

# ***Anatomy and Physiology***

## ***Exercise 9a***

### **Grip Strength Comparison**

The importance of hand strength and function is evident in all aspects of our daily living, from eating and maintaining personal hygiene to keyboarding at the computer, performing brain surgery, or playing tennis or the piano. People suffering from arthritis or hand injury quickly appreciate the difficulty of performing even the most mundane tasks with reduced grip strength.

Testing of hand grip strength is used by orthopedic surgeons and physical therapists to evaluate the extent of an injury and the progress of recovery. Grip strength can also be used to diagnose neuromuscular problems such as stroke, herniated disks in the neck, carpal tunnel syndrome, and elbow tendonitis. Athletes are interested in grip strength because it relates to performance in many sports, such as tennis, golf, baseball, football, gymnastics, and rock climbing.

Pinch strength is a way for occupational therapists to measure loss of fine-motor strength in the thumb, fingers, and forearm. It is useful for analyzing the extent of an injury and the outcome from surgery or therapy.

In Part I of this experiment, you will measure and compare grip strength in your right and left hands. You will also correlate grip strength with gender, handedness, and height. In Part II you will analyze the pinch strength of each of your four fingers.

**Important:** Do not attempt this exercise if you have arthritis, carpal tunnel syndrome, or any ailment that might be exacerbated by using the muscles of your arm and hand.



Figure 1

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## OBJECTIVES

In this experiment, you will

- Measure and compare grip strength of your right and left hands.
- Correlate grip strength with gender and certain physical characteristics.
- Compare the pinch strengths of the individual fingers of the dominant hand.

## MATERIALS

- Vernier Labquest2 interface with Logger Pro software
- Vernier Hand Dynamometer

## PROCEDURE

Each person in the group will take turns being subject and tester.

### Part I Hand Grip Strength

1. Connect the Hand Dynamometer to the Vernier Labquest2 interface Channel 1. Select



mode.

2. Zero the readings for the Hand Dynamometer: Tap on Ch1:Force and select "Zero"
  - a. Hold the Hand Dynamometer along the sides, in an upright position (see Figure 2). Do not put any force on the pads of the Hand Dynamometer.

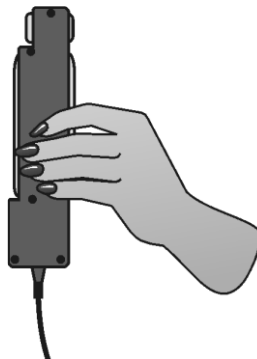



Figure 2

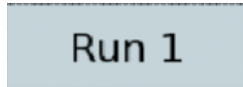
- b. Zero the readings for the Hand Dynamometer.
3. Have the subject sit with his or her back straight and feet flat on the floor. The Hand Dynamometer should be held in the right hand. The elbow should be at a 90° angle, with the arm unsupported (see Figure 1).
  4. Have the subject close his or her eyes, or avert them from the screen.
  5. Click ► to begin data collection. After collecting 2 s of baseline data, instruct the subject to grip the sensor with full strength for the next 8 s. Data will be collected for 10 s.
  6. Store this run by choosing  icon.
  7. Repeat Step 2–5 with the left hand.

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8. Determine the maximum and mean force exerted by your hands during a portion of the data collection period.



- a. In tab



or Run 2)

- b. Tap with pen over your graph at 4 s and drag to highlight both runs from 4 s to 8 s.
    - c. Select Analyze->Statistics->Force for both checkboxes.
    - d. Record the maximum and mean force for each run in Table 1.
    - e. Close the Statistics box by clicking the × in the corner of the box.
9. Work with your group to complete Table 2.

### Part II Pinch Strength



10. Switch to Table tab and clear all data (Table->Clear All Data)

11. Have the subject sit with his or her back straight and feet flat on the floor, holding the Hand Dynamometer along the sides in the non-dominant hand (see Figure 3). Note: No additional force should be placed on the sensor by this hand.



Figure 3

12. Have the subject close his or her eyes, or avert them from the screen.
13. Zero the readings for the Hand Dynamometer.
14. Click to begin data collection. Instruct the subject to immediately pinch the end of the sensor between the pads of the thumb and forefinger of his or her dominant hand, and hold for 5 s.
15. Instruct the subject to switch to successive fingers every 5s. Stop data collection after 20s.
16. Determine the mean force applied during each pinch.
  - a. Click and drag the cursor over the first plateau on the graph, representing the pinch strength of the thumb and index finger (see Figure 4).

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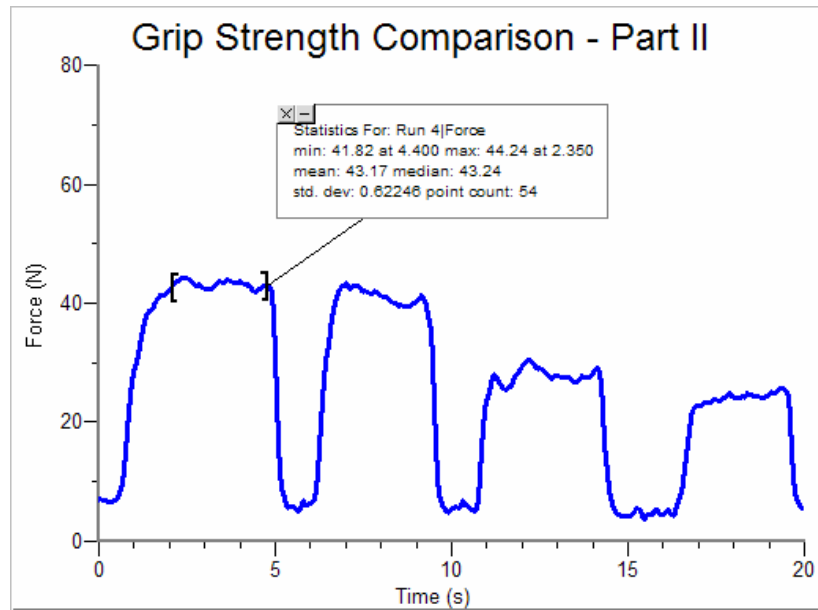


Figure 4

- b. Select Analyze->Statistics->Force and record the mean pinch strength to the nearest 0.1 N in Table 3.
  - c. Repeat the step for each finger recording.
  - d. Record the mean pinch strength to the nearest 0.1 N in Table 3.
  - e. Repeat this process to obtain statistics for the remaining two pinch strengths.
17. Clear data, repeat measurements for the second hand and record values in Table 3.

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### DATA

**Table 1**

Individual Grip Strength			
		Maximum force (N)	Mean force (N)
Person 1	Right hand grip strength		
	Left hand grip strength		
Person 2	Right hand grip strength		
	Left hand grip strength		
Person 3	Right hand grip strength		
	Left hand grip strength		

## Anatomy and Physiology - Exercise 9a - Grip Strength

**Table 2**

Grip Strength Analysis - personal characteristics		
	Average mean force (N)	
	Right hand	Left hand
Males		
Females		
Right-handed persons		
Left-handed persons		

**Table 3**

Individual Pinch Strength			
		Mean force (N)	
		Right hand	Left hand
Person 1	Index finger		
	Middle finger		
	Ring finger		
	Little finger		
Person 2	Index finger		
	Middle finger		
	Ring finger		
	Little finger		
Person 3	Index finger		
	Middle finger		
	Ring finger		
	Little finger		

### DATA ANALYSIS

1. Is there a difference in grip strength in your dominant and non-dominant hands? Are you surprised by the result?
2. Examining the data in Table 2, does there appear to be a correlation between “handedness” and grip strength? Are the results similar for right-handed and left-handed people?
3. Is there a difference between the grip strengths in the different categories of height for which data was collected in Table 2? What conclusion can you draw about the relationship between height and grip strength?
4. Does gender play a more significant role in grip strength than height? than “handedness?”
5. Using the pinch strength data in Table 3, describe the difference in strength between fingers. Where is the difference the largest?