

# Clinical Trial Protocol

## Iranian Registry of Clinical Trials

27 Jun 2026

### Is there a difference in knee biomechanics due to fatigue of the quadriceps versus hamstrings during landing on a single limb? Three-dimensional analysis study

#### Protocol summary

##### Study aim

The study aimed to clarify the contribution of quadriceps induced-fatigue and hamstring-induced fatigue separately on the knee joint biomechanics during a forward-drop jump with a single-leg landing.

##### Design

A randomized, single-blinded, two-arm, parallel-group clinical trial

##### Settings and conduct

The eligible and enrolled athletes for the induced-fatigue protocol will be directed to the biomechanics lab in the College of applied medical sciences, Prince Sattam Bin Abdulaziz University, Saudi Arabia. They will be randomly assigned to intervention group 1 and intervention group 2 through simple randomization. This clinical trial will be single-blinded so the outcomes assessors/investigator researchers will not be aware of the study groups.

##### Participants/Inclusion and exclusion criteria

Inclusion criteria: 1-Age ranged from 20-25 years. 2-A minimum of five-year experience in the participant's recorded sport was required. Exclusion criteria: 1-History of cardiovascular disorders. 2-History of respiratory disorders. 3-History of neurological disorders. 4-Previous lower extremity injury. 5-The athlete suffered from a previous anterior cruciate ligament injury.

##### Intervention groups

The study has two intervention groups: the Quadriceps group (intervention group 1) and the hamstring group (intervention group 2). The three-dimensional (3D) kinematic and kinetic data of the knee joint will be analyzed before and after the fatigue protocol of quadriceps and hamstring muscles during a forward-drop jump with a single-leg landing. A 3D motion analysis system and Isokinetic dynamometer will be used to measure the knee's Kinematics and Kinetics and fatigue level of quadriceps and hamstring muscles, respectively.

##### Main outcome variables

Peak knee flexion angle. Peak vGRF (vertical ground reaction force). Proximal tibial anterior shear force. Knee flexion-extension moments. Knee valgus-varus moment.

#### General information

##### Reason for update

##### Acronym

##### IRCT registration information

IRCT registration number: **IRCT20230329057784N1**

Registration date: **2023-05-05, 1402/02/15**

Registration timing: **registered\_while\_recruiting**

Last update: **2023-05-05, 1402/02/15**

Update count: **0**

##### Registration date

2023-05-05, 1402/02/15

##### Registrant information

##### Name

Waleed Mahmoud

##### Name of organization / entity

Prince Sattam bin Abdulaziz University

##### Country

Saudi Arabia

##### Phone

+966 56 311 4324

##### Email address

w.mahmoud@psau.edu.sa

##### Recruitment status

**Recruitment complete**

##### Funding source

##### Expected recruitment start date

2023-05-01, 1402/02/11

##### Expected recruitment end date

2023-08-31, 1402/06/09

##### Actual recruitment start date

empty

**Actual recruitment end date**  
empty

**Trial completion date**  
empty

**Scientific title**  
Is there a difference in knee biomechanics due to fatigue of the quadriceps versus hamstrings during landing on a single limb? Three-dimensional analysis study

**Public title**  
The difference between fatigue of quadriceps and hamstrings muscles on knee biomechanics during landing on one limb

**Purpose**  
Screening

**Inclusion/Exclusion criteria**  
**Inclusion criteria:**  
The age ranged from 20-25 years. A minimum of five-year experience in the recorded sport was required.  
**Exclusion criteria:**  
History of cardiovascular problems. History of respiratory problems. History of neurological disorders. History of neurological problems. Anterior cruciate ligament injury. Previous lower extremity injury.

**Age**  
From **20 years** old to **25 years** old

**Gender**  
Male

**Phase**  
N/A

**Groups that have been masked**

- Outcome assessor

**Sample size**  
Target sample size: **90**

**Randomization (investigator's opinion)**  
Randomized

**Randomization description**  
Each of the 108 athletes was given a number. A researcher not involved in the study performed the randomization using sealed envelopes. Each envelope was labeled as either a Quadriceps group "Intervention group 1" or a Hamstring group "Intervention group 2". Each athlete was requested to choose a sealed envelope using a 1:1 simple randomization. The examining researcher/assessor was not included in the randomization process and was unaware of the group allocation. Athletes will be asked not to report their treatment allocation to the examiner/researcher during their assessment.

**Blinding (investigator's opinion)**  
Single blinded

**Blinding description**  
The athletes were recruited and assigned randomly into one of the two groups. Based on the simple randomization design 1:1 ratio, A researcher not involved in the study performed the randomization using sealed envelopes. Each envelope was labeled as either a Quadriceps group "Intervention group 1" or a Hamstring group "Intervention group 2". Each athlete was

requested to choose a sealed envelope. The examining researcher/assessor was not included in the randomization process and was unaware of the group allocation so, the outcome assessor/investigator researcher will examine the outcome measures without knowing the study groups.

**Placebo**  
Not used

**Assignment**  
Parallel

**Other design features**

## Secondary Ids

empty

## Ethics committees

### 1

#### Ethics committee

##### Name of ethics committee

The Standing Committee of Bioethics Research (SCBR).

##### Street address

King Abdulallah Abdulaziz street

##### City

Al-Kharj

##### Postal code

11942

#### Approval date

2023-01-10, 1401/10/20

#### Ethics committee reference number

No: 002/2023.

## Health conditions studied

### 1

#### Description of health condition studied

the effects of the fatigued quadriceps muscle.

#### ICD-10 code

T73.3XXA

#### ICD-10 code description

Exhaustion due to excessive exertion, initial encounter

### 2

#### Description of health condition studied

2- We will study the effects of the fatigued hamstring muscle.

#### ICD-10 code

T73.3XXA

#### ICD-10 code description

Exhaustion due to excessive exertion, initial encounter

## Primary outcomes

### 1

#### Description

The peak knee flexion angle (in degrees).

## **Timepoint**

Pre- and post-fatigue program.

## **Method of measurement**

3D motion analysis system (Vicon).

## **2**

### **Description**

The peak vGRF (expressed in BW) at initial contact.

### **Timepoint**

Pre- and post-fatigue program.

### **Method of measurement**

Force plate forms (Vicon).

## **3**

### **Description**

The proximal tibial anterior shear force was measured in (Nm/Kg).

### **Timepoint**

Pre- and post-fatigue program.

### **Method of measurement**

3D motion analysis system (Vicon).

## **4**

### **Description**

The knee flexion-extension moments.

### **Timepoint**

Pre- and post-fatigue program.

### **Method of measurement**

3D motion analysis system (Vicon).

## **5**

### **Description**

Knee valgus-varus moment were measured in (Nm/Kg\*m).

### **Timepoint**

Pre- and post-fatigue program.

### **Method of measurement**

3D motion analysis system (Vicon).

## **Secondary outcomes**

empty

## **Intervention groups**

### **1**

#### **Description**

In Intervention Group 1 (quadriceps muscle group), the 3D kinematic and kinetic data of the knee joint will be collected before and after the fatigue protocol applied to the quadriceps muscle during a single-leg landing in a forward-drop jump task. The 3D motion analysis system consists of the 12 infrared cameras (100Hz) of motion capture system Vicon (Oxford Metrics Limited UK), and two ground reaction forces collect synchronously at 2000 Hz with an AMTI GEN-5 force plate (Watertown, MA, USA). The participant will stand over a 30-cm height box, which will be placed 20 cm behind the force plate form,

and perform a forward drop jump onto the force plate, landing on the forefoot (metatarsal heads) with a dominant single leg. The peak torque of quadriceps muscles will be determined by an isokinetic dynamometer (CSMI Humac 2009, Cybex II, II+, version 129, USA) to measure maximal voluntary concentric contraction (MVCC) at 120°.s-1 and the range of motion, in which the measured peak torque, is available from 10 to 90 degrees of knee flexion. The fatigue protocol commences with performing three consecutive repetitions of knee extension of MVCC at 300°.s-1 (16) until the torque measured in the quadriceps declines below 50% of the participant's baseline peak torque value. A 30-second rest will be provided to the participant who will be asked again to replicate MVCC of knee extension until the baseline of peak torque of quadriceps muscle drops to 50% of its value. The cycle of MVCC and rest will be repeated. If five consecutive cycles decrease the baseline of quadriceps' baseline of peak torque to 50%, fatigue is achieved.

#### **Category**

Diagnosis

### **2**

#### **Description**

In Intervention Group 2 (hamstrings muscle group), the 3D kinematic and kinetic data of the knee joint will be collected before and after the fatigue protocol applied to the hamstrings muscle during a single-leg landing in a forward-drop jump task. The 3D motion analysis system consists of the 12 infrared cameras (100Hz) of motion capture system Vicon (Oxford Metrics Limited UK), and two ground reaction forces collect synchronously at 2000 Hz with an AMTI GEN-5 force plate (Watertown, MA, USA). The participant will stand over a 30-cm height box, which will be placed 20 cm behind the force plate form, and perform a forward drop jump onto the force plate, landing on the forefoot (metatarsal heads) with a dominant single leg. The peak torque of hamstrings muscles will be determined by an isokinetic dynamometer (CSMI Humac 2009, Cybex II, II+, version 129, USA) to measure maximal voluntary concentric contraction (MVCC) at 120°.s-1 and the range of motion, in which the measured peak torque, is available from 10 to 90 degrees of knee flexion. The fatigue protocol commences with performing three consecutive repetitions of knee flexion of MVCC at 300°.s-1 (16) until the torque measured in the hamstrings declines below 50% of the participant's baseline peak torque value. A 30-second rest will be provided to the participant who will be asked again to replicate MVCC of knee flexion until the baseline of peak torque of hamstrings muscle drops to 50% of its value. The cycle of MVCC and rest will be repeated. If five consecutive cycles decrease the baseline of hamstring's baseline of peak torque to 50%, fatigue is achieved.

#### **Category**

Diagnosis

## Recruitment centers

1

### Recruitment center

**Name of recruitment center**

Alshulla Club

**Full name of responsible person**

Khalefah Abdullah Altofel

**Street address**

Mesharif 15- 45

**City**

Al-Kharj

**Postal code**

00966

**Phone**

+966 56 311 4324

**Email**

alshullaclub@ alshullaclub.net

**Web page address**

<http://alshullahclub.com/About>

## Sponsors / Funding sources

1

### Sponsor

**Name of organization / entity**

Prince Sattam Bin Abdulaziz University

**Full name of responsible person**

Mohammed Alshehri

**Street address**

King Abdullaah Abdulaziz street

**City**

Al-Kharj

**Postal code**

00966

**Phone**

+966 56 311 4324

**Email**

waleeds306@yahoo.com

**Grant name**

Prince Sattam Bin Abdulaziz University

**Grant code / Reference number**

2022/03/22477

**Is the source of funding the same sponsor organization/entity?**

Yes

**Title of funding source**

Prince Sattam Bin Abdulaziz University

**Proportion provided by this source**

100

**Public or private sector**

Public

**Domestic or foreign origin**

Domestic

**Category of foreign source of funding**

empty

**Country of origin**

**Type of organization providing the funding**

Academic

## Person responsible for general inquiries

### Contact

**Name of organization / entity**

Prince Sattam Bin Abdulaziz University

**Full name of responsible person**

Waleed Salah Eldin Mahmoud

**Position**

Associate Professor

**Latest degree**

Ph.D.

**Other areas of specialty/work**

Physiotherapy

**Street address**

Aljamaa District, King Abdulla street, Alkharj, Riyadh, Saudi Arabia

**City**

Al-Kharj

**Province**

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**Email**

waleeds306@yahoo.com

## Person responsible for scientific inquiries

### Contact

**Name of organization / entity**

Prince Sattam Bin Abdulaziz University

**Full name of responsible person**

Waleed Salah Eldin Mahmoud

**Position**

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## Person responsible for updating data

### Contact

**Name of organization / entity**

Prince Sattam bin Abdulaziz University

**Full name of responsible person**

Waleed Salah Eldin Mahmoud

**Position**

Associate Professor

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**Phone**

+966 11 588 6327

**Email**

waleeds306@yahoo.com

**Sharing plan**

**Deidentified Individual Participant Data Set (IPD)**

Yes - There is a plan to make this available

**Study Protocol**

Yes - There is a plan to make this available

**Statistical Analysis Plan**

Yes - There is a plan to make this available

**Informed Consent Form**

Yes - There is a plan to make this available

**Clinical Study Report**

Undecided - It is not yet known if there will be a plan to  
make this available

**Analytic Code**

Undecided - It is not yet known if there will be a plan to  
make this available

**Data Dictionary**

Undecided - It is not yet known if there will be a plan to  
make this available

**Title and more details about the data/document**

Patient information sheet, raw data, results

**When the data will become available and for how  
long**

After publication

**To whom data/document is available**

Public

**Under which criteria data/document could be used**

Statistical analysis

**From where data/document is obtainable**

Researchgate

**What processes are involved for a request to access  
data/document**

via email. research gate

**Comments**