03
77	7.99	8.68	9.96	8.45	12.04	10.49
78	9.36	8.95	11.60	9.37	10.98	10.42
79	10.86	10.57	10.40	9.63	17.65	15.59
80	10.13	9.34	14.38	12.24	16.31	15.04
81	9.73	9.15	10.21	10.22	14.88	11.66
82	12.34	10.08	14.59	13.38	16.91	14.06
83	10.06	9.16	10.19	11.78	110.25	10.46
84	8.73	9.59	13.66	10.88	12.59	14.28
85	13.48	13.06	11.88	13.54	19.24	15.94
86	9.09	10.20	10.65	11.77	13.55	12.45
87	10.98	10.93	10.62	10.96	13.70	16.11
88	10.24	12.75	13.20	11.46	13.49	14.17
89	10.45	11.04	10.95	11.16	16.88	14.30
90	13.17	11.63	13.09	12.32	11.73	13.71
91	10.41	10.38	12.11	10.38	13.19	14.52
92	10.56	11.35	11.81	12.04	17.29	17.30
93	8.27	9.19	10.60	10.24	12.07	10.45
94	11.99	9.95	11.35	12.85	14.02	12.91
95	9.82	10.40	13.77	12.96	17.21	16.71
96	12.62	11.74	14.78	12.83	13.98	12.68
97	11.75	12.00	13.25	13.96	13.18	11.50
98	12.81	13.66	12.41	15.35	17.31	16.19
99	10.97	10.50	12.87	12.19	15.28	16.70
100	12.15	11.41	11.97	12.34	13.94	16.78

APPENDIX E: Raw data of the rates of various hand function performances (second) (continued)

Case	Dominant hand, pegs test		Non-dominant hand, pegs test		Both hand	
no.	Small 1	Small 2	Small 1	Small 2	Button 1	Button 2
101	10.98	10.93	10.62	10.96	13.70	16.10
102	9.27	10.31	11.52	10.74	17.56	20.00
103	11.69	10.14	10.04	10.24	12.31	13.24
104	8.77	9.24	9.35	9.94	12.16	11.13
105	9.27	9.59	10.74	10.44	10.66	11.06
106	10.71	10.59	10.54	10.54	16.15	12.99
107	9.46	9.16	9.83	9.72	11.57	12.77
108	8.97	8.67	10.20	9.75	14.33	13.43
109	10.15	10.01	8.88	10.74	14.65	13.08
110	11.16	9.99	10.81	11.88	15.50	15.72
111	10.06	9.38	9.20	10.81	16.14	14.59
112	9.40	9.69	11.68	12.99	14.74	15.16
113	7.77	7.70	9.87	9.75	14.51	12.88
114	8.60	9.97	7.68	7.95	14.50	12.37
115	10.04	10.88	12.73	10.50	15.34	12.65
116	9.23	8.45	8.55	9.74	12.15	11.19
117	9.56	8.86	9.54	10.49	18.24	18.67
118	8.43	10.28	8.77	10.37	16.24	17.91
119	8.66	8.03	9.64	10.05	15.84	17.07
120	10.00	10.45	9.74	9.34	9.49	9.52
121	10.35	10.68	14.31	13.49	18.66	18.08
122	11.49	10.67	12.99	12.92	16.92	16.22
123	10.16	9.84	8.71	9.34	16.13	13.05
124	9.14	8.73	9.81	11.28	16.75	18.13
125	10.41	9.91	11.77	10.64	14.59	16.04
126	10.04	10.27	13.52	10.97	17.52	15.05
127	10.65	8.95	10.95	9.36	11.70	11.59
128	9.27	9.32	9.26	10.24	14.15	12.83
129	10.57	8.83	10.03	11.38	15.17	18.58
130	8.59	9.79	11.37	10.43	16.59	16.43
131	10.03	9.65	10.78	11.84	15.00	13.69
132	13.12	12.50	13.44	12.72	16.60	17.90
133	9.75	9.03	14.85	12.85	14.53	11.98
134	10.59	9.99	11.95	12.47	15.56	16.23
135	8.49	9.91	10.63	9.89	10.70	9.20
136	12.31	10.84	15.22	13.53	14.85	16.56
137	9.33	9.11	13.47	12.23	16.78	17.63
138	8.98	9.04	9.20	8.90	12.16	14.45
139	9.88	9.24	9.39	9.62	16.12	12.31
140	10.93	11.79	10.82	9.14	13.13	12.54
141	9.56	8.84	10.53	9.47	13.88	12.91
142	10.45	9.41	10.31	10.14	13.34	12.49
143	11.69	9.54	12.49	11.67	15.90	12.89
144	10.80	11.68	9.84	11.89	14.36	17.28
145	12.53	11.47	10.56	11.90	15.69	13.10
146	9.63	9.71	10.41	11.34	14.28	16.56
147	11.68	14.38	16.43	15.44	20.68	16.94
148	8.97	7.96	9.10	9.80	10.44	9.66
149	11.22	11.82	12.38	13.09	16.44	18.40
150	7.40	8.69	8.68	8.74	18.71	12.11

APPENDIX E: Raw data of the rates of various hand function performances (second) (continued)

Case	Dominant hand, pegs test		Non-dominant hand, pegs test		Both hand	
no.	Small 1	Small 2	Small 1	Small 2	Button 1	Button 2
151	9.95	9.27	11.55	11.69	13.45	10.37
152	10.52	9.97	12.91	12.49	14.66	14.92
153	14.54	12.65	15.44	12.42	26.34	23.01
154	9.39	11.45	10.09	11.19	15.35	15.70
155	9.94	9.58	11.49	11.06	13.69	13.50
156	10.48	10.76	14.66	15.46	17.88	15.34
157	11.09	10.91	12.33	11.91	19.59	18.42
158	9.32	9.95	14.19	12.21	18.31	14.85
159	11.42	11.61	13.16	12.98	15.48	12.54
160	10.27	10.96	9.94	9.39	15.67	18.08
161	12.00	12.34	13.60	13.27	14.88	13.69
162	13.53	12.59	13.68	13.35	22.84	21.47
163	13.19	13.75	14.47	15.15	19.16	20.87
164	10.39	9.03	10.11	9.65	11.03	12.81
165	11.33	11.93	12.09	11.09	15.16	16.52
166	9.20	8.67	9.88	9.52	16.07	15.00
167	11.34	10.74	13.16	13.28	16.81	14.09
168	9.90	10.49	10.86	11.61	13.41	17.52
169	10.72	12.16	11.53	13.14	15.58	14.26

APPENDIX F: Raw data for the intraclass correlation coefficient (ICC) of grip-strength (kg.)

Case no	Dominant hand		Non dominant hand	
	Grip 1	Grip 2	Grip 1	Grip 2
1	27.67	25.17	24.67	22.67
2	21.33	20.53	21.33	21.07
3	22.00	21.93	24.33	23.50
4	24.33	22.00	21.37	21.67
5	27.23	26.00	22.00	20.97
6	23.70	19.00	19.33	19.67
7	24.00	23.00	20.67	19.67
8	46.67	42.43	36.00	36.80
9	25.33	26.50	23.73	22.87
10	37.63	35.17	28.67	25.33

APPENDIX F: Raw data for the intraclass correlation coefficient (ICC) of pinch-strength (kg.)

Case no	Dominant hand		Non dominant hand		Dominant hand		Non dominant hand		Dominant hand		Non dominant hand	
	Palmar 1	Palmar 2	Palmar 1	Palmar 2	Key 1	Key 2	Key 1	Key 2	Tip 1	Tip 2	Tip 1	Tip 2
1	5.63	5.23	5.67	5.13	6.50	6.37	5.63	5.27	4.40	4.10	4.10	3.57
2	5.27	4.23	4.17	3.90	5.47	4.80	5.20	4.80	2.50	2.37	2.07	2.33
3	5.00	5.37	4.00	4.57	5.23	5.63	4.57	5.83	3.77	3.53	3.07	3.03
4	6.13	6.80	6.17	5.90	5.90	6.06	4.90	5.17	4.00	4.03	2.87	2.83
5	5.43	4.73	4.67	4.17	6.37	5.53	5.20	4.70	3.23	3.20	2.73	2.23
6	5.80	5.37	4.90	5.23	5.73	5.93	5.63	5.63	5.00	4.27	3.67	3.13
7	6.30	5.90	4.93	5.07	5.17	5.37	4.93	4.87	4.93	4.67	4.70	4.17
8	8.33	7.00	6.50	5.90	9.63	9.30	9.50	9.83	5.47	3.97	3.67	3.63
9	4.47	5.00	5.13	4.87	5.73	5.40	5.20	5.07	3.50	3.50	2.83	2.97
10	7.27	7.03	6.70	6.30	9.67	9.27	7.97	7.63	4.17	4.80	5.00	4.27

APPENDIX F: Raw data for the intraclass correlation coefficient (ICC) of the rates of various hand function performances (second)

Case no.	Dominant hand		Non dominant hand		DH, objects test		NDH, objects test		DH, objects test		NDH, objects test	
	Checker 1	Checker 2	Checker 1	Checker 2	Light 1	Light 2	Light 1	Light 2	Heavy 1	Heavy 2	Heavy 1	Heavy 2
1	2.86	2.77	3.52	3.03	2.78	2.85	3.04	2.88	2.99	2.98	3.12	2.98
2	3.49	2.92	3.95	3.40	2.92	2.80	3.20	2.64	3.02	2.80	3.30	2.69
3	3.08	3.03	3.32	3.91	2.98	3.25	3.53	3.24	3.13	3.29	3.72	3.51
4	2.73	2.94	4.20	3.30	3.09	2.85	3.21	3.01	3.15	3.24	3.14	3.26
5	3.23	3.03	3.48	3.55	3.05	2.89	3.47	3.52	3.13	3.09	3.65	3.30
6	3.82	3.57	4.63	4.15	2.81	3.03	3.47	3.27	2.85	2.93	3.08	3.11
7	3.31	3.65	3.98	3.60	3.89	3.77	4.28	3.95	4.19	4.09	4.62	4.30
8	4.34	3.92	5.15	4.67	2.85	2.84	3.58	3.06	2.13	2.72	3.52	3.08
9	4.88	4.38	4.32	4.58	3.79	3.39	3.69	3.72	3.59	3.27	3.80	3.60
10	3.00	2.94	3.58	3.33	2.83	2.67	3.05	2.94	2.88	2.82	3.37	2.84

DH = Dominant hand, NDH = Non dominant hand

APPENDIX F: Raw data for the intraclass correlation coefficient (ICC) of the rates of various hand function performances (second) (continued)

Case no.	Dominant hand		Non dominant hand		Dominant hand		Non dominant hand		DH, pegs test		NDH, pegs test	
	Block 1	Block 2	Block 1	Block 2	Nail 1	Nail 2	Nail 1	Nail 2	Large 1	Large 2	Large 1	Large 2
1	3.19	3.03	3.46	2.97	4.19	4.45	3.52	4.27	8.57	8.17	8.90	8.67
2	2.97	2.53	3.92	2.91	3.76	3.53	4.77	4.20	8.63	8.29	9.33	9.15
3	3.30	3.39	4.59	4.13	3.74	3.71	4.96	4.10	8.03	7.86	8.80	8.70
4	3.01	2.74	3.09	3.21	4.39	4.43	4.64	4.50	9.49	9.15	11.69	10.79
5	3.01	2.81	3.80	3.36	4.34	4.12	4.01	4.07	7.78	8.52	9.63	9.62
6	3.58	3.15	3.49	3.42	3.52	3.52	4.53	4.28	8.07	7.84	8.39	9.02
7	3.56	3.29	3.78	3.43	4.60	4.82	5.55	5.30	9.15	9.83	9.51	9.21
8	3.10	3.17	3.70	3.68	4.45	4.08	5.28	5.02	9.25	9.37	11.71	11.51
9	3.78	4.07	4.53	4.28	4.20	4.38	4.70	4.03	10.07	10.18	11.82	10.84
10	2.41	2.45	2.93	2.43	3.65	3.81	3.86	4.21	9.22	8.30	9.68	8.63

DH = Dominant hand, NDH = Non dominant hand

APPENDIX F: Raw data for the intraclass correlation coefficient (ICC) of the rates of various hand function performances (second) (continued)

Case no.	Dominant hand, pegs test		Non dominant hand, pegs test		Both hands		Dominant hand		Non dominant hand	
	Small 1	Small 2	Small 1	Small 2	Button 1	Button 2	Feeding 1	Feeding 2	Feeding 1	Feeding 2
1	8.62	8.38	9.07	8.70	13.52	11.09	5.55	5.28	6.65	5.34
2	8.27	8.79	8.65	8.59	14.60	13.73	3.19	3.29	6.66	5.87
3	8.18	8.00	9.58	9.20	11.50	11.16	6.39	6.10	7.36	6.60
4	8.83	8.74	10.83	10.61	13.22	13.64	5.31	4.92	5.72	5.55
5	8.90	8.63	9.33	9.29	13.14	12.67	5.75	5.28	7.20	6.51
6	8.19	8.40	9.96	9.14	11.27	10.53	5.49	5.13	6.60	5.79
7	9.73	9.10	10.21	9.87	13.32	13.84	6.21	5.85	6.75	6.27
8	9.55	8.99	12.34	12.49	14.95	14.15	6.98	8.00	9.56	9.22
9	10.60	10.48	13.14	11.12	11.87	11.12	6.40	6.33	8.44	8.12
10	7.74	7.82	9.81	9.24	13.70	11.68	5.48	5.20	7.13	6.10

BIOGRAPHY

NAME	Mrs.Rienporn Phoojaroenchanachai
DATE OF BIRTH	4 July 1962
PLACE OF BIRTH	Bangkok, Thailand
INSTITUTIONS ATTENDED	Mahidol University, 1982-1985: Bachelor of Science (Physiotherapy) Mahidol University, 2000-2004: Master of Science (Physiotherapy)
POSITION&OFFICE	Siriraj Hospital, Prannok road, Bangkok-noi, Bangkok, Thailand Position: Physiotherapist Tel. 0-2419-8320 E-mail: Phoorienporn@ hotmail.com
HOME ADDRESS	50/14 moo 5 Plybang road, Bangkrua, Nonthaburi, Thailand.