

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

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

computer
Vernier computer interface

Logger Pro
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 computer interface. Open the file “16a Compare Grip Strength” from the *Human Physiology with Vernier* folder.
2. Zero the readings for the Hand Dynamometer.
 - 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.
 - b. Click the Zero button, .
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 Store Latest Run from the Experiment menu.
7. Repeat Step 2–5 with the left hand.
8. Determine the maximum and mean force exerted by your hands during a portion of the data collection period.
 - a. Place the cursor over your graph at 4 s and click and drag to highlight both runs from 4 s to 8 s.
 - b. Click the Statistics button, , to see the Statistics box.
 - c. Check the boxes in front of Run 1 and Latest and click .
 - 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.

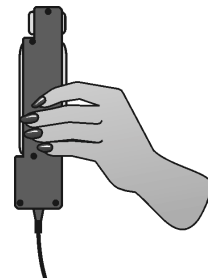





Figure 2

- Work with your classmates to complete Tables 2–4. **Note:** In Table 4, round height to the nearest inch.

Part II Pinch Strength

- Open the file “16b Compare Grip Strength” from the *Human Physiology with Vernier* folder.
- 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.
- Have the subject close his or her eyes, or avert them from the screen.
- Zero the readings for the Hand Dynamometer.
 - Hold the Hand Dynamometer along the sides, in an upright position. Do not put any force on the gray pads of the Hand Dynamometer.
 - Click the Zero button, .
- 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.
- Instruct the subject to switch to successive fingers every 5 s. Data collection will stop after 20 s.
- Determine the mean force applied during each pinch.
 - 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).
 - Click the Statistics button, , and record the mean pinch strength to the nearest 0.1 N in Table 5.
 - Move the brackets to obtain statistics for the second plateau, representing the pinch strength of the thumb and middle finger. As you move the brackets, the statistics in the Statistics box will be updated based on the data between the brackets.
 - Record the mean pinch strength to the nearest 0.1 N in Table 5.
 - Repeat this process to obtain statistics for the remaining two pinch strengths.
 - Close the Statistics box by clicking the × in the corner of the box.

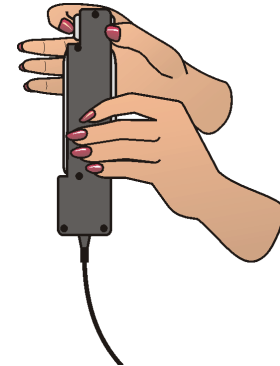


Figure 3

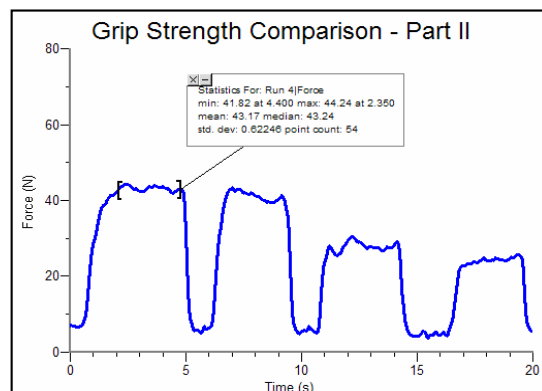


Figure 4

DATA

Table 1–Individual Grip Strength Data		
	Maximum force (N)	Mean force (N)
Right hand grip strength		
Left hand grip strength		

Table 2–Class Grip Strength Data	
	Average mean force (N)
Males (dominant hand grip strength)	
Females (dominant hand grip strength)	

Table 3–Class Grip Strength Data		
	Average mean force (N)	
	Right hand	Left hand
Right-handed individuals		
Left-handed individuals		

Table 4–Class Grip Strength Data	
Height (rounded to nearest inch)	Average mean grip strength of dominant hand (N)
1.52 m (5') or below	
1.55–1.63 m (5'1"–5'4")	
1.65–1.73 m (5'5"–5'8")	
1.75–1.83 m (5'9"–6')	
1.85 m (6'1") and above	

Table 5–Individual Pinch Strength Data	
	Mean force (N)
Dominant hand index finger	
Dominant hand middle finger	
Dominant hand ring finger	
Dominant hand 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 3, 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 4? 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 5, describe the difference in strength between fingers. Where is the difference the largest?

Experiment 16

6. List at least two possible reasons for the differences you see between the pinch strength of the first two fingers and the second two fingers. In your answer consider actions of the hand and musculature (Use an anatomy textbook or atlas to view the muscles of the forearm and hand).

EXTENSIONS

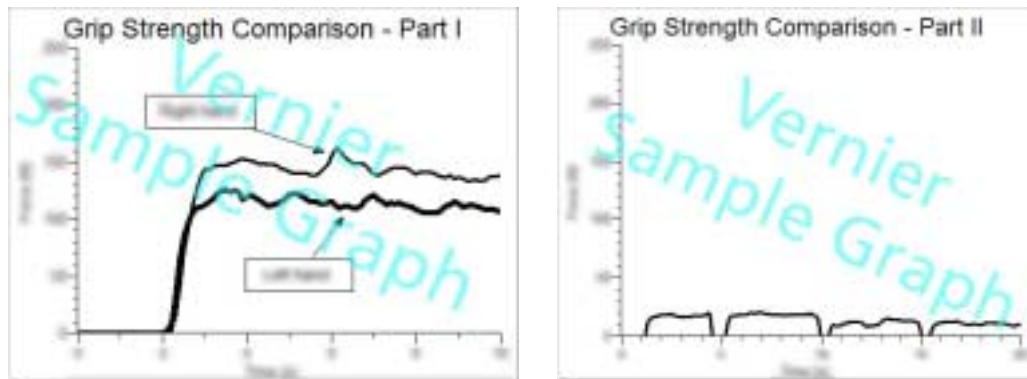
1. Plot a graph of the maximum and average grip strengths for each participant in each category. Do the results correspond with what you would expect in a human population?
2. Perform daily hand-strengthening exercises to increase your grip and/or pinch strength (such as squeezing a rubber ball). Measure your grip and/or pinch strength after two weeks and after four weeks. Compare the results with your original data.

TEACHER INFORMATION

Grip Strength Comparison

1. Students should work in pairs or groups for this exercise. Because it is important that the subject not look at the data as it is being collected, one person should be responsible for data collection while the other is performing the experiment.
2. The person who is collecting the data should act as a “coach” for the subject, encouraging him/her to exert maximum effort throughout the duration of data collection.
3. Class averages are easiest to calculate if each lab group averages the data and shares it with the class. If Extension 1 is done, students will need to devise data-collection tables to collect class data. This can be done by using the manual entry feature in Logger Pro.

SAMPLE DATA



*Gripping strength of a female subject’s hands (Part I)
and fingers of the dominant hand (Part II)*

Table 1–Individual Grip Strength Data		
	Maximum force (N)	Mean force (N)
Right hand grip strength	xxxx	xxxx
Left hand grip strength	xxxx	xxxx

Table 2–Class Grip Strength Data	
	Average mean force (N)
Males (dominant hand grip strength)	xxxx
Females (dominant hand grip strength)	xxxx

Experiment 16

Table 3–Class Grip Strength Data		
	Average mean force (N)	
	Right hand	Left hand
Right-handed individuals	xxxx	xxxx
Left-handed individuals	xxxx	xxxx

Table 4–Class Grip Strength Data	
Height (rounded to nearest inch)	Average mean grip strength of dominant hand (N)
1.52 m (5') or below	
1.55–1.63 m (5'1"–5'4")	xxxx
1.65–1.73 m (5'5"–5'8")	xxxx
1.75–1.83 m (5'9"–6')	xxxx
1.85 m (6'1") and above	xxxx

Table 5–Individual Pinch Strength Data	
	Mean force (N)
Dominant hand index finger	xxxx
Dominant hand middle finger	xxxx
Dominant hand ring finger	xxxx
Dominant hand little finger	xxxx

ANSWERS TO THE DATA ANALYSIS QUESTIONS

Answers have been removed from the online versions of Vernier curriculum material in order to prevent inappropriate student use. Graphs and data tables have also been obscured. Full answers and sample data are available in the print versions of these labs.