Study Protocol

Official Title

Region-Specific Associations Between Q-Angle and Plantar Loading in Physically Active Young Adults

Brief Title

Q-Angle and Plantar Loading in Active Young Adults

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Brief Summary

This observational study aims to examine the association between Q-angle and plantar loading characteristics in physically active young adults. Q-angle is a commonly used clinical measure of lower-extremity alignment, but its relationship with regional plantar loading during gait remains unclear. Participants will undergo bilateral Q-angle assessment and plantar pressure evaluation during walking. The study will investigate whether Q-angle is associated with specific plantar loading variables across different foot regions in active young adults.

Detailed Description

This observational study is designed to investigate the association between Q-angle and plantar loading characteristics in physically active young adults. Q-angle is a commonly used measure of lower-extremity alignment, but its relationship with regional plantar loading during gait has not been fully clarified.

Participants will undergo bilateral Q-angle assessment under standardized conditions and dynamic pedobarographic evaluation during walking. Plantar pressure variables will be obtained for different foot regions, including the toes, forefoot, midfoot, hindfoot, and total foot. The primary objective is to determine whether Q-angle is associated with selected regional plantar loading variables. Secondary analyses will explore whether these associations differ according to sex and limb dominance.

Statistical analyses will be performed using linear mixed-effects models to account for within-subject dependence between bilateral measurements.This study focuses on the relationship between lower-extremity alignment and regional plantar loading patterns in physically active young adults.

Study Design

- **Study Type:** Observational
- **Observational Model:** Other
- **Time Perspective:** Cross-Sectional

- **Enrollment:** 92 participants
- **Enrollment Type:** Actual
- **Number of Groups/Cohorts:** 1

Study Population

Physically active young adults aged 18 years and older who are able to walk independently and who have no current lower-extremity injury, previous lower-extremity surgery, neurological disorder, vestibular disorder, structural deformity, or musculoskeletal pain affecting gait or balance.

Sampling Method

Non-Probability Sample

Group/Cohort

Group/Cohort Label

Physically active young adults

Group/Cohort Description

Physically active young adults who underwent Q-angle measurement and plantar pressure assessment during walking. No therapeutic or preventive intervention was applied.

Intervention / Exposure

Intervention Name

Q-angle and plantar pressure assessment

Intervention Description

Participants underwent observational Q-angle measurement and dynamic plantar pressure assessment during walking. No therapeutic or preventive intervention was administered.

Eligibility Criteria

Inclusion Criteria

1. Age 18 to 27 years
2. High physical activity level according to the International Physical Activity Questionnaire-Short Form (IPAQ-SF) classification
3. Ability to complete the assessment procedures independently
4. Voluntary agreement to participate

Exclusion Criteria

1. History of lower-extremity injury within the previous 6 months
2. Previous lower-extremity fracture or surgery
3. Known neurological or vestibular disorder affecting gait or balance
4. Current musculoskeletal pain in the spine or lower extremities during assessment
5. Diagnosed structural lower-extremity deformity
6. Inability to complete the assessment procedures independently

Outcome Measures

Primary Outcome Measure

Association between Q-angle and regional pedobarography outcomes
Description: Regional plantar pressure, force, contact area, and contact time outcomes assessed in relation to Q-angle.
Time Frame: At baseline

Outcome Variables

- Peak pressure (kPa)
- Contact area (cm^2)
- Contact time (ms)
- Maximum force (N)
- Maximum force normalized to body weight (%BW)

Plantar Regions

- Toes
- Forefoot
- Midfoot
- Hindfoot
- Total foot

Study Procedures

Q-Angle Assessment

Bilateral Q-angle measurements are obtained under standardized conditions with participants in the supine position, knees extended, and quadriceps relaxed. Each extremity is measured three times using a standard goniometer, and the mean of the three trials is used for analysis. All measurements are performed by the same examiner.

Dominance Determination

Lower-extremity dominance is determined according to the participant’s self-reported preferred leg for kicking a ball.

Dynamic Pedobarographic Assessment

Dynamic plantar pressure measurements are collected using an **Emed®-a50/D** pedobarography system (Novel GmbH, Munich, Germany). Participants walk barefoot at a self-selected comfortable speed along a 4-meter walkway with the pressure platform embedded flush with the floor. A mid-gait protocol is used. Familiarization trials are completed before formal data collection. At least three valid trials are recorded for each foot, and the mean of three valid trials is used in analysis.

Statistical Analysis Plan

Descriptive statistics are reported as mean ± standard deviation for continuous variables and frequency (n) and percentage (%) for categorical variables. Intra-rater reliability of repeated Q-angle measurements is evaluated using the intraclass correlation coefficient (ICC) with 95% confidence intervals. Standard error of measurement (SEM) and minimal detectable change at the 95% confidence level (MDC95) are also calculated.

Because bilateral extremity data are obtained from the same participant, observations are not considered independent. Therefore, linear mixed-effects models are used to account for within-subject correlation, with participant included as a random intercept. Q-angle is entered as a fixed effect in the main models. Separate models are fitted for each pedobarographic outcome and plantar region. Additional interaction analyses are conducted for sex and extremity dominance. To control for multiple comparisons, p-values are adjusted using the false discovery rate (FDR) method. Statistical significance is defined as a two-sided p-value of less than 0.05.

Ethics and Informed Consent

The study protocol was approved by the **Clinical Research Ethics Committee of Harran University** (**Ethics Committee No: 25.14.83**). The study was conducted in accordance with the Declaration of Helsinki. All participants were informed verbally and in writing about the study objectives, procedures, and voluntary nature of participation, and written informed consent was obtained from all participants.

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Data Sharing Statement

Individual participant data sharing has not yet been determined. Any future data sharing will depend on ethical approval, participant consent, institutional policies, and data de-identification requirements.