



THE FOOTBALL PLAYERS  
HEALTH STUDY  
AT HARVARD UNIVERSITY

# IN-PERSON ASSESSMENTS

POST-VISIT RESULTS REPORT

BOSTON, MA

Helping us understand the impact of professional football on the health and well-being of former and current players

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# Introduction

Thank you again for participating in the In-Person Assessments Study; part of the Football Players Health Study at Harvard University. This report completes the results of the assessments you underwent as part of this research study. If you should need another copy of the first set of results that were given to you when you finished the study, the Medical Navigation Nurse can provide that to you.

**Please do not forget that these assessments were conducted for RESEARCH PURPOSES ONLY.** These assessments are not intended to be diagnostic of any disease process. Any results that may have clinical implications for you will be discussed with you, and we encourage you to seek medical follow-up with your health care provider. Reports and/or images (e.g., MRI, x-ray, etc.) are available upon request through the Medical Navigation Registered Nurse. The Nurse can also assist you in finding appropriate care in your area. The phone number is 617-643-0686 and the email address is [linda.pitler@mgh.harvard.edu](mailto:linda.pitler@mgh.harvard.edu).

None of your individual research results will be provided to anyone outside of the study team, yourself, or those who you have agreed to share your results with, (for example, your doctor). Please remember that the study has obtained a Certificate of Confidentiality from the National Institutes of Health in order to best protect your privacy. Please refer to your consent form or ask the study doctor or Medical Navigation Nurse to discuss this with you if you have questions.

This report provides the remainder of the results of the assessments that were completed during your three-day visit. The following is an outline of what you will find in this report:

- Sensory Testing
- Liver Magnetic Resonance Imaging (MRI)
- Physical Function Assessments
- Electroencephalogram (EEG) Sleep Assessment
- Cardiac Testing
- X-ray Assessment

# Sensory Testing

The goal of this testing is to help researchers better understand the relationship between football history and the perception of pain. Individuals vary widely in their sensitivity to painful stimulation. Pain sensitivity is affected by many factors, including your genes, your medical history, and the presence of chronic pain conditions. During your participation in this study, you had a brief set of sensory tests that measured your responses to different types of standardized mechanical and cold stimulation. These tests are described below with your results.

## **Mechanical Pain Sensitivity (Pressure Response)**

Your pain threshold was measured at multiple body sites by applying pressure. Pain threshold refers to the level of stimulation at which you first experience pain. There is a very large normal range of pain sensitivity, and pain sensitivity varies across body sites. Your responses indicate that you were most pain-sensitive on the [value](#) and that your pain thresholds were within the normal range. Overall, your sensitivity to mechanical (pressure) pain was [value](#) relative to the general population.

## **Pain Tolerance**

Your pain tolerance was measured using the cold-water test. There is a very large normal range of cold pain tolerance. Your responses indicate that your pain tolerance was within the normal range and was [value](#) relative to the general population.

## **Temporal Summation of Pain**

For most people, some sensitization takes place when repeated painful stimuli are rapidly applied. This is referred to as “Temporal Summation” of pain. Some research suggests that individuals with a high degree of temporal summation tend to experience more intense acute pain in response to invasive procedures such as surgeries. Your responses indicate that your temporal summation was within the normal range and was [value](#) relative to the general population.

## **Pain Inhibition**

Your nervous system’s level of pain inhibition was measured using the combined cold water test and pressure pain threshold test. There is a very large normal range of pain inhibition values. Your responses indicate that your level of pain inhibition was within the normal range and was [value](#) relative to the general population.

# Liver MRI

You underwent an MRI scan of your liver. The purpose of this scan was to measure the level of fat in your liver. Upon clinical review of your scan, it has been determined that you have value% liver fat. If your result is greater than 5% this means that the amount of fat in your liver is higher than is considered healthy. Fat can accumulate in the liver due to a variety of conditions and medications, including obesity, diabetes, excessive alcohol intake, steroid use and several other important health conditions. If the level of fat in your liver is greater than 5%, we recommend that you see a primary care physician, gastroenterologist or liver doctor, who can help determine whether further testing is indicated.

# Physical Function

You were assessed for important measures of physical performance that might have been affected by your career in professional football. It is also possible that you have maintained much of the outstanding characteristics of your years of training and play. Our interest is to evaluate selected measures of physical performance that are associated with good health, physical function, and quality of life from a movement and mobility perspective.

You completed some or all the following tests:

- Selective Functional Movement Assessment
- Sitting and Rising Test
- Dynamic Balance (Y-Balance Test)
- 6-Minute Walk Test
- Stair climbing while carrying a load
- Muscle Performance: Strength, Power, and Endurance
- Reaction Time
- Dual Task Assessment

This report presents a brief description of the tests and your results together with scores obtained on healthy, non-athletic men of your age for comparison.

We conducted several tests to determine your muscle strength, power, endurance, and physical function. What we learn from those tests are compared with values expected from healthy, although not necessarily athletic men of your age. This information will identify your strengths and areas in which improvement is recommended for good health, lowered health risks, and improved performance. You can share these results with a physical therapist, certified athletic trainer, strength and conditioning coach, or other appropriate health care professional.

## **Selective Functional Movement Assessment (SFMA)**

The SFMA is a movement-based evaluation that systematically finds the cause of pain, not just the source, by logically breaking down your movement patterns in a structured, repeatable assessment. For example, you may remember completing some of the movements such as flexing your neck, reaching your arm behind you, bending at the waist and squatting. The different movements are rated as:

	Movements	FN	FP	DP	DN
NECK	<b>Active cervical flexion</b> <i>(Touching your chin to your chest)</i>				
	<b>Active cervical extension</b> <i>(Tipping your head back)</i>				
	<b>Active cervical rotation</b> <i>(Turning your head)</i>				
	⇒ <i>To the LEFT</i>				
	⇒ <i>To the RIGHT</i>				
ARM & SHOULDER	<b>Medial rotation of upper extremity</b> <i>(Reaching your arm behind your back from below)</i>				
	⇒ <i>With your left arm</i>				
	⇒ <i>With your right arm</i>				
	<b>Lateral rotation of upper extremity</b> <i>(Reaching your arm behind your back from below)</i>				
	⇒ <i>With your left arm</i>				
	⇒ <i>With your right arm</i>				
CORE	<b>Multisegment trunk flexion</b> <i>(Bending forward and touching your toes)</i>				
	<b>Multisegment trunk extension</b> <i>(Reaching your arms above your head and stretching "backwards" from your waist)</i>				
	<b>Multisegment trunk rotation</b> <i>(Standing upright and turning to the side from the waist)</i>				
	⇒ <i>Turning to your LEFT</i>				
	⇒ <i>Turning to your RIGHT</i>				
LOWER EXTREMITY	<b>Single leg stance</b>				
	⇒ <i>Left</i>				
	⇒ <i>Right</i>				
	<b>Single leg stance with eyes closed</b>				
	⇒ <i>Left</i>				
	⇒ <i>Right</i>				
	<b>Overhead deep squat</b>				

FN: normal function, no pain; FP: normal function, but painful; DP: abnormal function and pain; DN: abnormal function, no pain

Movements that are *not* FN (functional, no pain) suggest further evaluation and perhaps therapy. This might be as simple as adding appropriate stretching and/or strengthening exercises with a physical therapist, certified athletic trainer, strength and conditioning coach, or other appropriate health care professional.

## **Sitting-Rising Test (SRT)**

The SRT is a reliable measure of the integration of muscle strength, power, coordination, body composition, balance, and flexibility required for various daily activities. This simple test of mobility required you to try to sit on the floor from a standing position and then rise from the floor using as little support as possible. Support included use of your hands, forearms, knees, side of leg on the ground, or external objects.

### **Scoring**

You started with a maximum score of 10. Both the sitting and rising movements were scored from a maximum of 5. Points were deducted from 5 based on the number of times you used a support during the maneuvers. For example, if you used your right hand to help you, your score was reduced by one point. Scores close to 10 predict better physical function and performance and just a one point increase has been associated with increased longevity. You can increase your score by improving your lower extremity strength, balance, flexibility, coordination, and/or your body fat to lean ratio.

### **Your Results**

Sit Score	Stand Score	Total Score

As points of reference, one study of over 2000 people reported a score of 8-10 in:

- 72% of 51 to 55 year olds
- 69% of 56-60 year olds
- 52% of 61 to 65 year olds

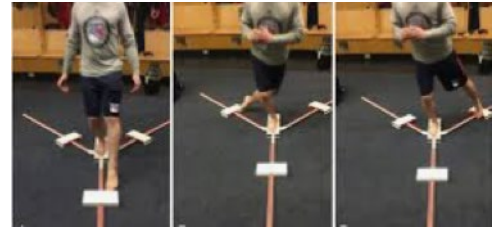
If your score is 8 or higher you are doing well. Presently, there is no average data (scores) available for individuals under 50 years old.

The farther your score is below 8 points the greater the impact on your physical function. Your trainer, physical therapist, or other health care professional may be able to help you to improve those factors which limit performance on this test. Self-administering the sitting-rising test at your convenience will give you an idea of your progress.



## Dynamic Balance (Y-Balance Test)

The Y Balance Test is used to assess the body’s stability during movement. Performance on this test depends on muscle strength and their coordinated contraction, flexibility, stiffness, and stability of your “core”; the muscles in your lower back, abdomen, pelvis, and hip area. You were asked to stand on one leg and to push a marker in three different directions: forwards, backwards towards the right and backwards towards the left. Your results are shown in the tables below.



### Your Results

This chart shows the difference between your right leg and left leg during the *forward movement*.

Your Leg Reach (in inches)		*Your Score of Asymmetry – the difference between the Right and Left leg in inches
Right Leg		
Left Leg		

\*If this difference is greater than **1.6 inches**, there is an asymmetry between your legs (they are uneven in strength, stability and/or stiffness). You can share this information with a trainer or physical therapist to help work on your overall core strength and stability.

This chart shows the average reach of your right and left legs during the *three movements that you completed*. The scores are expressed as a percentage of your leg length. This adjustment allows your score to be compared to normal values as shown in the chart below.

	Your Score	*Mid-Range of Normal
Right Leg		94%
Left Leg		95%

\*If your score is at or above the “mid-range of normal”, then your “core” has good overall strength, stability and flexibility. If your score is below the “mid-range of normal”, then you can share this information with your trainer or physical therapist to help increase your overall strength, stability and flexibility. Core muscle stability provides the base of support for all movement. A strong core is linked to improved performance in activities from swinging a golf club to avoiding a fall, improved posture, and as a contributor to reduced injuries.

## 6-Minute Walk Test (6MWT)

This test evaluates how far you are able to walk at a steady, normal pace that is meant to reflect everyday activities. Distance walked in 6 minutes is associated with your aerobic exercise capacity and therefore provides a simple means of tracking your change in that measure. Your results are provided in the chart below.

### Your Results

Distance Walked (yards)			Gait Speed (mph)
Your Score	Mid-Range of Normal	Lower Limit of normal	Score
<b>yd</b>	<b>yd</b>	<b>yd</b>	<b>mph</b>

Your Distance walked results:

- The **mid-range of a normal** score for men of your age is given in the chart for comparison
- If your score is less than the **lower limit of normal**, also shown in the chart, improvement is recommended

Your Gait Speed results:

- Your speed of walking at normal pace for 6 minutes is given in the chart. Walking speeds below 2.2 mph are associated with a higher risk of mobility limitations.

Improving your walking spread over longer distances will help improve your aerobic capacity as well as associated health benefits. You can speak with a trainer or physical therapist to develop a training plan. You should check with your health care provider before starting a new exercise regimen.

## Stair Climb Power

This assessment is a valid and reliable measure of lower extremity function that takes into account muscle strength, balance, coordination, and most important, muscle power. Power is a measure of how fast you can contract a muscle against a resistance; some refer to power as “explosive force.” Power has been shown to be the key attribute of many activities of daily living such as rising from a seated position and climbing stairs as well as in athletics and recreational activities.

We measured your ability to climb 12 steps as quickly as possible without running while carrying weight equivalent to 20% of your body weight. Higher power scores are desirable and suggest better and easier completion of activities of daily living and athletic activities where explosive movements are important.

### Your Results

Stair Climbing Power (watts)	*Mid-Range of Normal (watts)		
Score	Ages 20-44	**Ages 45-49	Ages 50-59
	689	554	419

\*If your score is at or above the “mid-range of normal”, then your stair climbing power is average, or above average, compared to what is expected for men your age. If your score is below the “mid-range of normal”, then you can share this information with your trainer or physical therapist to help you work towards improving lower extremity function and power— a key attribute in many activities of daily living.

\*\* No reference values for men ages 45 to 49 are available. This column represents the midway point between values for men 20-44 and 50-59 years old.

## Muscle Performance

We evaluated the strength, power, and endurance, of the large muscle groups of your legs and upper body using the leg press and chest press exercises, respectively.

- **Muscle Strength** is important in promoting good health and physical function. Stronger people typically have more muscle and bone mass, improved weight control, reduced risk of diabetes and other chronic diseases. Increased muscle strength also improves mobility and balance and is associated with greater longevity. Your Muscle Strength was measured following a warm-up period and a gradual increase in weight. The number below is the maximum number of pounds you were able to lift for one repetition.
- **Muscle Power** is defined as how fast you can overcome a resistance and is more important than strength in performing most activities of daily living, recreational and sport activities. Training for power is especially important as one ages since the ability to generate power declines faster than strength over the age span. You were asked to perform the leg and chest press actions 3 times quickly. The weight that was used for this activity was a percent of your Muscle Strength. The power score is the peak power that you generated during the testing as measured in watts. Watts are used to describe how much power is generated or consumed – for reference, a 100 watt lightbulb uses 100 watts in one hour.
- **Muscle Endurance** reflects your ability to make repeated muscle contractions over time. The NFL 225 test is an example. High levels of muscle endurance allow you to keep working at higher rates for longer periods of time. This can be useful when doing back-to-back tasks that require muscular effort such as a full weekend of work around the house, your weight workout, and a bike ride. For Muscle Endurance, you used 80% of you Muscle Strength score for both Leg Press and Chest Press, respectively.

### Your Results

	Strength (Maximum lbs.)	Peak Power Generation (watts)	Endurance (# of reps/weight used)
Leg Press			
Chest Press			

## Reaction Time

We tested your brain’s ability to react to a stimulus (the color of the light seen on the computer screen) and then cause the correct muscular movement (stepping on the correct pad). Fast reactions and accurate movements are needed for good athletic and everyday physical performance. How your body responds to unexpected challenges in order to avoid sudden trip and slip hazards are examples. Reaction time and movement time slow after age 30 with an accelerated decline after age 60. Our reaction time test evaluated your ability to coordinate reaction time, leg strength, balance, and awareness of your body’s position. The following chart shows your results. Definitions of the chart variables are given below.

Your scores are calculated from the average of 36 responses during the test.

### Your Results

① Reaction Time (seconds)		② Movement Time (seconds)		③ Correct Responses to Stimuli (percent)		④ Sidedness Right or Left Dominance
Right	Left	Right	Left	Right	Left	

**Reaction Time** is the time from the appearance of the stimulus (the change of color on the computer screen) to taking your foot off the central foot pad.

**Movement Time** is the time from the appearance of the stimulus to placing the correct foot on the correct pad.

**Correct Response to Stimuli** is the percentage of all the trials in which you stepped on the correct pad or withheld stepping when indicated to do so.

**Sidedness** shows whether your right or left foot performed more accurately and faster than the other. This is determined by the average movement time for correct responses to stimuli. Right side dominance would be seen if the right foot was  $\geq 10\%$  better than the other foot.

A good way to evaluate your performance is by looking at columns 3 and 4.

1. Scores greater than 80% in column 3 demonstrate a good reaction time,
2. Scores in column 3 for right and left responses should be about equal
3. There should be no “sidedness:” This means that the difference between right and left responses in column 3 should be less than 10%

There are no reference data (averages) for reaction time or movement time on this test. Faster is better.

# Dual Task

Nobody can stand completely still. Instead, our body is always “swaying”. Our standing balance – the ability to control and minimize this sway – is predictive of mobility decline and fall risk. Humans have the unique and amazing ability to stand, and at the same time, perform other cognitive tasks like talking, reading and thinking. This “dual tasking” enables us to “think on our feet”, and requires quick and efficient brain activation. Often times, dual tasking disrupts our standing balance and this “cost” is predictive of brain health.

We placed small movement sensors on different parts of your body and asked you to stand as still as possible two separate times.

1. The first time you, were asked to stand quietly.
2. The second time, you were asked to dual task, that is, stand and count backwards in multiples of 3.

## Postural Sway

While you were standing, the movement sensors measured the “sway” of your body. We calculate the amount of sway in each condition (#1 and #2 above). Your sway is also represented as ovals within the figure on page 14.

An individual with better balance will tend to have less sway (i.e. smaller circles on the green graph). See how your sway compared to the “low”, “medium”, and “high” risk zones.

### Your Results:

Risk Level	Your sway is:
Low	Similar to people who have excellent balance and very low risk of falling.
Medium	Similar to people who have good balance, but who have fallen in the past.
High	Similar to people who have moderate-to-poor balance and high risk of falling

## Dual Task Cost

We calculated the dual task “cost”, by measuring the change in your sway from normal to dual task conditions (#1 versus #2 above).

This measures your cognitive-motor “reserve”, or how well you can maintain your balance when you engage in another task. Individuals with more reserve tend to have lower costs. See how your cost compares to the “low”, “medium”, and “high” risks zones.

### Your Results:

Risk Level	Your cognitive-motor ‘reserve’ is:
Low	Excellent
Medium	Sufficient: You have minor difficulty dual tasking.
High	Moderate-to-poor: You have major difficulty dual tasking, and should be sure to focus your attention on balance, especially when in distracting situations.

# Sleep Assessment

Your contribution to this study will help researchers collect information to better understand the relationship between sleep disturbances and football exposure. As a result of your participation, you completed an overnight sleep study which included monitoring of your oxygen saturation, breathing pattern, heart rate, leg movements, and sleep stage.

It is common for adults to have a few dips in their oxygen levels as a result of pauses in breathing or shallow breaths during sleep. Whether you have a condition known as “sleep apnea” is based on the number of these breathing events (known as apneas or hypopneas) each hour of sleep. This is called the Apnea/Hypopnea Index or AHI. Sleep apnea may be associated with poor quality sleep, sleepiness, mood problems, high blood pressure and heart disease.

AHI (events each hour)	
0-5	Normal
5-15	Mild sleep apnea
15-30	Moderate sleep apnea
Above 30	Severe sleep apnea

- Your AHI was value /h
  - (For AHI 5-15): If you have symptoms of poor sleep or daytime sleepiness, we recommend that you speak with your doctor to discuss the need for further evaluation and treatment.
  - (For AHI >15) We recommend that you speak with your doctor to discuss the need for further evaluation and treatment.

Regardless of your AHI, if you experience problems sleeping, unrefreshing sleep or if snoring or breathing problems during your sleep are bothersome to you, we recommend that you speak with your doctor.



# Cardiovascular Testing

A cardiopulmonary exercise test (CPET) is an evaluation of the cardiopulmonary system (your heart and your lungs).

Physical exercise requires your heart and lungs to work together to support the energy demands of exercise. The purpose of this test is to measure how your heart and your lungs perform during exercise. This testing measured your metabolic rate, exercise capacity, and heart structure and function.

## Metabolic Rate

Using measurements of the amount of oxygen you breathe while resting, we are able to determine how many calories your body consumes on a daily basis in order to maintain function of your brain and other organs (metabolic rate). This reflects that amount of energy your body requires for basic organ function and can be used, when combined with information about your physical activity habits, to develop strategies for weight gain or loss. Your test of resting metabolism indicates that you burn approximately value kcal (calories) per day under resting conditions.

## Exercise Capacity

Using the same measurement of oxygen consumption, this time during exercise, we are able to assess your fitness. During your exercise test, we also looked at evidence of coronary artery blockages and electrical rhythm disturbances. Your exercise test demonstrated a peak oxygen consumption ( $VO_{2PEAK}$ ) of value mL/kg/min, which represents value% (normal > 80% as predicted for your age and gender).

## Heart Structure and Function

During your echocardiogram, the ultrasound test designed to examine the heart valves and heart muscle, we measured your heart's contractile function by calculating an ejection fraction, which reflects the amount of blood being pumped with each heartbeat. Your ejection fraction is value% (normal >50 %).

# X-ray Assessment

During your x-ray scan, several joints were screened for arthritis. The x-rays demonstrated the following:

<b>Right HIP</b>	<input type="checkbox"/> normal	<input type="checkbox"/> mild	<input type="checkbox"/> moderate	<input type="checkbox"/> severe
<b>Left HIP</b>	<input type="checkbox"/> normal	<input type="checkbox"/> mild	<input type="checkbox"/> moderate	<input type="checkbox"/> severe
<b>Right KNEE</b>	<input type="checkbox"/> normal	<input type="checkbox"/> mild	<input type="checkbox"/> moderate	<input type="checkbox"/> severe
<b>Left KNEE</b>	<input type="checkbox"/> normal	<input type="checkbox"/> mild	<input type="checkbox"/> moderate	<input type="checkbox"/> severe
<b>Lumbar*</b>	<input type="checkbox"/> normal	<input type="checkbox"/> mild	<input type="checkbox"/> moderate	<input type="checkbox"/> severe

The degree of arthritis shown by the x-ray may not match your actual level of function. Good general treatments for arthritis include proper nutrition, adequate sleep, regular exercise, weight management, simple analgesics as needed, and relaxation. In the future, we hope to test newer therapies that may reduce pain, restore function, and delay arthritis progression.

# Electroencephalogram (EEG)

## What is an EEG?

An electroencephalogram (EEG) is a test used to evaluate the electrical activity in the brain. Brain cells communicate with each other through electrical impulses, and this electrical activity can show how the brain is functioning. An EEG can help to diagnose certain brain disorders, such as head injury, seizure disorders (such as epilepsy), memory problems, dementia, or sleep disorders.

## What do the results mean?

By itself, an EEG cannot determine whether you have a certain brain disorder; your doctor will need to interpret the EEG in combination with your symptoms and results of other testing.

A normal EEG shows that your brain is working fairly well at the time the EEG is recorded. This is reassuring, but because it is only a snapshot in time, normal EEGs do not rule out brain disorders.

Abnormal EEGs show changes in the expected brain rhythms, or waves. Sometimes these changes can just be the result of getting older or taking certain medications. Diffuse or generalized abnormalities can suggest that there is a problem in overall brain function. Focal abnormalities can show that one specific part of your brain is not functioning at its best.

Your EEG has been reviewed by a doctor who specializes in interpreting EEGs. If your EEG revealed any areas of potential concern, we will discuss this directly with you on the phone. *We will have the full report available for you to share with-your doctor if needed.*