HIP AND KNEE BIOMECHANICS FOR TRANSTIBIAL AMPUTEES IN GAIT, CYCLING, AND
ELLIPTICAL TRAINING

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Greg Orekhov
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COMMITTEE MEMBERSHIP

TITLE: Hip and Knee Biomechanics for Transtibial
Amputees in Gait, Cycling, and Elliptical Training

AUTHOR: Greg Orekhov

DATE SUBMITTED: December 2018

COMMITTEE CHAIR: Stephen Klisch, Ph.D
Professor of Mechanical Engineering

COMMITTEE MEMBER: Scott Hazelwood, Ph.D
Professor of Biomedical Engineering

COMMITTEE MEMBER: William Murray, Ph.D
Professor of Mechanical Engineering

ABSTRACT

Hip and Knee Biomechanics for Transtibial Amputees in Gait, Cycling, and Elliptical Training

Greg Orekhov

Transtibial amputees are at increased risk of contralateral hip and knee joint osteoarthritis, likely due to abnormal biomechanics. Biomechanical challenges exist for transtibial amputees in gait and cycling; particularly, asymmetry in ground/pedal reaction forces and joint kinetics is well documented and state-of-the-art passive and powered prostheses do not fully restore natural biomechanics. Elliptical training has not been studied as a potential exercise for rehabilitation, nor have any studies been published that compare joint kinematics and kinetics and ground/pedal reaction forces for the same group of transtibial amputees in gait, cycling, and elliptical training.

The hypothesis was that hip and knee joint kinematics and kinetics and ground and pedal reaction forces would differ due to exercise (gait, cycling, elliptical) amputee status (amputated, control [non-amputated]), and leg (dominant [intact], non-dominant [amputated]). Ten unilateral transtibial amputees and ten control participants performed the three exercises while kinematic and kinetic data were collected. Hip and knee joint flexion angle, resultant forces, and resultant moments were calculated by inverse dynamics for the dominant and non-dominant legs of both participant groups. Joint biomechanics and measured ground/pedal reaction forces were then compared between exercises, between the dominant and non-dominant legs within each participant group, and across participant groups.

Significant differences in hip and knee joint flexion angles and timing, compressive forces, extension-flexion (EF) and adduction-abduction (AddAbd) moments, and anterior-posterior (AP) and lateral-medial (LM) reaction forces were found. Particularly, transtibial amputees showed maximum knee flexion angle asymmetry as compared to controls in all three exercises. Maximum hip and knee compressive forces, EF moments, and AddAbd moments were lowest in cycling and highest in gait. Asymmetry in amputee midstance knee flexion and timing in

gait, coupled with low maximum EF moment for the non-dominant leg, suggests that amputees avoid contraction of the non-dominant quadriceps muscle. Knee flexion angle and EF moment asymmetry in elliptical training suggests that a similar phenomenon occurs.

Asymmetry in AP and LM reaction forces in gait, but not other exercises, suggests that exercises that constrain kinematics reduce loading imbalances. The results suggest that cycling and elliptical training should be recommended to transtibial amputees for rehabilitation due to reduced hip and knee joint forces and moments. Elliptical training may be preferred over gait due to decreased joint loading and loading asymmetry, but some asymmetry and differences from control participants still exist. Non-weight bearing exercises such as cycling may be best at reducing overall joint loading and joint load asymmetry but do not eliminate all kinematic and temporal asymmetries.

Current state-of-the-art prosthetic leg design is insufficient in restoring natural biomechanics not only in gait but also in cycling and elliptical training. Improved prosthesis kinematics that restore non-dominant knee flexion in amputees to normal levels could help reprogram quadriceps muscle patterns in gait and elliptical training and hip and knee joint biomechanical asymmetries. Further work in comparing contralateral and prosthesis ankle joint biomechanics would help to elucidate the relationship between prosthesis design and its impact on lower limb joint biomechanics.

Keywords: Transtibial amputee, osteoarthritis, hip joint, knee joint, gait, cycling, elliptical training

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Chapter 1

INTRODUCTION

Transtibial amputees face the problem of decreased quality of life due to the high prevalence of hip and knee joint osteoarthritis (OA). There are a lack of studies aimed at measuring and predicting intact limb hip and knee joint loads in transtibial amputees using prostheses during common fitness sustainment exercises.

Abnormal biomechanics during daily activities, including gait, is well accepted to be a risk factor for knee joint OA [1,3,14,23], and is likely related to the high prevalence of joint pain and OA among military and civilian unilateral transtibial and transfemoral amputees [9,16,19,20,26]. Traumatic amputees are at an increased risk for hip and knee joint OA compared to the general population. In one study [26], the prevalence of knee OA was 28.3% in amputee men and 22.2% in amputee women while the rate for the general population was 1.58% and 1.33%, respectively; and the prevalence of hip OA was 15.3% in amputee men and 11.1% in amputee women compared to 1.13% and 0.98% in the general population, respectively. Other literature shows that the standardized prevalence ratio of symptomatic knee OA was 1.4 among transtibial amputees and 1.3 among transfemoral amputees [16].

Transtibial amputees are more likely to develop pain and OA in the intact limb hip and knee joints than in the residual (amputated) limb joints, likely due to abnormal gait biomechanics including asymmetric ground reaction forces, muscle activation patterns, and knee joint kinetics between the intact and residual limbs [13,15-18,21,24,25,27,30]. Prosthetic limb design has advanced rapidly in recent years, with energy storage and release (ESAR) and bionic prostheses representing the state-of-the art. However, these prostheses do not completely restore natural biomechanics of the lower limb during gait [12,28,29].

Although guidelines have been proposed for prosthetic use among transtibial amputees during cycling [10], only a few studies have addressed intact limb hip and knee joint loading during cycling for this population [4,5]. It is known that biomechanical challenges exist for transtibial amputees during cycling [4]. Significantly higher pedal force and work asymmetries

between intact and residual limbs exist for transtibial amputees [5] and such asymmetries depend on cycling intensity and prosthetic foot stiffness [4]. Although elliptical training has been recommended during rehabilitation for this population [11], there do not appear to be any biomechanical studies of hip and knee joint loading during elliptical training for transtibial amputees. There also do not appear to be any studies comparing gait, cycling, and elliptical training kinematics, kinetics, and reaction forces for the same transtibial amputee group.

The long-term goal of this study is to provide evidence-based guidelines to recommend rehabilitation exercises for military and civilian transtibial amputees that reduce the risk of hip and knee OA development. The primary hypothesis was that hip and knee joint kinematics and kinetics and ground and pedal reaction forces would differ due to exercise (gait, cycling, elliptical) amputee status (amputated, control [non-amputated]), and leg (dominant [intact], non-dominant [amputated]). A secondary hypothesis was that joint kinematics and kinetics and ground and pedal reaction forces for dominant and non-dominant legs would be asymmetrical for amputees but not control participants. To address these hypotheses the specific aims were to (1) conduct gait, cycling, and elliptical training experiments with transtibial amputee and control participants, (2) measure ground and pedal reaction forces for gait and machine exercises, respectively, (3) perform kinematic and inverse dynamic analyses to obtain hip and knee joint angles and resultant loads, and (4) compare hip and knee joint kinematics and kinetics and measured reaction forces between exercises, between participant groups, and between the dominant and non-dominant legs.

Chapter 2

METHODS

2.1: Participant Selection and Informed Consent

All protocols were approved by Cal Poly's Institutional Review Board and were designed to minimize risk to human participants.

2.1.1 Recruitment

Ten unilateral transtibial amputees (7 male, 3 female) were recruited from the Hanger Clinic in San Luis Obispo, California and from other clinics in the state recommended by Mr. Robinson. Ten control participants (8 male, 2 female) were recruited from Cal Poly San Luis Obispo University student and faculty populations. Amputee patients were contacted by A. Matt Robinson CPO or Cal Poly Human Motion Biomechanics (HMB) researchers by phone and were screened for eligibility. After screening, eligible patients were invited to the HMB Lab where informed consent, Physical Activity Readiness Questionnaires, Photographic Image Releases, and Test Participant Information forms were filled out. Amputee participants were fitted with an Energy Storage and Release (ESAR) prosthesis by Mr. Robinson.

2.1.2 Inclusion and Exclusion Criteria

The telephone screening prior to inviting patients to participate in the experiment ensured that all participants fit the inclusion criteria. Participant characteristics for amputee and control groups are in tables 2.1 and 2.2, respectively.

Exclusion criteria for the study included obesity (body mass index $> 30 \text{ kg/m}^2$); history of cardiovascular disease, respiratory disease, or any other metabolic disease/complication; substantial weight loss or gain over the previous six months; history of major psychiatric illness, drug abuse, or unsafe dieting practices; major medical conditions that prohibit physical activity; pregnant women or women expecting or trying to be pregnant; and pre-existing conditions other than amputation that produce abnormal knee loading such as varus-valgus misalignment or other lower limb injuries.

Table 2.1: Tabulated transtibial amputee participant characteristics. Mass was measured with a scale and height measured with a stadiometer. Age, gender, and years since amputation were reported by the participant. The dominant leg for amputee participants is the non-amputated or contralateral leg.

Subject ID	Age	Mass [kg]	Height [m]	BMI	Dominant Leg	Gender	Years Since Amputation
2016Nov10-01	32	74.8	1.82	22.6	L	M	11.9
2016Nov14-01	31	83.9	1.69	29.4	R	M	2.8
2017Mar18-01	45	80.7	1.81	24.6	R	M	6.2
2017Sep09-01	32	80.6	1.78	25.4	R	M	12.4
2017Oct30-01	32	72.4	1.80	22.3	R	M	8.1
2017Nov11-01	34	92.2	1.77	29.6	L	F	10.6
2018Jan20-01	29	58.4	1.54	24.7	L	F	4.2
2018May18-01	37	82.9	1.82	25.0	L	M	8.2
2018May26-01	18	76.8	1.73	25.5	R	F	1.5
2018Jun01-01	32	75.0	1.81	22.8	R	M	6.8
Average (SD)	32.2 (6.7)	77.8 (8.9)	1.76 (0.09)	25.2 (2.6)	-	-	7.3 (3.7)

Table 2.2: Tabulated control participant characteristics. Mass was measured with a scale and height measured with a stadiometer. Age, gender, and dominant leg were self-reported. Dominant leg for control participants is the strongest or favored leg.

Subject ID	Age	Mass [kg]	Height [m]	BMI	Dominant Leg	Gender
2016Aug15-01	26	86.6	1.79	27.0	R	M
2016Aug19-01	23	88.5	1.75	23.0	L	M
2016Nov05-01	22	61.2	1.79	19.1	R	M
2018Jan19-01	22	79.1	1.82	24.0	R	M
2018Jan22-01	20	90.4	1.80	27.9	L	M
2018Apr13-01	23	70.3	1.75	22.9	R	M
2018Apr24-01	23	56.2	1.63	21.3	R	M
2018Apr27-01	21	64.8	1.65	23.9	R	M
2018May04-01	20	68.1	1.61	26.1	R	F
2018Jun08-01	21	68.7	1.72	23.4	R	F
Average (SD)	22.1 (1.8)	73.4 (12.0)	1.73 (0.08)	24.4 (3.1)	-	-

Although efforts were made to recruit amputee participants with absence of all other lower limb injuries besides amputation, several amputees had injuries in the contralateral leg related to the event that resulted in loss of limb that may have impacted results. These injuries and their extent are in table 2.3.

Table 2.3: Tabulated injuries as reported by amputee participants.

Subject ID	Contralateral Leg Injury
2016Nov14-01	Evidence of ACL tear; pelvis and torso injuries
2017Mar18-01	Charcot foot
2017Sep09-01	Screws in lateral ankle
2018May18-01	Partial hip implant; rod in femur; tibia fracture

2.1.3 ESAR Prosthesis

To eliminate confounding variables due to differences in prosthetic assembly, Mr. Robinson fit all amputee participants with the Vari-Flex® prosthesis (Össur, Reykjavik, Iceland), a light-weight carbon fiber energy storing foot (Fig. 2.1), that is advertised for all activity levels including fast walking [31]. Participants tested out the provided prosthesis after Mr. Robinson adjusted the alignment of the device until they were satisfied with their mobility and Mr. Robinson confirmed that the participant was walking properly. Other components of the participant's original prosthetic assembly, such as the socket and pylon, were adjusted as needed to accommodate the Vari-Flex®. During the experiment participants wore a silicone foot cover over the prosthesis.

Figure 2.1: Össur Vari-Flex® carbon fiber prosthetic foot provided to amputee participants that did not use a similar energy storing device.

2.2 Equipment

The Human Motion Biomechanics Lab utilizes the standard suite of marker-based motion capture equipment including near-infrared digital cameras (Motion Analysis Corp., Santa Rosa, CA, USA), ground force plates (Accugait, AMTI, Watertown, MA, USA), and 6-axis load cells (AD2.5D, AMTI). Cortex software (Version 7.01, Motion Analysis) was used to interface with all equipment including twelve (6 Owl, 3 Osprey, 2 Kestrel, 1 Eagle) near-infrared digital cameras (Motion Analysis). Cameras tracked participants throughout the three exercises by capturing the position of reflective markers placed on anatomical landmarks to define body segments (Fig. 2.2). Cortex was used for calibration of cameras, kinematic and kinetic data capture, and post-processing.

Four ground force plates (Accugait, AMTI) were used to capture time-based reaction forces in the anterior, lateral, and vertical directions; the free reaction moment about the vertical axis; and the center of pressure of the reaction force vector on the surface of the force platform. The force plates were aligned in a walkway and were not fixed to the ground (Fig 2.2).

Figure 2.2: Experimental setup for gait (left), cycling (middle), and elliptical training (right) motion capture experiments. Digital cameras, ground force plates, reflective markers, the Vari-Flex® prosthesis with foot cover, and instrumented exercise machine pedals are indicated.

A stationary bicycle (Lifecycle GX, Life Fitness, Schiller Park, IL, USA) and elliptical trainer (XE795, Spirit Fitness, Jonesboro, AR, USA) with moderate resistance settings (10 out of 20) were used. The pedals of both machines were instrumented with 6-axis load cells (AD2.5D,

AMTI) and fit with custom marker configurations (Fig. 2.2) to track pedal position and orientation relative to a global coordinate system defined in Cortex.

2.3 Experimental Protocol

2.3.1 Participant Preparation

Participants were asked to change into tight compression clothing that exposed as much of their skin as they were comfortable with. Anatomical landmarks where reflective markers were to be placed were wiped down with sticky alcohol pads that improved adhesion to the skin. 32 reflective markers were placed onto the participant's body per a modified enhanced Helen Hayes marker set (Fig. 2.3) that defined the head, torso, pelvis, thigh, shank, and foot segments.

Markers included the Top.Head, R. and L.Shoulder (acromion processes), C7 (7th cervical spine), Sternum, R. and L. PSIS (posterior superior iliac spine), R. and L. ASIS (anterior superior iliac spine), V.Sacrum (the bottom of the sacral canal "V" shape), R. and L. GTroch (greater trochanters), R. and L. Thigh, R. and L. Knee (lateral condyles), R. and L. Knee.Med (medial condyles), R. and L. Fibula (fibular head), R. and L. TibTub (tibial tuberosity), R. and L. Shank, R. and L. Ankle (lateral malleoli), R. and L. Ankle.Med (medial malleoli), R. and L. Heel (Achilles tendon insertion site), and R. and L. Toe (between the 2nd and 3rd metatarsals). When possible, markers were placed on skin. ASIS, trochanter, sacrum, and thigh markers were placed on compression clothing depending on the participant's clothing size.

Figure 2.3: Modified enhanced Helen Hayes marker set consisting of 32 markers. Reprinted from [46].

2.3.2 Static Capture

After marker placement participants were asked to stand stationary in a static pose in the center of the capture volume with feet at shoulder width and arms bent at the elbows (Fig 2.4). The static pose was used to begin the post-processing procedure and defines initial joint angles for later analysis. Six static pose captures were taken; each lasted about a second. The top head and medial knee and ankle markers were removed after the static captures.

Figure 2.4: Amputee participant in static pose with modified enhanced Helen Hayes marker set.

2.3.3 Dynamic Captures

Three gait trials were collected for each participant at self-selected speeds in each direction. One full gait cycle (defined as heel strike of one foot to heel strike of the same foot) for both the contralateral and prosthesis-side (affected) legs was collected.

Cycling and elliptical trials had similar protocols. Three trials were collected at 70 revolutions per minute (RPM) as measured by the corresponding machine at moderate resistance settings (level 10 of 20). Load cells were calibrated to capture the zero-force state prior to stepping on machine pedals. Once the participant reached the target speed, data for 30 seconds were collected. One machine cycle is defined in a similar fashion to gait – there exists a loading phase similar to stance in which reaction forces are high and an unloaded phase similar to swing in which loading is minimal. For cycling, the top dead center (TDC) is defined as both 0% and 100% [32]. For elliptical, the most anterior pedal position (APP) is defined as both 0% and 100% [33].

2.4 Cortex Processing

Static pose, gait, cycling, and elliptical captures were processed in Cortex to define body segments that were tracked through space to calculate kinematics and joint kinetics. The procedure for processing motion capture trials and calculating kinematics and kinetics in Cortex is well-documented [34,35] and will not be covered in extensive detail.

2.4.1 Static Capture

All Cortex processing began with identifying markers floating in space with names corresponding to the enhanced Helen Hayes marker set in the static pose. Defined markers oriented a mass segment in space and defined parent-child relationships between body segments (Fig. 2.5).

Figure 2.5: Static capture after processing in Cortex. Pelvis, thigh, shank, and foot segments and coordinate systems (CS) are shown. The global CS is in the lower left-hand corner.

Each segment had a coordinate system (CS) defined relative to its parent frame – particularly, the foot segment was defined relative to the shank CS, which was relative to the thigh CS, which was relative to the pelvis CS defined with respect to the global coordinate system.

The static capture provided a template from which dynamic trials were processed. The static kinematics were collected from Cortex to be used as reference angles in later analysis to remove anatomical variability between participants [36].

2.4.2 Dynamic Captures

Dynamic captures were processed in a similar fashion to static captures. With cycling and elliptical trials, additional markers defined pedal segments which were necessary to track load cells relative to the global CS so that measured forces and moments would properly be applied to the foot segments (Fig 2.6).

Figure 2.6: Gait (left), cycling (center), and elliptical (right) dynamic captures with force plates and load cells tracking pedal segments. Red vectors indicate magnitude and direction of reaction forces.

Kinetics were calculated using the Cortex KinTools RT engine [35] which uses Euler's equations for three-dimensional rigid body inverse dynamics to calculate three forces and three moments at the proximal end of each segment. Cortex uses a bottom-up approach in which the order of segment and joint analysis moves from the ground up: the foot is analyzed to obtain ankle loads, then the shank is analyzed to obtain knee loads, and so on. The resultant forces, resultant moments, and joint angles for the knee were resolved into a floating axis joint coordinate system [37] (Fig. 2.7). The hip joint coordinate system is identical to the knee but centered at the hip joint center with the flexion axis also pointing through the lateral knee marker and the internal

rotation axis oriented along the thigh segment longitudinal axis (Fig. 2.8). Hip and knee flexion angles; joint lateral, anterior, and compressive forces; joint extension, adduction, and external rotation moments; and lateral, anterior, and vertical reaction forces were defined to be positive.

Figure 2.7: Floating axis knee joint coordinate system. Angle and force axes are indicated in the positive direction in black. Joint moments are indicated in the positive orientation in gray. HJC is hip joint center, KJC is knee joint center, and AJC is ankle joint center. “Z” vectors indicate the longitudinal axis of the thigh and shank. The knee internal rotation axis is defined as the shank axis. The knee flexion axis is defined as the axis perpendicular to the thigh axis pointing through the lateral knee marker (LKM). The abduction axis is the cross product of the internal rotation axis and the flexion axis and points anteriorly.

Figure 2.8: Hip joint coordinate system (JCS) defined similarly to knee JCS. The hip flexion axis is parallel to the knee flexion axis.

2.4.3 Combining Elliptical Pedal Reactions

Each elliptical pedal had two AMTI load cells in order to handle the combined dynamic loading of a participant performing the exercise. Cortex cannot calculate kinetics for multiple force platforms per foot segment nor can it calculate a resultant force-couple system that is equivalent to the two individual force platform reaction force-moment systems. Combining multi-plate systems into a single resultant system is well documented [38] and the generalized equations used to combine arbitrary numbers of force platforms are below.

$$\vec{\bar{F}} = \sum_i \vec{F}_i \quad (2-1)$$

$$\bar{x} = \frac{\sum_i x_i F_{z_i}}{\sum_i F_{z_i}} \quad (2-2)$$

$$\bar{y} = \frac{\sum_i y_i F_{z_i}}{\sum_i F_{z_i}} \quad (2-3)$$

$$\bar{T}_z = \sum_i (x_i F_{y_i} - y_i F_{x_i} + T_{z_i}) - \bar{x} \bar{F}_y + \bar{y} \bar{F}_x \quad (2-4)$$

The resultant force vector ($\vec{\bar{F}}$) is the summation of force vectors at each force platform ($\vec{F}_i$) (Eq. 2-1). The resultant center of pressure (COP) is the point where the sum of the moments about the x and y directions is equal to zero. The COP on the surface of the resultant force platform is defined in local coordinates $(\bar{x}, \bar{y})$ (where x is the longitudinal direction and y is the lateral direction of the force platform (Fig. 2.9)) relative to the pedal mass segment and is dependent on the local COP coordinates measured from each force platform origin to the center of the resultant force platform (x_i, y_i) multiplied by the vertical force component of each force platform (Eq. 2-2, 2-3). Consequently, the force platform COP that has the larger vertical force will influence the resultant COP more. The free moment is the sum of all shear forces about the vertical axis centered at the resultant COP. The free moment about the resultant force platform vertical axis ($\bar{T}_z$) is the sum of force platform free moments (T_{z_i}), moments about the center of the resultant platform by individual platform shear forces (F_{x_i}, F_{y_i}), and moments about the center by resultant platform shear forces ($\bar{F}_x, \bar{F}_y$) measured from the resultant COP (Eq. 2-4). Cortex files containing

force data were modified based on these equations in MATLAB (The MathWorks, Natick, MA, USA). Figure 2.8 shows the original and resultant elliptical pedal in Cortex.

Figure 2.9: Elliptical force platforms in Cortex before (left) and after (right) combining load cell data into a resultant force-couple system.

2.4.4 Exported Data

Data exported from Cortex after calculating kinetics includes the hip and knee joint flexion angles, resultant forces and moments, and ground or pedal reaction forces for gait and machine trials, respectively. The time in seconds at which cycling and elliptical pedals passed through their respective start of cycle and end of cycle were stored and used to calculate actual RPM.

Kinematic and kinetic data were captured in Cortex at 150 Hz. Marker trajectories were filtered in Cortex using a two-pass, 4th order, zero phase shift Butterworth filter [34] with a cutoff frequency of 6 Hz and ground & pedal reaction forces were filtered using the same filter with a 10 Hz cutoff frequency. Cutoff frequency for reaction forces was calculated using the optimal method [39]. Missing marker data were interpolated using a cubic spline in Cortex [34].

2.5 Analysis

Analysis of Cortex results was done in MATLAB. All dynamic trials were interpolated to 101 data points from 0% to 100% cycle. Three trials for each participant in each exercise for the

dominant and non-dominant leg were averaged. Joint kinematics and kinetics and reaction forces were then averaged across ten participants in each participant group.

Reference joint angles for each participant were averaged across the entire length of the static capture and subtracted from gait, cycling, and elliptical dynamic angles to eliminate participant anatomical variability [36]. Maximum and minimum hip and knee flexion angles in gait, cycling, and elliptical for the dominant and non-dominant legs were analyzed for each participant group. Both knee flexion peaks in gait for amputee and control groups were found as well.

Participant walking speeds were calculated by averaging sacrum marker velocity in the direction of motion during six gait trials. Participant and average walking speeds for amputees and controls are in table 2.4. Kinetics are known to depend on walking speed [40].

Table 2.4: Tabulated amputee and control walking speeds.

Amputees		Controls	
Subject ID	Walking Speed [m/s]	Subject ID	Walking Speed [m/s]
2016Nov10-01	1.48	2016Aug15-01	1.15
2016Nov14-01	0.82	2016Aug19-01	1.36
2017Mar18-01	1.33	2016Nov05-01	1.26
2017Sep09-01	1.29	2018Jan19-01	1.23
2017Oct30-01	1.22	2018Jan22-01	1.40
2017Nov11-01	1.31	2018Apr13-01	1.32
2018Jan20-01	1.17	2018Apr24-01	1.30
2018May18-01	1.33	2018Apr27-01	1.36
2018May26-01	1.30	2018May04-01	1.32
2018Jun01-01	1.30	2018Jun08-01	1.22
Average (SD)	1.26 (0.17)	Average (SD)	1.29 (0.08)

For cycling and elliptical dynamic trials, individual machine cycles were selected at random without replacement (to avoid selecting the same cycle again) in MATLAB before normalizing and averaging data. RPM for each machine cycle was calculated and cycles with RPM larger than 72 or less than 68 were eliminated from the pool of samples as kinetics vary with machine power [4]. Participant and average actual RPM for amputees and controls are in table 2.5. Elliptical RPM was calculated by the XE795 as half of a complete rotation of one pedal so

tabulated values correspond to the angular velocity between the APP and the posterior pedal position (PPP).

Table 2.5: Tabulated amputee and control cycling and elliptical RPM.

Amputees			Controls		
Subject ID	Cycling RPM	Elliptical RPM	Subject ID	Cycling RPM	Elliptical RPM
2016Nov10-01	68.88	70.07	2016Aug15-01	69.31	70.25
2016Nov14-01	69.99	69.03	2016Aug19-01	70.25	70.09
2017Mar18-01	69.77	69.66	2016Nov05-01	70.12	69.47
2017Sep09-01	70.16	70.28	2018Jan19-01	70.25	70.92
2017Oct30-01	69.06	70.76	2018Jan22-01	70.60	69.11
2017Nov11-01	69.16	70.33	2018Apr13-01	68.89	70.48
2018Jan20-01	69.76	70.77	2018Apr24-01	69.31	70.37
2018May18-01	68.43	70.77	2018Apr27-01	70.33	69.88
2018May26-01	70.22	70.61	2018May04-01	69.16	70.33
2018Jun01-01	69.05	70.88	2018Jun08-01	69.32	70.61
Average (SD)	69.45 (0.61)	70.32 (0.59)	Average (SD)	69.75 (0.61)	70.15 (0.54)

Forces were normalized by body weight. Moments were normalized by body weight times height [41]. Maximum and minimum hip and knee lateral, anterior, and compressive forces and extension, adduction, and external rotation moments and peak times in percent cycle in gait, cycling, and elliptical training for the dominant and non-dominant legs for both participant groups were analyzed. Maximum and minimum lateral, anterior, and vertical reaction forces and timing of peaks in all exercises for both legs in both participant groups were analyzed. Both vertical reaction force peaks in gait and corresponding timing for amputee and control groups analyzed.

2.6 Statistics

Two-factor repeated measures ANOVA with post-hoc Tukey tests were conducted to analyze the effects of participant type (Amp-Dominant, Amp-NonDominant, Con-Dominant, Con-NonDominant) and exercise (gait, cycling, elliptical) on maximum and minimum joint kinematics and kinetics and reaction forces. Two-sample t-tests were conducted to analyze the effects of participant type (Amputee, Control) and leg dominance (dominant, non-dominant) on participant walking speeds, knee flexion peaks and peak times, and vertical reaction force peaks and peak times. Levene tests were done before performing t-tests to determine whether to run the t-tests

with pooled or unequal variance. Significance for all tests was defined by $p < 0.05$. All statistical analyses were performed in Minitab 2018 (Minitab, Inc., State College, PA, USA).

Chapter 3

RESULTS

Summary figures of amputee and control participant mean results with standard deviation bands for dominant and non-dominant legs in gait, cycling, and elliptical training can be found in Appendix A. Mean and standard deviation bar graphs with significance markers can be found in Appendix C and tabulated values for Appendix C bar graphs can be found in Appendix B. P-values within 1% of the significance level are considered noteworthy but ultimately inconclusive for the selected type I error rate of 5%. Appendix F contains summarized Minitab outputs and p-values for two-factor repeated measures ANOVAs and two-sample t-tests.

3.1 Hip Joint Results

3.1.1 Kinematics

Maximum hip flexion-extension (FE) angles were significantly different in gait vs. cycling, gait vs. elliptical, and cycling vs. elliptical for all participant groups (Amp Dominant, Amp Non-Dominant, Control-Dominant, Control Non-Dominant) (Fig. C-1, Fig. 3.1). Refer to Appendix F for p-values related to significance across exercise type for each participant group. Maximum hip FE angle times were significantly different in gait vs. cycling and cycling vs. elliptical, but not gait vs. elliptical, for all participant groups (Fig. C-1, Fig. 3.2). Minimum hip FE angles were significantly different in gait vs. cycling, gait vs. elliptical, and cycling vs. elliptical for all participant groups. Minimum hip FE angle times were significantly different in gait vs. elliptical and cycling vs. elliptical, but not gait vs. cycling, for all participant groups (Fig. C-1). Amputee dominant and non-dominant leg minimum hip FE angle time was asymmetrical ($p=0.001$) and amputee non-dominant vs. control non-dominant leg minimum hip FE angle time was significantly different ($p<0.001$) (Fig. C-1).

Figure 3.1: Mean $\pm$ 1 standard deviation maximum hip flexion-extension (FE) angle bar graph. + = significance across leg type (dominant vs. non-dominant). * = significance across participant type (amputee vs. control). ✓ = significance across exercise type (gait vs. cycling vs. elliptical). $P < 0.05$ significant.

Figure 3.2: Mean $\pm$ 1 standard deviation maximum hip flexion-extension (FE) angle times bar graph. + = significance across leg type (dominant vs. non-dominant). * = significance across participant type (amputee vs. control). ✓ = significance across exercise type (gait vs. cycling vs. elliptical). $P < 0.05$ significant.

3.1.2 Resultant Kinetics

Maximum hip compressive forces varied across all exercises for all participant types but no asymmetry or inter-participant differences were found (Fig. C-3, Fig. 3.3). Minimum hip compressive force was significantly different in gait vs. cycling and gait vs. elliptical for all participant types, and in also cycling vs. elliptical for amputee non-dominant leg only (Fig. C-3). Amputee vs. control non-dominant leg minimum hip compressive force in elliptical was significantly different ($p=0.038$) (Fig. C-3). Maximum and minimum hip compressive force times were significantly different in gait vs. cycling and cycling vs. elliptical for all participant types (Fig. C-3). Amputee dominant leg and control non-dominant leg maximum hip compressive force times were significantly different in gait vs. elliptical (Fig. C-3).

Figure 3.3: Mean $\pm$ 1 standard deviation maximum hip compressive (C) force bar graph. + = significance across leg type (dominant vs. non-dominant). * = significance across participant type (amputee vs. control). ✓ = significance across exercise type (gait vs. cycling vs. elliptical). $P < 0.05$ significant.

Maximum hip anterior-posterior (AP) force varied across all exercises for all participant types (Fig. C-5). Amputee vs. control non-dominant leg maximum hip AP force in cycling was significantly different ($p=0.025$) (Fig. C-5). Amputee dominant vs. non-dominant leg maximum hip

AP force timing in cycling was significantly different ($p=0.011$) (Fig. C-5). Minimum hip AP force was significantly different in gait vs. cycling and cycling vs. elliptical for all participant types (Fig. C-5). Amputee dominant vs. non-dominant ($p<0.001$) and amputee vs. control non-dominant leg ($p=0.01$) minimum hip AP force was significantly different (Fig. C-5).

Maximum hip lateral-medial (LM) force was significantly different in gait vs. cycling and gait vs. elliptical, but not cycling vs. elliptical, for all participant types (Fig. C-7). No significant differences in maximum hip LM force timing were found (Fig. C-7). Minimum hip LM force was significantly different in gait vs. cycling for amputee dominant leg, control dominant leg, and amputee non-dominant leg (Fig. C-7). Amputee vs. control non-dominant leg minimum hip LM force timing in elliptical was significantly different ($p=0.04$) (Fig. C-7).

Maximum hip extension-flexion (EF) moment was significantly different in gait vs. cycling and cycling vs. elliptical for all participant types (Fig. C-9, Fig. 3.4). Amputee dominant vs. non-dominant leg maximum hip EF moment in elliptical was significantly different ($p=0.023$) (Fig. C-9, Fig. 3.4). Maximum hip EF moment timing was significantly different in cycling vs. elliptical for amputee dominant leg and also in gait vs. cycling for control non-dominant leg (Fig. C-9). Control dominant vs. non-dominant leg maximum hip EF moment timing in gait was significantly different ($p=0.017$) (Fig. C-9). Minimum hip EF moment varied across all exercises for both amputee dominant and non-dominant legs, and across gait vs. cycling and gait vs. elliptical for both control dominant and non-dominant legs (Fig. C-9). Amputee dominant vs. non-dominant leg minimum hip EF moment in elliptical was significantly different ($p<0.001$) (Fig. C-9). Amputee vs. control non-dominant leg minimum hip EF moment in elliptical was near significance ($p=0.051$) (Fig. C-9). Minimum hip EF moment was significantly different in gait vs. cycling and cycling vs. elliptical for amputee dominant leg and both control dominant and non-dominant leg (Fig. C-9). Amputee dominant vs. non-dominant ($p=0.001$) and amputee vs. control ($p=0.003$) minimum hip EF moment timing in cycling was significantly different (Fig. C-9).

Figure 3.4: Mean $\pm$ 1 standard deviation maximum hip extension-flexion (EF) moment bar graph. + = significance across leg type (dominant vs. non-dominant). * = significance across participant type (amputee vs. control). ✓ = significance across exercise type (gait vs. cycling vs. elliptical). $P < 0.05$ significant. Duplicate significance markers indicate p-values within 1% of significance.

Maximum hip adduction-abduction (AddAbd) moment was significantly different in gait vs. cycling and gait vs. elliptical for all participant types, and in cycling vs. elliptical for amputee dominant leg (Fig. C-11, Fig. 3.5). No significant differences in maximum hip AddAbd timing were found (Fig. C-11). Minimum hip AddAbd moment was significantly different in gait vs. cycling and cycling vs. elliptical for amputee and control dominant legs (Fig. C-11). No significant differences were found in minimum hip AddAbd moment timing (Fig. C-11).

Figure 3.5: Mean $\pm$ 1 standard deviation maximum hip adduction-abduction (AddAbd) moment bar graph. + = significance across leg type (dominant vs. non-dominant). * = significance across participant type (amputee vs. control). ✓ = significance across exercise type (gait vs. cycling vs. elliptical). $P < 0.05$ significant. Duplicate significance markers indicate p-values within 1% of significance.

Maximum hip external-internal rotation (ERIR) moment was significantly different in gait vs. cycling and gait vs. elliptical for amputee dominant leg and both control dominant and non-dominant legs (Fig. C-13). Amputee dominant vs. non-dominant leg ($p < 0.001$) and amputee vs. control ($p = 0.004$) non-dominant leg maximum hip ERIR moment in gait were significantly different (Fig. C-13). No significant differences in maximum hip ERIR moment timing were found but gait vs. elliptical for amputee dominant leg was within 1% of significance ($p = 0.055$) (Fig. C-13). Minimum hip ERIR moment was significantly different in gait vs. cycling for all participant types, in gait vs. elliptical for amputee non-dominant leg and both control dominant and non-dominant legs, and in cycling vs. elliptical for control non-dominant leg (Fig. C-13). No significant differences were found in minimum hip ERIR moment timing (Fig. C-13).

3.2 Knee Joint Results

3.2.1 Kinematics

Maximum knee FE angles were significantly different between exercise types for all participant groups (Fig. C-2, Fig. 3.6). Amputee participants showed statistically significant asymmetry between dominant and non-dominant maximum knee FE angles in gait ($p=0.005$), cycling ($p=0.014$), and elliptical ($p<0.001$) (Fig. C-2, Fig. 3.6). Amputee vs. control maximum non-dominant knee FE angles were significantly different ($p=0.018$) in elliptical (Fig. C-2, Fig. 3.6). Maximum knee FE angle timing was significantly different in gait vs. cycling and cycling vs. elliptical for all participants, and also in gait vs. elliptical for both amputee dominant and non-dominant legs and for control non-dominant leg (Fig. C-2, Fig. 3.7). Minimum knee FE angles were significantly different between exercise types for all participant groups (Fig. C-2). Minimum knee FE angle timing was significantly different in gait vs. elliptical for all participant types and also in gait vs. cycling for both control dominant and non-dominant legs (Fig. C-2).

Figure 3.6: Mean $\pm$ 1 standard deviation maximum knee flexion-extension (FE) angle bar graph. + = significance across leg type (dominant vs. non-dominant). * = significance across participant type (amputee vs. control). ✓ = significance across exercise type (gait vs. cycling vs. elliptical). $P<0.05$ significant.

Figure 3.7: Mean $\pm$ 1 standard deviation maximum knee flexion-extension (FE) angle times bar graph. + = significance across leg type (dominant vs. non-dominant). * = significance across participant type (amputee vs. control). ✓ = significance across exercise type (gait vs. cycling vs. elliptical). $P < 0.05$ significant.

3.2.2 Resultant Kinetics

Maximum knee compressive forces varied across all exercises for all participant types (Fig. C-4, Fig. 3.8). Amputee vs. control dominant leg maximum knee compressive force in elliptical was significantly different ($p=0.049$) (Fig. C-4, Fig. 3.8). Minimum knee compressive force was significantly different in gait vs. cycling and gait vs. elliptical for all participant types, and also in cycling vs. elliptical for amputee dominant and non-dominant leg only (Fig. C-4). Maximum and minimum knee compressive force times were significantly different in gait vs. elliptical for amputee dominant leg only (Fig. C-4).

Figure 3.8: Mean $\pm$ 1 standard deviation maximum knee compressive (C) force bar graph. + = significance across leg type (dominant vs. non-dominant). * = significance across participant type (amputee vs. control). ✓ = significance across exercise type (gait vs. cycling vs. elliptical). $P < 0.05$ significant.

Maximum knee AP force varied across all exercises for all participant types (Fig. C-6). Amputee dominant vs. non-dominant leg ($p=0.002$) and amputee vs. control non-dominant leg ($p=0.001$) maximum knee AP force timing in cycling were significantly different but no differences were found between exercises (Fig. C-6). Minimum knee AP force was significantly different in gait vs. cycling and gait vs. elliptical for all participant types, and also in cycling vs. elliptical for amputee and control dominant legs (Fig. C-6). Amputee dominant vs. non-dominant leg minimum knee AP force in elliptical was significantly different ($p < 0.001$) (Fig. C-6.) No significant differences in minimum knee AP force timing were found (Fig. C-6).

Maximum knee LM force was significantly different in gait vs. cycling and gait vs. elliptical for all participant types, and in cycling vs. elliptical for amputee dominant leg and control non-dominant leg (Fig. C-8). Minimum knee LM force was significantly different in gait vs. cycling and cycling vs. elliptical for amputee dominant leg, and in cycling vs. elliptical for amputee non-dominant leg (Fig. C-8). No significant differences were found in maximum and minimum knee LM force timing were found (Fig. C-8).

Maximum knee EF moment was significantly different in gait vs. cycling and cycling vs. elliptical for amputee dominant leg and both control dominant and non-dominant legs (Fig. C-10, Fig. 3.9). Amputee dominant vs. non-dominant leg maximum knee EF moment in gait ($p<0.001$) and elliptical ($p=0.002$) were significantly different (Fig. C-10, Fig. 3.9). Amputee vs. control non-dominant leg maximum knee EF moment in gait were significantly different ($p<0.001$) (Fig. C-10, Fig. 3.9). There were significant differences in maximum knee EF moment timing in gait vs cycling for amputee non-dominant leg, in gait vs. elliptical for amputee dominant leg and both control dominant and non-dominant legs, and in cycling vs. elliptical for control non-dominant leg (Fig. C-10). Amputee dominant vs. non-dominant leg ($p<0.001$) and amputee vs. control ($p<0.001$) non-dominant leg maximum EF knee moment timing were significantly different (Fig. C-10). Minimum knee EF moment was significantly different in gait vs. cycling for all participant types, in gait vs. elliptical for amputee and control dominant legs, and in cycling vs. elliptical for amputee non-dominant leg (Fig. C-10). Minimum knee EF moment timing was significantly different in gait vs. cycling for amputee non-dominant leg and in gait vs. elliptical for amputee non-dominant leg and both control dominant and non-dominant legs (Fig. C-10).

Figure 3.9: Mean $\pm$ 1 standard deviation maximum knee extension-flexion (EF) moment bar graph. + = significance across leg type (dominant vs. non-dominant). * = significance across participant type (amputee vs. control). ✓ = significance across exercise type (gait vs. cycling vs. elliptical). $P < 0.05$ significant.

Maximum knee AddAbd moment was significantly different in gait vs. cycling and gait vs. elliptical for all participant types (Fig. C-12, Fig. 3-10). No significant differences in maximum knee AddAbd moment timing were found (Fig. C-12). Minimum knee AddAbd moment was significantly different in cycling vs. elliptical for amputee dominant leg (Fig. C-12). No significant differences in minimum knee AddAbd moment timing were found (Fig. C-12).

Figure 3.10: Mean $\pm$ 1 standard deviation maximum knee adduction-abduction (AddAbd) moment bar graph. + = significance across leg type (dominant vs. non-dominant). * = significance across participant type (amputee vs. control). ✓ = significance across exercise type (gait vs. cycling vs. elliptical). $P < 0.05$ significant.

Maximum knee ERIR moment was significantly different in gait vs. cycling for amputee dominant leg and control non-dominant leg, and in cycling vs. elliptical for all participant types (Fig. C-14). No significant differences were found in maximum knee ERIR moment timing (Fig. C-14). Minimum knee ERIR moment was significantly different in gait vs. cycling and gait vs. elliptical for all participant types, and in cycling vs. elliptical for amputee dominant leg (Fig. C-14). Amputee vs. control non-dominant leg minimum knee ERIR moment in gait ($p=0.007$) was significantly different and amputee dominant vs. non-dominant leg minimum knee ERIR moment in elliptical was nearly significant with a p -value of 0.052 (Fig. C-14). Minimum knee ERIR moment timing was significantly different in gait vs. elliptical for amputee dominant leg and both control dominant and non-dominant leg, and in cycling vs. elliptical for both amputee dominant and non-dominant legs and was nearly significant ($p=0.053$) for control dominant leg (Fig. C-14).

3.3 Reaction Forces

Maximum vertical reaction force was significantly different across all exercises for all participant types (Fig. C-15). Amputee vs. control dominant leg maximum vertical reaction force in elliptical was significantly different ($p=0.033$) (Fig. C-15). Maximum vertical reaction force timing was significantly different in gait vs. elliptical for amputee dominant leg and control non-dominant leg and nearly significant for amputee non-dominant leg ($p=0.056$), and also in cycling vs. elliptical for all participant types (Fig. C-15). Minimum vertical reaction force was significantly different in gait vs. cycling for amputee non-dominant leg, in gait vs. elliptical for all participant types, and in cycling vs. elliptical for amputee dominant leg and both control dominant and non-dominant legs (Fig. C-15). Minimum vertical reaction force timing was significantly different in gait vs. cycling and cycling vs. elliptical for control non-dominant leg (Fig. C-15).

Maximum AP reaction force was significantly different across all exercises for all participant types (Fig. C-16). Amputee dominant vs. non-dominant leg ($p<0.001$) and amputee vs. control ($p<0.001$) non-dominant leg maximum AP reaction force in gait were significantly different (Fig. C-16). No significant differences were found for maximum AP reaction force timing (Fig. C-16). Minimum AP reaction force was significantly different in gait vs. cycling and gait vs. elliptical for all participant types, and also in cycling vs. elliptical for amputee dominant leg (Fig. C-16). Amputee vs. control non-dominant leg minimum AP reaction force in cycling was significantly different ($p=0.002$), and amputee dominant vs. non-dominant leg force in gait was nearly significant ($p=0.052$) (Fig. C-16). Minimum AP reaction force timing was significantly different in gait vs. cycling for amputee non-dominant leg, in gait vs. elliptical for all participant types, and in cycling vs. elliptical for both amputee dominant and non-dominant legs and for control dominant leg (Fig. C-16). Amputee dominant vs. non-dominant leg ($p=0.01$) and amputee vs. control ($p=0.011$) non-dominant leg minimum AP reaction force timing in cycling were significantly different (Fig. C-16).

Maximum LM reaction force was significantly different in gait vs. cycling and gait vs. elliptical for all participant types (Fig. C-17). Amputee dominant vs. non-dominant leg maximum

LM reaction force in gait was significantly different ($p=0.008$) (Fig. C-17). Maximum LM reaction force timing was significantly different in gait vs. cycling for control and amputee dominant legs, and also in gait vs. elliptical for amputee dominant leg and both control dominant and non-dominant legs (Fig. C-17). Minimum LM reaction force was significantly different in gait vs. cycling and cycling vs. elliptical for all participant types (Fig. C-17). No significant differences in minimum LM reaction force timing were found but cycling vs. elliptical was nearly significant ($p=0.054$) for amputee non-dominant leg (Fig. C-17).

3.4 Gait Parameters

Amputee dominant vs. non-dominant leg ($p=0.025$) and amputee vs. control ($p=0.008$) non-dominant leg first knee FE angle peak in gait were significantly different (Fig. C-18, Fig. 3.11). Corresponding first knee FE angle peak times were also significantly different (respectively: $p<0.001$, $p=0.001$) (Fig. C-18, Fig. 3.11). Amputee dominant vs. non-dominant leg ($p=0.001$) and amputee vs. control ($p=0.033$) dominant leg second knee FE angle peak were significantly different (Fig. C-18, Fig. 3.11). Amputee vs. control dominant leg second knee FE angle peak time were significantly different ($p=0.041$) (Fig. C-18, Fig. 3.11).

No significant differences were found in first vertical reaction force peak or corresponding time (Fig. C-19). Amputee dominant vs. non-dominant leg ($p=0.005$) and amputee vs. control non-dominant leg ($p=0.003$) second vertical reaction force peak were significantly different (Fig. C-19, Fig. 3.12). No significant differences were found in second vertical reaction force peak timing (Fig. C-19). No significant differences were found for walking speed across participants (Fig. C-20).

Figure 3.11: Mean $\pm$ 1 standard deviation first (top row) and second (bottom row) knee flexion-extension (FE) angle peaks (left column) and corresponding times (right column) bar graphs. + = significance across leg. * = significance across participant type.

Figure 3.12: Mean $\pm$ 1 standard second vertical reaction force peak bar graph. + = significance across leg. * = significance across participant type.

Chapter 4

DISCUSSION

Research has shown that transtibial amputees have a higher prevalence of dominant knee osteoarthritis as opposed to hip osteoarthritis [16,26]. Compressive force and EF and AddAbd moments are the biomechanical variables most closely linked to knee osteoarthritis because of the net compressive joint contact load due to compressive force and EF moment and increased medial cartilage loading under high AddAbd moment. Joint contact forces are comprised of resultant forces due to ground and pedal reaction forces and resultant moments due to muscle forces acting on bones. Muscle force affects joint loading by pulling bones toward each other and increasing cartilage compression. Flexion angle and timing is also considered to be linked to knee osteoarthritis due to hypotheses that low midstance flexion angle and altered temporal characteristics will cause abnormal knee loading [42]. Similar responses of the hip joint to high compressive force, EF and AddAbd moments, and flexion angle and timing are likely. The results have implications for joint injury and osteoarthritis prevention in rehabilitative and lifelong fitness sustainment exercises.

Presented results, particularly kinematic and kinetic magnitudes, are generally consistent with other publications on amputee biomechanics in gait [18,21,28,30] although different prostheses are used. Cycling pedal reaction forces and knee joint kinetics trends for controls were generally similar to published data [47,48] but depend on intensity and resistance settings. Elliptical kinematics, kinetics, and reaction forces for controls were consistent with published research [33,49,50] but depend on intensity, ramp height, and elliptical trainer.

4.1 Joint Kinetics

Maximum compressive force and EF and AddAbd moments were generally largest in gait and lowest in cycling for both the hip and knee (maximum hip and knee EF moments were similar between gait and elliptical, and maximum hip and knee AddAbd moments were similar between cycling and elliptical), reinforcing that non-weightbearing exercises should be recommended for rehabilitation due to reduced joint loading. Hip and knee joint AddAbd moments were not

significantly asymmetrical for transtibial amputees although AddAbd moments are closely correlated to tibiofemoral osteoarthritis severity [1,43].

Large asymmetries were present in maximum EF moment for amputees in gait and elliptical training (non-dominant leg EF moment was significantly less than the dominant leg moment) suggesting that muscle coordination may be altered for the non-dominant leg. While the magnitude of maximum knee EF moment was not asymmetrical in cycling for amputees, the timing for non-dominant leg maximum knee EF moment was significantly higher than for the dominant leg moment. For the non-dominant leg, the maximum knee EF moment occurred in the recovery phase of cycling [4], suggesting abnormal quadriceps behavior. Abnormal maximum EF moment and timing is present for the non-dominant leg for amputees in some fashion for all exercises but dominant leg EF moment magnitude and timing are not significantly different from control characteristics. Asymmetry in maximum hip EF moment was present for amputees in elliptical training but not other exercises. Reduced peak EF moment magnitude for amputees in gait was consistent with published research [10,18,21].

4.2 Joint Kinematics

The largest number of significant differences was in maximum knee FE angle. Particularly, asymmetry was present in all exercises for amputees and the elliptical maximum non-dominant knee FE angle varied between amputees and controls. In all cases, the non-dominant knee FE angle was greater than the dominant knee angle. The absence of similar asymmetries in hip angle, and the general lack of asymmetry in pedal reaction forces, suggests that knee flexor-extensor activity could be responsible for knee kinematic and kinetic differences.

Under closer observation of gait characteristics, asymmetry is present for amputees in the maximum midstance and swing knee flexion angles, and in the maximum midstance knee flexion angle timing. The non-dominant leg midstance knee flexion angle is significantly less than the dominant leg for amputees and the non-dominant leg for controls. Furthermore, the timing of the non-dominant midstance peak is significantly delayed compared to the dominant leg for amputees and the non-dominant leg for controls. Magnitude and timing of midstance flexion angle

for amputees and controls was consistent with published research [18,21]. Decreased midstance knee angle suggests an avoidance strategy to reduce quadriceps activity (quadriceps-avoidance gait [42]).

4.3 Mechanisms for Abnormal Biomechanics in Amputees

Altered muscle biomechanics due to the loss of musculature below the non-dominant knee could explain decreased maximum knee EF moments in gait and elliptical training (which is typically offered as an alternative to walking), increased EF moment timing in cycling, and increased knee flexion angle in all exercises for amputee participants. Loss of stabilizing muscles below the non-dominant knee may cause quadriceps and hamstring muscle activity to compensate and could explain the quadriceps-avoidance strategies in amputees. Altered muscle patterns in the non-dominant leg could affect muscle patterns, and consequently joint contact loads, in the dominant leg which could explain increased prevalence of joint osteoarthritis in amputees even though dominant leg joint biomechanics for amputees are generally similar to control biomechanics.

The conclusions drawn are consistent with published findings. In gait, biceps femoris activity was asymmetrical in stance for amputees [13] and both quadriceps and hamstrings EMG activity were significantly higher in stance for amputees than controls [18]. In cycling gastrocnemius timing activity in amputees was found to be shifted to later in the cycle [4].

4.4 Prosthesis Design

State-of-the-art prosthetic design does not sufficiently return amputee biomechanics to normal levels, as evidenced by knee flexion angle asymmetry in all exercises. The absence of the ankle joint and musculature changes the way the amputee uses the non-dominant leg. While some asymmetries exist in ground and pedal reaction forces, they do not explain maximum knee EF moment magnitude and time asymmetries that are present in some fashion in all exercises that were tested. Prosthesis design must improve to restore natural knee biomechanics and reduce quadriceps activity avoidance. Increased prosthesis stiffness has been shown to reduce

asymmetries in cycling but only for high power (competitive) cycling and not rehabilitation [4,5]. Prosthetic ankle stiffness and orientation was shown to significantly affect ground reaction force magnitude and muscle activity in gait [28] and as such plays a large role in knee biomechanics.

4.5 Limitations

4.5.1 Marker Placement

An inherent problem with marker-based motion capture is the potential to improperly place a marker on an anatomical landmark due to human error or to improperly track a marker through space during data collection. Several markers, such as the ASIS which are critical in defining hip joint centers, were placed on compression clothing and may have moved relative to the participant's body during experiments. Other marker-based errors, such as soft-tissue artifact [44] and knee angle crosstalk [45], are prevalent and can impact results. Particularly, crosstalk can significantly influence knee abduction and internal rotation angles which is why only flexion angles were considered in this study.

When the participant walks along a walkway that is oriented along a global coordinate system axis (or when a machine is oriented along an axis), camera noise can mask the lateral motion of markers due to limited participant movement in the direction. In these cases, particularly for cycling, lateral joint positions are noisy and calculated biomechanics such as abduction angles or LM forces can be noisy as well. LM forces and AddAbd moments have large standard deviations in this study and may be explained by marker noise.

Another source of marker-based error was marker obstruction or loss during data collection. Missing marker data were interpolated using a cubic spline but for early participant experiments marker loss and ghost markers (erroneous reflections in the virtual space) were prevalent and could have affected joint load calculations.

4.5.2 Electromyography Data

Muscle activations for the dominant leg in amputees and for both dominant and non-dominant legs in controls were collected using wireless electromyography (EMG) sensors

(Trigno, Delsys, Natick, MA, USA) but were not analyzed for this study. Measured muscle activations could confirm whether dominant leg muscle activity in amputees is abnormal which would alter joint contact loads.

4.5.3 Statistical Assumptions

Several assumptions were made when performing statistical analyses on presented results. For two-factor repeated measures ANOVAs, equal variance and normal distribution of data is assumed. As seen in Appendix D, the inter-quartile ranges of many datasets vary significantly between participant and exercise types. An alternative to two-factor ANOVAs is to perform pairwise t-tests with an unequal variance assumption as was done in Appendix E. However, this method still assumes a normal distribution which may not be the case. A larger sample size would improve the validity of the normality assumption and reduce variance.

Many of the data analyzed were interrelated. Tukey's multiple comparisons test after running ANOVA and two-sample t-tests controlled the Type I error rate but Bonferroni corrections for the significance level are necessary in order to properly analyze the results.

4.5.4 Prosthetic Assembly

The same ESAR foot was used for all participants but the remainder of the prosthetic assembly including the socket, liner, and pylon were not modified. There was some variability in prosthetic assemblies between participants that may have affected results. Particularly, socket-limb interfaces (such as liners, sleeves, or vacuum-based sockets) can permit motion of the prosthesis relative to the residual limb which can affect joint biomechanics. Future studies should make efforts to standardize the prosthetic assemblies for all participants and also measure prosthesis motion relative to the residual limb.

4.6 Future Work

Future work would involve EMG-driven inverse dynamics in OpenSim (Stanford University, Palo Alto, CA, USA) to calculate dominant leg hip and knee joint contact loads as resultant forces and moments for the amputee dominant leg were not significantly different from

that of controls. Muscle activation patterns could be responsible for the increased prevalence of osteoarthritis in amputee populations.

REFERENCES

- [1] T.P. Andriacchi and A. Mündermann, "The role of ambulatory mechanics in the initiation and progression of knee osteoarthritis.", *Current Opinion of Rheumatology*, vol 18, no. 8, p. 514-518, 2006.
- [2] K. Bennell, M. Duncan, S. Cowan, J. McConnell, P. Hodges, and K. Crossley, "Effects of vastus medialis oblique retraining versus general quadriceps strengthening on vasti onset.", *Medicine and Science in Sports and Exercise*, vol. 42, no. 5, p. 856-864, 2010.
- [3] R.C. Browning and R. Kram, "Effects of obesity on the biomechanics of walking at different speeds.", *Medicine and Science in Sports and Exercise*, vol. 39, no. 9, p. 1632, 2007.
- [4] W.L. Childers, R.S. Kistenberg, and R.J. Gregor, "The biomechanics of cycling with a transtibial amputation: recommendations for prosthetic design and direction for future research.", *Prosthetics and Orthotics International*, vol. 33, no. 3, p. 256-271, 2009.
- [5] W.L. Childers, R.S. Kistenberg, and R.J. Gregor, "Pedaling asymmetries in cyclists with unilateral transtibial amputation: effect of prosthetic foot stiffness.", *Journal of Applied Biomechanics*, vol. 27, no. 4, 2011.
- [6] S.M. Cowan, K.L. Bennell, K.M. Crossley, P.W. Hodges, and J. McConnell, "Physical therapy alters recruitment of the vasti in patellofemoral pain syndrome.", *Medicine and Science in Sports and Exercise*, vol 34, no. 12, p. 1879-1885, 2002.
- [7] N.A. Czapla, M.K. Sylvia, Z.F. Lerner, D.J. Tuttle, O.J. Schueckler, S.J. Hazelwood, and S.M. Klisch, "Human knee joint finite element model using a two bundle anterior cruciate ligament: validation and gait analysis.", *Summer Biomechanics, Bioengineering & Biotransport Conference*, 2015.
- [8] S.L. Delp, F.C. Anderson, A.S. Arnold, P. Loan, A. Habib, C.T. John, E. Guendelman, and D.G. Thelen, "OpenSim: open-source software to create and analyze dynamic simulations of movement.", *IEEE Transactions on Biomedical Engineering*, vol. 54, no. 11, p. 1940-1950, 2007.
- [9] M.H. Ebrahimzadeh and S. Hariri, "Long-term outcomes of unilateral transtibial amputations.", *Military Medicine*, vol 174, no. 6, p. 593-597, 2009.

- [10] R. Gailey and P. Harsch, "Introduction to triathlon for lower limb amputee triathlete.", *Prosthetics and Orthotics International*, vol. 33, no. 3, p. 242-255, 2009.
- [11] R.S. Gailey, B. Springer, and M. Scherer, "Physical therapy for the polytrauma casualty with limb loss.", *Care of the Combat Amputee. Washington (DC): Borden Institute Textbooks of Military Medicine*, p. 451-492, 2009.
- [12] B.J. Hafner, J.E. Sanders, J. Czerniecki, and J. Fergason, "Energy storage and return prostheses: does patient perception correlate with biomechanical analysis?", *Clinical Biomechanics*, vol. 17, no. 5, p. 325-344, 2002.
- [13] E. Isakov, H. Burger, J. Krajnik, M. Gregoric, and C. Marincek, "Knee muscle activity during ambulation of trans-tibial amputees.", *Journal of Rehabilitation Medicine*, vol. 33, no. 5, p. 196-199, 2001.
- [14] S.P. Messier, "Osteoarthritis of the knee and associated factors of age and obesity: effects on gait.", *Medicine and Science in Sports and Exercise*, vol 26, no. 12, p. 1446, 1994.
- [15] L. Nolan and A. Lees, "The functional demands on the intact limb during walking for active trans-femoral and trans-tibial amputees.", *Prosthetics and Orthotics International*, vol. 24, no. 2, p.117-125, 2000.
- [16] D.C. Norvell, J.M. Czerniecki, G.E. Reiber, C. Maynard, J.A. Pecoraro, and N.S. Weiss, "The prevalence of knee pain and symptomatic knee osteoarthritis among veteran traumatic amputees and nonamputees.", *Archives of Physical Medicine and Rehabilitation*, vol. 86, no. 3, p. 487-493, 2005.
- [17] M. Pinzur, M. Asselmeier, and D. Smith, "Dynamic electromyography in active and limited walking below-knee amputees.", *Orthopedics*, vol. 14, no. 5, p. 535-7; discussion 537-8, 1991.
- [18] C.M. Powers, S. Rao, and J. Perry, "Knee kinetics in trans-tibial amputee gait.", *Gait & Posture*, vol. 8, no. 1, p. 1-7, 1998.
- [19] G.E. Reiber, L.V. McFarland, S. Hubbard, C. Maynard, D.K. Blough, J.M. Gambel, and D.G. Smith, "Servicemenbers and veterans with major traumatic limb loss from Vietnam

- war and OIF/OEF conflicts: survey methods, participants, and summary findings.”, *Journal of Rehabilitation Research and Development*, vol. 47, no. 4, p. 275-298, 2010.
- [20] C.B. Robbins, D.J. Vreeman, M.S. Sothmann, S.L. Wilson, and N.B. Oldridge, “A review of the long-term health outcomes associated with war-related amputation.”, *Military Medicine*, vol. 174, no. 6, p. 588-592, 2009.
- [21] D.J. Sanderson and P.E. Martin, “Lower extremity kinematic and kinetic adaptations in unilateral below-knee amputees during walking.”, *Gait & Posture*, vol. 6, no. 2, p. 126-136, 1997.
- [22] K. Sasaki and R.R. Neptune, “Differences in muscle function during walking and running at the same speed.”, *Journal of Biomechanics*, vol. 39, no. 11, p. 2005-2013, 2006.
- [23] L. Sharma, C. Lou, S. Cahue, and D.D. Dunlop, “The mechanism of the effect of obesity in knee osteoarthritis: the mediating role of malalignment.”, *Arthritis & Rheumatism*, vol. 43, no. 3, p. 568-575, 2000.
- [24] A.K. Silverman, N.P. Fey, A. Portilo, J.G. Walden, G. Bosker, and R.R. Neptune, “Compensatory mechanisms in below-knee amputee gait in response to increasing steady-state walking speeds.”, *Gait & Posture*, vol. 28, no. 4, p. 602-609, 2008.
- [25] R.D. Snyder, C.M. Powers, C. Fountain, and J. Perry, “The effect of five prosthetic feet on the gait and loading of the sound limb in dysvascular below-knee amputees.”, *Journal of Rehabilitation Research and Development*, vol. 32, p. 309-315, 1995.
- [26] P.A. Struyf, C.M. van Heugten, M.W. Hitters, and R.J. Smeets, “The prevalence of osteoarthritis of the intact hip and knee among traumatic leg amputees.”, *Archives of Physical Medicine and Rehabilitation*, vol. 90, no. 3, p. 440-446, 2009.
- [27] H.A. Underwood, C.D. Tokuno, and J.J. Eng, “A comparison of two prosthetic feet on the multi-joint and multi-plane kinetic gait compensations in individuals with a unilateral trans-tibial amputation.”, *Clinical Biomechanics*, vol. 19, no. 6, p. 609-616, 2004.
- [28] J.D. Ventura, G.K. Klute, and R.R. Neptune. “The effect of prosthetic ankle energy storage and return properties on muscle activity in below-knee amputee walking.”, *Gait & Posture*, vol. 33, no. 2, p. 220-226, 2011.

- [29] R. Versluys, P. Beyl, M. Van Damme, A. Desomer, R. Van Ham, and D. Lefeber, "Prosthetic feet: State-of-the-art review and the importance of mimicking human ankle-foot biomechanics.", *Disability & Rehabilitation: Assistive Technology*, vol. 4, no. 2, p. 65-75, 2009.
- [30] D.A. Winter and S.E. Sienko, "Biomechanics of below-knee amputee gait.", *Journal of Biomechanics*, vol. 21, no. 5, p. 361-367, 1988.
- [31] Össur. (n.d.). Vari-Flex®. Retrieved November 26, 2018, from <https://www.ossur.com/prosthetic-solutions/products/dynamic-solutions/vari-flex#for-users>
- [32] J.D. Gutierrez-Franco, "The effects of obesity on resultant knee joint loads for gait and cycling.", Published master's thesis, California Polytechnic State University, San Luis Obispo, 2016.
- [33] T.W. Lu, H.L. Chien, and H.L. Chen, "Joint loading in the lower extremities during elliptical exercise.", *Medicine and Science in Sports and Exercise*, vol. 39, no. 9, p. 1651-1658, 2007.
- [34] Motion Analysis Corporation, "Cortex version 7.0 reference manual.", 2017.
- [35] Motion Analysis Corporation, "KinTools RT user's manual.", 2013.
- [36] A. Leardini, Z. Sawacha, G. Paolini, S. Inghosio, R. Nativio, and M.G. Benedetti, "A new anatomically based protocol for gait analysis in children.", *Gait & Posture*, vol. 26, no. 4, p. 560-571, 2007.
- [37] G. Wu and P.R. Cavanagh, "ISB recommendations for standardization in the reporting of kinematic data.", *Journal of Biomechanics*, vol. 28, no. 10, p. 1257-1261, 1995.
- [38] Y.H. Kwon, "Theories and practices of motion analysis: multiple plates.", 1998. Retrieved from <http://www.kwon3d.com/theory/grf/multi.html> on November 26, 2018.
- [39] Y. Bing, D. Gabriel, L. Noble, and K.N. An, "Estimate of the optimum cutoff frequency for the butterworth low-pass digital filter.", *Journal of Applied Biomechanics*, vol. 15, p. 318-329, 1999.

- [40] Z.F. Lerner, D.J. Haight, M.S. DeMers, W.J. Board, and R.C. Browning, "The effects of walking speed on tibiofemoral loading estimated via musculoskeletal modeling.", *Journal of Applied Biomechanics*, vol. 30, p. 197-205, 2014.
- [41] K.C. Moision, D.R. Sumner, S. Shott, and D.E. Hurwitz, "Normalization of joint moments during gait: a comparison of two techniques.", *Journal of Biomechanics*, vol. 36, no. 4, p. 599-603, 2003.
- [42] M. Berchuck, T.P. Andriacchi, B.R. Bach, and B. Reider, "Gait adaptations by patients who have a deficient anterior cruciate ligament.", *Journal of Bone and Joint Surgery*, vol. 72-A, no. 6, p. 871-877, 1990.
- [43] L. Sharma, D.E. Hurwitz, E.J.M.A. Thonar, J.A. Sum, M.E. Lenz, D.D. Dunlop, T.J. Schnitzer, G. Kirwan-Mellis, and T.P. Andriacchi, "Knee adduction moment, serum hyaluronan level, and disease severity in medial tibiofemoral osteoarthritis", *Arthritis & Rheumatism*, vol. 41, no. 7, p. 1233-1240, 1998.
- [44] S.L. Tucker, V. Profiti, S.J. Hazelwood, and S.M. Klisch, "Knee angles with soft tissue artifact correction for normal weight and overweight subjects in gait and cycling.", Abstract presented at 8th World Congress of Biomechanics, 2018.
- [45] J. M. Skaro, S.J. Hazelwood, and S.M. Klisch, "Knee angle and axes crosstalk correction in gait, bicycling, and elliptical exercises using principal component analysis.", Abstract presented at 42nd Annual Meeting of the American Society of Biomechanics, 2018.
- [46] K. Dudum, "Placing markers in accordance with enhanced helen hayes.", Human Motion Biomechanics Lab Standard Operation Procedure, 2015.
- [47] P. Ruby, M.L. Hull, and D. Hawkins, "Three-dimensional knee joint loading during seated cycling.", *Journal of Biomechanics*, vol. 25, no. 1, p. 41-53, 1992.
- [48] R.R. Davis and M. L. Hull, "Measurement of pedal loading in bicycling: II. analysis and results.", *Journal of Biomechanics*, vol. 14, no. 12, p. 857-872, 1981.
- [49] K.M. Knutzen, W.L. McLaughlin, A.J. Lawson, B.S. Row, and L.T. Martin, "Influence of ramp position on joint biomechanics during elliptical trainer exercise.", *The Open Sports Sciences Journal*, vol. 3, p. 165-177, 2010.

- [50] M.J. Rogatzki, T.W. Kernozek, J.D. Willson, J.F. Greany, D.A. Hong, and J.P. Porcari, "Peak muscle activation, joint kinematics, and kinetics during elliptical and stepping movement pattern on a precor adaptive motion trainer.", *Research Quarterly for Exercise and Sport*, vol. 83, no.2, p. 1-8, 2012.

Appendix A: Averaged Results Summary Plots

A.1: Kinematics

Figure A.1: Mean ± 1 standard deviation dominant and non-dominant hip and knee flexion-extension (FE) angle for amputee participants in gait, cycling, and elliptical training.

Figure A.2: Mean $\pm$ 1 standard deviation dominant and non-dominant hip and knee flexion-extension (FE) angle for control participants in gait, cycling, and elliptical training.

A.2: Resultant Forces

Figure A.3: Mean ± 1 standard deviation dominant and non-dominant hip and knee compressive force for amputee participants in gait, cycling, and elliptical training.

Figure A.4: Mean ± 1 standard deviation dominant and non-dominant hip and knee compressive force for control participants in gait, cycling, and elliptical training.

Figure A.5: Mean ± 1 standard deviation dominant and non-dominant hip and knee anterior-posterior (AP) force for amputee participants in gait, cycling, and elliptical training.

Figure A.6: Mean ± 1 standard deviation dominant and non-dominant hip and knee anterior-posterior (AP) force for control participants in gait, cycling, and elliptical training.

Figure A.7: Mean ± 1 standard deviation dominant and non-dominant hip and knee lateral-medial (LM) force for amputee participants in gait, cycling, and elliptical training.

Figure A.8: Mean ± 1 standard deviation dominant and non-dominant hip and knee lateral-medial (LM) force for control participants in gait, cycling, and elliptical training.

A.3: Resultant Moments

Figure A.9: Mean ± 1 standard deviation dominant and non-dominant hip and knee extension-flexion (EF) moment for amputee participants in gait, cycling, and elliptical training.

Figure A.10: Mean ± 1 standard deviation dominant and non-dominant hip and knee extension-flexion (EF) moment for control participants in gait, cycling, and elliptical training.

Figure A.11: Mean ± 1 standard deviation dominant and non-dominant hip and knee adduction-abduction (AddAbd) moment for amputee participants in gait, cycling, and elliptical training.

Figure A.12: Mean ± 1 standard deviation dominant and non-dominant hip and knee adduction-abduction (AddAbd) moment for control participants in gait, cycling, and elliptical training.

Figure A.13: Mean ± 1 standard deviation dominant and non-dominant hip and knee external-internal rotation (ERIR) moment for amputee participants in gait, cycling, and elliptical training.

Figure A.14: Mean ± 1 standard deviation dominant and non-dominant hip and knee external-internal rotation (ERIR) moment for control participants in gait, cycling, and elliptical training.

Figure A.15: Mean ± 1 standard deviation dominant and non-dominant vertical reaction force for amputee (left) and control (right) participants in gait, cycling, and elliptical training.

Figure A.16: Mean $\pm$ standard deviation dominant and non-dominant anterior-posterior (AP) reaction force for amputee (left) and control (right) participants in gait, cycling, and elliptical training.

Figure A.17: Mean $\pm$ 1 standard deviation dominant and non-dominant lateral-medial (LM) reaction force for amputee (left) and control (right) participants in gait, cycling, and elliptical training.

Appendix B: Tables of Mean Maximum and Minimum Values

B.1: Kinematics

Table B.1: Mean and standard deviation (SD) maximum and minimum hip flexion-extension (FE) angle and corresponding times for the dominant and non-dominant legs of amputee and control participants in gait, cycling, and elliptical.

Parameter	Participant	Gait		Cycling		Elliptical	
		Mean	SD	Mean	SD	Mean	SD
Max Hip FE [deg]	Amp Dom	27.847	3.545	76.879	7.612	48.580	5.432
	Amp NonDom	30.961	2.586	82.177	7.025	59.453	4.976
	Con Dom	28.677	4.510	73.354	7.549	52.617	7.487
	Con NonDom	30.082	3.683	74.023	7.422	53.930	6.399
Max Hip FE Time [% Cycle]	Amp Dom	48.8	44.4	4.7	0.7	84.0	2.5
	Amp NonDom	71.6	37.1	4.6	0.8	78.9	2.0
	Con Dom	65.3	45.1	5.3	0.9	83.7	1.8
	Con NonDom	55.0	44.5	5.4	1.1	81.8	2.4
Min Hip FE [deg]	Amp Dom	-16.851	4.758	29.035	9.745	5.607	6.722
	Amp NonDom	-16.732	3.619	33.696	6.346	7.281	7.310
	Con Dom	-15.826	3.469	25.562	6.076	3.455	7.452
	Con NonDom	-15.196	2.366	26.367	6.002	5.599	8.974
Min Hip FE Time [% Cycle]	Amp Dom	54.2	2.1	52.6	1.3	39.7	3.2
	Amp NonDom	52.1	2.2	51.6	1.9	35.8	3.4
	Con Dom	52.7	1.5	54.4	1.0	41.7	1.4
	Con NonDom	52.9	0.9	54.0	0.7	41.0	1.5

Table B.2: Mean and standard deviation (SD) maximum and minimum knee flexion-extension (FE) angle and corresponding times for the dominant and non-dominant legs of amputee and control participants in gait, cycling, and elliptical.

Parameter	Participant	Gait		Cycling		Elliptical	
		Mean	SD	Mean	SD	Mean	SD
Max Knee FE [deg]	Amp Dom	54.764	5.104	104.657	4.525	73.774	5.252
	Amp NonDom	64.211	5.848	113.443	4.804	85.948	6.795
	Con Dom	59.226	3.359	108.973	3.527	74.844	5.196
	Con NonDom	61.404	4.504	109.907	5.072	77.376	7.201
Max Knee FE Time [% Cycle]	Amp Dom	74.4	1.1	95.2	0.8	69.8	2.0
	Amp NonDom	72.3	3.5	94.8	0.9	68.6	2.1
	Con Dom	73.1	1.5	95.6	0.7	71.7	1.4
	Con NonDom	73.4	1.3	95.7	0.7	70.8	2.0
Min Knee FE [deg]	Amp Dom	-2.358	4.039	33.560	6.905	9.676	4.817
	Amp NonDom	-0.904	3.024	42.699	8.553	10.185	9.238
	Con Dom	0.920	3.440	37.056	6.274	11.536	7.058
	Con NonDom	1.477	3.987	37.350	8.111	12.093	9.818
Min Knee FE Time [% Cycle]	Amp Dom	69.0	30.2	45.3	0.8	27.3	5.7
	Amp NonDom	58.3	36.0	45.4	1.0	28.2	5.1
	Con Dom	80.4	27.2	45.8	0.6	31.1	2.5
	Con NonDom	74.6	29.6	45.8	0.8	30.1	2.8

B.2: Resultant Forces

Table B.3: Mean and standard deviation (SD) maximum and minimum hip compressive (C) force and corresponding times for the dominant and non-dominant legs of amputee and control participants in gait, cycling, and elliptical.

Parameter	Participant	Gait		Cycling		Elliptical	
		Mean	SD	Mean	SD	Mean	SD
Max Hip C Force [N/N]	Amp Dom	0.919	0.076	0.118	0.019	0.775	0.067
	Amp NonDom	0.849	0.075	0.115	0.027	0.709	0.093
	Con Dom	0.962	0.037	0.114	0.016	0.689	0.087
	Con NonDom	0.911	0.050	0.117	0.013	0.682	0.083
Max Hip C Force Time [% Cycle]	Amp Dom	30.6	17.7	64.8	8.5	11.3	1.9
	Amp NonDom	20.7	12.0	62.4	11.1	13.4	4.5
	Con Dom	26.6	17.6	64.6	12.7	14.1	2.0
	Con NonDom	33.2	16.8	66.4	12.5	14.6	2.6
Min Hip C Force [N/N]	Amp Dom	-0.248	0.022	-0.017	0.024	-0.074	0.063
	Amp NonDom	-0.277	0.023	-0.015	0.010	-0.125	0.037
	Con Dom	-0.267	0.023	-0.012	0.018	-0.060	0.077
	Con NonDom	-0.271	0.024	-0.005	0.010	-0.062	0.074
Min Hip C Force Time [% Cycle]	Amp Dom	66.8	8.2	12.8	4.9	61.0	2.5
	Amp NonDom	63.9	2.6	9.3	2.1	60.9	2.2
	Con Dom	66.6	11.4	15.1	3.7	63.5	2.5
	Con NonDom	63.1	1.3	13.2	2.0	63.1	3.9

Table B.4: Mean and standard deviation (SD) maximum and minimum knee compressive (C) force and corresponding times for the dominant and non-dominant legs of amputee and control participants in gait, cycling, and elliptical.

Parameter	Participant	Gait		Cycling		Elliptical	
		Mean	SD	Mean	SD	Mean	SD
Max Knee C Force [N/N]	Amp Dom	1.068	0.078	0.103	0.035	0.942	0.077
	Amp NonDom	1.004	0.085	0.084	0.019	0.868	0.104
	Con Dom	1.097	0.045	0.107	0.027	0.845	0.077
	Con NonDom	1.053	0.063	0.102	0.015	0.842	0.077
Max Knee C Force Time [% Cycle]	Amp Dom	34.0	17.9	21.7	9.3	11.2	1.5
	Amp NonDom	21.4	12.9	28.1	33.3	13.0	4.4
	Con Dom	26.4	17.6	21.7	3.6	13.8	2.0
	Con NonDom	33.4	17.0	25.7	8.7	14.0	2.2
Min Knee C Force [N/N]	Amp Dom	-0.098	0.012	-0.002	0.023	0.042	0.038
	Amp NonDom	-0.100	0.012	-0.007	0.029	0.039	0.027
	Con Dom	-0.097	0.008	0.022	0.015	0.054	0.052
	Con NonDom	-0.098	0.009	0.021	0.018	0.061	0.045
Min Knee C Force Time [% Cycle]	Amp Dom	76.8	14.4	66.2	3.9	60.3	2.9
	Amp NonDom	71.1	15.1	60.9	7.5	61.0	5.1
	Con Dom	67.0	11.6	66.4	9.7	61.2	4.0
	Con NonDom	73.0	14.2	64.2	13.5	62.6	4.1

Table B.5: Mean and standard deviation (SD) maximum and minimum hip anterior-posterior (AP) force and corresponding times for the dominant and non-dominant legs of amputee and control participants in gait, cycling, and elliptical.

Parameter	Participant	Gait		Cycling		Elliptical	
		Mean	SD	Mean	SD	Mean	SD
Max Hip AP Force [N/N]	Amp Dom	0.190	0.039	0.129	0.016	0.034	0.021
	Amp NonDom	0.214	0.065	0.152	0.032	0.044	0.032
	Con Dom	0.224	0.031	0.102	0.009	0.040	0.037
	Con NonDom	0.218	0.020	0.099	0.019	0.036	0.037
Max Hip AP Force Time [% Cycle]	Amp Dom	48.5	1.7	69.2	4.7	41.0	14.3
	Amp NonDom	45.5	2.6	51.0	7.3	53.3	20.0
	Con Dom	47.1	1.1	63.0	13.4	37.6	11.9
	Con NonDom	45.9	1.9	60.1	11.9	42.1	13.6
Min Hip AP Force [N/N]	Amp Dom	-0.273	0.063	-0.002	0.019	-0.214	0.062
	Amp NonDom	-0.162	0.054	-0.016	0.018	-0.189	0.049
	Con Dom	-0.241	0.062	-0.012	0.015	-0.180	0.051
	Con NonDom	-0.244	0.058	-0.010	0.011	-0.207	0.053
Min Hip AP Force Time [% Cycle]	Amp Dom	11.1	0.7	8.4	4.6	67.2	41.9
	Amp NonDom	12.5	1.4	13.3	29.8	42.9	47.7
	Con Dom	11.4	1.6	9.5	3.1	49.8	50.0
	Con NonDom	11.4	1.0	9.7	4.6	59.3	49.8

Table B.6: Mean and standard deviation (SD) maximum and minimum knee anterior-posterior (AP) force and corresponding times for the dominant and non-dominant legs of amputee and control participants in gait, cycling, and elliptical.

Parameter	Participant	Gait		Cycling		Elliptical	
		Mean	SD	Mean	SD	Mean	SD
Max Knee AP Force [N/N]	Amp Dom	0.329	0.048	0.040	0.023	0.218	0.044
	Amp NonDom	0.301	0.049	0.042	0.011	0.168	0.051
	Con Dom	0.346	0.042	0.044	0.017	0.213	0.034
	Con NonDom	0.314	0.035	0.030	0.013	0.206	0.034
Max Knee AP Force Time [% Cycle]	Amp Dom	47.0	11.7	24.3	27.8	48.5	32.1
	Amp NonDom	50.4	2.0	73.0	33.4	42.6	28.9
	Con Dom	42.1	14.3	24.8	26.3	38.3	23.4
	Con NonDom	45.8	10.2	23.6	27.3	47.0	35.0
Min Knee AP Force [N/N]	Amp Dom	-0.096	0.023	-0.008	0.007	0.065	0.042
	Amp NonDom	-0.097	0.025	-0.004	0.006	0.008	0.039
	Con Dom	-0.088	0.027	-0.004	0.005	0.042	0.023
	Con NonDom	-0.081	0.024	-0.008	0.012	0.027	0.045
Min Knee AP Force Time [% Cycle]	Amp Dom	49.7	51.4	61.4	16.3	60.9	19.8
	Amp NonDom	51.6	47.3	42.5	21.3	44.7	30.6
	Con Dom	40.0	50.6	63.6	19.3	52.7	17.3
	Con NonDom	40.2	50.4	61.3	19.6	55.2	19.4

Table B.7: Mean and standard deviation (SD) maximum and minimum hip lateral-medial (LM) force and corresponding times for the dominant and non-dominant legs of amputee and control participants in gait, cycling, and elliptical.

Parameter	Participant	Gait		Cycling		Elliptical	
		Mean	SD	Mean	SD	Mean	SD
Max Hip LM Force [N/N]	Amp Dom	0.126	0.048	0.028	0.010	0.060	0.036
	Amp NonDom	0.114	0.045	0.027	0.010	0.053	0.021
	Con Dom	0.122	0.040	0.036	0.013	0.039	0.031
	Con NonDom	0.104	0.037	0.030	0.007	0.045	0.025
Max Hip LM Force Time [% Cycle]	Amp Dom	25.2	16.6	38.7	27.8	22.4	22.0
	Amp NonDom	35.2	18.5	40.7	29.6	31.9	28.4
	Con Dom	37.9	13.4	57.5	23.8	30.8	21.2
	Con NonDom	37.2	17.6	60.4	22.3	29.2	29.0
Min Hip LM Force [N/N]	Amp Dom	-0.030	0.012	0.001	0.012	-0.011	0.020
	Amp NonDom	-0.035	0.013	-0.002	0.008	-0.013	0.034
	Con Dom	-0.023	0.017	0.005	0.007	-0.020	0.031
	Con NonDom	-0.020	0.012	0.006	0.005	-0.008	0.021
Min Hip LM Force Time [% Cycle]	Amp Dom	70.8	16.3	51.7	20.8	58.1	28.3
	Amp NonDom	70.9	14.3	51.0	29.0	39.6	25.0
	Con Dom	51.0	26.8	54.9	39.1	58.4	33.3
	Con NonDom	68.2	12.9	81.4	33.5	79.4	18.1

Table B.8: Mean and standard deviation (SD) maximum and minimum knee lateral-medial (LM) force and corresponding times for the dominant and non-dominant legs of amputee and control participants in gait, cycling, and elliptical.

Parameter	Participant	Gait		Cycling		Elliptical	
		Mean	SD	Mean	SD	Mean	SD
Max Knee LM Force [N/N]	Amp Dom	0.092	0.027	0.012	0.008	0.048	0.028
	Amp NonDom	0.094	0.031	0.012	0.009	0.035	0.027
	Con Dom	0.112	0.027	0.011	0.008	0.037	0.020
	Con NonDom	0.111	0.027	0.018	0.008	0.052	0.032
Max Knee LM Force Time [% Cycle]	Amp Dom	35.4	16.6	27.5	12.8	29.3	36.7
	Amp NonDom	35.4	25.2	41.3	17.7	30.2	28.2
	Con Dom	39.4	12.4	29.3	19.8	28.9	29.1
	Con NonDom	39.7	12.0	24.6	12.6	11.9	4.2
Min Knee LM Force [N/N]	Amp Dom	-0.030	0.017	-0.004	0.004	-0.039	0.024
	Amp NonDom	-0.024	0.017	-0.005	0.007	-0.029	0.030
	Con Dom	-0.017	0.005	-0.006	0.005	-0.023	0.014
	Con NonDom	-0.016	0.009	-0.002	0.004	-0.020	0.014
Min Knee LM Force Time [% Cycle]	Amp Dom	61.2	4.7	48.6	33.5	52.0	19.4
	Amp NonDom	57.6	25.1	80.7	25.1	58.7	30.6
	Con Dom	58.7	1.9	63.7	23.1	53.4	19.3
	Con NonDom	56.0	19.8	54.3	45.4	65.1	20.6

B.3: Resultant Moments

Table B.9: Mean and standard deviation (SD) maximum and minimum hip extension-flexion (EF) moment and corresponding times for the dominant and non-dominant legs of amputee and control participants in gait, cycling, and elliptical.

Parameter	Participant	Gait		Cycling		Elliptical	
		Mean	SD	Mean	SD	Mean	SD
Max Hip EF Moment [N*m/N*m]	Amp Dom	0.0470	0.0087	0.0076	0.0025	0.0335	0.0161
	Amp NonDom	0.0431	0.0102	0.0105	0.0030	0.0522	0.0136
	Con Dom	0.0388	0.0115	0.0090	0.0029	0.0313	0.0172
	Con NonDom	0.0329	0.0097	0.0100	0.0041	0.0405	0.0206
Max Hip EF Moment Time [% Cycle]	Amp Dom	22.6	41.0	7.2	3.3	61.2	47.6
	Amp NonDom	46.1	45.5	15.7	29.7	13.3	29.0
	Con Dom	11.9	31.0	11.9	9.2	41.1	48.2
	Con NonDom	70.4	47.7	10.9	7.3	24.0	40.1
Min Hip EF Moment [N*m/N*m]	Amp Dom	-0.0370	0.0103	-0.0143	0.0043	-0.0233	0.0082
	Amp NonDom	-0.0393	0.0155	-0.0200	0.0076	-0.0032	0.0047
	Con Dom	-0.0388	0.0102	-0.0088	0.0022	-0.0155	0.0064
	Con NonDom	-0.0416	0.0049	-0.0072	0.0052	-0.0152	0.0082
Min Hip EF Moment Time [% Cycle]	Amp Dom	51.2	3.6	69.1	5.2	52.7	6.1
	Amp NonDom	50.7	5.7	52.9	4.3	61.3	13.2
	Con Dom	48.3	1.1	71.5	8.5	55.4	9.8
	Con NonDom	47.6	2.4	67.5	9.9	52.7	12.1

Table B.10: Mean and standard deviation (SD) maximum and minimum knee extension-flexion (EF) moment and corresponding times for the dominant and non-dominant legs of amputee and control participants in gait, cycling, and elliptical.

Parameter	Participant	Gait		Cycling		Elliptical	
		Mean	SD	Mean	SD	Mean	SD
Max Knee EF Moment [N*m/N*m]	Amp Dom	0.0451	0.0121	0.0093	0.0054	0.0324	0.0067
	Amp NonDom	0.0072	0.0030	0.0100	0.0037	0.0130	0.0105
	Con Dom	0.0362	0.0212	0.0096	0.0037	0.0280	0.0073
	Con NonDom	0.0403	0.0163	0.0068	0.0035	0.0259	0.0040
Max Knee EF Moment Time [% Cycle]	Amp Dom	13.1	2.0	32.6	33.4	68.8	32.2
	Amp NonDom	44.4	24.0	86.6	22.5	77.1	28.3
	Con Dom	12.6	1.6	42.9	37.0	68.8	37.4
	Con NonDom	12.8	1.6	26.5	24.9	83.8	15.1
Min Knee EF Moment [N*m/N*m]	Amp Dom	-0.0251	0.0072	-0.0068	0.0030	-0.0093	0.0104
	Amp NonDom	-0.0225	0.0060	-0.0021	0.0015	-0.0200	0.0078
	Con Dom	-0.0238	0.0083	-0.0063	0.0022	-0.0075	0.0079
	Con NonDom	-0.0202	0.0055	-0.0069	0.0042	-0.0105	0.0094
Min Knee EF Moment Time [% Cycle]	Amp Dom	54.6	49.8	45.8	2.8	27.5	5.2
	Amp NonDom	74.7	30.8	38.8	5.2	21.9	7.0
	Con Dom	72.8	37.1	45.8	2.6	30.8	4.2
	Con NonDom	72.8	37.2	47.0	2.2	26.2	6.4

Table B.11: Mean and standard deviation (SD) maximum and minimum hip adduction-abduction (AddAbd) moment and corresponding times for the dominant and non-dominant legs of amputee and control participants in gait, cycling, and elliptical.

Parameter	Participant	Gait		Cycling		Elliptical	
		Mean	SD	Mean	SD	Mean	SD
Max Hip AddAbd Moment [N*m/N*m]	Amp Dom	0.0530	0.0160	0.0056	0.0033	0.0265	0.0185
	Amp NonDom	0.0431	0.0109	0.0065	0.0053	0.0140	0.0102
	Con Dom	0.0557	0.0094	0.0052	0.0032	0.0149	0.0099
	Con NonDom	0.0486	0.0094	0.0067	0.0041	0.0200	0.0124
Max Hip AddAbd Moment Time [% Cycle]	Amp Dom	27.1	18.2	37.4	19.6	14.3	14.6
	Amp NonDom	34.8	14.0	39.5	21.2	20.9	19.8
	Con Dom	39.9	14.0	32.8	16.3	18.0	14.0
	Con NonDom	33.3	16.3	26.6	13.4	14.4	6.9
Min Hip AddAbd Moment [N*m/N*m]	Amp Dom	-0.0094	0.0032	-0.0012	0.0027	-0.0082	0.0078
	Amp NonDom	-0.0071	0.0033	-0.0003	0.0018	-0.0051	0.0058
	Con Dom	-0.0094	0.0055	-0.0011	0.0018	-0.0084	0.0088
	Con NonDom	-0.0061	0.0027	-0.0009	0.0012	-0.0059	0.0034
Min Hip AddAbd Moment Time [% Cycle]	Amp Dom	68.1	11.7	54.7	23.9	52.4	21.4
	Amp NonDom	61.1	23.4	59.5	32.5	52.6	35.3
	Con Dom	47.5	41.9	37.4	30.7	68.7	25.2
	Con NonDom	48.4	33.9	58.8	37.5	76.6	18.5

Table B.12: Mean and standard deviation (SD) maximum and minimum knee adduction-abduction (AddAbd) moment and corresponding times for the dominant and non-dominant legs of amputee and control participants in gait, cycling, and elliptical.

Parameter	Participant	Gait		Cycling		Elliptical	
		Mean	SD	Mean	SD	Mean	SD
Max Knee AddAbd Moment [N*m/N*m]	Amp Dom	0.0250	0.0098	0.0020	0.0023	0.0105	0.0090
	Amp NonDom	0.0228	0.0095	0.0031	0.0033	0.0084	0.0077
	Con Dom	0.0295	0.0054	0.0018	0.0019	0.0061	0.0036
	Con NonDom	0.0267	0.0072	0.0034	0.0028	0.0097	0.0075
Max Knee AddAbd Moment Time [% Cycle]	Amp Dom	40.7	13.6	22.1	19.7	29.5	36.7
	Amp NonDom	33.9	24.8	30.6	14.4	29.0	28.5
	Con Dom	40.3	13.7	31.3	21.8	18.9	16.2
	Con NonDom	43.6	9.9	23.9	11.2	11.5	4.1
Min Knee AddAbd Moment [N*m/N*m]	Amp Dom	-0.0046	0.0019	-0.0027	0.0012	-0.0087	0.0057
	Amp NonDom	-0.0029	0.0012	-0.0017	0.0019	-0.0063	0.0066
	Con Dom	-0.0031	0.0010	-0.0026	0.0011	-0.0054	0.0042
	Con NonDom	-0.0031	0.0021	-0.0018	0.0015	-0.0061	0.0032
Min Knee AddAbd Moment Time [% Cycle]	Amp Dom	62.0	17.7	61.7	25.6	66.3	22.9
	Amp NonDom	58.1	30.0	75.3	22.9	62.0	31.4
	Con Dom	53.5	26.9	62.8	20.5	51.4	28.6
	Con NonDom	47.2	30.6	48.3	36.4	72.7	23.9

Table B.13: Mean and standard deviation (SD) maximum and minimum hip external-internal rotation (ERIR) moment and corresponding times for the dominant and non-dominant legs of amputee and control participants in gait, cycling, and elliptical.

Parameter	Participant	Gait		Cycling		Elliptical	
		Mean	SD	Mean	SD	Mean	SD
Max Hip ERIR Moment [N*m/N*m]	Amp Dom	0.0100	0.0044	0.0018	0.0013	0.0033	0.0027
	Amp NonDom	0.0035	0.0012	0.0023	0.0021	0.0018	0.0014
	Con Dom	0.0081	0.0038	0.0015	0.0015	0.0019	0.0013
	Con NonDom	0.0083	0.0041	0.0028	0.0026	0.0019	0.0016
Max Hip ERIR Moment Time [% Cycle]	Amp Dom	13.4	2.0	16.1	8.0	54.8	45.4
	Amp NonDom	49.4	24.8	34.3	24.5	24.5	23.5
	Con Dom	21.5	27.6	34.5	28.5	46.8	37.5
	Con NonDom	22.5	27.3	20.2	6.4	43.3	41.8
Min Hip ERIR Moment [N*m/N*m]	Amp Dom	-0.0071	0.0040	-0.0024	0.0009	-0.0048	0.0019
	Amp NonDom	-0.0070	0.0026	-0.0007	0.0014	-0.0032	0.0022
	Con Dom	-0.0086	0.0019	-0.0023	0.0013	-0.0045	0.0027
	Con NonDom	-0.0082	0.0019	-0.0015	0.0011	-0.0048	0.0023
Min Hip ERIR Moment Time [% Cycle]	Amp Dom	47.9	6.9	64.4	18.1	60.8	22.4
	Amp NonDom	49.5	14.6	68.4	30.1	55.6	33.9
	Con Dom	44.0	1.1	69.3	16.4	70.5	16.2
	Con NonDom	44.0	2.0	53.4	40.5	72.7	17.2

Table B.14: Mean and standard deviation (SD) maximum and minimum knee external-internal rotation (ERIR) moment and corresponding times for the dominant and non-dominant legs of amputee and control participants in gait, cycling, and elliptical.

Parameter	Participant	Gait		Cycling		Elliptical	
		Mean	SD	Mean	SD	Mean	SD
Max Knee ERIR Moment [N*m/N*m]	Amp Dom	0.0021	0.0008	0.0003	0.0004	0.0026	0.0020
	Amp NonDom	0.0016	0.0013	0.0002	0.0003	0.0020	0.0015
	Con Dom	0.0017	0.0013	0.0003	0.0004	0.0023	0.0015
	Con NonDom	0.0019	0.0008	0.0001	0.0004	0.0019	0.0005
Max Knee ERIR Moment Time [% Cycle]	Amp Dom	39.2	42.2	46.7	36.0	73.8	17.5
	Amp NonDom	70.9	40.6	64.3	36.5	44.4	30.5
	Con Dom	43.9	48.4	54.6	37.9	55.2	26.4
	Con NonDom	64.1	46.4	44.1	38.7	70.3	23.1
Min Knee ERIR Moment [N*m/N*m]	Amp Dom	-0.0090	0.0034	-0.0010	0.0006	-0.0051	0.0023
	Amp NonDom	-0.0070	0.0028	-0.0007	0.0007	-0.0022	0.0014
	Con Dom	-0.0117	0.0026	-0.0007	0.0008	-0.0024	0.0019
	Con NonDom	-0.0105	0.0024	-0.0010	0.0007	-0.0031	0.0011
Min Knee ERIR Moment Time [% Cycle]	Amp Dom	48.4	1.6	37.0	15.4	12.9	5.5
	Amp NonDom	46.5	6.4	55.4	24.1	30.8	25.0
	Con Dom	46.0	1.1	37.7	15.2	17.8	8.2
	Con NonDom	46.0	1.6	35.3	11.1	18.0	14.7

B.4: Reaction Forces

Table B.15: Mean and standard deviation (SD) maximum and minimum vertical (V) reaction force and corresponding times for the dominant and non-dominant legs of amputee and control participants in gait, cycling, and elliptical.

Parameter	Participant	Gait		Cycling		Elliptical	
		Mean	SD	Mean	SD	Mean	SD
Max V Reaction Force [N/N]	Amp Dom	1.162	0.085	0.174	0.036	1.019	0.071
	Amp NonDom	1.077	0.082	0.155	0.023	0.941	0.099
	Con Dom	1.195	0.038	0.183	0.020	0.919	0.083
	Con NonDom	1.147	0.057	0.177	0.019	0.914	0.082
Max V Reaction Force Time [% Cycle]	Amp Dom	34.4	17.8	37.6	8.8	11.3	1.6
	Amp NonDom	29.5	16.5	43.2	5.1	13.1	4.3
	Con Dom	30.2	17.5	37.6	8.6	14.0	2.1
	Con NonDom	33.5	16.8	36.3	9.6	14.1	2.1
Min V Reaction Force [N/N]	Amp Dom	0	0	0.045	0.012	0.139	0.056
	Amp NonDom	0	0	0.055	0.014	0.095	0.038
	Con Dom	0	0	0.045	0.021	0.145	0.076
	Con NonDom	0	0	0.047	0.022	0.146	0.062
Min V Reaction Force Time [% Cycle]	Amp Dom	64.4	1.9	40.8	49.1	63.1	3.9
	Amp NonDom	61.1	2.1	48.4	40.8	61.9	6.0
	Con Dom	62.4	1.3	31.1	44.9	62.6	6.1
	Con NonDom	62.8	1.3	12.8	30.3	63.0	5.7

Table B.16: Mean and standard deviation (SD) maximum and minimum anterior-posterior (AP) reaction force and corresponding times for the dominant and non-dominant legs of amputee and control participants in gait, cycling, and elliptical.

Parameter	Participant	Gait		Cycling		Elliptical	
		Mean	SD	Mean	SD	Mean	SD
Max AP Reaction Force [N/N]	Amp Dom	0.236	0.037	-0.002	0.014	0.047	0.020
	Amp NonDom	0.157	0.020	-0.010	0.018	0.041	0.012
	Con Dom	0.238	0.019	-0.007	0.013	0.057	0.022
	Con NonDom	0.234	0.020	-0.004	0.014	0.053	0.016
Max AP Reaction Force Time [% Cycle]	Amp Dom	53.0	1.6	52.8	27.5	35.4	6.6
	Amp NonDom	53.1	1.8	52.9	17.2	42.4	11.5
	Con Dom	52.1	1.3	46.2	18.0	34.1	7.8
	Con NonDom	52.3	1.4	54.8	26.3	38.7	5.7
Min AP Reaction Force [N/N]	Amp Dom	-0.182	0.037	-0.063	0.023	-0.109	0.021
	Amp NonDom	-0.139	0.046	-0.052	0.015	-0.085	0.028
	Con Dom	-0.203	0.031	-0.067	0.027	-0.096	0.031
	Con NonDom	-0.195	0.034	-0.053	0.021	-0.095	0.025
Min AP Reaction Force Time [% Cycle]	Amp Dom	9.8	1.2	22.2	2.0	70.8	36.6
	Amp NonDom	11.9	4.6	48.4	35.5	91.4	8.0
	Con Dom	10.0	1.8	22.3	2.1	88.5	3.8
	Con NonDom	9.6	1.8	22.4	2.2	86.8	7.5

Table B.17: Mean and standard deviation (SD) maximum and minimum lateral-medial (LM) reaction force and corresponding times for the dominant and non-dominant legs of amputee and control participants in gait, cycling, and elliptical.

Parameter	Participant	Gait		Cycling		Elliptical	
		Mean	SD	Mean	SD	Mean	SD
Max LM Reaction Force [N/N]	Amp Dom	0.031	0.014	0.001	0.003	0.002	0.013
	Amp NonDom	0.016	0.014	-0.003	0.003	-0.008	0.008
	Con Dom	0.019	0.011	0.002	0.006	-0.003	0.004
	Con NonDom	0.014	0.007	-0.001	0.004	-0.005	0.006
Max LM Reaction Force Time [% Cycle]	Amp Dom	2.8	0.4	67.6	11.0	62.5	7.8
	Amp NonDom	37.6	47.0	46.8	36.2	60.4	10.0
	Con Dom	13.5	24.0	59.1	36.0	57.0	9.5
	Con NonDom	17.7	33.6	39.8	42.6	64.2	8.0
Min LM Reaction Force [N/N]	Amp Dom	-0.071	0.014	-0.026	0.009	-0.071	0.017
	Amp NonDom	-0.057	0.014	-0.014	0.006	-0.071	0.024
	Con Dom	-0.066	0.013	-0.022	0.010	-0.071	0.022
	Con NonDom	-0.061	0.012	-0.024	0.006	-0.059	0.012
Min LM Reaction Force Time [% Cycle]	Amp Dom	33.8	17.8	25.8	5.9	28.3	38.2
	Amp NonDom	25.0	13.6	41.8	21.1	14.0	10.0
	Con Dom	19.3	13.6	34.2	23.0	17.4	6.9
	Con NonDom	20.7	12.5	26.5	9.3	19.4	26.1

B.5: Gait Parameters

Table B.18: Mean and standard deviation (SD) first and second peak knee flexion-extension (FE) angle and corresponding times for the dominant and non-dominant legs of amputee and control participants in gait.

Parameter	Participant	Peak 1		Peak 2	
		Mean	SD	Mean	SD
Knee FE Angle [deg]	Amp Dom	17.39	4.12	54.76	5.10
	Amp NonDom	10.92	7.32	64.21	5.85
	Con Dom	19.43	4.17	59.23	3.36
	Con NonDom	20.07	6.46	61.40	4.50
Knee FE Angle Time [% Cycle]	Amp Dom	13.1	1.7	74.4	1.1
	Amp NonDom	17.9	2.5	72.3	3.5
	Con Dom	14.2	1.4	73.1	1.5
	Con NonDom	14.0	1.4	73.4	1.3

Table B.19: Mean and standard deviation (SD) first and second peak vertical (V) reaction force and corresponding times for the dominant and non-dominant legs of amputee and control participants in gait.

Parameter	Participant	Peak 1		Peak 2	
		Mean	SD	Mean	SD
V Reaction Force [N/N]	Amp Dom	1.126	0.078	1.140	0.092
	Amp NonDom	1.056	0.088	1.028	0.063
	Con Dom	1.148	0.069	1.148	0.061
	Con NonDom	1.086	0.087	1.113	0.050
V Reaction Force Time [% Cycle]	Amp Dom	13.7	1.1	47.7	2.9
	Amp NonDom	15.1	2.8	45.1	3.0
	Con Dom	13.5	1.4	46.8	0.8
	Con NonDom	13.6	1.4	46.8	1.5

Table B.20: Mean and standard deviation (SD) walking speeds for amputee and control participants.

Participant	Walking Speed [m/s]	
	Mean	SD
Amputee	1.26	0.17
Control	1.29	0.08

Appendix C: Results Bar Graphs

C.1: Kinematics Two-Factor Repeated Measures ANOVA Results

Figure C.1: Mean maximum and minimum hip flexion-extension (FE) angle and corresponding time in percent cycle for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. + = significance across leg. * = significance across participant type. ✓ = significance across exercise type. Refer to Appendix B for p-values. Duplicated significance markers indicate significance within 90%. Whiskers indicate ± 1 standard deviation.

Figure C.2: Mean maximum and minimum knee flexion-extension (FE) angle and corresponding time in percent cycle for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. + = significance across leg. * = significance across participant type. ✓ = significance across exercise type. Refer to Appendix B for p-values. Duplicated significance markers indicate significance within 90%. Whiskers indicate ± 1 standard deviation.

C.2: Resultant Forces Two-Factor Repeated Measures ANOVA Results

Figure C.3: Mean maximum and minimum hip compressive force and corresponding time in percent cycle for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. + = significance across leg. * = significance across participant type. ✓ = significance across exercise type. Refer to Appendix B for p-values. Duplicated significance markers indicate significance within 90%. Whiskers indicate ± 1 standard deviation.

Figure C.4: Mean maximum and minimum knee compressive force and corresponding time in percent cycle for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. + = significance across leg. * = significance across participant type. ✓ = significance across exercise type. Refer to Appendix B for p-values. Duplicated significance markers indicate significance within 90%. Whiskers indicate ± 1 standard deviation.

Figure C.5: Mean maximum and minimum hip anterior-posterior (AP) force and corresponding time in percent cycle for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. + = significance across leg. * = significance across participant type. ✓ = significance across exercise type. Refer to Appendix B for p-values. Duplicated significance markers indicate significance within 90%. Whiskers indicate ± 1 standard deviation.

Figure C.6: Mean maximum and minimum knee anterior-posterior (AP) force and corresponding time in percent cycle for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. + = significance across leg. * = significance across participant type. ✓ = significance across exercise type. Refer to Appendix B for p-values. Duplicated significance markers indicate significance within 90%. Whiskers indicate ± 1 standard deviation.

Figure C.7: Mean maximum and minimum hip lateral-medial (LM) force and corresponding time in percent cycle for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. + = significance across leg. * = significance across participant type. ✓ = significance across exercise type. Refer to Appendix B for p-values. Duplicated significance markers indicate significance within 90%. Whiskers indicate ± 1 standard deviation.

Figure C.8: Mean maximum and minimum knee lateral-medial (LM) force and corresponding time in percent cycle for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. + = significance across leg. * = significance across participant type. ✓ = significance across exercise type. Refer to Appendix B for p-values. Duplicated significance markers indicate significance within 90%. Whiskers indicate ± 1 standard deviation.

C.3: Resultant Moments Two-Factor Repeated Measures ANOVA Results

Figure C.9: Mean maximum and minimum hip extension-flexion (EF) moment and corresponding time in percent cycle for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. + = significance across leg. * = significance across participant type. ✓ = significance across exercise type. Refer to Appendix B for p-values. Duplicated significance markers indicate significance within 90%. Whiskers indicate ± 1 standard deviation.

Figure C.10: Mean maximum and minimum knee extension-flexion (EF) moment and corresponding time in percent cycle for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. + = significance across leg. * = significance across participant type. ✓ = significance across exercise type. Refer to Appendix B for p-values. Duplicated significance markers indicate significance within 90%. Whiskers indicate ± 1 standard deviation.

Figure C.11: Mean maximum and minimum hip adduction-abduction (AddAbd) moment and corresponding time in percent cycle for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. + = significance across leg. * = significance across participant type. ✓ = significance across exercise type. Refer to Appendix B for p-values. Duplicated significance markers indicate significance within 90%. Whiskers indicate ± 1 standard deviation.

Figure C.12: Mean maximum and minimum knee adduction-abduction (AddAbd) moment and corresponding time in percent cycle for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. + = significance across leg. * = significance across participant type. ✓ = significance across exercise type. Refer to Appendix B for p-values. Duplicated significance markers indicate significance within 90%. Whiskers indicate ± 1 standard deviation.

Figure C.13: Mean maximum and minimum hip external-internal rotation (ERIR) moment and corresponding time in percent cycle for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. + = significance across leg. * = significance across participant type. ✓ = significance across exercise type. Refer to Appendix B for p-values. Duplicated significance markers indicate significance within 90%. Whiskers indicate ± 1 standard deviation.

Figure C.14: Mean maximum and minimum knee external-internal rotation (ERIR) moment and corresponding time in percent cycle for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. + = significance across leg. * = significance across participant type. ✓ = significance across exercise type. Refer to Appendix B for p-values. Duplicated significance markers indicate significance within 90%. Whiskers indicate ± 1 standard deviation.

C.4: Reaction Forces Two-Factor Repeated Measures ANOVA Results

Figure C.15: Mean maximum and minimum vertical reaction force and corresponding time in percent cycle for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. + = significance across leg. * = significance across participant type. ✓ = significance across exercise type. Refer to Appendix B for p-values. Duplicated significance markers indicate significance within 90%. Whiskers indicate ± 1 standard deviation.

Figure C.16: Mean maximum and minimum anterior-posterior (AP) reaction force and corresponding time in percent cycle for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. + = significance across leg. * = significance across participant type. ✓ = significance across exercise type. Refer to Appendix B for p-values. Duplicated significance markers indicate significance within 90%. Whiskers indicate ± 1 standard deviation.

Figure C.17: Mean maximum and minimum lateral-medial (LM) reaction force and corresponding time in percent cycle for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. + = significance across leg. * = significance across participant type. ✓ = significance across exercise type. Refer to Appendix B for p-values. Duplicated significance markers indicate significance within 90%. Whiskers indicate ± 1 standard deviation.

C.5: Two-Sample t-Test Results

Figure C.18: Mean first and second knee flexion angle peaks and corresponding times in percent cycle in gait for the dominant and non-dominant legs of amputee and control participants. + = significance across leg. * = significance across participant type. Refer to Appendix B for p-values. Duplicated significance markers indicate significance within 90%. Whiskers indicate ± 1 standard deviation.

Figure C.19: Mean first and vertical reaction force peaks and corresponding times in percent cycle in gait for the dominant and non-dominant legs of amputee and control participants. + = significance across leg. * = significance across participant type. Refer to Appendix B for p-values. Duplicated significance markers indicate significance within 90%. Whiskers indicate ± 1 standard deviation.

Figure C.20: Mean walking speeds for amputee and control participants. Refer to Appendix B for p-values. Whiskers indicate ± 1 standard deviation.

Appendix D: Results Box and Whisker Plots

D.1: Kinematics

Figure D.1: Maximum and minimum hip flexion-extension (FE) angle and corresponding time in percent cycle box and whisker plots for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. Plots show maximum, 75% quartile, median, 25% quartile, and minimum values. Circles indicate outliers. A-D = Amputee Dominant, A-ND = Amputee Non-Dominant, C-D = Control Dominant, C-ND = Control Non-Dominant.

Figure D.2: Maximum and minimum knee flexion-extension (FE) angle and corresponding time in percent cycle box and whisker plots for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. Plots show maximum, 75% quartile, median, 25% quartile, and minimum values. Circles indicate outliers. A-D = Amputee Dominant, A-ND = Amputee Non-Dominant, C-D = Control Dominant, C-ND = Control Non-Dominant.

D.2: Resultant Forces

Figure D.3: Maximum and minimum hip compressive force and corresponding times in percent cycle box and whisker plots for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. Plots show maximum, 75% quartile, median, 25% quartile, and minimum values. Circles indicate outliers. A-D = Amputee Dominant, A-ND = Amputee Non-Dominant, C-D = Control Dominant, C-ND = Control Non-Dominant.

Figure D.4: Maximum and minimum knee compressive force and corresponding times in percent cycle box and whisker plots for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. Plots show maximum, 75% quartile, median, 25% quartile, and minimum values. Circles indicate outliers. A-D = Amputee Dominant, A-ND = Amputee Non-Dominant, C-D = Control Dominant, C-ND = Control Non-Dominant.

Figure D.5: Maximum and minimum hip anterior force and corresponding times in percent cycle box and whisker plots for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. Plots show maximum, 75% quartile, median, 25% quartile, and minimum values. Circles indicate outliers. A-D = Amputee Dominant, A-ND = Amputee Non-Dominant, C-D = Control Dominant, C-ND = Control Non-Dominant.

Figure D.6: Maximum and minimum knee anterior force and corresponding times in percent cycle box and whisker plots for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. Plots show maximum, 75% quartile, median, 25% quartile, and minimum values. Circles indicate outliers. A-D = Amputee Dominant, A-ND = Amputee Non-Dominant, C-D = Control Dominant, C-ND = Control Non-Dominant.

Figure D.7: Maximum and minimum hip lateral force and corresponding times in percent cycle box and whisker plots for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. Plots show maximum, 75% quartile, median, 25% quartile, and minimum values. Circles indicate outliers. A-D = Amputee Dominant, A-ND = Amputee Non-Dominant, C-D = Control Dominant, C-ND = Control Non-Dominant.

Figure D.8: Maximum and minimum knee lateral force and corresponding times in percent cycle box and whisker plots for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. Plots show maximum, 75% quartile, median, 25% quartile, and minimum values. Circles indicate outliers. A-D = Amputee Dominant, A-ND = Amputee Non-Dominant, C-D = Control Dominant, C-ND = Control Non-Dominant.

D.3: Resultant Moments

Figure D.9: Maximum and minimum hip extension moment and corresponding times in percent cycle box and whisker plots for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. Plots show maximum, 75% quartile, median, 25% quartile, and minimum values. Circles indicate outliers. A-D = Amputee Dominant, A-ND = Amputee Non-Dominant, C-D = Control Dominant, C-ND = Control Non-Dominant.

Figure D.10: Maximum and minimum knee extension moment and corresponding times in percent cycle box and whisker plots for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. Plots show maximum, 75% quartile, median, 25% quartile, and minimum values. Circles indicate outliers. A-D = Amputee Dominant, A-ND = Amputee Non-Dominant, C-D = Control Dominant, C-ND = Control Non-Dominant.

Figure D.11: Maximum and minimum hip adduction moment and corresponding times in percent cycle box and whisker plots for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. Plots show maximum, 75% quartile, median, 25% quartile, and minimum values. Circles indicate outliers. A-D = Amputee Dominant, A-ND = Amputee Non-Dominant, C-D = Control Dominant, C-ND = Control Non-Dominant.

Figure D.11: Maximum and minimum knee adduction moment and corresponding times in percent cycle box and whisker plots for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. Plots show maximum, 75% quartile, median, 25% quartile, and minimum values. Circles indicate outliers. A-D = Amputee Dominant, A-ND = Amputee Non-Dominant, C-D = Control Dominant, C-ND = Control Non-Dominant.

Figure D.13: Maximum and minimum hip external rotation moment and corresponding times in percent cycle box and whisker plots for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. Plots show maximum, 75% quartile, median, 25% quartile, and minimum values. Circles indicate outliers. A-D = Amputee Dominant, A-ND = Amputee Non-Dominant, C-D = Control Dominant, C-ND = Control Non-Dominant.

Figure D.14: Maximum and minimum knee external rotation moment and corresponding times in percent cycle box and whisker plots for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. Plots show maximum, 75% quartile, median, 25% quartile, and minimum values. Circles indicate outliers. A-D = Amputee Dominant, A-ND = Amputee Non-Dominant, C-D = Control Dominant, C-ND = Control Non-Dominant.

D.4: Reaction Forces

Figure D.15: Maximum and minimum vertical reaction force and corresponding times in percent cycle box and whisker plots for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. Plots show maximum, 75% quartile, median, 25% quartile, and minimum values. Circles indicate outliers. A-D = Amputee Dominant, A-ND = Amputee Non-Dominant, C-D = Control Dominant, C-ND = Control Non-Dominant.

Figure D.16: Maximum and minimum anterior reaction force and corresponding times in percent cycle box and whisker plots for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. Plots show maximum, 75% quartile, median, 25% quartile, and minimum values. Circles indicate outliers. A-D = Amputee Dominant, A-ND = Amputee Non-Dominant, C-D = Control Dominant, C-ND = Control Non-Dominant.

Figure D.17: Maximum and minimum lateral reaction force and corresponding times in percent cycle box and whisker plots for gait, cycling, and elliptical training for the dominant and non-dominant legs of amputee and control participants. Plots show maximum, 75% quartile, median, 25% quartile, and minimum values. Circles indicate outliers. A-D = Amputee Dominant, A-ND = Amputee Non-Dominant, C-D = Control Dominant, C-ND = Control Non-Dominant.

D.5: Gait Parameters

Figure D.18: First and second knee flexion angle peaks and corresponding times box and whisker plots for amputee and control participants in gait. Plots show maximum, 75% quartile, median, 25% quartile, and minimum values. Circles indicate outliers. A-D = Amputee Dominant, A-ND = Amputee Non-Dominant, C-D = Control Dominant, C-ND = Control Non-Dominant.

Figure D.19: First and vertical reaction force peaks and corresponding times box and whisker plots for amputee and control participants in gait. Plots show maximum, 75% quartile, median, 25% quartile, and minimum values. Circles indicate outliers. A-D = Amputee Dominant, A-ND = Amputee Non-Dominant, C-D = Control Dominant, C-ND = Control Non-Dominant.

Figure D.20: Walking speed box and whisker plot for amputee and control participants. Plots show maximum, 75% quartile, median, 25% quartile, and minimum values. Circles indicate outliers.

Appendix E: Maximum Knee Compressive Force Power Analysis

Define Problem

The max knee compressive force was expected to be significant across the dominant and non-dominant legs for amputees and to differ significantly between amputees and controls. A two-factor repeated measures ANOVA showed significant differences across exercises and for dominant amputee elliptical force compared to dominant control elliptical force. In this document power analyses are performed to calculate the required sample size to obtain significant differences at 90% power.

Pairwise t-Test

Normalized maximum knee compressive force data for amputees and controls are assembled into a response vector. A vector of factors defining the subject type, leg dominance, and exercise corresponding to the response vector is also assembled.

```
Response <- c(1.04502,0.88547,1.14339,1.09425,1.08240,1.04176,1.08160,
1.10898,1.02775,1.16712,1.03293,0.92226,1.05748,1.06484,
0.86289,0.92425,1.00430,1.00612,1.15973,1.00677,0.07070,
0.08006,0.10773,0.08824,0.10599,0.07545,0.08793,0.12994,
0.10063,0.18822,0.09995,0.08206,0.05875,0.10774,0.07018,
0.05029,0.09611,0.09936,0.08338,0.09415,0.85844,1.01270,
0.95350,0.99416,1.02435,0.98927,0.98012,0.83545,0.81593,
0.95777,0.74076,0.86683,1.01148,0.93686,0.89051,0.83846,
1.01920,0.83047,0.69393,0.85555,1.02903,1.05537,1.09775,
1.11271,1.14155,1.15619,1.05927,1.15488,1.10722,1.05865,
0.97512,1.04632,1.05471,1.03441,1.07293,1.14573,0.99522,
1.16650,1.05283,0.98673,0.07944,0.10006,0.08989,0.07407,
0.13161,0.12387,0.11865,0.07465,0.14682,0.13181,0.10162,
0.08847,0.10727,0.10517,0.10769,0.10731,0.10124,0.08189,
0.13628,0.08721,0.68985,0.87587,0.78125,0.90534,0.92944,
0.90318,0.88286,0.78090,0.80854,0.89622,0.64365,0.85149,
0.80873,0.88589,0.88119,0.90343,0.87261,0.81734,0.85711,
0.90192)
Group <- as.factor(rep(c('A-D-G','A-ND-G','A-D-C','A-ND-C','A-D-E','A-N
D-E',
                        'C-D-G','C-ND-G','C-D-C','C-ND-C','C-D-E','C-N
D-E'),
                      each=10))
```

```
Data <- data.frame(Response,Group)
car::leveneTest(Data$Response,Data$Group)

## Levene's Test for Homogeneity of Variance (center = median)
##           Df F value  Pr(>F)
## group    11  2.0449 0.03075 *
##           108
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Levene's test is used to determine that the equal variance assumption for ANOVA is violated and thus the pairwise t-test must be used to determine significance. Bonferroni correction is utilized.

```
pairwise.t.test(Response,Group,p.adjust.method='bonf',pool.sd=FALSE,alt
ernative="two.sided")

##
## Pairwise comparisons using t tests with non-pooled SD
##
## data: Response and Group
##
##           A-D-C  A-D-E  A-D-G  A-ND-C  A-ND-E  A-ND-G  C-D-C  C-D-E
## A-D-E  1.7e-11 -      -      -      -      -      -      -
## A-D-G  4.2e-12 0.12391 -      -      -      -      -      -
## A-ND-C 1.00000 5.5e-10 1.7e-10 -      -      -      -      -
## A-ND-E 1.3e-08 1.00000 0.01047 5.6e-08 -      -      -      -
## A-ND-G 5.7e-11 1.00000 1.00000 1.0e-09 0.34267 -      -      -
## C-D-C  1.00000 1.3e-10 3.7e-11 1.00000 3.5e-08 3.3e-10 -      -
## C-D-E  7.6e-11 0.73646 0.00030 1.8e-09 1.00000 0.02341 5.1e-10 -
## C-D-G  < 2e-16 0.00433 1.00000 5.8e-15 0.00210 0.56412 < 2e-16 1.7e-
05
## C-ND-C 1.00000 1.3e-09 4.2e-10 1.00000 9.4e-08 2.2e-09 1.00000 4.3e-
09
## C-ND-E 8.6e-11 0.61671 0.00026 2.0e-09 1.00000 0.01979 5.7e-10 1.000
00
## C-ND-G 3.3e-14 0.16541 1.00000 8.8e-12 0.01615 1.00000 7.2e-13 0.000
26
##           C-D-G  C-ND-C  C-ND-E
## A-D-E  -      -      -
## A-D-G  -      -      -
## A-ND-C  -      -      -
## A-ND-E  -      -      -
## A-ND-G  -      -      -
## C-D-C  -      -      -
## C-D-E  -      -      -
## C-D-G  -      -      -
## C-ND-C 8.0e-14 -      -
## C-ND-E 1.5e-05 4.7e-09 -
## C-ND-G 1.00000 3.3e-11 0.00022
```



```
##
## P value adjustment method: bonferroni
```

Observe that the “A-D-G” vs. “A-ND-G” comparison returns a p-value of 1.0. Two-factor ANOVA with post-hoc Tukey test in Minitab returned a p-value of 0.697.

Tukey Test

Also run a Tukey Honest Significant Differences (HSD) calculation to compare to the pairwise t-test.

```
model<-aov(Response~Group)
TukeyHSD(model)

##    Tukey multiple comparisons of means
##      95% family-wise confidence level
##
## Fit: aov(formula = Response ~ Group)
##
## $Group
##              diff              lwr              upr              p adj
## A-D-E-A-D-C    0.838680    0.741974163    0.9353858367    0.0000000
## A-D-G-A-D-C    0.964285    0.867579163    1.0609908367    0.0000000
## A-ND-C-A-D-C   -0.019292   -0.115997837    0.0774138367    0.9999449
## A-ND-E-A-D-C    0.764916    0.668210163    0.8616218367    0.0000000
## A-ND-G-A-D-C    0.900668    0.803962163    0.9973738367    0.0000000
## C-D-C-A-D-C    0.003598   -0.093107837    0.1003038367    1.0000000
## C-D-E-A-D-C    0.741856    0.645150163    0.8385618367    0.0000000
## C-D-G-A-D-C    0.993773    0.897067163    1.0904788367    0.0000000
## C-ND-C-A-D-C   -0.001074   -0.097779837    0.0956318367    1.0000000
## C-ND-E-A-D-C    0.738847    0.642141163    0.8355528367    0.0000000
## C-ND-G-A-D-C    0.949561    0.852855163    1.0462668367    0.0000000
## A-D-G-A-D-E     0.125605    0.028899163    0.2223108367    0.0018445
## A-ND-C-A-D-E   -0.857972   -0.954677837   -0.7612661633    0.0000000
## A-ND-E-A-D-E   -0.073764   -0.170469837    0.0229418367    0.3223909
## A-ND-G-A-D-E     0.061988   -0.034717837    0.1586938367    0.5946887
## C-D-C-A-D-E   -0.835082   -0.931787837   -0.7383761633    0.0000000
## C-D-E-A-D-E   -0.096824   -0.193529837   -0.0001181633    0.0494246
## C-D-G-A-D-E     0.155093    0.058387163    0.2517988367    0.0000302
## C-ND-C-A-D-E   -0.839754   -0.936459837   -0.7430481633    0.0000000
## C-ND-E-A-D-E   -0.099833   -0.196538837   -0.0031271633    0.0365880
## C-ND-G-A-D-E     0.110881    0.014175163    0.2075868367    0.0110593
## A-ND-C-A-D-G   -0.983577   -1.080282837   -0.8868711633    0.0000000
## A-ND-E-A-D-G   -0.199369   -0.296074837   -0.1026631633    0.0000000
## A-ND-G-A-D-G   -0.063617   -0.160322837    0.0330888367    0.5548871
## C-D-C-A-D-G   -0.960687   -1.057392837   -0.8639811633    0.0000000
## C-D-E-A-D-G   -0.222429   -0.319134837   -0.1257231633    0.0000000
```

## C-D-G-A-D-G	0.029488	-0.067217837	0.1261938367	0.9969554
## C-ND-C-A-D-G	-0.965359	-1.062064837	-0.8686531633	0.0000000
## C-ND-E-A-D-G	-0.225438	-0.322143837	-0.1287321633	0.0000000
## C-ND-G-A-D-G	-0.014724	-0.111429837	0.0819818367	0.9999965
## A-ND-E-A-ND-C	0.784208	0.687502163	0.8809138367	0.0000000
## A-ND-G-A-ND-C	0.919960	0.823254163	1.0166658367	0.0000000
## C-D-C-A-ND-C	0.022890	-0.073815837	0.1195958367	0.9997053
## C-D-E-A-ND-C	0.761148	0.664442163	0.8578538367	0.0000000
## C-D-G-A-ND-C	1.013065	0.916359163	1.1097708367	0.0000000
## C-ND-C-A-ND-C	0.018218	-0.078487837	0.1149238367	0.9999690
## C-ND-E-A-ND-C	0.758139	0.661433163	0.8548448367	0.0000000
## C-ND-G-A-ND-C	0.968853	0.872147163	1.0655588367	0.0000000
## A-ND-G-A-ND-E	0.135752	0.039046163	0.2324578367	0.0004808
## C-D-C-A-ND-E	-0.761318	-0.858023837	-0.6646121633	0.0000000
## C-D-E-A-ND-E	-0.023060	-0.119765837	0.0736458367	0.9996836
## C-D-G-A-ND-E	0.228857	0.132151163	0.3255628367	0.0000000
## C-ND-C-A-ND-E	-0.765990	-0.862695837	-0.6692841633	0.0000000
## C-ND-E-A-ND-E	-0.026069	-0.122774837	0.0706368367	0.9989964
## C-ND-G-A-ND-E	0.184645	0.087939163	0.2813508367	0.0000003
## C-D-C-A-ND-G	-0.897070	-0.993775837	-0.8003641633	0.0000000
## C-D-E-A-ND-G	-0.158812	-0.255517837	-0.0621061633	0.0000173
## C-D-G-A-ND-G	0.093105	-0.003600837	0.1898108367	0.0705215
## C-ND-C-A-ND-G	-0.901742	-0.998447837	-0.8050361633	0.0000000
## C-ND-E-A-ND-G	-0.161821	-0.258526837	-0.0651151633	0.0000109
## C-ND-G-A-ND-G	0.048893	-0.047812837	0.1455988367	0.8692681
## C-D-E-C-D-C	0.738258	0.641552163	0.8349638367	0.0000000
## C-D-G-C-D-C	0.990175	0.893469163	1.0868808367	0.0000000
## C-ND-C-C-D-C	-0.004672	-0.101377837	0.0920338367	1.0000000
## C-ND-E-C-D-C	0.735249	0.638543163	0.8319548367	0.0000000
## C-ND-G-C-D-C	0.945963	0.849257163	1.0426688367	0.0000000
## C-D-G-C-D-E	0.251917	0.155211163	0.3486228367	0.0000000
## C-ND-C-C-D-E	-0.742930	-0.839635837	-0.6462241633	0.0000000
## C-ND-E-C-D-E	-0.003009	-0.099714837	0.0936968367	1.0000000
## C-ND-G-C-D-E	0.207705	0.110999163	0.3044108367	0.0000000
## C-ND-C-C-D-G	-0.994847	-1.091552837	-0.8981411633	0.0000000
## C-ND-E-C-D-G	-0.254926	-0.351631837	-0.1582201633	0.0000000
## C-ND-G-C-D-G	-0.044212	-0.140917837	0.0524938367	0.9296102
## C-ND-E-C-ND-C	0.739921	0.643215163	0.8366268367	0.0000000
## C-ND-G-C-ND-C	0.950635	0.853929163	1.0473408367	0.0000000
## C-ND-G-C-ND-E	0.210714	0.114008163	0.3074198367	0.0000000

Tukey's HSD returns a p-value of 0.555 for the A-D-G vs. A-ND-G comparison.

Power Analysis

Perform a power analysis to determine how many samples are needed to detect a difference in means for amputee dominant vs. non-dominant maximum knee compressive force. We are also

interested in detecting a difference in means for amputee vs. control maximum knee compressive force for both dominant and non-dominant legs. True difference in means is taken from Tukey's HSD. Pooled standard deviation is used for each group. Power defined to be 90%.

Amputee Dominant vs. Non-Dominant Max Knee Compressive Force Power Analysis

```
diff <- -0.063617
s1 <- (sd(Data$Response[Data$Group=='A-D-G']))^2
s2 <- (sd(Data$Response[Data$Group=='A-ND-G']))^2
n <- 10
pool.sd <- sqrt(((n-1)*s1 + (n-1)*s2)/(2*(n-1)))
power.t.test(n=NULL,delta=diff,sd=pool.sd,sig.level=0.05,power=0.9,type
="two.sample",
              alternative="two.sided")

##
##      Two-sample t test power calculation
##
##              n = 35.32813
##            delta = 0.063617
##              sd = 0.08132188
##      sig.level = 0.05
##        power = 0.9
##   alternative = two.sided
##
## NOTE: n is number in *each* group
```

n=36 for each group is required to detect asymmetry in amputee gait max knee compressive force.

Amputee vs. Control Dominant Max Knee Compressive Force Power Analysis

```
diff <- 0.029488
s1 <- (sd(Data$Response[Data$Group=='A-D-G']))^2
s2 <- (sd(Data$Response[Data$Group=='C-D-G']))^2
n <- 10
pool.sd <- sqrt(((n-1)*s1 + (n-1)*s2)/(2*(n-1)))
power.t.test(n=NULL,delta=diff,sd=pool.sd,sig.level=0.05,power=0.9,type
="two.sample",
              alternative="two.sided")

##
##      Two-sample t test power calculation
##
##              n = 98.79473
##            delta = 0.029488
##              sd = 0.06362179
```

```
##          sig.level = 0.05
##          power = 0.9
##          alternative = two.sided
##
## NOTE: n is number in *each* group
```

n=99 for each group is required to detect a difference between amputee and control gait max dominant knee compressive force.

Amputee vs. Control Non-dominant Max Knee Compressive Force Power Analysis

```
diff <- 0.048893
s1 <- (sd(Data$Response[Data$Group=='A-ND-G']))^2
s2 <- (sd(Data$Response[Data$Group=='C-ND-G']))^2
n <- 10
pool.sd <- sqrt(((n-1)*s1 + (n-1)*s2)/(2*(n-1)))
power.t.test(n=NULL,delta=diff,sd=pool.sd,sig.level=0.05,power=0.9,type
="two.sample",
             alternative="two.sided")

##
##          Two-sample t test power calculation
##
##          n = 50.1519
##          delta = 0.048893
##          sd = 0.07478967
##          sig.level = 0.05
##          power = 0.9
##          alternative = two.sided
##
## NOTE: n is number in *each* group
```

n=51 for each group is required to detect a difference between amputee and control gait max dominant knee compressive force.

Appendix F: Statistical Summaries

F.1: Kinematics Two-Factor Repeated Measures ANOVA with Post-hoc Tukey Test

General Linear Model: MaxHipFE versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	44599.4	22299.7	631.42	0.000
Subject	3	784.4	261.5	7.40	0.000
Exercise Type*Subject	6	362.7	60.4	1.71	0.125
Error	108	3814.2	35.3		
Total	119	49560.7			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	1.99	0.697
(Cycling Con-Dom) - (Cycling Amp-Dom)	-1.33	0.974
(Cycling Con-ND) - (Cycling Amp-Dom)	-1.07	0.995
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	-10.65	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-6.56	0.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-9.13	0.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	-8.64	0.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	-18.45	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	-17.28	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	-18.14	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	-17.61	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	-3.32	0.053
(Cycling Con-ND) - (Cycling Amp-ND)	-3.07	0.104
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-12.64	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	-8.55	0.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	-11.12	0.000
(Elliptical Con-ND) - (Cycling Amp-ND)	-10.63	0.000
(Gait Amp-Dom) - (Cycling Amp-ND)	-20.44	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	-19.27	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	-20.13	0.000
(Gait Con-ND) - (Cycling Amp-ND)	-19.60	0.000
(Cycling Con-ND) - (Cycling Con-Dom)	0.25	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-9.32	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	-5.23	0.000
(Elliptical Con-Dom) - (Cycling Con-Dom)	-7.80	0.000

(Elliptical Con-ND) - (Cycling Con-Dom)	-7.31	0.000
(Gait Amp-Dom) - (Cycling Con-Dom)	-17.12	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	-15.95	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	-16.81	0.000
(Gait Con-ND) - (Cycling Con-Dom)	-16.28	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	-9.57	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	-5.48	0.000
(Elliptical Con-Dom) - (Cycling Con-ND)	-8.05	0.000
(Elliptical Con-ND) - (Cycling Con-ND)	-7.56	0.000
(Gait Amp-Dom) - (Cycling Con-ND)	-17.37	0.000
(Gait Amp-ND) - (Cycling Con-ND)	-16.20	0.000
(Gait Con-Dom) - (Cycling Con-ND)	-17.06	0.000
(Gait Con-ND) - (Cycling Con-ND)	-16.53	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	4.09	0.005
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	1.52	0.932
(Elliptical Con-ND) - (Elliptical Amp-Dom)	2.01	0.684
(Gait Amp-Dom) - (Elliptical Amp-Dom)	-7.80	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	-6.63	0.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	-7.49	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	-6.96	0.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	-2.57	0.309
(Elliptical Con-ND) - (Elliptical Amp-ND)	-2.08	0.636
(Gait Amp-Dom) - (Elliptical Amp-ND)	-11.89	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	-10.72	0.000
(Gait Con-Dom) - (Elliptical Amp-ND)	-11.58	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	-11.05	0.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	0.49	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	-9.32	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	-8.15	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	-9.01	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	-8.48	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	-9.81	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	-8.64	0.000
(Gait Con-Dom) - (Elliptical Con-ND)	-9.50	0.000
(Gait Con-ND) - (Elliptical Con-ND)	-8.97	0.000
(Gait Amp-ND) - (Gait Amp-Dom)	1.17	0.999
(Gait Con-Dom) - (Gait Amp-Dom)	0.31	1.000
(Gait Con-ND) - (Gait Amp-Dom)	0.84	0.999
(Gait Con-Dom) - (Gait Amp-ND)	-0.86	0.999
(Gait Con-ND) - (Gait Amp-ND)	-0.33	1.000
(Gait Con-ND) - (Gait Con-Dom)	0.53	1.000

Individual confidence level = 99.89%

Figure F.1: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for maximum hip flexion angle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	126259	63129.3	102.46	0.000
Subject	3	773	257.7	0.42	0.740
Exercise Type*Subject	6	2527	421.1	0.68	0.663
Error	108	66542	616.1		
Total	119	196100			

Difference of Exercise Type*Subject Levels	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	0.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	0.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	0.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	0.007
(Gait Amp-ND) - (Cycling Amp-Dom)	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	0.001
(Cycling Con-Dom) - (Cycling Amp-ND)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	0.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	0.000
(Elliptical Con-ND) - (Cycling Amp-ND)	0.000
(Gait Amp-Dom) - (Cycling Amp-ND)	0.007
(Gait Amp-ND) - (Cycling Amp-ND)	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	0.000
(Gait Con-ND) - (Cycling Amp-ND)	0.001
(Cycling Con-ND) - (Cycling Con-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	0.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	0.000
(Elliptical Con-ND) - (Cycling Con-Dom)	0.000
(Gait Amp-Dom) - (Cycling Con-Dom)	0.008
(Gait Amp-ND) - (Cycling Con-Dom)	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	0.000
(Gait Con-ND) - (Cycling Con-Dom)	0.001
(Elliptical Amp-Dom) - (Cycling Con-ND)	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	0.000
(Elliptical Con-Dom) - (Cycling Con-ND)	0.000
(Elliptical Con-ND) - (Cycling Con-ND)	0.000
(Gait Amp-Dom) - (Cycling Con-ND)	0.009
(Gait Amp-ND) - (Cycling Con-ND)	0.000
(Gait Con-Dom) - (Cycling Con-ND)	0.000
(Gait Con-ND) - (Cycling Con-ND)	0.001
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	0.080
(Gait Amp-ND) - (Elliptical Amp-Dom)	0.993
(Gait Con-Dom) - (Elliptical Amp-Dom)	0.871
(Gait Con-ND) - (Elliptical Amp-Dom)	0.286
(Elliptical Con-Dom) - (Elliptical Amp-ND)	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	0.235
(Gait Amp-ND) - (Elliptical Amp-ND)	1.000
(Gait Con-Dom) - (Elliptical Amp-ND)	0.986
(Gait Con-ND) - (Elliptical Amp-ND)	0.587
(Elliptical Con-ND) - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	0.086
(Gait Amp-ND) - (Elliptical Con-Dom)	0.995
(Gait Con-Dom) - (Elliptical Con-Dom)	0.882
(Gait Con-ND) - (Elliptical Con-Dom)	0.301
(Gait Amp-Dom) - (Elliptical Con-ND)	0.131
(Gait Amp-ND) - (Elliptical Con-ND)	0.999
(Gait Con-Dom) - (Elliptical Con-ND)	0.941
(Gait Con-ND) - (Elliptical Con-ND)	0.406
(Gait Amp-ND) - (Gait Amp-Dom)	0.656
(Gait Con-Dom) - (Gait Amp-Dom)	0.941
(Gait Con-ND) - (Gait Amp-Dom)	1.000
(Gait Con-Dom) - (Gait Amp-ND)	1.000
(Gait Con-ND) - (Gait Amp-ND)	0.999
(Gait Con-ND) - (Gait Con-Dom)	0.999

Individual confidence level = 99.89%

Figure F.2: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for maximum hip flexion angle time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MinHipFE versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)
Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	40186.2	20093.1	485.90	0.000
Subject	3	212.3	70.8	1.71	0.169
Exercise Type*Subject	6	283.5	47.2	1.14	0.343
Error	108	4466.1	41.4		
Total	119	45148.0			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	1.62	0.898
(Cycling Con-Dom) - (Cycling Amp-Dom)	-1.21	0.987
(Cycling Con-ND) - (Cycling Amp-Dom)	-0.93	0.999
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	-8.15	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-7.56	0.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-8.90	0.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	-8.15	0.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	-15.96	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	-15.91	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	-15.60	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	-15.38	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	-2.83	0.183
(Cycling Con-ND) - (Cycling Amp-ND)	-2.55	0.322
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-9.77	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	-9.18	0.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	-10.52	0.000
(Elliptical Con-ND) - (Cycling Amp-ND)	-9.77	0.000
(Gait Amp-Dom) - (Cycling Amp-ND)	-17.58	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	-17.53	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	-17.22	0.000
(Gait Con-ND) - (Cycling Amp-ND)	-17.00	0.000
(Cycling Con-ND) - (Cycling Con-Dom)	0.28	1.000

(Elliptical Amp-Dom) - (Cycling Con-Dom)	-6.94	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	-6.36	0.000
(Elliptical Con-Dom) - (Cycling Con-Dom)	-7.69	0.000
(Elliptical Con-ND) - (Cycling Con-Dom)	-6.94	0.000
(Gait Amp-Dom) - (Cycling Con-Dom)	-14.75	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	-14.71	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	-14.39	0.000
(Gait Con-ND) - (Cycling Con-Dom)	-14.17	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	-7.22	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	-6.64	0.000
(Elliptical Con-Dom) - (Cycling Con-ND)	-7.97	0.000
(Elliptical Con-ND) - (Cycling Con-ND)	-7.22	0.000
(Gait Amp-Dom) - (Cycling Con-ND)	-15.03	0.000
(Gait Amp-ND) - (Cycling Con-ND)	-14.99	0.000
(Gait Con-Dom) - (Cycling Con-ND)	-14.67	0.000
(Gait Con-ND) - (Cycling Con-ND)	-14.45	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	0.58	1.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	-0.75	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	-0.00	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	-7.81	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	-7.77	0.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	-7.45	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	-7.23	0.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	-1.33	0.973
(Elliptical Con-ND) - (Elliptical Amp-ND)	-0.58	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	-8.39	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	-8.35	0.000
(Gait Con-Dom) - (Elliptical Amp-ND)	-8.03	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	-7.82	0.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	0.75	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	-7.06	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	-7.02	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	-6.70	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	-6.49	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	-7.81	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	-7.77	0.000
(Gait Con-Dom) - (Elliptical Con-ND)	-7.45	0.000
(Gait Con-ND) - (Elliptical Con-ND)	-7.23	0.000
(Gait Amp-ND) - (Gait Amp-Dom)	0.04	1.000
(Gait Con-Dom) - (Gait Amp-Dom)	0.36	1.000
(Gait Con-ND) - (Gait Amp-Dom)	0.58	1.000
(Gait Con-Dom) - (Gait Amp-ND)	0.32	1.000
(Gait Con-ND) - (Gait Amp-ND)	0.53	1.000
(Gait Con-Dom) - (Gait Con-Dom)	0.22	1.000

Individual confidence level = 99.89%

Figure F.3: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for minimum hip flexion angle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	4869.6	2434.81	653.32	0.000
Subject	3	178.4	59.48	15.96	0.000
Exercise Type*Subject	6	103.1	17.18	4.61	0.000
Error	108	402.5	3.73		
Total	119	5553.6			

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	-1.16	0.991
(Cycling Con-Dom) - (Cycling Amp-Dom)	2.08	0.634
(Cycling Con-ND) - (Cycling Amp-Dom)	1.62	0.897
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	-14.94	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-19.46	0.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-12.63	0.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	-13.44	0.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	1.85	0.785
(Gait Amp-ND) - (Cycling Amp-Dom)	-0.58	1.000
(Gait Con-Dom) - (Cycling Amp-Dom)	0.12	1.000
(Gait Con-ND) - (Cycling Amp-Dom)	0.35	1.000
(Cycling Con-Dom) - (Cycling Amp-ND)	3.24	0.066
(Cycling Con-ND) - (Cycling Amp-ND)	2.78	0.204
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-13.78	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	-18.30	0.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	-11.47	0.000
(Elliptical Con-ND) - (Cycling Amp-ND)	-12.28	0.000
(Gait Amp-Dom) - (Cycling Amp-ND)	3.01	0.120
(Gait Amp-ND) - (Cycling Amp-ND)	0.58	1.000
(Gait Con-Dom) - (Cycling Amp-ND)	1.27	0.981
(Gait Con-ND) - (Cycling Amp-ND)	1.51	0.936
(Cycling Con-ND) - (Cycling Con-Dom)	-0.46	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-17.03	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	-21.54	0.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	-14.71	0.000
(Elliptical Con-ND) - (Cycling Con-Dom)	-15.52	0.000
(Gait Amp-Dom) - (Cycling Con-Dom)	-0.23	1.000
(Gait Amp-ND) - (Cycling Con-Dom)	-2.66	0.259
(Gait Con-Dom) - (Cycling Con-Dom)	-1.97	0.713
(Gait Con-ND) - (Cycling Con-Dom)	-1.74	0.847
(Elliptical Amp-Dom) - (Cycling Con-ND)	-16.56	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	-21.08	0.000
(Elliptical Con-Dom) - (Cycling Con-ND)	-14.25	0.000
(Elliptical Con-ND) - (Cycling Con-ND)	-15.06	0.000
(Gait Amp-Dom) - (Cycling Con-ND)	0.23	1.000
(Gait Amp-ND) - (Cycling Con-ND)	-2.20	0.553
(Gait Con-Dom) - (Cycling Con-ND)	-1.51	0.936
(Gait Con-ND) - (Cycling Con-ND)	-1.27	0.981
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	-4.52	0.001
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	2.32	0.472
(Elliptical Con-ND) - (Elliptical Amp-Dom)	1.51	0.936
(Gait Amp-Dom) - (Elliptical Amp-Dom)	16.80	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	14.36	0.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	15.06	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	15.29	0.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	6.83	0.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	6.02	0.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	21.31	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	18.88	0.000
(Gait Con-Dom) - (Elliptical Amp-ND)	19.57	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	19.81	0.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	-0.81	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	14.48	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	12.05	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	12.74	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	12.97	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	15.29	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	12.86	0.000
(Gait Con-Dom) - (Elliptical Con-ND)	13.55	0.000
(Gait Con-ND) - (Elliptical Con-ND)	13.78	0.000
(Gait Amp-ND) - (Gait Amp-Dom)	-2.43	0.394
(Gait Con-Dom) - (Gait Amp-Dom)	-1.74	0.847
(Gait Con-ND) - (Gait Amp-Dom)	-1.51	0.936
(Gait Con-Dom) - (Gait Amp-ND)	0.69	1.000
(Gait Con-ND) - (Gait Amp-ND)	0.93	0.999
(Gait Con-Dom) - (Gait Con-Dom)	0.23	1.000

Individual confidence level = 99.89%

Figure F.4: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for minimum hip flexion angle time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MaxKneeFE versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	49853.7	24926.8	917.13	0.000
Subject	3	1615.4	538.5	19.81	0.000
Exercise Type*Subject	6	167.0	27.8	1.02	0.414
Error	108	2935.4	27.2		
Total	119	54571.4			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	3.77	0.014
(Cycling Con-Dom) - (Cycling Amp-Dom)	1.85	0.786
(Cycling Con-ND) - (Cycling Amp-Dom)	2.25	0.517
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	-13.25	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-8.02	0.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-12.79	0.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	-11.70	0.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	-21.40	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	-17.35	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	-19.49	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	-18.55	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	-1.92	0.746
(Cycling Con-ND) - (Cycling Amp-ND)	-1.52	0.933
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-17.01	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	-11.79	0.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	-16.56	0.000
(Elliptical Con-ND) - (Cycling Amp-ND)	-15.47	0.000
(Gait Amp-Dom) - (Cycling Amp-ND)	-25.17	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	-21.12	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	-23.25	0.000
(Gait Con-ND) - (Cycling Amp-ND)	-22.32	0.000
(Cycling Con-ND) - (Cycling Con-Dom)	0.40	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-15.10	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	-9.88	0.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	-14.64	0.000
(Elliptical Con-ND) - (Cycling Con-Dom)	-13.55	0.000
(Gait Amp-Dom) - (Cycling Con-Dom)	-23.25	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	-19.20	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	-21.34	0.000
(Gait Con-ND) - (Cycling Con-Dom)	-20.40	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	-15.50	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	-10.28	0.000
(Elliptical Con-Dom) - (Cycling Con-ND)	-15.04	0.000
(Elliptical Con-ND) - (Cycling Con-ND)	-13.95	0.000
(Gait Amp-Dom) - (Cycling Con-ND)	-23.65	0.000
(Gait Amp-ND) - (Cycling Con-ND)	-19.60	0.000
(Gait Con-Dom) - (Cycling Con-ND)	-21.74	0.000
(Gait Con-ND) - (Cycling Con-ND)	-20.80	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	5.22	0.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	0.46	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	1.55	0.924
(Gait Amp-Dom) - (Elliptical Amp-Dom)	-8.15	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	-4.10	0.004
(Gait Con-Dom) - (Elliptical Amp-Dom)	-6.24	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	-5.31	0.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	-4.76	0.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	-3.68	0.018
(Gait Amp-Dom) - (Elliptical Amp-ND)	-13.38	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	-9.32	0.000
(Gait Con-Dom) - (Elliptical Amp-ND)	-11.46	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	-10.53	0.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	1.09	0.995
(Gait Amp-Dom) - (Elliptical Con-Dom)	-8.61	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	-4.56	0.001
(Gait Con-Dom) - (Elliptical Con-Dom)	-6.70	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	-5.76	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	-9.70	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	-5.65	0.000
(Gait Con-Dom) - (Elliptical Con-ND)	-7.78	0.000
(Gait Con-ND) - (Elliptical Con-ND)	-6.85	0.000
(Gait Amp-ND) - (Gait Amp-Dom)	4.05	0.005
(Gait Con-Dom) - (Gait Amp-Dom)	1.91	0.748
(Gait Con-ND) - (Gait Amp-Dom)	2.85	0.175
(Gait Con-Dom) - (Gait Amp-ND)	-2.14	0.597
(Gait Con-ND) - (Gait Amp-ND)	-1.20	0.988
(Gait Con-ND) - (Gait Con-Dom)	0.93	0.995

Individual confidence level = 99.89%

Figure F.5: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for maximum knee flexion angle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	14994.2	7497.11	2618.65	0.000
Subject	3	45.8	15.26	5.33	0.002
Exercise Type*Subject	6	35.2	5.86	2.05	0.065
Error	108	309.2	2.86		
Total	119	15384.4			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
Cycling Amp-ND - (Cycling Amp-Dom)	-0.53	1.000
Cycling Con-Dom - (Cycling Amp-Dom)	0.53	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.66	1.000
Elliptical Amp-Dom - (Cycling Amp-Dom)	-33.57	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-35.15	0.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-31.06	0.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	-32.25	0.000
Gait Amp-Dom - (Cycling Amp-Dom)	-27.49	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	-30.26	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	-29.21	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	-28.81	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	1.06	0.996
Cycling Con-ND - (Cycling Amp-ND)	1.19	0.989
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-33.04	0.000
Elliptical Amp-ND - (Cycling Amp-ND)	-34.62	0.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	-30.53	0.000
(Elliptical Con-ND) - (Cycling Amp-ND)	-31.72	0.000
(Gait Amp-Dom) - (Cycling Amp-ND)	-26.96	0.000
Gait Amp-ND - (Cycling Amp-ND)	-29.73	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	-28.68	0.000
(Gait Con-ND) - (Cycling Amp-ND)	-28.28	0.000
Cycling Con-ND - (Cycling Con-Dom)	0.13	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-34.10	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	-35.68	0.000

Elliptical Con-Dom - (Cycling Con-Dom)	-31.58	0.000
(Elliptical Con-ND) - (Cycling Con-Dom)	-32.77	0.000
(Gait Amp-Dom) - (Cycling Con-Dom)	-28.02	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	-30.79	0.000
Gait Con-Dom - (Cycling Con-Dom)	-29.73	0.000
(Gait Con-ND) - (Cycling Con-Dom)	-29.34	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	-34.23	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	-35.81	0.000
(Elliptical Con-Dom) - (Cycling Con-ND)	-31.72	0.000
Elliptical Con-ND - (Cycling Con-ND)	-32.91	0.000
(Gait Amp-Dom) - (Cycling Con-ND)	-28.15	0.000
(Gait Amp-ND) - (Cycling Con-ND)	-30.92	0.000
(Gait Con-Dom) - (Cycling Con-ND)	-29.87	0.000
Gait Con-ND - (Cycling Con-ND)	-29.47	0.000
Elliptical Amp-ND - (Elliptical Amp-Dom)	-1.59	0.911
Elliptical Con-Dom - (Elliptical Amp-Dom)	2.51	0.346
(Elliptical Con-ND) - (Elliptical Amp-Dom)	1.32	0.975
Gait Amp-Dom - (Elliptical Amp-Dom)	6.08	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	3.30	0.056
(Gait Con-Dom) - (Elliptical Amp-Dom)	4.36	0.002
(Gait Con-ND) - (Elliptical Amp-Dom)	4.76	0.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	4.10	0.004
Elliptical Con-ND - (Elliptical Amp-ND)	2.91	0.154
(Gait Amp-Dom) - (Elliptical Amp-ND)	7.66	0.000
Gait Amp-ND - (Elliptical Amp-ND)	4.89	0.000
(Gait Con-Dom) - (Elliptical Amp-ND)	5.95	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	6.34	0.000
Elliptical Con-ND - (Elliptical Con-Dom)	-1.19	0.989
(Gait Amp-Dom) - (Elliptical Con-Dom)	3.57	0.026
(Gait Amp-ND) - (Elliptical Con-Dom)	0.79	1.000
Gait Con-Dom - (Elliptical Con-Dom)	1.85	0.786
(Gait Con-ND) - (Elliptical Con-Dom)	2.25	0.520
(Gait Amp-Dom) - (Elliptical Con-ND)	4.76	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	1.98	0.704
(Gait Con-Dom) - (Elliptical Con-ND)	3.04	0.112
Gait Con-ND - (Elliptical Con-ND)	3.44	0.038
Gait Amp-ND - (Gait Amp-Dom)	-2.78	0.206
Gait Con-Dom - (Gait Amp-Dom)	-1.72	0.856
(Gait Con-ND) - (Gait Amp-Dom)	-1.32	0.975
(Gait Con-Dom) - (Gait Amp-ND)	1.06	0.996
Gait Con-ND - (Gait Amp-ND)	1.45	0.949
Gait Con-ND - (Gait Con-Dom)	0.40	1.000

Figure F.6: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for maximum knee flexion angle time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MinKneeFE versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	30346.3	15173.2	341.02	0.000
Subject	3	256.5	85.5	1.92	0.130
Exercise Type*Subject	6	300.6	50.1	1.13	0.352
Error	108	4805.3	44.5		
Total	119	35708.7			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
Cycling Amp-ND - (Cycling Amp-Dom)	3.06	0.105
Cycling Con-Dom - (Cycling Amp-Dom)	1.17	0.990
(Cycling Con-ND) - (Cycling Amp-Dom)	1.27	0.981
Elliptical Amp-Dom - (Cycling Amp-Dom)	-8.01	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-7.84	0.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-7.38	0.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	-7.20	0.000
Gait Amp-Dom - (Cycling Amp-Dom)	-12.04	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	-11.55	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	-10.94	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	-10.76	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	-1.89	0.762
Cycling Con-ND - (Cycling Amp-ND)	-1.79	0.818
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-11.07	0.000
Elliptical Amp-ND - (Cycling Amp-ND)	-10.90	0.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	-10.45	0.000
(Elliptical Con-ND) - (Cycling Amp-ND)	-10.26	0.000
(Gait Amp-Dom) - (Cycling Amp-ND)	-15.10	0.000
Gait Amp-ND - (Cycling Amp-ND)	-14.62	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	-14.01	0.000
(Gait Con-ND) - (Cycling Amp-ND)	-13.82	0.000
Cycling Con-ND - (Cycling Con-Dom)	0.10	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-9.18	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	-9.01	0.000

Elliptical Con-Dom - (Cycling Con-Dom)	-8.55	0.000
(Elliptical Con-ND) - (Cycling Con-Dom)	-8.37	0.000
(Gait Amp-Dom) - (Cycling Con-Dom)	-13.21	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	-12.73	0.000
Gait Con-Dom - (Cycling Con-Dom)	-12.11	0.000
(Gait Con-ND) - (Cycling Con-Dom)	-11.93	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	-9.28	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	-9.11	0.000
(Elliptical Con-Dom) - (Cycling Con-ND)	-8.65	0.000
Elliptical Con-ND - (Cycling Con-ND)	-8.47	0.000
(Gait Amp-Dom) - (Cycling Con-ND)	-13.31	0.000
(Gait Amp-ND) - (Cycling Con-ND)	-12.82	0.000
(Gait Con-Dom) - (Cycling Con-ND)	-12.21	0.000
Gait Con-ND - (Cycling Con-ND)	-12.03	0.000
Elliptical Amp-ND - (Elliptical Amp-Dom)	0.17	1.000
Elliptical Con-Dom - (Elliptical Amp-Dom)	0.62	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.81	1.000
Gait Amp-Dom - (Elliptical Amp-Dom)	-4.03	0.006
(Gait Amp-ND) - (Elliptical Amp-Dom)	-3.55	0.027
(Gait Con-Dom) - (Elliptical Amp-Dom)	-2.94	0.144
(Gait Con-ND) - (Elliptical Amp-Dom)	-2.75	0.218
(Elliptical Con-Dom) - (Elliptical Amp-ND)	0.45	1.000
Elliptical Con-ND - (Elliptical Amp-ND)	0.64	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	-4.20	0.003
Gait Amp-ND - (Elliptical Amp-ND)	-3.72	0.016
(Gait Con-Dom) - (Elliptical Amp-ND)	-3.11	0.094
(Gait Con-ND) - (Elliptical Amp-ND)	-2.92	0.149
Elliptical Con-ND - (Elliptical Con-Dom)	0.19	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	-4.66	0.001
(Gait Amp-ND) - (Elliptical Con-Dom)	-4.17	0.003
Gait Con-Dom - (Elliptical Con-Dom)	-3.56	0.026
(Gait Con-ND) - (Elliptical Con-Dom)	-3.37	0.046
(Gait Amp-Dom) - (Elliptical Con-ND)	-4.84	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	-4.36	0.002
(Gait Con-Dom) - (Elliptical Con-ND)	-3.75	0.015
Gait Con-ND - (Elliptical Con-ND)	-3.56	0.026
Gait Amp-ND - (Gait Amp-Dom)	0.49	1.000
Gait Con-Dom - (Gait Amp-Dom)	1.10	0.994
(Gait Con-ND) - (Gait Amp-Dom)	1.29	0.979
(Gait Con-Dom) - (Gait Amp-ND)	0.61	1.000
Gait Con-ND - (Gait Amp-ND)	0.80	1.000
Gait Con-ND - (Gait Con-Dom)	0.19	1.000

Figure F.7: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for minimum knee flexion angle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	34772	17386.1	53.47	0.000
Subject	3	1214	404.8	1.24	0.297
Exercise Type*Subject	6	1537	256.2	0.79	0.581
Error	108	35116	325.1		
Total	119	72640			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
Cycling Amp-ND - (Cycling Amp-Dom)	1.000
Cycling Con-Dom - (Cycling Amp-Dom)	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	1.000
Elliptical Amp-Dom - (Cycling Amp-Dom)	0.531
(Elliptical Amp-ND) - (Cycling Amp-Dom)	0.610
(Elliptical Con-Dom) - (Cycling Amp-Dom)	0.835
(Elliptical Con-ND) - (Cycling Amp-Dom)	0.766
Gait Amp-Dom - (Cycling Amp-Dom)	0.142
(Gait Amp-ND) - (Cycling Amp-Dom)	0.901
(Gait Con-Dom) - (Cycling Amp-Dom)	0.002
(Gait Con-ND) - (Cycling Amp-Dom)	0.021
(Cycling Con-Dom) - (Cycling Amp-ND)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	0.522
Elliptical Amp-ND - (Cycling Amp-ND)	0.601
(Elliptical Con-Dom) - (Cycling Amp-ND)	0.829
(Elliptical Con-ND) - (Cycling Amp-ND)	0.758
(Gait Amp-Dom) - (Cycling Amp-ND)	0.147
Gait Amp-ND - (Cycling Amp-ND)	0.906
(Gait Con-Dom) - (Cycling Amp-ND)	0.002
(Gait Con-ND) - (Cycling Amp-ND)	0.022
Cycling Con-ND - (Cycling Con-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	0.487
(Elliptical Amp-ND) - (Cycling Con-Dom)	0.566

Elliptical Con-Dom - (Cycling Con-Dom)	0.802
(Elliptical Con-ND) - (Cycling Con-Dom)	0.727
(Gait Amp-Dom) - (Cycling Con-Dom)	0.164
(Gait Amp-ND) - (Cycling Con-Dom)	0.923
Gait Con-Dom - (Cycling Con-Dom)	0.002
(Gait Con-ND) - (Cycling Con-Dom)	0.025
(Elliptical Amp-Dom) - (Cycling Con-ND)	0.487
(Elliptical Amp-ND) - (Cycling Con-ND)	0.566
(Elliptical Con-Dom) - (Cycling Con-ND)	0.802
Elliptical Con-ND - (Cycling Con-ND)	0.727
(Gait Amp-Dom) - (Cycling Con-ND)	0.164
(Gait Amp-ND) - (Cycling Con-ND)	0.923
(Gait Con-Dom) - (Cycling Con-ND)	0.002
Gait Con-ND - (Cycling Con-ND)	0.025
Elliptical Amp-ND - (Elliptical Amp-Dom)	1.000
Elliptical Con-Dom - (Elliptical Amp-Dom)	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	1.000
Gait Amp-Dom - (Elliptical Amp-Dom)	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	0.011
(Gait Con-Dom) - (Elliptical Amp-Dom)	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	0.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	1.000
Elliptical Con-ND - (Elliptical Amp-ND)	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	0.000
Gait Amp-ND - (Elliptical Amp-ND)	0.015
(Gait Con-Dom) - (Elliptical Amp-ND)	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	0.000
Elliptical Con-ND - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	0.046
Gait Con-Dom - (Elliptical Con-Dom)	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	0.032
(Gait Con-Dom) - (Elliptical Con-ND)	0.000
Gait Con-ND - (Elliptical Con-ND)	0.000
Gait Amp-ND - (Gait Amp-Dom)	0.974
Gait Con-Dom - (Gait Amp-Dom)	0.958
(Gait Con-ND) - (Gait Amp-Dom)	1.000
(Gait Con-Dom) - (Gait Amp-ND)	0.221
Gait Con-ND - (Gait Amp-ND)	0.676
Gait Con-ND - (Gait Con-Dom)	1.000

Figure F.8: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for minimum knee flexion angle time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

F.2: Resultant Forces Two-Factor Repeated Measures ANOVA with Post-hoc Tukey Test

General Linear Model: MaxVHip versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)
Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	13.6840	6.84200	1855.29	0.000
Subject	3	0.0376	0.01253	3.40	0.020
Exercise Type*Subject	6	0.0816	0.01360	3.69	0.002
Error	108	0.3983	0.00369		
Total	119	14.2015			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.14	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.17	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	-0.05	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	24.19	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	21.75	0.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	21.01	0.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	20.76	0.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	29.46	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	26.89	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	31.05	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	29.18	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	-0.03	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	0.09	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	24.33	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	21.88	0.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	21.15	0.000
(Elliptical Con-ND) - (Cycling Amp-ND)	20.90	0.000
(Gait Amp-Dom) - (Cycling Amp-ND)	29.60	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	27.03	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	31.19	0.000
(Gait Con-ND) - (Cycling Amp-ND)	29.31	0.000
(Cycling Con-ND) - (Cycling Con-Dom)	0.13	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	24.37	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	21.92	0.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	21.19	0.000
(Elliptical Con-ND) - (Cycling Con-Dom)	20.94	0.000
(Gait Amp-Dom) - (Cycling Con-Dom)	29.63	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	27.07	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	31.22	0.000
(Gait Con-ND) - (Cycling Con-Dom)	29.35	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	24.24	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	21.79	0.000
(Elliptical Con-Dom) - (Cycling Con-ND)	21.06	0.000
(Elliptical Con-ND) - (Cycling Con-ND)	20.81	0.000
(Gait Amp-Dom) - (Cycling Con-ND)	29.51	0.000
(Gait Amp-ND) - (Cycling Con-ND)	26.94	0.000
(Gait Con-Dom) - (Cycling Con-ND)	31.09	0.000
(Gait Con-ND) - (Cycling Con-ND)	29.22	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	2.44	0.386
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	3.14	0.078
(Elliptical Con-ND) - (Elliptical Amp-Dom)	-3.43	0.039
(Gait Amp-Dom) - (Elliptical Amp-Dom)	5.27	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	2.70	0.240
(Gait Con-Dom) - (Elliptical Amp-Dom)	6.86	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	4.98	0.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	-0.73	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	0.98	0.998
(Gait Amp-Dom) - (Elliptical Amp-ND)	7.71	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	5.15	0.000
(Gait Con-Dom) - (Elliptical Amp-ND)	9.30	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	7.43	0.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	0.25	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	8.45	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	5.88	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	10.03	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	8.16	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	8.70	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	6.13	0.000
(Gait Con-Dom) - (Elliptical Con-ND)	10.28	0.000
(Gait Con-ND) - (Elliptical Con-ND)	8.41	0.000
(Gait Amp-ND) - (Gait Amp-Dom)	2.57	0.312
(Gait Con-Dom) - (Gait Amp-Dom)	1.58	0.910
(Gait Con-ND) - (Gait Amp-Dom)	-0.28	1.000
(Gait Con-Dom) - (Gait Amp-ND)	4.15	0.004
(Gait Con-ND) - (Gait Amp-ND)	2.28	0.495
(Gait Con-ND) - (Gait Con-Dom)	1.87	0.774

Figure F.9: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for maximum hip compressive force between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	55759.0	27879.5	209.25	0.000
Subject	3	526.8	175.6	1.32	0.272
Exercise Type*Subject	6	506.0	84.3	0.63	0.704
Error	108	14389.1	133.2		
Total	119	71180.9			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	-0.46	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	-0.04	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.31	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	-10.36	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-9.96	0.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-9.82	0.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	-9.72	0.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	-6.63	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	-8.54	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	-7.40	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	-6.12	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	0.43	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	0.77	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-9.90	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	-9.49	0.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	-9.36	0.000
(Elliptical Con-ND) - (Cycling Amp-ND)	-9.26	0.000
(Gait Amp-Dom) - (Cycling Amp-ND)	-6.16	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	-8.08	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	-6.94	0.000
(Gait Con-ND) - (Cycling Amp-ND)	-5.66	0.000
(Cycling Con-ND) - (Cycling Con-Dom)	0.35	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-10.33	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	-9.92	0.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	-9.78	0.000
(Elliptical Con-ND) - (Cycling Con-Dom)	-9.69	0.000
(Gait Amp-Dom) - (Cycling Con-Dom)	-6.59	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	-8.50	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	-7.36	0.000
(Gait Con-ND) - (Cycling Con-Dom)	-6.08	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	-10.67	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	-10.27	0.000
(Elliptical Con-Dom) - (Cycling Con-ND)	-10.13	0.000
(Elliptical Con-ND) - (Cycling Con-ND)	-10.03	0.000
(Gait Amp-Dom) - (Cycling Con-ND)	-6.94	0.000
(Gait Amp-ND) - (Cycling Con-ND)	-8.85	0.000
(Gait Con-Dom) - (Cycling Con-ND)	-7.71	0.000
(Gait Con-ND) - (Cycling Con-ND)	-6.43	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	0.41	1.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	0.54	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.64	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	3.74	0.015
(Gait Amp-ND) - (Elliptical Amp-Dom)	1.82	0.803
(Gait Con-Dom) - (Elliptical Amp-Dom)	2.96	0.134
(Gait Con-ND) - (Elliptical Amp-Dom)	4.24	0.003
(Elliptical Con-Dom) - (Elliptical Amp-ND)	0.14	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	0.23	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	3.33	0.051
(Gait Amp-ND) - (Elliptical Amp-ND)	1.41	0.956
(Gait Con-Dom) - (Elliptical Amp-ND)	2.56	0.317
(Gait Con-ND) - (Elliptical Amp-ND)	3.84	0.011
(Elliptical Con-ND) - (Elliptical Con-Dom)	0.10	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	3.20	0.074
(Gait Amp-ND) - (Elliptical Con-Dom)	1.28	0.980
(Gait Con-Dom) - (Elliptical Con-Dom)	2.42	0.401
(Gait Con-ND) - (Elliptical Con-Dom)	3.70	0.017
(Gait Amp-Dom) - (Elliptical Con-ND)	3.10	0.096
(Gait Amp-ND) - (Elliptical Con-ND)	1.18	0.989
(Gait Con-Dom) - (Elliptical Con-ND)	2.32	0.466
(Gait Con-ND) - (Elliptical Con-ND)	3.60	0.023
(Gait Amp-ND) - (Gait Amp-Dom)	-1.92	0.746
(Gait Con-Dom) - (Gait Amp-Dom)	-0.77	1.000
(Gait Con-ND) - (Gait Amp-Dom)	0.50	1.000
(Gait Con-Dom) - (Gait Amp-ND)	1.14	0.992
(Gait Con-ND) - (Gait Amp-ND)	2.42	0.401
(Gait Con-ND) - (Gait Con-Dom)	1.28	0.980

Figure F.10: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for maximum hip compressive force time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MinVHip versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	1.37464	0.687320	411.76	0.000
Subject	3	0.01540	0.005133	3.08	0.031
Exercise Type*Subject	6	0.01786	0.002977	1.78	0.109
Error	108	0.18027	0.001669		
Total	119	1.58817			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
Cycling Amp-ND - (Cycling Amp-Dom)	0.11	1.000
Cycling Con-Dom - (Cycling Amp-Dom)	0.29	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.67	1.000
Elliptical Amp-Dom - (Cycling Amp-Dom)	-3.10	0.005
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-5.89	0.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-2.34	0.453
(Elliptical Con-ND) - (Cycling Amp-Dom)	-2.45	0.383
(Gait Amp-Dom) - (Cycling Amp-Dom)	-12.62	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	-14.21	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	-13.67	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	-13.86	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	0.18	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	0.55	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-3.22	0.071
(Elliptical Amp-ND) - (Cycling Amp-ND)	-6.00	0.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	-2.46	0.378
(Elliptical Con-ND) - (Cycling Amp-ND)	-2.56	0.314
(Gait Amp-Dom) - (Cycling Amp-ND)	-12.74	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	-14.33	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	-13.78	0.000
(Gait Con-ND) - (Cycling Amp-ND)	-13.98	0.000
Cycling Con-ND - (Cycling Con-Dom)	0.37	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-3.40	0.043
(Elliptical Amp-ND) - (Cycling Con-Dom)	-6.18	0.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	-2.64	0.274
(Elliptical Con-ND) - (Cycling Con-Dom)	-2.74	0.221
(Gait Amp-Dom) - (Cycling Con-Dom)	-12.91	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	-14.51	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	-13.96	0.000
(Gait Con-ND) - (Cycling Con-Dom)	-14.15	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	-3.77	0.014
(Elliptical Amp-ND) - (Cycling Con-ND)	-6.56	0.000
(Elliptical Con-Dom) - (Cycling Con-ND)	-3.01	0.120
(Elliptical Con-ND) - (Cycling Con-ND)	-3.12	0.092
(Gait Amp-Dom) - (Cycling Con-ND)	-13.29	0.000
(Gait Amp-ND) - (Cycling Con-ND)	-14.88	0.000
(Gait Con-Dom) - (Cycling Con-ND)	-14.34	0.000
(Gait Con-ND) - (Cycling Con-ND)	-14.53	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	-2.79	0.206
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	0.76	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.65	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	-9.52	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	-11.11	0.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	-10.57	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	-10.76	0.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	3.55	0.027
(Elliptical Con-ND) - (Elliptical Amp-ND)	3.44	0.038
(Gait Amp-Dom) - (Elliptical Amp-ND)	-6.73	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	-8.32	0.000
(Gait Con-Dom) - (Elliptical Amp-ND)	-7.78	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	-7.97	0.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	-0.11	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	-10.28	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	-11.87	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	-11.33	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	-11.52	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	-10.17	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	-11.76	0.000
(Gait Con-Dom) - (Elliptical Con-ND)	-11.22	0.000
(Gait Con-ND) - (Elliptical Con-ND)	-11.41	0.000
(Gait Amp-ND) - (Gait Amp-Dom)	-1.58	0.908
(Gait Con-Dom) - (Gait Amp-Dom)	-1.05	0.996
(Gait Con-ND) - (Gait Amp-Dom)	-1.24	0.984
(Gait Con-Dom) - (Gait Amp-ND)	0.55	1.000
(Gait Con-ND) - (Gait Amp-ND)	0.35	1.000
(Gait Con-ND) - (Gait Con-Dom)	-0.19	1.000

Figure F.11: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for minimum hip compressive force between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)
Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	69571.0	34785.5	1465.05	0.000
Subject	3	208.2	69.4	2.92	0.037
Exercise Type*Subject	6	129.1	21.5	0.91	0.493
Error	108	2564.3	23.7		
Total	119	72472.6			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.903
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.996
(Cycling Con-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	0.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	0.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	0.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	0.260
(Cycling Con-ND) - (Cycling Amp-ND)	0.826
(Elliptical Amp-Dom) - (Cycling Amp-ND)	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	0.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	0.000
(Elliptical Con-ND) - (Cycling Amp-ND)	0.000
(Gait Amp-Dom) - (Cycling Amp-ND)	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	0.000
(Gait Con-ND) - (Cycling Amp-ND)	0.000
(Cycling Con-ND) - (Cycling Con-Dom)	0.996
(Elliptical Amp-Dom) - (Cycling Con-Dom)	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	0.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	0.000
(Elliptical Con-ND) - (Cycling Con-Dom)	0.000
(Gait Amp-Dom) - (Cycling Con-Dom)	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	0.000
(Gait Con-ND) - (Cycling Con-Dom)	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	0.000
(Elliptical Con-Dom) - (Cycling Con-ND)	0.000
(Elliptical Con-ND) - (Cycling Con-ND)	0.000
(Gait Amp-Dom) - (Cycling Con-ND)	0.000
(Gait Amp-ND) - (Cycling Con-ND)	0.000
(Gait Con-Dom) - (Cycling Con-ND)	0.000
(Gait Con-ND) - (Cycling Con-ND)	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	0.992
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.998
(Gait Amp-Dom) - (Elliptical Amp-Dom)	0.260
(Gait Amp-ND) - (Elliptical Amp-Dom)	0.973
(Gait Con-Dom) - (Elliptical Amp-Dom)	0.310
(Gait Con-ND) - (Elliptical Amp-Dom)	0.998
(Elliptical Con-Dom) - (Elliptical Amp-ND)	0.988
(Elliptical Con-ND) - (Elliptical Amp-ND)	0.997
(Gait Amp-Dom) - (Elliptical Amp-ND)	0.237
(Gait Amp-ND) - (Elliptical Amp-ND)	0.966
(Gait Con-Dom) - (Elliptical Amp-ND)	0.284
(Gait Con-ND) - (Elliptical Amp-ND)	0.997
(Elliptical Con-ND) - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	0.933
(Gait Amp-ND) - (Elliptical Con-Dom)	1.000
(Gait Con-Dom) - (Elliptical Con-Dom)	0.957
(Gait Con-ND) - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-ND)	0.865
(Gait Amp-ND) - (Elliptical Con-ND)	1.000
(Gait Con-Dom) - (Elliptical Con-ND)	0.903
(Gait Con-ND) - (Elliptical Con-ND)	1.000
(Gait Amp-ND) - (Gait Amp-Dom)	0.973
(Gait Con-Dom) - (Gait Amp-Dom)	1.000
(Gait Con-ND) - (Gait Amp-Dom)	0.865
(Gait Con-Dom) - (Gait Amp-ND)	0.984
(Gait Con-ND) - (Gait Amp-ND)	1.000
(Gait Con-ND) - (Gait Con-Dom)	0.903

Figure F.12: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for minimum hip compressive force time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MaxVKnee versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)
Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	20.6432	10.3216	2463.78	0.000
Subject	3	0.0458	0.0153	3.65	0.015
Exercise Type*Subject	6	0.0677	0.0113	2.69	0.018
Error	108	0.4524	0.0042		
Total	119	21.2092			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.67	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.32	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	-0.04	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	28.97	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	26.43	0.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	25.63	0.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	25.53	0.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	33.31	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	31.12	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	34.33	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	32.80	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	0.79	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	0.63	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	29.64	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	27.09	0.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	26.30	0.000
(Elliptical Con-ND) - (Cycling Amp-ND)	26.19	0.000
(Gait Amp-Dom) - (Cycling Amp-ND)	33.98	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	31.78	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	35.00	0.000
(Gait Con-ND) - (Cycling Amp-ND)	33.47	0.000
(Cycling Con-ND) - (Cycling Con-Dom)	0.16	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	28.85	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	26.30	0.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	25.50	0.000
(Elliptical Con-ND) - (Cycling Con-Dom)	25.40	0.000
(Gait Amp-Dom) - (Cycling Con-Dom)	33.19	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	30.99	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	34.21	0.000
(Gait Con-ND) - (Cycling Con-Dom)	32.68	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	29.01	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	26.46	0.000
(Elliptical Con-Dom) - (Cycling Con-ND)	25.67	0.000
(Elliptical Con-ND) - (Cycling Con-ND)	25.56	0.000
(Gait Amp-Dom) - (Cycling Con-ND)	33.35	0.000
(Gait Amp-ND) - (Cycling Con-ND)	31.15	0.000
(Gait Con-Dom) - (Cycling Con-ND)	34.37	0.000
(Gait Con-ND) - (Cycling Con-ND)	32.84	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	-2.55	0.322
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	-3.34	0.049
(Elliptical Con-ND) - (Elliptical Amp-Dom)	-3.45	0.037
(Gait Amp-Dom) - (Elliptical Amp-Dom)	4.34	0.002
(Gait Amp-ND) - (Elliptical Amp-Dom)	2.14	0.595
(Gait Con-Dom) - (Elliptical Amp-Dom)	5.36	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	3.83	0.011
(Elliptical Con-Dom) - (Elliptical Amp-ND)	-0.80	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	0.90	0.999
(Gait Amp-Dom) - (Elliptical Amp-ND)	6.89	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	4.69	0.001
(Gait Con-Dom) - (Elliptical Amp-ND)	7.91	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	6.38	0.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	-0.10	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	7.68	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	5.49	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	8.70	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	7.18	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	7.79	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	5.59	0.000
(Gait Con-Dom) - (Elliptical Con-ND)	8.81	0.000
(Gait Con-ND) - (Elliptical Con-ND)	7.28	0.000
(Gait Amp-ND) - (Gait Amp-Dom)	-2.20	0.555
(Gait Con-Dom) - (Gait Amp-Dom)	1.02	0.997
(Gait Con-ND) - (Gait Amp-Dom)	-0.51	1.000
(Gait Con-Dom) - (Gait Amp-ND)	3.22	0.071
(Gait Con-ND) - (Gait Amp-ND)	1.69	0.869
(Gait Con-ND) - (Gait Con-Dom)	-1.52	0.930

Figure F.13: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for maximum knee compressive force between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	5301.1	2650.53	13.27	0.000
Subject	3	267.5	89.16	0.45	0.720
Exercise Type*Subject	6	1167.7	194.62	0.97	0.446
Error	108	21565.6	199.68		
Total	119	28301.9			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.997
(Cycling Con-Dom) - (Cycling Amp-Dom)	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	0.881
(Elliptical Amp-ND) - (Cycling Amp-Dom)	0.966
(Elliptical Con-Dom) - (Cycling Amp-Dom)	0.983
(Elliptical Con-ND) - (Cycling Amp-Dom)	0.986
(Gait Amp-Dom) - (Cycling Amp-Dom)	0.728
(Gait Amp-ND) - (Cycling Amp-Dom)	1.000
(Gait Con-Dom) - (Cycling Amp-Dom)	1.000
(Gait Con-ND) - (Cycling Amp-Dom)	0.786
(Cycling Con-Dom) - (Cycling Amp-ND)	0.997
(Cycling Con-ND) - (Cycling Amp-ND)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	0.254
(Elliptical Amp-ND) - (Cycling Amp-ND)	0.422
(Elliptical Con-Dom) - (Cycling Amp-ND)	0.509
(Elliptical Con-ND) - (Cycling Amp-ND)	0.531
(Gait Amp-Dom) - (Cycling Amp-ND)	0.999
(Gait Amp-ND) - (Cycling Amp-ND)	0.996
(Gait Con-Dom) - (Cycling Amp-ND)	1.000
(Gait Con-ND) - (Cycling Amp-ND)	0.999
(Cycling Con-ND) - (Cycling Con-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	0.881
(Elliptical Amp-ND) - (Cycling Con-Dom)	0.966

(Elliptical Con-Dom) - (Cycling Con-Dom)	0.983
(Elliptical Con-ND) - (Cycling Con-Dom)	0.986
(Gait Amp-Dom) - (Cycling Con-Dom)	0.728
(Gait Amp-ND) - (Cycling Con-Dom)	1.000
(Gait Con-Dom) - (Cycling Con-Dom)	1.000
(Gait Con-ND) - (Cycling Con-Dom)	0.786
(Elliptical Amp-Dom) - (Cycling Con-ND)	0.487
(Elliptical Amp-ND) - (Cycling Con-ND)	0.686
(Elliptical Con-Dom) - (Cycling Con-ND)	0.767
(Elliptical Con-ND) - (Cycling Con-ND)	0.786
(Gait Amp-Dom) - (Cycling Con-ND)	0.976
(Gait Amp-ND) - (Cycling Con-ND)	1.000
(Gait Con-Dom) - (Cycling Con-ND)	1.000
(Gait Con-ND) - (Cycling Con-ND)	0.986
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	0.023
(Gait Amp-ND) - (Elliptical Amp-Dom)	0.900
(Gait Con-Dom) - (Elliptical Amp-Dom)	0.412
(Gait Con-ND) - (Elliptical Amp-Dom)	0.030
(Elliptical Con-Dom) - (Elliptical Amp-ND)	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	0.053
(Gait Amp-ND) - (Elliptical Amp-ND)	0.973
(Gait Con-Dom) - (Elliptical Amp-ND)	0.610
(Gait Con-ND) - (Elliptical Amp-ND)	0.068
(Elliptical Con-ND) - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	0.074
(Gait Amp-ND) - (Elliptical Con-Dom)	0.988
(Gait Con-Dom) - (Elliptical Con-Dom)	0.697
(Gait Con-ND) - (Elliptical Con-Dom)	0.095
(Gait Amp-Dom) - (Elliptical Con-ND)	0.081
(Gait Amp-ND) - (Elliptical Con-ND)	0.990
(Gait Con-Dom) - (Elliptical Con-ND)	0.717
(Gait Con-ND) - (Elliptical Con-ND)	0.103
(Gait Amp-ND) - (Gait Amp-Dom)	0.697
(Gait Con-Dom) - (Gait Amp-Dom)	0.988
(Gait Con-ND) - (Gait Amp-Dom)	1.000
(Gait Con-Dom) - (Gait Amp-ND)	1.000
(Gait Con-ND) - (Gait Amp-ND)	0.757
(Gait Con-ND) - (Gait Con-Dom)	0.994

Figure F.14: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for maximum knee compressive force time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MinVKnee versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)
Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	0.461374	0.230687	298.26	0.000
Subject	3	0.006669	0.002223	2.87	0.040
Exercise Type*Subject	6	0.003292	0.000549	0.71	0.643
Error	108	0.083531	0.000773		
Total	119	0.554866			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.38	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	1.90	0.758
(Cycling Con-ND) - (Cycling Amp-Dom)	1.88	0.768
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	3.51	0.030
(Elliptical Amp-ND) - (Cycling Amp-Dom)	3.30	0.056
(Elliptical Con-Dom) - (Cycling Amp-Dom)	4.45	0.001
(Elliptical Con-ND) - (Cycling Amp-Dom)	5.06	0.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	-7.69	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	-7.88	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	-7.67	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	-7.69	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	2.27	0.502
(Cycling Con-ND) - (Cycling Amp-ND)	2.26	0.512
(Elliptical Amp-Dom) - (Cycling Amp-ND)	3.89	0.009
(Elliptical Amp-ND) - (Cycling Amp-ND)	3.68	0.018
(Elliptical Con-Dom) - (Cycling Amp-ND)	4.83	0.000
(Elliptical Con-ND) - (Cycling Amp-ND)	5.43	0.000
(Gait Amp-Dom) - (Cycling Amp-ND)	-7.31	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	-7.50	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	-7.29	0.000
(Gait Con-ND) - (Cycling Amp-ND)	-7.32	0.000
(Cycling Con-ND) - (Cycling Con-Dom)	0.02	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	1.62	0.899
(Elliptical Amp-ND) - (Cycling Con-Dom)	1.40	0.961

(Elliptical Con-Dom) - (Cycling Con-Dom)	2.56	0.316
(Elliptical Con-ND) - (Cycling Con-Dom)	3.16	0.082
(Gait Amp-Dom) - (Cycling Con-Dom)	-9.59	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	-9.78	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	-9.57	0.000
(Gait Con-ND) - (Cycling Con-Dom)	-9.59	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	1.63	0.893
(Elliptical Amp-ND) - (Cycling Con-ND)	1.42	0.958
(Elliptical Con-Dom) - (Cycling Con-ND)	2.57	0.308
(Elliptical Con-ND) - (Cycling Con-ND)	3.17	0.075
(Gait Amp-Dom) - (Cycling Con-ND)	-9.57	0.000
(Gait Amp-ND) - (Cycling Con-ND)	-9.76	0.000
(Gait Con-Dom) - (Cycling Con-ND)	-9.55	0.000
(Gait Con-ND) - (Cycling Con-ND)	-9.58	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	-0.21	1.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	0.94	0.998
(Elliptical Con-ND) - (Elliptical Amp-Dom)	1.54	0.925
(Gait Amp-Dom) - (Elliptical Amp-Dom)	-11.20	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	-11.39	0.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	-11.18	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	-11.21	0.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	1.16	0.991
(Elliptical Con-ND) - (Elliptical Amp-ND)	1.76	0.837
(Gait Amp-Dom) - (Elliptical Amp-ND)	-10.99	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	-11.18	0.000
(Gait Con-Dom) - (Elliptical Amp-ND)	-10.97	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	-10.99	0.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	0.60	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	-12.15	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	-12.34	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	-12.12	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	-12.15	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	-12.75	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	-12.94	0.000
(Gait Con-Dom) - (Elliptical Con-ND)	-12.72	0.000
(Gait Con-ND) - (Elliptical Con-ND)	-12.75	0.000
(Gait Amp-ND) - (Gait Amp-Dom)	0.19	1.000
(Gait Con-Dom) - (Gait Amp-Dom)	0.02	1.000
(Gait Con-ND) - (Gait Amp-Dom)	-0.00	1.000
(Gait Con-Dom) - (Gait Amp-ND)	0.21	1.000
(Gait Con-ND) - (Gait Amp-ND)	0.19	1.000
(Gait Con-ND) - (Gait Con-Dom)	-0.02	1.000

Figure F.15: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for minimum knee compressive force between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)
Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	2418.9	1209.43	12.21	0.000
Subject	3	224.9	74.96	0.76	0.521
Exercise Type*Subject	6	496.7	82.79	0.84	0.545
Error	108	10697.1	99.05		
Total	119	13837.6			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.985
(Cycling Con-Dom) - (Cycling Amp-Dom)	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	0.974
(Elliptical Amp-ND) - (Cycling Amp-Dom)	0.990
(Elliptical Con-Dom) - (Cycling Amp-Dom)	0.993
(Elliptical Con-ND) - (Cycling Amp-Dom)	1.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	0.427
(Gait Amp-ND) - (Cycling Amp-Dom)	0.994
(Gait Con-Dom) - (Cycling Amp-Dom)	1.000
(Gait Con-ND) - (Cycling Amp-Dom)	0.929
(Cycling Con-Dom) - (Cycling Amp-ND)	0.985
(Cycling Con-ND) - (Cycling Amp-ND)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	1.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	1.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	1.000
(Elliptical Con-ND) - (Cycling Amp-ND)	1.000
(Gait Amp-Dom) - (Cycling Amp-ND)	0.025
(Gait Amp-ND) - (Cycling Amp-ND)	0.485
(Gait Con-Dom) - (Cycling Amp-ND)	0.967
(Gait Con-ND) - (Cycling Amp-ND)	0.232
(Cycling Con-ND) - (Cycling Con-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	0.967
(Elliptical Amp-ND) - (Cycling Con-Dom)	0.987

(Elliptical Con-Dom) - (Cycling Con-Dom)	0.990
(Elliptical Con-ND) - (Cycling Con-Dom)	0.999
(Gait Amp-Dom) - (Cycling Con-Dom)	0.458
(Gait Amp-ND) - (Cycling Con-Dom)	0.996
(Gait Con-Dom) - (Cycling Con-Dom)	1.000
(Gait Con-ND) - (Cycling Con-Dom)	0.942
(Elliptical Amp-Dom) - (Cycling Con-ND)	0.999
(Elliptical Amp-ND) - (Cycling Con-ND)	1.000
(Elliptical Con-Dom) - (Cycling Con-ND)	1.000
(Elliptical Con-ND) - (Cycling Con-ND)	1.000
(Gait Amp-Dom) - (Cycling Con-ND)	0.182
(Gait Amp-ND) - (Cycling Con-ND)	0.923
(Gait Con-Dom) - (Cycling Con-ND)	1.000
(Gait Con-ND) - (Cycling Con-ND)	0.708
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	0.017
(Gait Amp-ND) - (Elliptical Amp-Dom)	0.398
(Gait Con-Dom) - (Elliptical Amp-Dom)	0.936
(Gait Con-ND) - (Elliptical Amp-Dom)	0.173
(Elliptical Con-Dom) - (Elliptical Amp-ND)	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	0.027
(Gait Amp-ND) - (Elliptical Amp-ND)	0.505
(Gait Con-Dom) - (Elliptical Amp-ND)	0.970
(Gait Con-ND) - (Elliptical Amp-ND)	0.243
(Elliptical Con-ND) - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	0.031
(Gait Amp-ND) - (Elliptical Con-Dom)	0.536
(Gait Con-Dom) - (Elliptical Con-Dom)	0.977
(Gait Con-ND) - (Elliptical Con-Dom)	0.265
(Gait Amp-Dom) - (Elliptical Con-ND)	0.076
(Gait Amp-ND) - (Elliptical Con-ND)	0.751
(Gait Con-Dom) - (Elliptical Con-ND)	0.998
(Gait Con-ND) - (Elliptical Con-ND)	0.458
(Gait Amp-ND) - (Gait Amp-Dom)	0.980
(Gait Con-Dom) - (Gait Amp-Dom)	0.552
(Gait Con-ND) - (Gait Amp-Dom)	0.999
(Gait Con-Dom) - (Gait Amp-ND)	0.999
(Gait Con-ND) - (Gait Amp-ND)	1.000
(Gait Con-ND) - (Gait Con-Dom)	0.970

Figure F.16: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for minimum knee compressive force time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MaxAPHip versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)
Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	0.598946	0.299473	275.11	0.000
Subject	3	0.007111	0.002370	2.18	0.095
Exercise Type*Subject	6	0.018874	0.003146	2.89	0.012
Error	108	0.117563	0.001089		
Total	119	0.742494			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	1.59	0.910
(Cycling Con-Dom) - (Cycling Amp-Dom)	1.85	0.787
(Cycling Con-ND) - (Cycling Amp-Dom)	-1.99	0.696
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	-6.45	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-5.78	0.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-6.03	0.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	-6.27	0.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	4.14	0.004
(Gait Amp-ND) - (Cycling Amp-Dom)	5.74	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	6.42	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	6.07	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	-3.44	0.038
(Cycling Con-ND) - (Cycling Amp-ND)	-3.58	0.025
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-8.04	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	-7.36	0.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	-7.61	0.000
(Elliptical Con-ND) - (Cycling Amp-ND)	-7.85	0.000
(Gait Amp-Dom) - (Cycling Amp-ND)	2.56	0.318
(Gait Amp-ND) - (Cycling Amp-ND)	4.15	0.004
(Gait Con-Dom) - (Cycling Amp-ND)	4.83	0.000
(Gait Con-ND) - (Cycling Amp-ND)	4.48	0.001
(Cycling Con-ND) - (Cycling Con-Dom)	-0.15	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-4.60	0.001
(Elliptical Amp-ND) - (Cycling Con-Dom)	-3.93	0.008

(Elliptical Con-Dom) - (Cycling Con-Dom)	-4.18	0.003
(Elliptical Con-ND) - (Cycling Con-Dom)	-4.42	0.001
(Gait Amp-Dom) - (Cycling Con-Dom)	5.99	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	7.59	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	8.27	0.000
(Gait Con-ND) - (Cycling Con-Dom)	7.92	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	-4.45	0.001
(Elliptical Amp-ND) - (Cycling Con-ND)	-3.78	0.013
(Elliptical Con-Dom) - (Cycling Con-ND)	-4.03	0.006
(Elliptical Con-ND) - (Cycling Con-ND)	-4.27	0.002
(Gait Amp-Dom) - (Cycling Con-ND)	6.14	0.000
(Gait Amp-ND) - (Cycling Con-ND)	7.73	0.000
(Gait Con-Dom) - (Cycling Con-ND)	8.42	0.000
(Gait Con-ND) - (Cycling Con-ND)	8.06	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	0.67	1.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	0.42	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.18	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	10.59	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	12.19	0.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	12.87	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	12.52	0.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	-0.25	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	0.49	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	9.92	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	11.52	0.000
(Gait Con-Dom) - (Elliptical Amp-ND)	12.20	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	11.85	0.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	0.24	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	10.17	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	11.77	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	12.45	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	12.10	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	10.41	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	12.01	0.000
(Gait Con-Dom) - (Elliptical Con-ND)	12.69	0.000
(Gait Con-ND) - (Elliptical Con-ND)	12.34	0.000
(Gait Amp-ND) - (Gait Amp-Dom)	1.60	0.907
(Gait Con-Dom) - (Gait Amp-Dom)	2.28	0.499
(Gait Con-ND) - (Gait Amp-Dom)	1.93	0.740
(Gait Con-Dom) - (Gait Amp-ND)	0.68	1.000
(Gait Con-ND) - (Gait Amp-ND)	0.33	1.000
(Gait Con-ND) - (Gait Con-Dom)	0.35	1.000

Figure F.17: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for maximum hip anterior force between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	6784.3	3392.16	30.27	0.000
Subject	3	266.7	88.90	0.79	0.500
Exercise Type*Subject	6	2897.9	482.98	4.31	0.001
Error	108	12102.7	112.06		
Total	119	22051.6			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	-3.84	0.011
(Cycling Con-Dom) - (Cycling Amp-Dom)	-1.31	0.976
(Cycling Con-ND) - (Cycling Amp-Dom)	-1.92	0.743
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	-5.96	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-3.36	0.048
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-6.67	0.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	-5.72	0.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	-4.37	0.002
(Gait Amp-ND) - (Cycling Amp-Dom)	-5.01	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	-4.67	0.001
(Gait Con-ND) - (Cycling Amp-Dom)	-4.92	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	2.53	0.330
(Cycling Con-ND) - (Cycling Amp-ND)	1.92	0.743
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-2.11	0.615
(Elliptical Amp-ND) - (Cycling Amp-ND)	0.49	1.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	-2.83	0.182
(Elliptical Con-ND) - (Cycling Amp-ND)	-1.88	0.769
(Gait Amp-Dom) - (Cycling Amp-ND)	-0.53	1.000
(Gait Amp-ND) - (Cycling Amp-ND)	-1.16	0.991
(Gait Con-Dom) - (Cycling Amp-ND)	-0.82	1.000
(Gait Con-ND) - (Cycling Amp-ND)	-1.08	0.995
(Cycling Con-ND) - (Cycling Con-Dom)	0.61	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-4.65	0.001
(Elliptical Amp-ND) - (Cycling Con-Dom)	-2.05	0.659

(Elliptical Con-Dom) - (Cycling Con-Dom)	-5.37	0.000
(Elliptical Con-ND) - (Cycling Con-Dom)	-4.41	0.001
(Gait Amp-Dom) - (Cycling Con-Dom)	-3.06	0.105
(Gait Amp-ND) - (Cycling Con-Dom)	-3.70	0.017
(Gait Con-Dom) - (Cycling Con-Dom)	-3.36	0.048
(Gait Con-ND) - (Cycling Con-Dom)	-3.61	0.022
(Elliptical Amp-Dom) - (Cycling Con-ND)	-4.03	0.006
(Elliptical Amp-ND) - (Cycling Con-ND)	-1.44	0.953
(Elliptical Con-Dom) - (Cycling Con-ND)	-4.75	0.000
(Elliptical Con-ND) - (Cycling Con-ND)	-3.80	0.012
(Gait Amp-Dom) - (Cycling Con-ND)	-2.45	0.383
(Gait Amp-ND) - (Cycling Con-ND)	-3.08	0.100
(Gait Con-Dom) - (Cycling Con-ND)	-2.75	0.219
(Gait Con-ND) - (Cycling Con-ND)	-3.00	0.123
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	2.60	0.294
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	-0.72	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.23	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	1.58	0.911
(Gait Amp-ND) - (Elliptical Amp-Dom)	0.95	0.998
(Gait Con-Dom) - (Elliptical Amp-Dom)	1.29	0.979
(Gait Con-ND) - (Elliptical Amp-Dom)	1.04	0.997
(Elliptical Con-Dom) - (Elliptical Amp-ND)	-3.32	0.054
(Elliptical Con-ND) - (Elliptical Amp-ND)	-2.37	0.438
(Gait Amp-Dom) - (Elliptical Amp-ND)	-1.01	0.997
(Gait Amp-ND) - (Elliptical Amp-ND)	-1.65	0.887
(Gait Con-Dom) - (Elliptical Amp-ND)	-1.31	0.976
(Gait Con-ND) - (Elliptical Amp-ND)	-1.56	0.918
(Elliptical Con-ND) - (Elliptical Con-Dom)	0.95	0.998
(Gait Amp-Dom) - (Elliptical Con-Dom)	2.30	0.481
(Gait Amp-ND) - (Elliptical Con-Dom)	1.67	0.878
(Gait Con-Dom) - (Elliptical Con-Dom)	2.01	0.688
(Gait Con-ND) - (Elliptical Con-Dom)	1.75	0.839
(Gait Amp-Dom) - (Elliptical Con-ND)	1.35	0.970
(Gait Amp-ND) - (Elliptical Con-ND)	0.72	1.000
(Gait Con-Dom) - (Elliptical Con-ND)	1.06	0.996
(Gait Con-ND) - (Elliptical Con-ND)	0.80	1.000
(Gait Amp-ND) - (Gait Amp-Dom)	-0.63	1.000
(Gait Con-Dom) - (Gait Amp-Dom)	-0.30	1.000
(Gait Con-ND) - (Gait Amp-Dom)	-0.55	1.000
(Gait Con-Dom) - (Gait Amp-ND)	0.34	1.000
(Gait Con-ND) - (Gait Amp-ND)	0.08	1.000
(Gait Con-ND) - (Gait Con-Dom)	-0.25	1.000

Figure F.18: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for maximum hip anterior force time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MinAPHip versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)
Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	1.12799	0.563995	252.83	0.000
Subject	3	0.02691	0.008969	4.02	0.009
Exercise Type*Subject	6	0.04902	0.008170	3.66	0.002
Error	108	0.24092	0.002231		
Total	119	1.44483			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.69	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.48	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	-0.37	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	-10.03	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-8.85	0.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-8.42	0.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	-9.72	0.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	-12.83	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	-7.60	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	-11.31	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	-11.46	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	0.21	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	0.32	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-9.34	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	-8.17	0.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	-7.73	0.000
(Elliptical Con-ND) - (Cycling Amp-ND)	-9.03	0.000
(Gait Amp-Dom) - (Cycling Amp-ND)	-12.15	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	-6.91	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	-10.62	0.000
(Gait Con-ND) - (Cycling Amp-ND)	-10.78	0.000
(Cycling Con-ND) - (Cycling Con-Dom)	0.11	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-9.55	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	-8.37	0.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	-7.94	0.000
(Elliptical Con-ND) - (Cycling Con-Dom)	-9.24	0.000
(Gait Amp-Dom) - (Cycling Con-Dom)	-12.35	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	-7.12	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	-10.83	0.000
(Gait Con-ND) - (Cycling Con-Dom)	-10.99	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	-9.66	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	-8.49	0.000
(Elliptical Con-Dom) - (Cycling Con-ND)	-8.05	0.000
(Elliptical Con-ND) - (Cycling Con-ND)	-9.35	0.000
(Gait Amp-Dom) - (Cycling Con-ND)	-12.47	0.000
(Gait Amp-ND) - (Cycling Con-ND)	-7.23	0.000
(Gait Con-Dom) - (Cycling Con-ND)	-10.94	0.000
(Gait Con-ND) - (Cycling Con-ND)	-11.10	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	1.18	0.990
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	1.61	0.902
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.31	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	-2.80	0.194
(Gait Amp-ND) - (Elliptical Amp-Dom)	2.43	0.393
(Gait Con-Dom) - (Elliptical Amp-Dom)	-1.28	0.981
(Gait Con-ND) - (Elliptical Amp-Dom)	-1.43	0.954
(Elliptical Con-Dom) - (Elliptical Amp-ND)	0.43	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	-0.87	0.990
(Gait Amp-Dom) - (Elliptical Amp-ND)	-3.98	0.007
(Gait Amp-ND) - (Elliptical Amp-ND)	1.26	0.983
(Gait Con-Dom) - (Elliptical Amp-ND)	-2.45	0.380
(Gait Con-ND) - (Elliptical Amp-ND)	-2.61	0.286
(Elliptical Con-ND) - (Elliptical Con-Dom)	-1.30	0.978
(Gait Amp-Dom) - (Elliptical Con-Dom)	-4.41	0.001
(Gait Amp-ND) - (Elliptical Con-Dom)	0.82	1.000
(Gait Con-Dom) - (Elliptical Con-Dom)	-2.88	0.161
(Gait Con-ND) - (Elliptical Con-Dom)	-3.04	0.110
(Gait Amp-Dom) - (Elliptical Con-ND)	-3.11	0.092
(Gait Amp-ND) - (Elliptical Con-ND)	2.12	0.608
(Gait Con-Dom) - (Elliptical Con-ND)	-1.59	0.910
(Gait Con-ND) - (Elliptical Con-ND)	-1.75	0.843
(Gait Amp-ND) - (Gait Amp-Dom)	5.24	0.000
(Gait Con-Dom) - (Gait Amp-Dom)	1.53	0.930
(Gait Con-ND) - (Gait Amp-Dom)	1.37	0.967
(Gait Con-Dom) - (Gait Amp-ND)	-3.71	0.016
(Gait Con-ND) - (Gait Amp-ND)	-3.87	0.010
(Gait Con-Dom) - (Gait Con-ND)	-0.16	1.000

Figure F.19: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for minimum hip anterior force between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	51401	25700.4	30.98	0.000
Subject	3	712	237.4	0.29	0.835
Exercise Type*Subject	6	2841	473.5	0.57	0.753
Error	108	89596	829.6		
Total	119	144550			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
Cycling Amp-ND - (Cycling Amp-Dom)	1.000
Cycling Con-Dom - (Cycling Amp-Dom)	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	1.000
Elliptical Amp-Dom - (Cycling Amp-Dom)	0.001
(Elliptical Amp-ND) - (Cycling Amp-Dom)	0.251
(Elliptical Con-Dom) - (Cycling Amp-Dom)	0.071
(Elliptical Con-ND) - (Cycling Amp-Dom)	0.007
Gait Amp-Dom - (Cycling Amp-Dom)	1.000
(Gait Amp-ND) - (Cycling Amp-Dom)	1.000
(Gait Con-Dom) - (Cycling Amp-Dom)	1.000
(Gait Con-ND) - (Cycling Amp-Dom)	1.000
(Cycling Con-Dom) - (Cycling Amp-ND)	1.000
Cycling Con-ND - (Cycling Amp-ND)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	0.003
Elliptical Amp-ND - (Cycling Amp-ND)	0.485
(Elliptical Con-Dom) - (Cycling Amp-ND)	0.181
(Elliptical Con-ND) - (Cycling Amp-ND)	0.025
(Gait Amp-Dom) - (Cycling Amp-ND)	1.000
Gait Amp-ND - (Cycling Amp-ND)	1.000
(Gait Con-Dom) - (Cycling Amp-ND)	1.000
(Gait Con-ND) - (Cycling Amp-ND)	1.000
Cycling Con-ND - (Cycling Con-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	0.001
(Elliptical Amp-ND) - (Cycling Con-Dom)	0.297

Elliptical Con-Dom - (Cycling Con-Dom)	0.089
(Elliptical Con-ND) - (Cycling Con-Dom)	0.010
(Gait Amp-Dom) - (Cycling Con-Dom)	1.000
(Gait Amp-ND) - (Cycling Con-Dom)	1.000
Gait Con-Dom - (Cycling Con-Dom)	1.000
(Gait Con-ND) - (Cycling Con-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	0.001
(Elliptical Amp-ND) - (Cycling Con-ND)	0.306
(Elliptical Con-Dom) - (Cycling Con-ND)	0.093
Elliptical Con-ND - (Cycling Con-ND)	0.010
(Gait Amp-Dom) - (Cycling Con-ND)	1.000
(Gait Amp-ND) - (Cycling Con-ND)	1.000
(Gait Con-Dom) - (Cycling Con-ND)	1.000
Gait Con-ND - (Cycling Con-ND)	1.000
Elliptical Amp-ND - (Elliptical Amp-Dom)	0.765
Elliptical Con-Dom - (Elliptical Amp-Dom)	0.970
(Elliptical Con-ND) - (Elliptical Amp-Dom)	1.000
Gait Amp-Dom - (Elliptical Amp-Dom)	0.002
(Gait Amp-ND) - (Elliptical Amp-Dom)	0.003
(Gait Con-Dom) - (Elliptical Amp-Dom)	0.002
(Gait Con-ND) - (Elliptical Amp-Dom)	0.002
(Elliptical Con-Dom) - (Elliptical Amp-ND)	1.000
Elliptical Con-ND - (Elliptical Amp-ND)	0.981
(Gait Amp-Dom) - (Elliptical Amp-ND)	0.371
Gait Amp-ND - (Elliptical Amp-ND)	0.442
(Gait Con-Dom) - (Elliptical Amp-ND)	0.386
(Gait Con-ND) - (Elliptical Amp-ND)	0.386
Elliptical Con-ND - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	0.122
(Gait Amp-ND) - (Elliptical Con-Dom)	0.157
Gait Con-Dom - (Elliptical Con-Dom)	0.129
(Gait Con-ND) - (Elliptical Con-Dom)	0.129
(Gait Amp-Dom) - (Elliptical Con-ND)	0.015
(Gait Amp-ND) - (Elliptical Con-ND)	0.021
(Gait Con-Dom) - (Elliptical Con-ND)	0.016
Gait Con-ND - (Elliptical Con-ND)	0.016
Gait Amp-ND - (Gait Amp-Dom)	1.000
Gait Con-Dom - (Gait Amp-Dom)	1.000
(Gait Con-ND) - (Gait Amp-Dom)	1.000
(Gait Con-Dom) - (Gait Amp-ND)	1.000
Gait Con-ND - (Gait Amp-ND)	1.000
Gait Con-ND - (Gait Con-Dom)	1.000

Figure F.20: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for minimum hip anterior force time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MaxAPKnee versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)
Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	1.62102	0.810508	615.29	0.000
Subject	3	0.01675	0.005582	4.24	0.007
Exercise Type*Subject	6	0.01092	0.001820	1.38	0.229
Error	108	0.14227	0.001317		
Total	119	1.79095			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.11	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.22	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	-0.59	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	10.96	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	7.89	0.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	10.68	0.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	10.21	0.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	17.81	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	16.11	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	18.86	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	16.87	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	0.11	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	-0.69	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	10.86	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	7.79	0.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	10.58	0.000
(Elliptical Con-ND) - (Cycling Amp-ND)	10.11	0.000
(Gait Amp-Dom) - (Cycling Amp-ND)	17.71	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	16.00	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	18.75	0.000
(Gait Con-ND) - (Cycling Amp-ND)	16.77	0.000
(Cycling Con-ND) - (Cycling Con-Dom)	-0.81	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	10.74	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	7.68	0.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	10.46	0.000
(Elliptical Con-ND) - (Cycling Con-Dom)	10.00	0.000
(Gait Amp-Dom) - (Cycling Con-Dom)	17.60	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	15.89	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	18.64	0.000
(Gait Con-ND) - (Cycling Con-Dom)	16.65	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	11.55	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	8.48	0.000
(Elliptical Con-Dom) - (Cycling Con-ND)	11.27	0.000
(Elliptical Con-ND) - (Cycling Con-ND)	10.80	0.000
(Gait Amp-Dom) - (Cycling Con-ND)	18.40	0.000
(Gait Amp-ND) - (Cycling Con-ND)	16.70	0.000
(Gait Con-Dom) - (Cycling Con-ND)	19.45	0.000
(Gait Con-ND) - (Cycling Con-ND)	17.46	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	-3.07	0.104
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	-0.28	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	-0.75	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	6.85	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	5.15	0.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	7.90	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	5.91	0.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	2.79	0.199
(Elliptical Con-ND) - (Elliptical Amp-ND)	2.32	0.468
(Gait Amp-Dom) - (Elliptical Amp-ND)	9.92	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	8.21	0.000
(Gait Con-Dom) - (Elliptical Amp-ND)	10.97	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	8.98	0.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	-0.47	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	7.13	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	5.42	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	8.18	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	6.19	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	7.60	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	5.89	0.000
(Gait Con-Dom) - (Elliptical Con-ND)	8.64	0.000
(Gait Con-ND) - (Elliptical Con-ND)	6.66	0.000
(Gait Amp-ND) - (Gait Amp-Dom)	-1.71	0.982
(Gait Con-Dom) - (Gait Amp-Dom)	1.05	0.996
(Gait Con-ND) - (Gait Amp-Dom)	-0.94	0.999
(Gait Con-Dom) - (Gait Amp-ND)	2.75	0.216
(Gait Con-ND) - (Gait Amp-ND)	0.76	1.000
(Gait Con-Dom) - (Gait Con-Dom)	-1.96	0.700

Figure F.21: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for maximum knee anterior force between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	2158	1079.1	1.75	0.179
Subject	3	7201	2400.4	3.89	0.011
Exercise Type*Subject	6	11631	1938.5	3.14	0.007
Error	108	66728	617.9		
Total	119	87718			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.002
(Cycling Con-Dom) - (Cycling Amp-Dom)	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	0.576
(Elliptical Amp-ND) - (Cycling Amp-Dom)	0.888
(Elliptical Con-Dom) - (Cycling Amp-Dom)	0.982
(Elliptical Con-ND) - (Cycling Amp-Dom)	0.664
(Gait Amp-Dom) - (Cycling Amp-Dom)	0.664
(Gait Amp-ND) - (Cycling Amp-Dom)	0.450
(Gait Con-Dom) - (Cycling Amp-Dom)	0.905
(Gait Con-ND) - (Cycling Amp-Dom)	0.735
(Cycling Con-Dom) - (Cycling Amp-ND)	0.002
(Cycling Con-ND) - (Cycling Amp-ND)	0.001
(Elliptical Amp-Dom) - (Cycling Amp-ND)	0.551
(Elliptical Amp-ND) - (Cycling Amp-ND)	0.224
(Elliptical Con-Dom) - (Cycling Amp-ND)	0.091
(Elliptical Con-ND) - (Cycling Amp-ND)	0.456
(Gait Amp-Dom) - (Cycling Amp-ND)	0.456
(Gait Amp-ND) - (Cycling Amp-ND)	0.676
(Gait Con-Dom) - (Cycling Amp-ND)	0.204
(Gait Con-ND) - (Cycling Amp-ND)	0.385
(Cycling Con-ND) - (Cycling Con-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	0.601
(Elliptical Amp-ND) - (Cycling Con-Dom)	0.905

(Elliptical Con-Dom) - (Cycling Con-Dom)	0.987
(Elliptical Con-ND) - (Cycling Con-Dom)	0.694
(Gait Amp-Dom) - (Cycling Con-Dom)	0.694
(Gait Amp-ND) - (Cycling Con-Dom)	0.481
(Gait Con-Dom) - (Cycling Con-Dom)	0.921
(Gait Con-ND) - (Cycling Con-Dom)	0.763
(Elliptical Amp-Dom) - (Cycling Con-ND)	0.525
(Elliptical Amp-ND) - (Cycling Con-ND)	0.860
(Elliptical Con-Dom) - (Cycling Con-ND)	0.974
(Elliptical Con-ND) - (Cycling Con-ND)	0.620
(Gait Amp-Dom) - (Cycling Con-ND)	0.620
(Gait Amp-ND) - (Cycling Con-ND)	0.408
(Gait Con-Dom) - (Cycling Con-ND)	0.880
(Gait Con-ND) - (Cycling Con-ND)	0.694
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	0.995
(Elliptical Con-ND) - (Elliptical Amp-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	1.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	1.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	1.000
(Gait Con-ND) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	1.000
(Gait Amp-ND) - (Elliptical Amp-ND)	1.000
(Gait Con-Dom) - (Elliptical Amp-ND)	1.000
(Gait Con-ND) - (Elliptical Amp-ND)	1.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	1.000
(Gait Amp-ND) - (Elliptical Con-Dom)	0.995
(Gait Con-Dom) - (Elliptical Con-Dom)	1.000
(Gait Con-ND) - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-ND)	1.000
(Gait Amp-ND) - (Elliptical Con-ND)	1.000
(Gait Con-Dom) - (Elliptical Con-ND)	1.000
(Gait Con-ND) - (Elliptical Con-ND)	1.000
(Gait Con-ND) - (Elliptical Con-ND)	1.000
(Gait Con-ND) - (Gait Amp-Dom)	1.000
(Gait Con-ND) - (Gait Amp-ND)	1.000
(Gait Con-ND) - (Gait Con-Dom)	1.000

Figure F.22: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for maximum knee anterior force time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MinAPKnee versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)
Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	0.329192	0.164596	230.74	0.000
Subject	3	0.005418	0.001806	2.53	0.061
Exercise Type*Subject	6	0.013913	0.002319	3.25	0.006
Error	108	0.077040	0.000713		
Total	119	0.425563			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.35	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.33	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.04	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	6.15	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	1.36	0.968
(Elliptical Con-Dom) - (Cycling Amp-Dom)	4.18	0.003
(Elliptical Con-ND) - (Cycling Amp-Dom)	2.98	0.130
(Gait Amp-Dom) - (Cycling Amp-Dom)	-7.32	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	-7.42	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	-6.70	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	-6.05	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	-0.02	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	0.31	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	5.81	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	1.01	0.997
(Elliptical Con-Dom) - (Cycling Amp-ND)	3.84	0.011
(Elliptical Con-ND) - (Cycling Amp-ND)	2.63	0.277
(Gait Amp-Dom) - (Cycling Amp-ND)	-7.66	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	-7.77	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	-7.05	0.000
(Gait Con-ND) - (Cycling Amp-ND)	-6.40	0.000
(Cycling Con-ND) - (Cycling Con-Dom)	0.29	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	5.82	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	1.03	0.997

(Elliptical Con-Dom) - (Cycling Con-Dom)	3.85	0.010
(Elliptical Con-ND) - (Cycling Con-Dom)	2.65	0.267
(Gait Amp-Dom) - (Cycling Con-Dom)	-7.65	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	-7.75	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	-7.03	0.000
(Gait Con-ND) - (Cycling Con-Dom)	-6.38	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	6.11	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	1.32	0.975
(Elliptical Con-Dom) - (Cycling Con-ND)	4.14	0.004
(Elliptical Con-ND) - (Cycling Con-ND)	2.94	0.145
(Gait Amp-Dom) - (Cycling Con-ND)	-7.36	0.000
(Gait Amp-ND) - (Cycling Con-ND)	-7.46	0.000
(Gait Con-Dom) - (Cycling Con-ND)	-6.74	0.000
(Gait Con-ND) - (Cycling Con-ND)	-6.10	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	-4.79	0.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	-1.97	0.711
(Elliptical Con-ND) - (Elliptical Amp-Dom)	-3.18	0.078
(Gait Amp-Dom) - (Elliptical Amp-Dom)	-13.47	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	-13.58	0.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	-12.86	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	-12.21	0.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	2.82	0.185
(Elliptical Con-ND) - (Elliptical Amp-ND)	1.62	0.899
(Gait Amp-Dom) - (Elliptical Amp-ND)	-8.68	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	-8.78	0.000
(Gait Con-Dom) - (Elliptical Amp-ND)	-8.06	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	-7.41	0.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	-1.21	0.987
(Gait Amp-Dom) - (Elliptical Con-Dom)	-11.50	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	-11.60	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	-10.88	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	-10.24	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	-10.29	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	-10.40	0.000
(Gait Con-Dom) - (Elliptical Con-ND)	-9.68	0.000
(Gait Con-ND) - (Elliptical Con-ND)	-9.03	0.000
(Gait Amp-ND) - (Gait Amp-Dom)	-0.10	1.000
(Gait Con-Dom) - (Gait Amp-Dom)	0.62	1.000
(Gait Con-ND) - (Gait Amp-Dom)	1.26	0.982
(Gait Con-Dom) - (Gait Amp-ND)	0.72	1.000
(Gait Con-ND) - (Gait Amp-ND)	1.37	0.967
(Gait Con-ND) - (Gait Con-Dom)	0.65	1.000

Figure F.23: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for minimum knee anterior force between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	2913	1456.4	1.30	0.277
Subject	3	1841	613.8	0.55	0.651
Exercise Type*Subject	6	3562	593.6	0.53	0.785
Error	108	121096	1121.3		
Total	119	129412			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
Cycling Amp-ND - (Cycling Amp-Dom)	0.982
Cycling Con-Dom - (Cycling Amp-Dom)	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	1.000
Elliptical Amp-Dom - (Cycling Amp-Dom)	1.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	0.993
(Elliptical Con-Dom) - (Cycling Amp-Dom)	1.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	1.000
Gait Amp-Dom - (Cycling Amp-Dom)	1.000
(Gait Amp-ND) - (Cycling Amp-Dom)	1.000
(Gait Con-Dom) - (Cycling Amp-Dom)	0.955
(Gait Con-ND) - (Cycling Amp-Dom)	0.958
(Cycling Con-Dom) - (Cycling Amp-ND)	0.959
Cycling Con-ND - (Cycling Amp-ND)	0.982
(Elliptical Amp-Dom) - (Cycling Amp-ND)	0.985
Elliptical Amp-ND - (Cycling Amp-ND)	1.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	1.000
(Elliptical Con-ND) - (Cycling Amp-ND)	0.999
(Gait Amp-Dom) - (Cycling Amp-ND)	1.000
Gait Amp-ND - (Cycling Amp-ND)	1.000
(Gait Con-Dom) - (Cycling Amp-ND)	1.000
(Gait Con-ND) - (Cycling Amp-ND)	1.000
Cycling Con-ND - (Cycling Con-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	1.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	0.982

Elliptical Con-Dom - (Cycling Con-Dom)	1.000
(Elliptical Con-ND) - (Cycling Con-Dom)	1.000
(Gait Amp-Dom) - (Cycling Con-Dom)	0.999
(Gait Amp-ND) - (Cycling Con-Dom)	1.000
Gait Con-Dom - (Cycling Con-Dom)	0.914
(Gait Con-ND) - (Cycling Con-Dom)	0.918
(Elliptical Amp-Dom) - (Cycling Con-ND)	1.000
(Elliptical Amp-ND) - (Cycling Con-ND)	0.994
(Elliptical Con-Dom) - (Cycling Con-ND)	1.000
Elliptical Con-ND - (Cycling Con-ND)	1.000
(Gait Amp-Dom) - (Cycling Con-ND)	1.000
(Gait Amp-ND) - (Cycling Con-ND)	1.000
(Gait Con-Dom) - (Cycling Con-ND)	0.957
Gait Con-ND - (Cycling Con-ND)	0.955
Elliptical Amp-ND - (Elliptical Amp-Dom)	0.995
Elliptical Con-Dom - (Elliptical Amp-Dom)	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	1.000
Gait Amp-Dom - (Elliptical Amp-Dom)	1.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	1.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	0.962
(Gait Con-ND) - (Elliptical Amp-Dom)	0.965
(Elliptical Con-Dom) - (Elliptical Amp-ND)	1.000
Elliptical Con-ND - (Elliptical Amp-ND)	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	1.000
Gait Amp-ND - (Elliptical Amp-ND)	1.000
(Gait Con-Dom) - (Elliptical Amp-ND)	1.000
(Gait Con-ND) - (Elliptical Amp-ND)	1.000
Elliptical Con-ND - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	1.000
(Gait Amp-ND) - (Elliptical Con-Dom)	1.000
Gait Con-Dom - (Elliptical Con-Dom)	0.999
(Gait Con-ND) - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-ND)	1.000
(Gait Amp-ND) - (Elliptical Con-ND)	1.000
(Gait Con-Dom) - (Elliptical Con-ND)	0.997
Gait Con-ND - (Elliptical Con-ND)	0.997
Gait Amp-ND - (Gait Amp-Dom)	1.000
Gait Con-Dom - (Gait Amp-Dom)	1.000
(Gait Con-ND) - (Gait Amp-Dom)	1.000
(Gait Con-Dom) - (Gait Amp-ND)	1.000
Gait Con-ND - (Gait Con-Dom)	1.000

Figure F.24: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for minimum knee anterior force time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MaxLMHip versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)
Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	0.163548	0.081774	88.97	0.000
Subject	3	0.002073	0.000691	0.75	0.524
Exercise Type*Subject	6	0.003744	0.000624	0.68	0.667
Error	108	0.099263	0.000919		
Total	119	0.268627			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.05	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.60	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.11	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	2.32	0.466
(Elliptical Amp-ND) - (Cycling Amp-Dom)	1.86	0.781
(Elliptical Con-Dom) - (Cycling Amp-Dom)	0.78	1.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	1.23	0.985
(Gait Amp-Dom) - (Cycling Amp-Dom)	7.20	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	6.32	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	6.91	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	5.59	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	0.65	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	0.16	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	2.38	0.432
(Elliptical Amp-ND) - (Cycling Amp-ND)	1.91	0.756
(Elliptical Con-Dom) - (Cycling Amp-ND)	0.83	1.000
(Elliptical Con-ND) - (Cycling Amp-ND)	1.28	0.980
(Gait Amp-Dom) - (Cycling Amp-ND)	7.25	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	6.37	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	6.96	0.000
(Gait Con-ND) - (Cycling Amp-ND)	5.64	0.000
(Cycling Con-ND) - (Cycling Con-Dom)	0.49	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	1.73	0.851
(Elliptical Amp-ND) - (Cycling Con-Dom)	1.26	0.982

(Elliptical Con-Dom) - (Cycling Con-Dom)	0.19	1.000
(Elliptical Con-ND) - (Cycling Con-Dom)	0.64	1.000
(Gait Amp-Dom) - (Cycling Con-Dom)	6.61	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	5.73	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	6.32	0.000
(Gait Con-ND) - (Cycling Con-Dom)	5.00	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	2.22	0.540
(Elliptical Amp-ND) - (Cycling Con-ND)	1.75	0.838
(Elliptical Con-Dom) - (Cycling Con-ND)	0.68	1.000
(Elliptical Con-ND) - (Cycling Con-ND)	1.12	0.993
(Gait Amp-Dom) - (Cycling Con-ND)	7.09	0.000
(Gait Amp-ND) - (Cycling Con-ND)	6.21	0.000
(Gait Con-Dom) - (Cycling Con-ND)	6.80	0.000
(Gait Con-ND) - (Cycling Con-ND)	5.49	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	0.46	1.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	1.54	0.925
(Elliptical Con-ND) - (Elliptical Amp-Dom)	-1.09	0.994
(Gait Amp-Dom) - (Elliptical Amp-Dom)	4.88	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	4.00	0.006
(Gait Con-Dom) - (Elliptical Amp-Dom)	4.59	0.001
(Gait Con-ND) - (Elliptical Amp-Dom)	3.27	0.061
(Elliptical Con-Dom) - (Elliptical Amp-ND)	-1.08	0.995
(Elliptical Con-ND) - (Elliptical Amp-ND)	0.65	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	5.34	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	4.46	0.001
(Gait Con-Dom) - (Elliptical Amp-ND)	5.05	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	3.73	0.015
(Elliptical Con-ND) - (Elliptical Con-Dom)	0.45	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	6.42	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	5.54	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	6.13	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	4.81	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	5.97	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	5.09	0.000
(Gait Con-Dom) - (Elliptical Con-ND)	5.68	0.000
(Gait Con-ND) - (Elliptical Con-ND)	4.36	0.002
(Gait Amp-ND) - (Gait Amp-Dom)	0.88	0.999
(Gait Con-Dom) - (Gait Amp-Dom)	0.25	1.000
(Gait Con-ND) - (Gait Amp-Dom)	-1.61	0.903
(Gait Con-Dom) - (Gait Amp-ND)	0.59	1.000
(Gait Con-ND) - (Gait Amp-ND)	0.72	1.000
(Gait Con-ND) - (Gait Con-Dom)	1.32	0.975

Figure F.25: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test maximum hip lateral force between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	9298	4649.0	8.71	0.000
Subject	3	3662	1220.7	2.29	0.083
Exercise Type*Subject	6	1694	282.3	0.53	0.785
Error	108	57621	533.5		
Total	119	72275			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
Cycling Amp-ND - (Cycling Amp-Dom)	1.000
Cycling Con-Dom - (Cycling Amp-Dom)	0.803
(Cycling Con-ND) - (Cycling Amp-Dom)	0.623
Elliptical Amp-Dom - (Cycling Amp-Dom)	0.912
(Elliptical Amp-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	1.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	0.999
Gait Amp-Dom - (Cycling Amp-Dom)	0.977
(Gait Amp-ND) - (Cycling Amp-Dom)	1.000
(Gait Con-Dom) - (Cycling Amp-Dom)	1.000
(Gait Con-ND) - (Cycling Amp-Dom)	1.000
(Cycling Con-Dom) - (Cycling Amp-ND)	0.896
Cycling Con-ND - (Cycling Amp-ND)	0.752
(Elliptical Amp-Dom) - (Cycling Amp-ND)	0.830
Elliptical Amp-ND - (Cycling Amp-ND)	0.992
(Elliptical Con-Dom) - (Cycling Amp-ND)	0.998
(Elliptical Con-ND) - (Cycling Amp-ND)	0.993
(Gait Amp-Dom) - (Cycling Amp-ND)	0.937
Gait Amp-ND - (Cycling Amp-ND)	1.000
(Gait Con-Dom) - (Cycling Amp-ND)	1.000
(Gait Con-ND) - (Cycling Amp-ND)	1.000
Cycling Con-ND - (Cycling Con-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	0.043
(Elliptical Amp-ND) - (Cycling Con-Dom)	0.365

Elliptical Con-Dom - (Cycling Con-Dom)	0.302
(Elliptical Con-ND) - (Cycling Con-Dom)	0.222
(Gait Amp-Dom) - (Cycling Con-Dom)	0.089
(Gait Amp-ND) - (Cycling Con-Dom)	0.583
Gait Con-Dom - (Cycling Con-Dom)	0.752
(Gait Con-ND) - (Cycling Con-Dom)	0.715
(Elliptical Amp-Dom) - (Cycling Con-ND)	0.018
(Elliptical Amp-ND) - (Cycling Con-ND)	0.213
(Elliptical Con-Dom) - (Cycling Con-ND)	0.169
Elliptical Con-ND - (Cycling Con-ND)	0.117
(Gait Amp-Dom) - (Cycling Con-ND)	0.041
(Gait Amp-ND) - (Cycling Con-ND)	0.389
(Gait Con-Dom) - (Cycling Con-ND)	0.569
Gait Con-ND - (Cycling Con-ND)	0.521
Elliptical Amp-ND - (Elliptical Amp-Dom)	0.992
Elliptical Con-Dom - (Elliptical Amp-Dom)	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	1.000
Gait Amp-Dom - (Elliptical Amp-Dom)	1.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	0.984
(Gait Con-Dom) - (Elliptical Amp-Dom)	0.937
(Gait Con-ND) - (Elliptical Amp-Dom)	0.954
(Elliptical Con-Dom) - (Elliptical Amp-ND)	1.000
Elliptical Con-ND - (Elliptical Amp-ND)	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	1.000
Gait Amp-ND - (Elliptical Amp-ND)	1.000
(Gait Con-Dom) - (Elliptical Amp-ND)	1.000
(Gait Con-ND) - (Elliptical Amp-ND)	1.000
Elliptical Con-ND - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	1.000
(Gait Amp-ND) - (Elliptical Con-Dom)	1.000
Gait Con-Dom - (Elliptical Con-Dom)	1.000
(Gait Con-ND) - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-ND)	1.000
(Gait Amp-ND) - (Elliptical Con-ND)	1.000
(Gait Con-Dom) - (Elliptical Con-ND)	0.999
Gait Con-ND - (Elliptical Con-ND)	1.000
Gait Amp-ND - (Gait Amp-Dom)	0.998
Gait Con-Dom - (Gait Amp-Dom)	0.985
(Gait Con-ND) - (Gait Amp-Dom)	0.991
(Gait Con-Dom) - (Gait Amp-ND)	1.000
Gait Con-ND - (Gait Amp-ND)	1.000
Gait Con-ND - (Gait Con-Dom)	1.000

Figure F.26: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for maximum hip lateral force time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MinLMHip versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)
Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	0.017487	0.008743	26.01	0.000
Subject	3	0.001453	0.000484	1.44	0.235
Exercise Type*Subject	6	0.001242	0.000207	0.62	0.717
Error	108	0.036300	0.000336		
Total	119	0.056482			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.47	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.48	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.57	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	-1.54	0.927
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-1.79	0.821
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-2.64	0.271
(Elliptical Con-ND) - (Cycling Amp-Dom)	-1.11	0.994
(Gait Amp-Dom) - (Cycling Amp-Dom)	-3.85	0.010
(Gait Amp-ND) - (Cycling Amp-Dom)	-4.42	0.001
(Gait Con-Dom) - (Cycling Amp-Dom)	-2.99	0.127
(Gait Con-ND) - (Cycling Amp-Dom)	-2.58	0.303
(Cycling Con-Dom) - (Cycling Amp-ND)	0.94	0.998
(Cycling Con-ND) - (Cycling Amp-ND)	1.04	0.996
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-1.07	0.995
(Elliptical Amp-ND) - (Cycling Amp-ND)	-1.32	0.975
(Elliptical Con-Dom) - (Cycling Amp-ND)	-2.17	0.572
(Elliptical Con-ND) - (Cycling Amp-ND)	-0.64	1.000
(Gait Amp-Dom) - (Cycling Amp-ND)	-3.38	0.045
(Gait Amp-ND) - (Cycling Amp-ND)	-3.96	0.007
(Gait Con-Dom) - (Cycling Amp-ND)	-2.52	0.340
(Gait Con-ND) - (Cycling Amp-ND)	-2.11	0.613
(Cycling Con-ND) - (Cycling Con-Dom)	0.09	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-2.01	0.685
(Elliptical Amp-ND) - (Cycling Con-Dom)	-2.26	0.509

(Elliptical Con-Dom) - (Cycling Con-Dom)	-3.12	0.092
(Elliptical Con-ND) - (Cycling Con-Dom)	-1.58	0.911
(Gait Amp-Dom) - (Cycling Con-Dom)	-4.32	0.002
(Gait Amp-ND) - (Cycling Con-Dom)	-4.90	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	-3.46	0.035
(Gait Con-ND) - (Cycling Con-Dom)	-3.06	0.107
(Elliptical Amp-Dom) - (Cycling Con-ND)	-2.10	0.621
(Elliptical Amp-ND) - (Cycling Con-ND)	-2.36	0.445
(Elliptical Con-Dom) - (Cycling Con-ND)	-3.21	0.072
(Elliptical Con-ND) - (Cycling Con-ND)	-1.66	0.875
(Gait Amp-Dom) - (Cycling Con-ND)	-4.42	0.001
(Gait Amp-ND) - (Cycling Con-ND)	-4.99	0.000
(Gait Con-Dom) - (Cycling Con-ND)	-3.55	0.027
(Gait Con-ND) - (Cycling Con-ND)	-3.15	0.084
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	-0.25	1.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	-1.11	0.994
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.43	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	-2.31	0.474
(Gait Amp-ND) - (Elliptical Amp-Dom)	-2.89	0.161
(Gait Con-Dom) - (Elliptical Amp-Dom)	-1.45	0.950
(Gait Con-ND) - (Elliptical Amp-Dom)	-1.05	0.996
(Elliptical Con-Dom) - (Elliptical Amp-ND)	-0.85	0.999
(Elliptical Con-ND) - (Elliptical Amp-ND)	0.64	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	-2.06	0.650
(Gait Amp-ND) - (Elliptical Amp-ND)	-2.64	0.274
(Gait Con-Dom) - (Elliptical Amp-ND)	-1.20	0.988
(Gait Con-ND) - (Elliptical Amp-ND)	-0.80	1.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	1.53	0.928
(Gait Amp-Dom) - (Elliptical Con-Dom)	-1.21	0.987
(Gait Amp-ND) - (Elliptical Con-Dom)	-1.78	0.824
(Gait Con-Dom) - (Elliptical Con-Dom)	-0.35	1.000
(Gait Con-ND) - (Elliptical Con-Dom)	0.06	1.000
(Gait Amp-Dom) - (Elliptical Con-ND)	-2.74	0.221
(Gait Amp-ND) - (Elliptical Con-ND)	-3.31	0.054
(Gait Con-Dom) - (Elliptical Con-ND)	-1.88	0.770
(Gait Con-ND) - (Elliptical Con-ND)	-1.47	0.944
(Gait Amp-ND) - (Gait Amp-Dom)	-0.57	1.000
(Gait Con-Dom) - (Gait Amp-Dom)	0.86	0.999
(Gait Con-ND) - (Gait Amp-Dom)	1.27	0.982
(Gait Con-Dom) - (Gait Amp-ND)	1.44	0.953
(Gait Con-ND) - (Gait Amp-ND)	1.84	0.792
(Gait Con-ND) - (Gait Con-Dom)	0.40	1.000

Figure F.27: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test minimum hip lateral force between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	947.5	473.8	0.70	0.500
Subject	3	9769.4	3256.5	4.80	0.004
Exercise Type*Subject	6	7247.9	1208.0	1.78	0.110
Error	108	73275.6	678.5		
Total	119	91240.4			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
Cycling Amp-ND - (Cycling Amp-Dom)	1.000
Cycling Con-Dom - (Cycling Amp-Dom)	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.322
Elliptical Amp-Dom - (Cycling Amp-Dom)	1.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	0.996
(Elliptical Con-Dom) - (Cycling Amp-Dom)	1.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	0.430
Gait Amp-Dom - (Cycling Amp-Dom)	0.890
(Gait Amp-ND) - (Cycling Amp-Dom)	0.887
(Gait Con-Dom) - (Cycling Amp-Dom)	1.000
(Gait Con-ND) - (Cycling Amp-Dom)	0.958
(Cycling Con-Dom) - (Cycling Amp-ND)	1.000
Cycling Con-ND - (Cycling Amp-ND)	0.288
(Elliptical Amp-Dom) - (Cycling Amp-ND)	1.000
Elliptical Amp-ND - (Cycling Amp-ND)	0.998
(Elliptical Con-Dom) - (Cycling Amp-ND)	1.000
(Elliptical Con-ND) - (Cycling Amp-ND)	0.390
(Gait Amp-Dom) - (Cycling Amp-ND)	0.864
Gait Amp-ND - (Cycling Amp-ND)	0.861
(Gait Con-Dom) - (Cycling Amp-ND)	1.000
(Gait Con-ND) - (Cycling Amp-ND)	0.944
Cycling Con-ND - (Cycling Con-Dom)	0.501
(Elliptical Amp-Dom) - (Cycling Con-Dom)	1.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	0.976

Elliptical Con-Dom - (Cycling Con-Dom)	1.000
(Elliptical Con-ND) - (Cycling Con-Dom)	0.622
(Gait Amp-Dom) - (Cycling Con-Dom)	0.968
(Gait Amp-ND) - (Cycling Con-Dom)	0.966
Gait Con-Dom - (Cycling Con-Dom)	1.000
(Gait Con-ND) - (Cycling Con-Dom)	0.992
(Elliptical Amp-Dom) - (Cycling Con-ND)	0.692
(Elliptical Amp-ND) - (Cycling Con-ND)	0.024
(Elliptical Con-Dom) - (Cycling Con-ND)	0.709
Elliptical Con-ND - (Cycling Con-ND)	1.000
(Gait Amp-Dom) - (Cycling Con-ND)	0.999
(Gait Amp-ND) - (Cycling Con-ND)	0.999
(Gait Con-Dom) - (Cycling Con-ND)	0.288
Gait Con-ND - (Cycling Con-ND)	0.992
Elliptical Amp-ND - (Elliptical Amp-Dom)	0.910
Elliptical Con-Dom - (Elliptical Amp-Dom)	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.799
Gait Amp-Dom - (Elliptical Amp-Dom)	0.995
(Gait Amp-ND) - (Elliptical Amp-Dom)	0.994
(Gait Con-Dom) - (Elliptical Amp-Dom)	1.000
(Gait Con-ND) - (Elliptical Amp-Dom)	0.999
(Elliptical Con-Dom) - (Elliptical Amp-ND)	0.900
Elliptical Con-ND - (Elliptical Amp-ND)	0.040
(Gait Amp-Dom) - (Elliptical Amp-ND)	0.251
Gait Amp-ND - (Elliptical Amp-ND)	0.247
(Gait Con-Dom) - (Elliptical Amp-ND)	0.998
(Gait Con-ND) - (Elliptical Amp-ND)	0.379
Elliptical Con-ND - (Elliptical Con-Dom)	0.813
(Gait Amp-Dom) - (Elliptical Con-Dom)	0.996
(Gait Amp-ND) - (Elliptical Con-Dom)	0.995
Gait Con-Dom - (Elliptical Con-Dom)	1.000
(Gait Con-ND) - (Elliptical Con-Dom)	0.999
(Gait Amp-Dom) - (Elliptical Con-ND)	1.000
(Gait Amp-ND) - (Elliptical Con-ND)	1.000
(Gait Con-Dom) - (Elliptical Con-ND)	0.390
Gait Con-ND - (Elliptical Con-ND)	0.998
Gait Amp-ND - (Gait Amp-Dom)	1.000
Gait Con-Dom - (Gait Amp-Dom)	0.864
(Gait Con-ND) - (Gait Amp-Dom)	1.000
(Gait Con-Dom) - (Gait Amp-ND)	0.861
Gait Con-ND - (Gait Amp-ND)	1.000
Gait Con-ND - (Gait Con-Dom)	0.944

Figure F.28: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for minimum hip lateral force time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MaxLMKnee versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)
Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	0.164234	0.082117	154.34	0.000
Subject	3	0.002811	0.000937	1.76	0.159
Exercise Type*Subject	6	0.003097	0.000516	0.97	0.449
Error	108	0.057461	0.000532		
Total	119	0.227602			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.04	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.04	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.56	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	3.55	0.027
(Elliptical Amp-ND) - (Cycling Amp-Dom)	2.24	0.523
(Elliptical Con-Dom) - (Cycling Amp-Dom)	2.41	0.411
(Elliptical Con-ND) - (Cycling Amp-Dom)	3.91	0.008
(Gait Amp-Dom) - (Cycling Amp-Dom)	7.78	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	7.95	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	9.72	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	9.62	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	-0.08	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	0.52	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	3.50	0.031
(Elliptical Amp-ND) - (Cycling Amp-ND)	2.20	0.552
(Elliptical Con-Dom) - (Cycling Amp-ND)	2.37	0.438
(Elliptical Con-ND) - (Cycling Amp-ND)	3.87	0.010
(Gait Amp-Dom) - (Cycling Amp-ND)	7.74	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	7.91	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	9.68	0.000
(Gait Con-ND) - (Cycling Amp-ND)	9.58	0.000
(Cycling Con-ND) - (Cycling Con-Dom)	0.60	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	3.59	0.024
(Elliptical Amp-ND) - (Cycling Con-Dom)	2.29	0.493

(Elliptical Con-Dom) - (Cycling Con-Dom)	2.45	0.383
(Elliptical Con-ND) - (Cycling Con-Dom)	3.96	0.007
(Gait Amp-Dom) - (Cycling Con-Dom)	7.83	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	8.00	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	9.76	0.000
(Gait Con-ND) - (Cycling Con-Dom)	9.66	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	2.99	0.127
(Elliptical Amp-ND) - (Cycling Con-ND)	1.68	0.872
(Elliptical Con-Dom) - (Cycling Con-ND)	1.85	0.788
(Elliptical Con-ND) - (Cycling Con-ND)	3.35	0.048
(Gait Amp-Dom) - (Cycling Con-ND)	7.22	0.000
(Gait Amp-ND) - (Cycling Con-ND)	7.39	0.000
(Gait Con-Dom) - (Cycling Con-ND)	9.16	0.000
(Gait Con-ND) - (Cycling Con-ND)	9.06	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	1.30	0.977
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	1.14	0.992
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.37	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	4.24	0.003
(Gait Amp-ND) - (Elliptical Amp-Dom)	4.41	0.001
(Gait Con-Dom) - (Elliptical Amp-Dom)	6.17	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	6.07	0.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	0.16	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	1.67	0.877
(Gait Amp-Dom) - (Elliptical Amp-ND)	5.54	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	5.71	0.000
(Gait Con-Dom) - (Elliptical Amp-ND)	7.47	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	7.38	0.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	1.51	0.936
(Gait Amp-Dom) - (Elliptical Con-Dom)	5.38	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	5.55	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	7.31	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	7.21	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	3.87	0.010
(Gait Amp-ND) - (Elliptical Con-ND)	4.04	0.005
(Gait Con-Dom) - (Elliptical Con-ND)	5.80	0.000
(Gait Con-ND) - (Elliptical Con-ND)	5.71	0.000
(Gait Amp-ND) - (Gait Amp-Dom)	0.17	1.000
(Gait Con-Dom) - (Gait Amp-Dom)	1.93	0.735
(Gait Con-ND) - (Gait Amp-Dom)	1.84	0.794
(Gait Con-Dom) - (Gait Amp-ND)	1.76	0.834
(Gait Con-ND) - (Gait Amp-ND)	1.67	0.879
(Gait Con-ND) - (Gait Con-Dom)	0.16	1.000

Figure F.29: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test maximum knee lateral force between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

Linear Model: % Cycle versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	3085	1542.4	3.53	0.033
Subject	3	1657	552.3	1.26	0.290
Exercise Type*Subject	6	2457	409.5	0.94	0.472
Error	108	47190	436.9		
Total	119	54388			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.944
(Cycling Con-Dom) - (Cycling Amp-Dom)	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	1.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	1.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	0.878
(Gait Amp-Dom) - (Cycling Amp-Dom)	0.999
(Gait Amp-ND) - (Cycling Amp-Dom)	0.999
(Gait Con-Dom) - (Cycling Amp-Dom)	0.981
(Gait Con-ND) - (Cycling Amp-Dom)	0.977
(Cycling Con-Dom) - (Cycling Amp-ND)	0.980
(Cycling Con-ND) - (Cycling Amp-ND)	0.822
(Elliptical Amp-Dom) - (Cycling Amp-ND)	0.980
(Elliptical Amp-ND) - (Cycling Amp-ND)	0.984
(Elliptical Con-Dom) - (Cycling Amp-ND)	0.974
(Elliptical Con-ND) - (Cycling Amp-ND)	0.085
(Gait Amp-Dom) - (Cycling Amp-ND)	1.000
(Gait Amp-ND) - (Cycling Amp-ND)	1.000
(Gait Con-Dom) - (Cycling Amp-ND)	1.000
(Gait Con-ND) - (Cycling Amp-ND)	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	1.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	1.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	1.000
(Elliptical Con-ND) - (Cycling Con-Dom)	0.780
(Gait Amp-Dom) - (Cycling Con-Dom)	1.000
(Gait Amp-ND) - (Cycling Con-Dom)	1.000
(Gait Con-Dom) - (Cycling Con-Dom)	0.994
(Elliptical Amp-Dom) - (Cycling Con-ND)	1.000
(Elliptical Amp-ND) - (Cycling Con-ND)	1.000
(Elliptical Con-Dom) - (Cycling Con-ND)	1.000
(Elliptical Con-ND) - (Cycling Con-ND)	0.969
(Gait Amp-Dom) - (Cycling Con-ND)	0.991
(Gait Amp-ND) - (Cycling Con-ND)	0.991
(Gait Con-Dom) - (Cycling Con-ND)	0.911
(Gait Con-ND) - (Cycling Con-ND)	0.900
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.780
(Gait Amp-Dom) - (Elliptical Amp-Dom)	1.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	1.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	0.995
(Gait Con-ND) - (Elliptical Amp-Dom)	0.994
(Elliptical Con-Dom) - (Elliptical Amp-ND)	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	0.720
(Gait Amp-Dom) - (Elliptical Amp-ND)	1.000
(Gait Amp-ND) - (Elliptical Amp-ND)	1.000
(Gait Con-Dom) - (Elliptical Amp-ND)	0.998
(Gait Con-ND) - (Elliptical Amp-ND)	0.997
(Elliptical Con-ND) - (Elliptical Con-Dom)	0.804
(Gait Amp-Dom) - (Elliptical Con-Dom)	1.000
(Gait Amp-ND) - (Elliptical Con-Dom)	1.000
(Gait Con-Dom) - (Elliptical Con-Dom)	0.993
(Gait Con-ND) - (Elliptical Con-Dom)	0.991
(Gait Amp-Dom) - (Elliptical Con-ND)	0.343
(Gait Amp-ND) - (Elliptical Con-ND)	0.343
(Gait Con-Dom) - (Elliptical Con-ND)	0.141
(Gait Con-ND) - (Elliptical Con-ND)	0.131
(Gait Amp-ND) - (Gait Amp-Dom)	1.000
(Gait Con-Dom) - (Gait Amp-Dom)	1.000
(Gait Con-ND) - (Gait Amp-Dom)	1.000
(Gait Con-Dom) - (Gait Amp-ND)	1.000
(Gait Con-ND) - (Gait Amp-ND)	1.000
(Gait Con-Dom) - (Gait Con-ND)	1.000

Figure F.30: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for maximum knee lateral force time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MinLMKnee versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)
Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	0.011883	0.005942	26.71	0.000
Subject	3	0.002413	0.000804	3.62	0.016
Exercise Type*Subject	6	0.001075	0.000179	0.81	0.568
Error	108	0.024024	0.000222		
Total	119	0.039395			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.09	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.17	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.36	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	-5.17	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-3.65	0.020
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-2.80	0.195
(Elliptical Con-ND) - (Cycling Amp-Dom)	-2.37	0.434
(Gait Amp-Dom) - (Cycling Amp-Dom)	-3.88	0.009
(Gait Amp-ND) - (Cycling Amp-Dom)	-2.87	0.168
(Gait Con-Dom) - (Cycling Amp-Dom)	-1.81	0.807
(Gait Con-ND) - (Cycling Amp-Dom)	-1.73	0.851
(Cycling Con-Dom) - (Cycling Amp-ND)	-0.09	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	0.45	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-5.09	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	-3.56	0.026
(Elliptical Con-Dom) - (Cycling Amp-ND)	-2.71	0.234
(Elliptical Con-ND) - (Cycling Amp-ND)	-2.29	0.493
(Gait Amp-Dom) - (Cycling Amp-ND)	-3.80	0.012
(Gait Amp-ND) - (Cycling Amp-ND)	-2.78	0.203
(Gait Con-Dom) - (Cycling Amp-ND)	-1.73	0.851
(Gait Con-ND) - (Cycling Amp-ND)	-1.64	0.889
(Cycling Con-ND) - (Cycling Con-Dom)	0.53	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-5.00	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	-3.48	0.034

(Elliptical Con-Dom) - (Cycling Con-Dom)	-2.63	0.278
(Elliptical Con-ND) - (Cycling Con-Dom)	-2.20	0.554
(Gait Amp-Dom) - (Cycling Con-Dom)	-3.71	0.016
(Gait Amp-ND) - (Cycling Con-Dom)	-2.69	0.244
(Gait Con-Dom) - (Cycling Con-Dom)	-1.64	0.899
(Gait Con-ND) - (Cycling Con-Dom)	-1.56	0.921
(Elliptical Amp-Dom) - (Cycling Con-ND)	-5.53	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	-4.01	0.006
(Elliptical Con-Dom) - (Cycling Con-ND)	-3.16	0.082
(Elliptical Con-ND) - (Cycling Con-ND)	-2.73	0.225
(Gait Amp-Dom) - (Cycling Con-ND)	-4.24	0.003
(Gait Amp-ND) - (Cycling Con-ND)	-3.23	0.068
(Gait Con-Dom) - (Cycling Con-ND)	-2.17	0.571
(Gait Con-ND) - (Cycling Con-ND)	-2.06	0.631
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	1.52	0.931
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	2.37	0.433
(Elliptical Con-ND) - (Elliptical Amp-Dom)	2.80	0.194
(Gait Amp-Dom) - (Elliptical Amp-Dom)	1.29	0.979
(Gait Amp-ND) - (Elliptical Amp-Dom)	2.31	0.478
(Gait Con-Dom) - (Elliptical Amp-Dom)	3.36	0.047
(Gait Con-ND) - (Elliptical Amp-Dom)	3.44	0.037
(Elliptical Con-Dom) - (Elliptical Amp-ND)	0.85	0.999
(Elliptical Con-ND) - (Elliptical Amp-ND)	1.29	0.980
(Gait Amp-Dom) - (Elliptical Amp-ND)	-0.23	1.000
(Gait Amp-ND) - (Elliptical Amp-ND)	0.78	1.000
(Gait Con-Dom) - (Elliptical Amp-ND)	1.84	0.795
(Gait Con-ND) - (Elliptical Amp-ND)	1.92	0.744
(Elliptical Con-ND) - (Elliptical Con-Dom)	0.43	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	-1.08	0.995
(Gait Amp-ND) - (Elliptical Con-Dom)	-0.07	1.000
(Gait Con-Dom) - (Elliptical Con-Dom)	0.99	0.998
(Gait Con-ND) - (Elliptical Con-Dom)	1.07	0.995
(Gait Amp-Dom) - (Elliptical Con-ND)	-1.51	0.935
(Gait Amp-ND) - (Elliptical Con-ND)	-0.49	1.000
(Gait Con-Dom) - (Elliptical Con-ND)	0.56	1.000
(Gait Con-ND) - (Elliptical Con-ND)	0.64	1.000
(Gait Amp-ND) - (Gait Amp-Dom)	1.02	0.997
(Gait Con-Dom) - (Gait Amp-Dom)	2.07	0.646
(Gait Con-ND) - (Gait Amp-Dom)	2.15	0.586
(Gait Con-Dom) - (Gait Amp-ND)	1.05	0.996
(Gait Con-ND) - (Gait Amp-ND)	1.14	0.992
(Gait Con-ND) - (Gait Con-Dom)	0.09	1.000

Figure F.31: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test minimum knee lateral force between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject

Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	447.1	223.6	0.36	0.700
Subject	3	2113.5	704.5	1.13	0.342
Exercise Type*Subject	6	5003.9	834.0	1.33	0.249
Error	108	67568.2	625.6		
Total	119	75132.7			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
Cycling Amp-ND - (Cycling Amp-Dom)	0.167
Cycling Con-Dom - (Cycling Amp-Dom)	0.970
(Cycling Con-ND) - (Cycling Amp-Dom)	1.000
Elliptical Amp-Dom - (Cycling Amp-Dom)	1.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	0.999
(Elliptical Con-Dom) - (Cycling Amp-Dom)	1.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	0.944
Gait Amp-Dom - (Cycling Amp-Dom)	0.993
(Gait Amp-ND) - (Cycling Amp-Dom)	1.000
(Gait Con-Dom) - (Cycling Amp-Dom)	0.999
(Gait Con-ND) - (Cycling Amp-Dom)	1.000
(Cycling Con-Dom) - (Cycling Amp-ND)	0.932
Cycling Con-ND - (Cycling Amp-ND)	0.442
(Elliptical Amp-Dom) - (Cycling Amp-ND)	0.312
Elliptical Amp-ND - (Cycling Amp-ND)	0.714
(Elliptical Con-Dom) - (Cycling Amp-ND)	0.389
(Elliptical Con-ND) - (Cycling Amp-ND)	0.962
(Gait Amp-Dom) - (Cycling Amp-ND)	0.844
Gait Amp-ND - (Cycling Amp-ND)	0.648
(Gait Con-Dom) - (Cycling Amp-ND)	0.714
(Gait Con-ND) - (Cycling Amp-ND)	0.548
Cycling Con-ND - (Cycling Con-Dom)	0.996
(Elliptical Amp-Dom) - (Cycling Con-Dom)	0.996
(Elliptical Amp-ND) - (Cycling Con-Dom)	1.000

Elliptical Con-Dom - (Cycling Con-Dom)	0.999
(Elliptical Con-ND) - (Cycling Con-Dom)	1.000
(Gait Amp-Dom) - (Cycling Con-Dom)	1.000
(Gait Amp-ND) - (Cycling Con-Dom)	1.000
Gait Con-Dom - (Cycling Con-Dom)	1.000
(Gait Con-ND) - (Cycling Con-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	1.000
(Elliptical Amp-ND) - (Cycling Con-ND)	1.000
(Elliptical Con-Dom) - (Cycling Con-ND)	1.000
Elliptical Con-ND - (Cycling Con-ND)	0.998
(Gait Amp-Dom) - (Cycling Con-ND)	1.000
(Gait Amp-ND) - (Cycling Con-ND)	1.000
(Gait Con-Dom) - (Cycling Con-ND)	1.000
Gait Con-ND - (Cycling Con-ND)	1.000
Elliptical Amp-ND - (Elliptical Amp-Dom)	1.000
Elliptical Con-Dom - (Elliptical Amp-Dom)	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.990
Gait Amp-Dom - (Elliptical Amp-Dom)	1.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	1.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	1.000
(Gait Con-ND) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	1.000
Elliptical Con-ND - (Elliptical Amp-ND)	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	1.000
Gait Amp-ND - (Elliptical Amp-ND)	1.000
(Gait Con-Dom) - (Elliptical Amp-ND)	1.000
(Gait Con-ND) - (Elliptical Amp-ND)	1.000
Elliptical Con-ND - (Elliptical Con-Dom)	0.996
(Gait Amp-Dom) - (Elliptical Con-Dom)	1.000
(Gait Amp-ND) - (Elliptical Con-Dom)	1.000
Gait Con-Dom - (Elliptical Con-Dom)	1.000
(Gait Con-ND) - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-ND)	1.000
(Gait Amp-ND) - (Elliptical Con-ND)	1.000
(Gait Con-Dom) - (Elliptical Con-ND)	1.000
Gait Con-ND - (Elliptical Con-ND)	1.000
Gait Amp-ND - (Gait Amp-Dom)	1.000
Gait Con-Dom - (Gait Amp-Dom)	1.000
(Gait Con-ND) - (Gait Amp-Dom)	1.000
(Gait Con-Dom) - (Gait Amp-ND)	1.000
Gait Con-ND - (Gait Amp-ND)	1.000
Gait Con-ND - (Gait Con-Dom)	1.000

Figure F.32: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for minimum knee lateral force time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

F.3: Resultant Moments Two-Factor Repeated Measures ANOVA with Post-hoc Tukey Test

General Linear Model: MaxEFHipMom versus Exercise Type, Subject
Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	0.025079	0.012539	93.40	0.000
Subject	3	0.001377	0.000459	3.42	0.020
Exercise Type*Subject	6	0.002419	0.000403	3.00	0.009
Error	108	0.014500	0.000134		
Total	119	0.043374			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.56	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.26	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.46	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	5.00	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	8.60	0.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	4.57	0.001
(Elliptical Con-ND) - (Cycling Amp-Dom)	6.35	0.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	7.61	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	6.85	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	6.02	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	4.88	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	-0.30	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	-0.11	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	4.44	0.001
(Elliptical Amp-ND) - (Cycling Amp-ND)	8.03	0.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	4.00	0.006
(Elliptical Con-ND) - (Cycling Amp-ND)	5.79	0.000
(Gait Amp-Dom) - (Cycling Amp-ND)	7.05	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	6.29	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	5.46	0.000
(Gait Con-ND) - (Cycling Amp-ND)	4.32	0.002
(Cycling Con-ND) - (Cycling Con-Dom)	0.19	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	4.74	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	8.33	0.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	4.30	0.002
(Elliptical Con-ND) - (Cycling Con-Dom)	6.09	0.000
(Gait Amp-Dom) - (Cycling Con-Dom)	7.35	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	6.59	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	5.76	0.000
(Gait Con-ND) - (Cycling Con-Dom)	4.62	0.001
(Elliptical Amp-Dom) - (Cycling Con-ND)	4.55	0.001
(Elliptical Amp-ND) - (Cycling Con-ND)	8.14	0.000
(Elliptical Con-Dom) - (Cycling Con-ND)	4.11	0.004
(Elliptical Con-ND) - (Cycling Con-ND)	5.90	0.000
(Gait Amp-Dom) - (Cycling Con-ND)	7.15	0.000
(Gait Amp-ND) - (Cycling Con-ND)	6.40	0.000
(Gait Con-Dom) - (Cycling Con-ND)	5.57	0.000
(Gait Con-ND) - (Cycling Con-ND)	4.43	0.001
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	3.60	0.023
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	-0.44	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	1.35	0.970
(Gait Amp-Dom) - (Elliptical Amp-Dom)	2.61	0.289
(Gait Amp-ND) - (Elliptical Amp-Dom)	1.85	0.786
(Gait Con-Dom) - (Elliptical Amp-Dom)	1.02	0.997
(Gait Con-ND) - (Elliptical Amp-Dom)	-0.12	1.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	-4.03	0.006
(Elliptical Con-ND) - (Elliptical Amp-ND)	-2.25	0.521
(Gait Amp-Dom) - (Elliptical Amp-ND)	-0.99	0.998
(Gait Amp-ND) - (Elliptical Amp-ND)	-1.74	0.943
(Gait Con-Dom) - (Elliptical Amp-ND)	-2.57	0.308
(Gait Con-ND) - (Elliptical Amp-ND)	-3.71	0.016
(Elliptical Con-ND) - (Elliptical Con-Dom)	1.79	0.822
(Gait Amp-Dom) - (Elliptical Con-Dom)	3.04	0.111
(Gait Amp-ND) - (Elliptical Con-Dom)	2.29	0.492
(Gait Con-Dom) - (Elliptical Con-Dom)	1.44	0.948
(Gait Con-ND) - (Elliptical Con-Dom)	0.32	1.000
(Gait Amp-Dom) - (Elliptical Con-ND)	1.26	0.982
(Gait Amp-ND) - (Elliptical Con-ND)	0.50	1.000
(Gait Con-Dom) - (Elliptical Con-ND)	-0.33	1.000
(Gait Con-ND) - (Elliptical Con-ND)	-1.47	0.946
(Gait Amp-Dom) - (Gait Amp-Dom)	-0.76	1.000
(Gait Con-Dom) - (Gait Amp-Dom)	-1.58	0.911
(Gait Con-ND) - (Gait Amp-Dom)	-2.73	0.228
(Gait Con-Dom) - (Gait Amp-ND)	-0.83	1.000
(Gait Con-ND) - (Gait Amp-ND)	-1.97	0.713
(Gait Con-ND) - (Gait Con-Dom)	-1.14	0.992

Figure F.33: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test maximum hip extension moment between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject
Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	16696	8348	6.65	0.002
Subject	3	3156	1052	0.84	0.476
Exercise Type*Subject	6	30701	5117	4.08	0.001
Error	108	135587	1255		
Total	119	186139			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	0.041
(Elliptical Amp-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	0.596
(Elliptical Con-ND) - (Cycling Amp-Dom)	0.996
(Gait Amp-Dom) - (Cycling Amp-Dom)	0.998
(Gait Amp-ND) - (Cycling Amp-Dom)	0.380
(Gait Con-Dom) - (Cycling Amp-Dom)	1.000
(Gait Con-ND) - (Cycling Amp-Dom)	0.007
(Cycling Con-Dom) - (Cycling Amp-ND)	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	0.166
(Elliptical Amp-ND) - (Cycling Amp-ND)	1.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	0.904
(Elliptical Con-ND) - (Cycling Amp-ND)	1.000
(Gait Amp-Dom) - (Cycling Amp-ND)	1.000
(Gait Amp-ND) - (Cycling Amp-ND)	0.745
(Gait Con-Dom) - (Cycling Amp-ND)	1.000
(Gait Con-ND) - (Cycling Amp-ND)	0.036
(Cycling Con-ND) - (Cycling Con-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	0.093
(Elliptical Amp-ND) - (Cycling Con-Dom)	1.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	0.791
(Elliptical Con-ND) - (Cycling Con-Dom)	1.000
(Gait Amp-Dom) - (Cycling Con-Dom)	1.000
(Gait Amp-ND) - (Cycling Con-Dom)	0.583
(Gait Con-Dom) - (Cycling Con-Dom)	1.000
(Gait Con-ND) - (Cycling Con-Dom)	0.017
(Elliptical Amp-Dom) - (Cycling Con-ND)	0.079
(Elliptical Amp-ND) - (Cycling Con-ND)	1.000
(Elliptical Con-Dom) - (Cycling Con-ND)	0.753
(Elliptical Con-ND) - (Cycling Con-ND)	1.000
(Gait Amp-Dom) - (Cycling Con-ND)	1.000
(Gait Amp-ND) - (Cycling Con-ND)	0.538
(Gait Con-Dom) - (Cycling Con-ND)	1.000
(Gait Con-ND) - (Cycling Con-ND)	0.014
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	0.116
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	0.981
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.450
(Gait Amp-Dom) - (Elliptical Amp-Dom)	0.392
(Gait Amp-ND) - (Elliptical Amp-Dom)	0.998
(Gait Con-Dom) - (Elliptical Amp-Dom)	0.093
(Gait Con-ND) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	0.838
(Elliptical Con-ND) - (Elliptical Amp-ND)	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	1.000
(Gait Amp-ND) - (Elliptical Amp-ND)	0.645
(Gait Con-Dom) - (Elliptical Amp-ND)	1.000
(Gait Con-ND) - (Elliptical Amp-ND)	0.023
(Elliptical Con-ND) - (Elliptical Con-Dom)	0.995
(Gait Amp-Dom) - (Elliptical Con-Dom)	0.990
(Gait Amp-ND) - (Elliptical Con-Dom)	1.000
(Gait Con-Dom) - (Elliptical Con-Dom)	0.791
(Gait Con-ND) - (Elliptical Con-Dom)	0.787
(Gait Amp-Dom) - (Elliptical Con-ND)	1.000
(Gait Amp-ND) - (Elliptical Con-ND)	0.962
(Gait Con-Dom) - (Elliptical Con-ND)	1.000
(Gait Con-ND) - (Elliptical Con-ND)	0.146
(Gait Amp-ND) - (Gait Amp-Dom)	0.942
(Gait Con-Dom) - (Gait Amp-Dom)	1.000
(Gait Con-ND) - (Gait Amp-Dom)	0.118
(Gait Con-Dom) - (Gait Amp-ND)	0.583
(Gait Con-ND) - (Gait Amp-ND)	0.928
(Gait Con-ND) - (Gait Con-Dom)	0.017

Figure F.34: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for maximum hip extension moment time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MinEFHipMom versus Exercise Type, Subject Method

Factor coding (-1, 0, +1)
Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	0.017702	0.008851	136.34	0.000
Subject	3	0.000329	0.000110	1.69	0.174
Exercise Type*Subject	6	0.002856	0.000476	7.33	0.000
Error	108	0.007011	0.000065		
Total	119	0.027898			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	-1.57	0.915
(Cycling Con-Dom) - (Cycling Amp-Dom)	-1.54	0.925
(Cycling Con-ND) - (Cycling Amp-Dom)	1.98	0.703
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	-2.48	0.364
(Elliptical Amp-ND) - (Cycling Amp-Dom)	3.09	0.099
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-0.32	1.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	-0.25	1.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	-6.28	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	-6.93	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	-6.78	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	-7.56	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	3.12	0.092
(Cycling Con-ND) - (Cycling Amp-ND)	3.56	0.026
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-0.91	0.999
(Elliptical Amp-ND) - (Cycling Amp-ND)	4.66	0.001
(Elliptical Con-Dom) - (Cycling Amp-ND)	1.25	0.983
(Elliptical Con-ND) - (Cycling Amp-ND)	1.33	0.974
(Gait Amp-Dom) - (Cycling Amp-ND)	-4.71	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	-5.35	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	-5.21	0.000
(Gait Con-ND) - (Cycling Amp-ND)	-5.99	0.000
(Cycling Con-ND) - (Cycling Con-Dom)	0.44	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-4.02	0.006
(Elliptical Amp-ND) - (Cycling Con-Dom)	1.55	0.924

(Elliptical Con-Dom) - (Cycling Con-Dom)	-1.87	0.777
(Elliptical Con-ND) - (Cycling Con-Dom)	-1.79	0.819
(Gait Amp-Dom) - (Cycling Con-Dom)	-7.83	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	-8.47	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	-8.32	0.000
(Gait Con-ND) - (Cycling Con-Dom)	-9.11	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	-4.46	0.001
(Elliptical Amp-ND) - (Cycling Con-ND)	1.10	0.994
(Elliptical Con-Dom) - (Cycling Con-ND)	-2.31	0.477
(Elliptical Con-ND) - (Cycling Con-ND)	-2.23	0.531
(Gait Amp-Dom) - (Cycling Con-ND)	-8.27	0.000
(Gait Amp-ND) - (Cycling Con-ND)	-8.91	0.000
(Gait Con-Dom) - (Cycling Con-ND)	-8.77	0.000
(Gait Con-ND) - (Cycling Con-ND)	-9.55	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	5.57	0.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	2.16	0.585
(Elliptical Con-ND) - (Elliptical Amp-Dom)	2.23	0.531
(Gait Amp-Dom) - (Elliptical Amp-Dom)	-3.80	0.012
(Gait Amp-ND) - (Elliptical Amp-Dom)	-4.45	0.001
(Gait Con-Dom) - (Elliptical Amp-Dom)	-4.30	0.002
(Gait Con-ND) - (Elliptical Amp-Dom)	-5.09	0.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	-3.41	0.041
(Elliptical Con-ND) - (Elliptical Amp-ND)	3.34	0.051
(Gait Amp-Dom) - (Elliptical Amp-ND)	-9.37	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	-10.02	0.000
(Gait Con-Dom) - (Elliptical Amp-ND)	-9.87	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	-10.65	0.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	0.08	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	-5.96	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	-6.60	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	-6.46	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	-7.24	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	-6.04	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	-6.68	0.000
(Gait Con-Dom) - (Elliptical Con-ND)	-6.53	0.000
(Gait Con-ND) - (Elliptical Con-ND)	-7.32	0.000
(Gait Amp-ND) - (Gait Amp-Dom)	-0.64	1.000
(Gait Con-Dom) - (Gait Amp-Dom)	-0.50	1.000
(Gait Con-ND) - (Gait Amp-Dom)	-1.28	0.980
(Gait Con-Dom) - (Gait Amp-ND)	0.14	1.000
(Gait Con-ND) - (Gait Amp-ND)	-0.64	1.000
(Gait Con-ND) - (Gait Con-Dom)	-0.78	1.000

Figure F.35: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test minimum hip extension moment between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	5081.6	2540.81	42.21	0.000
Subject	3	222.3	74.10	1.23	0.302
Exercise Type*Subject	6	2479.4	413.23	6.86	0.000
Error	108	6501.7	60.20		
Total	119	14285.0			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	-4.67	0.001
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.69	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	-0.46	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	-4.73	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-2.25	0.520
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-3.95	0.007
(Elliptical Con-ND) - (Cycling Amp-Dom)	-4.73	0.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	-5.16	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	-5.30	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	-5.99	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	-6.20	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	5.36	0.000
(Cycling Con-ND) - (Cycling Amp-ND)	4.21	0.003
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-0.06	1.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	2.42	0.402
(Elliptical Con-Dom) - (Cycling Amp-ND)	0.72	1.000
(Elliptical Con-ND) - (Cycling Amp-ND)	-0.06	1.000
(Gait Amp-Dom) - (Cycling Amp-ND)	-0.49	1.000
(Gait Amp-ND) - (Cycling Amp-ND)	0.63	1.000
(Gait Con-Dom) - (Cycling Amp-ND)	-1.33	0.974
(Gait Con-ND) - (Cycling Amp-ND)	-1.53	0.930
(Cycling Con-ND) - (Cycling Con-Dom)	1.15	0.991
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-5.42	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	-2.94	0.142

(Elliptical Con-Dom) - (Cycling Con-Dom)	-4.64	0.001
(Elliptical Con-ND) - (Cycling Con-Dom)	-5.42	0.000
(Gait Amp-Dom) - (Cycling Con-Dom)	-5.85	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	-5.99	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	-6.69	0.000
(Gait Con-ND) - (Cycling Con-Dom)	-6.89	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	-4.27	0.002
(Elliptical Amp-ND) - (Cycling Con-ND)	-1.79	0.822
(Elliptical Con-Dom) - (Cycling Con-ND)	-3.49	0.033
(Elliptical Con-ND) - (Cycling Con-ND)	-4.27	0.002
(Gait Amp-Dom) - (Cycling Con-ND)	-4.70	0.000
(Gait Amp-ND) - (Cycling Con-ND)	-4.84	0.000
(Gait Con-Dom) - (Cycling Con-ND)	-5.53	0.000
(Gait Con-ND) - (Cycling Con-ND)	-5.74	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	2.48	0.365
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	0.78	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.00	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	0.43	1.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	-0.58	1.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	-1.27	0.981
(Gait Con-ND) - (Elliptical Amp-Dom)	-1.47	0.946
(Elliptical Con-Dom) - (Elliptical Amp-ND)	-1.70	0.864
(Elliptical Con-ND) - (Elliptical Amp-ND)	-2.48	0.365
(Gait Amp-Dom) - (Elliptical Amp-ND)	-2.91	0.152
(Gait Amp-ND) - (Elliptical Amp-ND)	-3.05	0.107
(Gait Con-Dom) - (Elliptical Amp-ND)	-3.75	0.015
(Gait Con-ND) - (Elliptical Amp-ND)	-3.95	0.007
(Elliptical Con-ND) - (Elliptical Con-Dom)	-0.78	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	-1.21	0.987
(Gait Amp-ND) - (Elliptical Con-Dom)	-1.35	0.969
(Gait Con-Dom) - (Elliptical Con-Dom)	-2.05	0.661
(Gait Con-ND) - (Elliptical Con-Dom)	-2.25	0.520
(Gait Amp-Dom) - (Elliptical Con-ND)	-0.43	1.000
(Gait Amp-ND) - (Elliptical Con-ND)	-0.58	1.000
(Gait Con-Dom) - (Elliptical Con-ND)	-1.27	0.981
(Gait Con-ND) - (Elliptical Con-ND)	-1.47	0.946
(Gait Amp-ND) - (Gait Amp-Dom)	-0.14	1.000
(Gait Con-Dom) - (Gait Amp-Dom)	-0.84	1.000
(Gait Con-ND) - (Gait Amp-Dom)	-1.04	0.996
(Gait Con-Dom) - (Gait Amp-ND)	-0.69	1.000
(Gait Con-ND) - (Gait Amp-ND)	-0.89	0.999
(Gait Con-ND) - (Gait Con-Dom)	-0.20	1.000

Figure F.36: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for minimum hip extension moment time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MaxEFFKneeMom versus Exercise Type, Subject Method

Factor coding (-1, 0, +1)
Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	0.011325	0.005662	58.48	0.000
Subject	3	0.006045	0.002015	20.81	0.000
Exercise Type*Subject	6	0.004798	0.000800	8.26	0.000
Error	108	0.010456	0.000097		
Total	119	0.032624			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	2.18	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.08	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	-0.56	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	5.25	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	0.85	0.999
(Elliptical Con-Dom) - (Cycling Amp-Dom)	4.25	0.003
(Elliptical Con-ND) - (Cycling Amp-Dom)	3.79	0.013
(Gait Amp-Dom) - (Cycling Amp-Dom)	8.14	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	-0.46	1.000
(Gait Con-Dom) - (Cycling Amp-Dom)	6.12	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	7.05	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	-0.10	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	0.74	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	5.07	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	0.68	1.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	4.08	0.005
(Elliptical Con-ND) - (Cycling Amp-ND)	3.61	0.022
(Gait Amp-Dom) - (Cycling Amp-ND)	7.97	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	0.63	1.000
(Gait Con-Dom) - (Cycling Amp-ND)	5.94	0.000
(Gait Con-ND) - (Cycling Amp-ND)	6.88	0.000
(Cycling Con-ND) - (Cycling Con-Dom)	0.64	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	5.17	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	0.78	1.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	4.17	0.003
(Elliptical Con-ND) - (Cycling Con-Dom)	3.71	0.016
(Gait Amp-Dom) - (Cycling Con-Dom)	8.06	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	-0.54	1.000
(Gait Con-Dom) - (Cycling Con-Dom)	6.04	0.000
(Gait Con-ND) - (Cycling Con-Dom)	6.98	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	5.81	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	1.42	0.958
(Elliptical Con-Dom) - (Cycling Con-ND)	4.82	0.000
(Elliptical Con-ND) - (Cycling Con-ND)	4.35	0.002
(Gait Amp-Dom) - (Cycling Con-ND)	8.70	0.000
(Gait Amp-ND) - (Cycling Con-ND)	0.10	1.000
(Gait Con-Dom) - (Cycling Con-ND)	6.68	0.000
(Gait Con-ND) - (Cycling Con-ND)	7.62	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	-4.40	0.002
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	-1.04	0.997
(Elliptical Con-ND) - (Elliptical Amp-Dom)	-1.46	0.947
(Gait Amp-Dom) - (Elliptical Amp-Dom)	2.88	0.159
(Gait Amp-ND) - (Elliptical Amp-Dom)	-5.71	0.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	0.87	0.999
(Gait Con-ND) - (Elliptical Amp-Dom)	1.80	0.813
(Elliptical Con-Dom) - (Elliptical Amp-ND)	3.40	0.042
(Elliptical Con-ND) - (Elliptical Amp-ND)	2.98	0.144
(Gait Amp-Dom) - (Elliptical Amp-ND)	7.29	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	-1.31	0.978
(Gait Con-Dom) - (Elliptical Amp-ND)	5.26	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	6.20	0.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	-0.47	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	3.89	0.009
(Gait Amp-ND) - (Elliptical Con-Dom)	-4.71	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	1.86	0.778
(Gait Con-ND) - (Elliptical Con-Dom)	2.80	0.195
(Gait Amp-Dom) - (Elliptical Con-ND)	4.35	0.002
(Gait Amp-ND) - (Elliptical Con-ND)	-4.25	0.003
(Gait Con-Dom) - (Elliptical Con-ND)	2.33	0.462
(Gait Con-ND) - (Elliptical Con-ND)	3.27	0.062
(Gait Amp-ND) - (Gait Amp-Dom)	-8.60	0.000
(Gait Con-Dom) - (Gait Amp-Dom)	-2.02	0.678
(Gait Con-ND) - (Gait Amp-Dom)	-1.09	0.995
(Gait Con-Dom) - (Gait Amp-ND)	6.58	0.000
(Gait Con-ND) - (Gait Amp-ND)	7.51	0.000
(Gait Con-ND) - (Gait Con-Dom)	0.94	0.999

Figure F.37: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test maximum knee extension moment between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	58112	29055.8	45.57	0.000
Subject	3	19317	6438.8	10.10	0.000
Exercise Type*Subject	6	11865	1977.5	3.10	0.008
Error	108	68861	637.6		
Total	119	158154			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.999
(Cycling Con-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	0.073
(Elliptical Amp-ND) - (Cycling Amp-Dom)	0.008
(Elliptical Con-Dom) - (Cycling Amp-Dom)	0.073
(Elliptical Con-ND) - (Cycling Amp-Dom)	0.001
(Gait Amp-Dom) - (Cycling Amp-Dom)	0.852
(Gait Amp-ND) - (Cycling Amp-Dom)	0.996
(Gait Con-Dom) - (Cycling Amp-Dom)	0.830
(Gait Con-ND) - (Cycling Amp-Dom)	0.839
(Cycling Con-Dom) - (Cycling Amp-ND)	0.010
(Cycling Con-ND) - (Cycling Amp-ND)	0.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	0.914
(Elliptical Amp-ND) - (Cycling Amp-ND)	0.999
(Elliptical Con-Dom) - (Cycling Amp-ND)	0.914
(Elliptical Con-ND) - (Cycling Amp-ND)	1.000
(Gait Amp-Dom) - (Cycling Amp-ND)	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	0.015
(Gait Con-Dom) - (Cycling Amp-ND)	0.000
(Gait Con-ND) - (Cycling Amp-ND)	0.000
(Cycling Con-ND) - (Cycling Con-Dom)	0.950
(Elliptical Amp-Dom) - (Cycling Con-Dom)	0.488
(Elliptical Amp-ND) - (Cycling Con-Dom)	0.115

(Elliptical Con-Dom) - (Cycling Con-Dom)	0.488
(Elliptical Con-ND) - (Cycling Con-Dom)	0.022
(Gait Amp-Dom) - (Cycling Con-Dom)	0.272
(Gait Amp-ND) - (Cycling Con-Dom)	1.000
(Gait Con-Dom) - (Cycling Con-Dom)	0.249
(Gait Con-ND) - (Cycling Con-Dom)	0.258
(Elliptical Amp-Dom) - (Cycling Con-ND)	0.015
(Elliptical Amp-ND) - (Cycling Con-ND)	0.001
(Elliptical Con-Dom) - (Cycling Con-ND)	0.015
(Elliptical Con-ND) - (Cycling Con-ND)	0.000
(Gait Amp-Dom) - (Cycling Con-ND)	0.989
(Gait Amp-ND) - (Cycling Con-ND)	0.911
(Gait Con-Dom) - (Cycling Con-ND)	0.985
(Gait Con-ND) - (Cycling Con-ND)	0.987
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.974
(Gait Amp-Dom) - (Elliptical Amp-Dom)	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	0.581
(Gait Con-Dom) - (Elliptical Amp-Dom)	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	0.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	0.157
(Gait Con-Dom) - (Elliptical Amp-ND)	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	0.000
(Elliptical Con-Dom) - (Elliptical Con-ND)	0.974
(Gait Amp-Dom) - (Elliptical Con-Dom)	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	0.581
(Gait Con-Dom) - (Elliptical Con-Dom)	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	0.033
(Gait Amp-ND) - (Elliptical Con-ND)	0.000
(Gait Con-Dom) - (Elliptical Con-ND)	0.000
(Gait Con-ND) - (Elliptical Con-ND)	0.000
(Gait Amp-ND) - (Gait Amp-Dom)	0.207
(Gait Con-Dom) - (Gait Amp-Dom)	1.000
(Gait Con-ND) - (Gait Amp-Dom)	1.000
(Gait Con-Dom) - (Gait Amp-ND)	0.188
(Gait Con-ND) - (Gait Amp-ND)	0.196
(Gait Con-Dom) - (Gait Con-Dom)	1.000

Figure F.38: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for maximum knee extension moment time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MinEFKneeMom versus Exercise Type, Subject Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	0.006208	0.003104	68.68	0.000
Subject	3	0.000113	0.000038	0.84	0.477
Exercise Type*Subject	6	0.001106	0.000184	4.08	0.001
Error	108	0.004881	0.000045		
Total	119	0.012309			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	1.56	0.920
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.18	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	-0.02	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	0.84	0.999
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-4.39	0.002
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-0.25	1.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	-1.23	0.986
(Gait Amp-Dom) - (Cycling Amp-Dom)	-6.10	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	-5.22	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	-5.67	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	-4.46	0.001
(Cycling Con-Dom) - (Cycling Amp-ND)	-1.38	0.965
(Cycling Con-ND) - (Cycling Amp-ND)	1.58	0.913
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-2.40	0.417
(Elliptical Amp-ND) - (Cycling Amp-ND)	-5.94	0.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	-1.80	0.812
(Elliptical Con-ND) - (Cycling Amp-ND)	-2.78	0.202
(Gait Amp-Dom) - (Cycling Amp-ND)	-7.66	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	-6.78	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	-7.22	0.000
(Gait Con-ND) - (Cycling Amp-ND)	-6.02	0.000
(Cycling Con-Dom) - (Cycling Con-Dom)	0.20	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-1.02	0.997
(Elliptical Amp-ND) - (Cycling Con-Dom)	-4.57	0.001

(Elliptical Con-Dom) - (Cycling Con-Dom)	-0.43	1.000
(Elliptical Con-ND) - (Cycling Con-Dom)	-1.40	0.960
(Gait Amp-Dom) - (Cycling Con-Dom)	-6.28	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	-5.40	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	-5.84	0.000
(Gait Con-ND) - (Cycling Con-Dom)	-4.64	0.001
(Elliptical Amp-Dom) - (Cycling Con-ND)	-0.82	1.000
(Elliptical Amp-ND) - (Cycling Con-ND)	-4.36	0.002
(Elliptical Con-Dom) - (Cycling Con-ND)	-0.22	1.000
(Elliptical Con-ND) - (Cycling Con-ND)	-1.26	0.988
(Gait Amp-Dom) - (Cycling Con-ND)	-6.08	0.000
(Gait Amp-ND) - (Cycling Con-ND)	-5.20	0.000
(Gait Con-Dom) - (Cycling Con-ND)	-5.64	0.000
(Gait Con-ND) - (Cycling Con-ND)	-4.44	0.001
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	-3.55	0.027
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	0.59	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	-0.39	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	-5.26	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	-4.38	0.002
(Gait Con-Dom) - (Elliptical Amp-Dom)	-4.83	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	-3.62	0.022
(Elliptical Con-Dom) - (Elliptical Amp-ND)	4.14	0.004
(Elliptical Con-ND) - (Elliptical Amp-ND)	3.16	0.082
(Gait Amp-Dom) - (Elliptical Amp-ND)	-1.71	0.859
(Gait Amp-ND) - (Elliptical Amp-ND)	-0.83	1.000
(Gait Con-Dom) - (Elliptical Amp-ND)	-1.28	0.980
(Gait Con-ND) - (Elliptical Amp-ND)	-0.07	1.000
(Elliptical Con-Dom) - (Elliptical Con-Dom)	-0.98	0.998
(Gait Amp-Dom) - (Elliptical Con-Dom)	-5.85	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	-4.97	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	-5.42	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	-4.21	0.003
(Gait Amp-Dom) - (Elliptical Con-ND)	-4.87	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	-3.99	0.006
(Gait Con-Dom) - (Elliptical Con-ND)	-4.44	0.001
(Gait Con-ND) - (Elliptical Con-ND)	-3.23	0.068
(Gait Amp-ND) - (Gait Amp-Dom)	0.88	0.999
(Gait Con-Dom) - (Gait Amp-Dom)	0.43	1.000
(Gait Con-ND) - (Gait Amp-Dom)	1.64	0.890
(Gait Con-Dom) - (Gait Amp-ND)	-0.45	1.000
(Gait Con-ND) - (Gait Amp-ND)	0.76	1.000
(Gait Con-ND) - (Gait Con-Dom)	1.21	0.982

Figure F.39: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test minimum knee extension moment between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject
Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	35782.9	17891.5	33.70	0.000
Subject	3	971.7	323.9	0.61	0.610
Exercise Type*Subject	6	2539.9	423.3	0.80	0.574
Error	108	57333.1	530.9		
Total	119	96627.6			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	0.827
(Elliptical Amp-ND) - (Cycling Amp-Dom)	0.470
(Elliptical Con-Dom) - (Cycling Amp-Dom)	0.949
(Elliptical Con-ND) - (Cycling Amp-Dom)	0.755
(Gait Amp-Dom) - (Cycling Amp-Dom)	0.999
(Gait Amp-ND) - (Cycling Amp-Dom)	0.193
(Gait Con-Dom) - (Cycling Amp-Dom)	0.282
(Gait Con-ND) - (Cycling Amp-Dom)	0.282
(Cycling Con-Dom) - (Cycling Amp-ND)	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	0.994
(Elliptical Amp-ND) - (Cycling Amp-ND)	0.890
(Elliptical Con-Dom) - (Cycling Amp-ND)	1.000
(Elliptical Con-ND) - (Cycling Amp-ND)	0.986
(Gait Amp-Dom) - (Cycling Amp-ND)	0.928
(Gait Amp-ND) - (Cycling Amp-ND)	0.033
(Gait Con-Dom) - (Cycling Amp-ND)	0.056
(Gait Con-ND) - (Cycling Amp-ND)	0.056
(Cycling Con-Dom) - (Cycling Con-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	0.827
(Elliptical Amp-ND) - (Cycling Con-Dom)	0.470

(Elliptical Con-Dom) - (Cycling Con-Dom)	0.949
(Elliptical Con-ND) - (Cycling Con-Dom)	0.755
(Gait Amp-Dom) - (Cycling Con-Dom)	0.999
(Gait Amp-ND) - (Cycling Con-Dom)	0.193
(Gait Con-Dom) - (Cycling Con-Dom)	0.282
(Gait Con-ND) - (Cycling Con-Dom)	0.282
(Elliptical Amp-Dom) - (Cycling Con-ND)	0.761
(Elliptical Amp-ND) - (Cycling Con-ND)	0.392
(Elliptical Con-Dom) - (Cycling Con-ND)	0.915
(Elliptical Con-ND) - (Cycling Con-ND)	0.680
(Gait Amp-Dom) - (Cycling Con-ND)	1.000
(Gait Amp-ND) - (Cycling Con-ND)	0.247
(Gait Con-Dom) - (Cycling Con-ND)	0.349
(Gait Con-ND) - (Cycling Con-ND)	0.349
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	0.277
(Gait Amp-ND) - (Elliptical Amp-Dom)	0.001
(Gait Con-Dom) - (Elliptical Amp-Dom)	0.002
(Gait Con-ND) - (Elliptical Amp-Dom)	0.002
(Elliptical Con-Dom) - (Elliptical Amp-ND)	0.999
(Elliptical Con-ND) - (Elliptical Amp-ND)	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	0.079
(Gait Amp-ND) - (Elliptical Amp-ND)	0.000
(Gait Con-Dom) - (Elliptical Amp-ND)	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	0.000
(Elliptical Con-Dom) - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	0.476
(Gait Amp-ND) - (Elliptical Con-Dom)	0.002
(Gait Con-Dom) - (Elliptical Con-Dom)	0.005
(Gait Con-ND) - (Elliptical Con-Dom)	0.005
(Gait Amp-Dom) - (Elliptical Con-ND)	0.214
(Gait Amp-ND) - (Elliptical Con-ND)	0.000
(Gait Con-Dom) - (Elliptical Con-ND)	0.001
(Gait Con-ND) - (Elliptical Con-ND)	0.001
(Gait Amp-ND) - (Gait Amp-Dom)	0.725
(Gait Con-Dom) - (Gait Amp-Dom)	0.832
(Gait Con-ND) - (Gait Amp-Dom)	0.832
(Gait Con-Dom) - (Gait Amp-ND)	1.000
(Gait Con-ND) - (Gait Amp-ND)	1.000

Figure F.40: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for minimum knee extension moment time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MaxAddAbdHipMom versus ... se Type, Subject Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	0.041155	0.020577	187.25	0.000
Subject	3	0.000774	0.000258	2.35	0.077
Exercise Type*Subject	6	0.001135	0.000189	1.72	0.123
Error	108	0.011868	0.000110		
Total	119	0.054932			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	9.18	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	9.09	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.23	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	4.45	0.001
(Elliptical Amp-ND) - (Cycling Amp-Dom)	1.80	0.816
(Elliptical Con-Dom) - (Cycling Amp-Dom)	1.98	0.706
(Elliptical Con-ND) - (Cycling Amp-Dom)	3.06	0.106
(Gait Amp-Dom) - (Cycling Amp-Dom)	10.10	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	7.99	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	10.69	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	9.18	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	-0.27	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	9.05	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	4.27	0.002
(Elliptical Amp-ND) - (Cycling Amp-ND)	1.62	0.900
(Elliptical Con-Dom) - (Cycling Amp-ND)	1.80	0.815
(Elliptical Con-ND) - (Cycling Amp-ND)	2.88	0.164
(Gait Amp-Dom) - (Cycling Amp-ND)	9.92	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	7.81	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	10.51	0.000
(Gait Con-ND) - (Cycling Amp-ND)	9.00	0.000
(Cycling Con-Dom) - (Cycling Con-Dom)	9.33	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	4.54	0.001
(Elliptical Amp-ND) - (Cycling Con-Dom)	1.89	0.763

(Elliptical Con-Dom) - (Cycling Con-Dom)	2.07	0.642
(Elliptical Con-ND) - (Cycling Con-Dom)	3.15	0.083
(Gait Amp-Dom) - (Cycling Con-Dom)	10.19	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	8.08	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	10.78	0.000
(Gait Con-ND) - (Cycling Con-Dom)	9.27	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	4.21	0.003
(Elliptical Amp-ND) - (Cycling Con-ND)	1.56	0.918
(Elliptical Con-Dom) - (Cycling Con-ND)	1.75	0.842
(Elliptical Con-ND) - (Cycling Con-ND)	2.85	0.184
(Gait Amp-Dom) - (Cycling Con-ND)	9.86	0.000
(Gait Amp-ND) - (Cycling Con-ND)	7.75	0.000
(Gait Con-Dom) - (Cycling Con-ND)	10.45	0.000
(Gait Con-ND) - (Cycling Con-ND)	8.94	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	2.65	0.265
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	2.47	0.371
(Elliptical Con-ND) - (Elliptical Amp-Dom)	-1.39	0.964
(Gait Amp-Dom) - (Elliptical Amp-Dom)	5.65	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	3.54	0.028
(Gait Con-Dom) - (Elliptical Amp-Dom)	6.24	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	4.73	0.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	0.18	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	1.26	0.982
(Gait Amp-Dom) - (Elliptical Amp-ND)	8.30	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	6.19	0.000
(Gait Con-Dom) - (Elliptical Amp-ND)	8.89	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	7.38	0.000
(Elliptical Con-Dom) - (Elliptical Con-Dom)	1.08	0.995
(Gait Amp-Dom) - (Elliptical Con-Dom)	8.12	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	6.01	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	8.71	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	7.20	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	7.04	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	4.93	0.000
(Gait Con-Dom) - (Elliptical Con-ND)	7.63	0.000
(Gait Con-ND) - (Elliptical Con-ND)	6.12	0.000
(Gait Amp-ND) - (Gait Amp-Dom)	2.11	0.617
(Gait Con-Dom) - (Gait Amp-Dom)	8.59	1.000
(Gait Con-ND) - (Gait Amp-Dom)	-0.92	0.999
(Gait Con-Dom) - (Gait Amp-ND)	2.70	0.242
(Gait Con-ND) - (Gait Amp-ND)	1.19	0.988
(Gait Con-Dom) - (Gait Con-Dom)	1.51	0.935

Figure F.41: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test maximum hip adduction moment between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject
Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	7731.2	3865.6	14.89	0.000
Subject	3	964.0	321.3	1.24	0.300
Exercise Type*Subject	6	1151.5	191.9	0.74	0.619
Error	108	28039.8	259.6		
Total	119	37886.5			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.938
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	0.075
(Elliptical Amp-ND) - (Cycling Amp-Dom)	0.490
(Elliptical Con-Dom) - (Cycling Amp-Dom)	0.245
(Elliptical Con-ND) - (Cycling Amp-Dom)	0.075
(Gait Amp-Dom) - (Cycling Amp-Dom)	0.955
(Gait Amp-ND) - (Cycling Amp-Dom)	1.000
(Gait Con-Dom) - (Cycling Amp-Dom)	1.000
(Gait Con-ND) - (Cycling Amp-Dom)	1.000
(Cycling Con-Dom) - (Cycling Amp-ND)	0.999
(Cycling Con-ND) - (Cycling Amp-ND)	0.820
(Elliptical Amp-Dom) - (Cycling Amp-ND)	0.032
(Elliptical Amp-ND) - (Cycling Amp-ND)	0.304
(Elliptical Con-Dom) - (Cycling Amp-ND)	0.128
(Elliptical Con-ND) - (Cycling Amp-ND)	0.033
(Gait Amp-Dom) - (Cycling Amp-ND)	0.855
(Gait Amp-ND) - (Cycling Amp-ND)	1.000
(Gait Con-Dom) - (Cycling Amp-ND)	1.000
(Gait Con-ND) - (Cycling Amp-ND)	0.999
(Cycling Con-ND) - (Cycling Con-Dom)	0.999
(Elliptical Amp-Dom) - (Cycling Con-Dom)	0.311
(Elliptical Amp-ND) - (Cycling Con-Dom)	0.885

(Elliptical Con-Dom) - (Cycling Con-Dom)	0.656
(Elliptical Con-ND) - (Cycling Con-Dom)	0.319
(Gait Amp-Dom) - (Cycling Con-Dom)	1.000
(Gait Amp-ND) - (Cycling Con-Dom)	1.000
(Gait Con-Dom) - (Cycling Con-Dom)	0.998
(Gait Con-ND) - (Cycling Con-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	0.861
(Elliptical Amp-ND) - (Cycling Con-ND)	1.000
(Elliptical Con-Dom) - (Cycling Con-ND)	0.988
(Elliptical Con-ND) - (Cycling Con-ND)	0.868
(Gait Amp-Dom) - (Cycling Con-ND)	1.000
(Gait Amp-ND) - (Cycling Con-ND)	0.992
(Gait Con-Dom) - (Cycling Con-ND)	0.789
(Gait Con-ND) - (Cycling Con-ND)	0.999
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	0.999
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	0.827
(Gait Amp-ND) - (Elliptical Amp-Dom)	0.177
(Gait Con-Dom) - (Elliptical Amp-Dom)	0.027
(Gait Con-ND) - (Elliptical Amp-Dom)	0.273
(Elliptical Con-Dom) - (Elliptical Amp-ND)	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	0.999
(Gait Amp-Dom) - (Elliptical Amp-ND)	0.999
(Gait Amp-ND) - (Elliptical Amp-ND)	0.739
(Gait Con-Dom) - (Elliptical Amp-ND)	0.273
(Gait Con-ND) - (Elliptical Amp-ND)	0.855
(Elliptical Con-ND) - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	0.982
(Gait Amp-ND) - (Elliptical Con-Dom)	0.461
(Gait Con-Dom) - (Elliptical Con-Dom)	0.112
(Gait Con-ND) - (Elliptical Con-Dom)	0.608
(Gait Amp-Dom) - (Elliptical Con-ND)	0.834
(Gait Amp-ND) - (Elliptical Con-ND)	0.182
(Gait Con-Dom) - (Elliptical Con-ND)	0.028
(Gait Con-ND) - (Elliptical Con-ND)	0.280
(Gait Amp-ND) - (Gait Amp-Dom)	0.995
(Gait Con-Dom) - (Gait Amp-Dom)	0.827
(Gait Con-ND) - (Gait Amp-Dom)	0.999
(Gait Con-Dom) - (Gait Con-ND)	1.000
(Gait Con-ND) - (Gait Con-Dom)	0.999

Figure F.42: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for maximum hip adduction moment time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MinAddAbdHipMom versus ... ise Type, Subject Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	0.001187	0.000594	27.62	0.000
Subject	3	0.000124	0.000041	1.93	0.129
Exercise Type*Subject	6	0.000045	0.000007	0.35	0.910
Error	108	0.002321	0.000021		
Total	119	0.003677			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.42	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.06	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.12	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	-3.39	0.043
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-1.89	0.761
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-3.48	0.033
(Elliptical Con-ND) - (Cycling Amp-Dom)	-2.29	0.493
(Gait Amp-Dom) - (Cycling Amp-Dom)	-3.98	0.007
(Gait Amp-ND) - (Cycling Amp-Dom)	-2.86	0.172
(Gait Con-Dom) - (Cycling Amp-Dom)	-3.98	0.007
(Gait Con-ND) - (Cycling Amp-Dom)	-2.40	0.418
(Cycling Con-Dom) - (Cycling Amp-ND)	-0.36	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	0.30	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-3.81	0.012
(Elliptical Amp-ND) - (Cycling Amp-ND)	-2.31	0.474
(Elliptical Con-Dom) - (Cycling Amp-ND)	-3.90	0.009
(Elliptical Con-ND) - (Cycling Amp-ND)	-2.71	0.237
(Gait Amp-Dom) - (Cycling Amp-ND)	-4.40	0.002
(Gait Amp-ND) - (Cycling Amp-ND)	-3.28	0.060
(Gait Con-Dom) - (Cycling Amp-ND)	-4.40	0.002
(Gait Con-ND) - (Cycling Amp-ND)	-2.82	0.188
(Cycling Con-ND) - (Cycling Con-Dom)	0.06	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-3.45	0.036
(Elliptical Amp-ND) - (Cycling Con-Dom)	-1.95	0.723

(Elliptical Con-Dom) - (Cycling Con-Dom)	-3.54	0.028
(Elliptical Con-ND) - (Cycling Con-Dom)	-2.35	0.450
(Gait Amp-Dom) - (Cycling Con-Dom)	-4.04	0.005
(Gait Amp-ND) - (Cycling Con-Dom)	-2.92	0.149
(Gait Con-Dom) - (Cycling Con-Dom)	-4.04	0.005
(Gait Con-ND) - (Cycling Con-Dom)	-2.46	0.378
(Elliptical Amp-Dom) - (Cycling Con-ND)	-3.52	0.030
(Elliptical Amp-ND) - (Cycling Con-ND)	-2.02	0.681
(Elliptical Con-Dom) - (Cycling Con-ND)	-3.60	0.023
(Elliptical Con-ND) - (Cycling Con-ND)	-2.41	0.408
(Gait Amp-Dom) - (Cycling Con-ND)	-4.10	0.004
(Gait Amp-ND) - (Cycling Con-ND)	-2.98	0.128
(Gait Con-Dom) - (Cycling Con-ND)	-4.10	0.004
(Gait Con-ND) - (Cycling Con-ND)	-2.52	0.339
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	1.50	0.937
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	-0.09	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	1.11	0.994
(Gait Amp-Dom) - (Elliptical Amp-Dom)	-0.58	1.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	0.54	1.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	-0.59	1.000
(Gait Con-ND) - (Elliptical Amp-Dom)	1.00	0.997
(Elliptical Con-Dom) - (Elliptical Amp-ND)	-1.59	0.910
(Elliptical Con-ND) - (Elliptical Amp-ND)	-0.39	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	-2.09	0.634
(Gait Amp-ND) - (Elliptical Amp-ND)	-0.96	0.998
(Gait Con-Dom) - (Elliptical Amp-ND)	-2.09	0.633
(Gait Con-ND) - (Elliptical Amp-ND)	-0.50	1.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	1.19	0.988
(Gait Amp-Dom) - (Elliptical Con-Dom)	-0.50	1.000
(Gait Amp-ND) - (Elliptical Con-Dom)	0.62	1.000
(Gait Con-Dom) - (Elliptical Con-Dom)	-0.50	1.000
(Gait Con-ND) - (Elliptical Con-Dom)	1.08	0.995
(Gait Amp-Dom) - (Elliptical Con-ND)	-1.69	0.868
(Gait Amp-ND) - (Elliptical Con-ND)	-0.57	1.000
(Gait Con-Dom) - (Elliptical Con-ND)	-1.69	0.868
(Gait Con-ND) - (Elliptical Con-ND)	-0.11	1.000
(Gait Amp-ND) - (Gait Amp-Dom)	1.12	0.993
(Gait Con-Dom) - (Gait Amp-Dom)	-0.06	1.000
(Gait Con-ND) - (Gait Amp-Dom)	1.58	0.912
(Gait Con-Dom) - (Gait Amp-ND)	-1.12	0.993
(Gait Con-ND) - (Gait Amp-ND)	0.46	1.000
(Gait Con-ND) - (Gait Con-Dom)	1.58	0.912

Figure F.43: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test minimum hip adduction moment between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject
Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	2036	1018.0	1.19	0.307
Subject	3	1628	542.5	0.64	0.594
Exercise Type*Subject	6	8981	1496.9	1.75	0.115
Error	108	92169	853.4		
Total	119	104813			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.974
(Cycling Con-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	1.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	0.995
(Elliptical Con-ND) - (Cycling Amp-Dom)	0.875
(Gait Amp-Dom) - (Cycling Amp-Dom)	0.997
(Gait Amp-ND) - (Cycling Amp-Dom)	1.000
(Gait Con-Dom) - (Cycling Amp-Dom)	1.000
(Gait Con-ND) - (Cycling Amp-Dom)	1.000
(Cycling Con-Dom) - (Cycling Amp-ND)	0.868
(Cycling Con-ND) - (Cycling Amp-ND)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	1.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	1.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	1.000
(Elliptical Con-ND) - (Cycling Amp-ND)	0.976
(Gait Amp-Dom) - (Cycling Amp-ND)	1.000
(Gait Amp-ND) - (Cycling Amp-ND)	1.000
(Gait Con-Dom) - (Cycling Amp-ND)	0.999
(Gait Con-ND) - (Cycling Amp-ND)	0.999
(Cycling Con-Dom) - (Cycling Con-Dom)	0.891
(Elliptical Amp-Dom) - (Cycling Con-Dom)	0.992
(Elliptical Amp-ND) - (Cycling Con-Dom)	0.991

(Elliptical Con-Dom) - (Cycling Con-Dom)	0.418
(Elliptical Con-ND) - (Cycling Con-Dom)	0.123
(Gait Amp-Dom) - (Cycling Con-Dom)	0.449
(Gait Amp-ND) - (Cycling Con-Dom)	0.807
(Gait Con-Dom) - (Cycling Con-Dom)	1.000
(Gait Con-ND) - (Cycling Con-Dom)	0.999
(Elliptical Amp-Dom) - (Cycling Con-ND)	1.000
(Elliptical Amp-ND) - (Cycling Con-ND)	1.000
(Elliptical Con-Dom) - (Cycling Con-ND)	1.000
(Elliptical Con-ND) - (Cycling Con-ND)	0.968
(Gait Amp-Dom) - (Cycling Con-ND)	1.000
(Gait Amp-ND) - (Cycling Con-ND)	1.000
(Gait Con-Dom) - (Cycling Con-ND)	0.999
(Gait Con-ND) - (Cycling Con-ND)	1.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	0.984
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.785
(Gait Amp-Dom) - (Elliptical Amp-Dom)	0.988
(Gait Amp-ND) - (Elliptical Amp-Dom)	1.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	1.000
(Gait Con-ND) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	0.985
(Elliptical Con-ND) - (Elliptical Amp-ND)	0.794
(Gait Amp-Dom) - (Elliptical Amp-ND)	0.989
(Gait Amp-ND) - (Elliptical Amp-ND)	1.000
(Gait Con-Dom) - (Elliptical Amp-ND)	1.000
(Gait Con-ND) - (Elliptical Amp-ND)	1.000
(Elliptical Con-Dom) - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	1.000
(Gait Amp-ND) - (Elliptical Con-Dom)	1.000
(Gait Con-Dom) - (Elliptical Con-Dom)	0.897
(Gait Con-ND) - (Elliptical Con-Dom)	0.921
(Gait Amp-Dom) - (Elliptical Con-ND)	1.000
(Gait Amp-ND) - (Elliptical Con-ND)	0.989
(Gait Con-Dom) - (Elliptical Con-ND)	0.534
(Gait Con-ND) - (Elliptical Con-ND)	0.583
(Gait Amp-ND) - (Gait Amp-Dom)	1.000
(Gait Con-Dom) - (Gait Amp-Dom)	0.914
(Gait Con-ND) - (Gait Amp-Dom)	0.935
(Gait Con-Dom) - (Gait Amp-ND)	0.996
(Gait Con-ND) - (Gait Amp-ND)	0.998
(Gait Con-ND) - (Gait Con-Dom)	1.000

Figure F.44: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for minimum hip adduction moment time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MaxAddAbdKneeMom versus ... Type, Subject Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	0.011831	0.005915	140.52	0.000
Subject	3	0.000050	0.000017	0.40	0.754
Exercise Type*Subject	6	0.000323	0.000054	1.28	0.274
Error	108	0.004546	0.000042		
Total	119	0.016750			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	2.40	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.08	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.49	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	2.92	0.149
(Elliptical Amp-ND) - (Cycling Amp-Dom)	2.21	0.545
(Elliptical Con-Dom) - (Cycling Amp-Dom)	1.42	0.956
(Elliptical Con-ND) - (Cycling Amp-Dom)	2.65	0.266
(Gait Amp-Dom) - (Cycling Amp-Dom)	7.94	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	7.16	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	9.50	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	8.52	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	-0.48	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	0.09	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	2.52	0.339
(Elliptical Amp-ND) - (Cycling Amp-ND)	1.81	0.808
(Elliptical Con-Dom) - (Cycling Amp-ND)	1.02	0.997
(Elliptical Con-ND) - (Cycling Amp-ND)	2.25	0.518
(Gait Amp-Dom) - (Cycling Amp-ND)	7.54	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	6.76	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	9.10	0.000
(Gait Con-ND) - (Cycling Amp-ND)	8.12	0.000
(Cycling Con-Dom) - (Cycling Con-ND)	0.56	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	3.00	0.124
(Elliptical Amp-ND) - (Cycling Con-Dom)	2.29	0.491

(Elliptical Con-Dom) - (Cycling Con-Dom)	1.56	0.937
(Elliptical Con-ND) - (Cycling Con-Dom)	2.73	0.227
(Gait Amp-Dom) - (Cycling Con-Dom)	8.02	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	7.24	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	9.57	0.000
(Gait Con-ND) - (Cycling Con-Dom)	8.60	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	2.43	0.392
(Elliptical Amp-ND) - (Cycling Con-ND)	1.73	0.852
(Elliptical Con-Dom) - (Cycling Con-ND)	0.94	0.999
(Elliptical Con-ND) - (Cycling Con-ND)	2.17	0.578
(Gait Amp-Dom) - (Cycling Con-ND)	7.46	0.000
(Gait Amp-ND) - (Cycling Con-ND)	6.67	0.000
(Gait Con-Dom) - (Cycling Con-ND)	9.01	0.000
(Gait Con-ND) - (Cycling Con-ND)	8.03	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	-0.71	1.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	-1.54	0.939
(Elliptical Con-ND) - (Elliptical Amp-Dom)	-0.27	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	5.02	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	4.24	0.003
(Gait Con-Dom) - (Elliptical Amp-Dom)	6.58	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	5.60	0.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	-0.79	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	0.44	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	5.73	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	4.95	0.000
(Gait Con-Dom) - (Elliptical Amp-ND)	7.29	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	6.31	0.000
(Elliptical Con-Dom) - (Elliptical Con-ND)	1.23	0.986
(Gait Amp-Dom) - (Elliptical Con-Dom)	6.52	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	5.73	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	8.07	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	7.10	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	5.29	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	4.51	0.001
(Gait Con-Dom) - (Elliptical Con-ND)	6.85	0.000
(Gait Con-ND) - (Elliptical Con-ND)	5.87	0.000
(Gait Amp-ND) - (Gait Amp-Dom)	-0.78	1.000
(Gait Con-Dom) - (Gait Amp-Dom)	1.55	0.922
(Gait Con-ND) - (Gait Amp-Dom)	0.58	1.000
(Gait Con-Dom) - (Gait Amp-ND)	2.34	0.456
(Gait Con-ND) - (Gait Amp-ND)	1.36	0.968
(Gait Con-Dom) - (Gait Con-ND)	-0.96	0.999

Figure F.45: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test maximum knee adduction moment between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject
Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	6471.3	3235.6	8.24	0.000
Subject	3	444.2	148.1	0.38	0.770
Exercise Type*Subject	6	2957.4	492.9	1.26	0.284
Error	108	42395.7	392.6		
Total	119	52268.6			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.998
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.998
(Cycling Con-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	1.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	1.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	0.988
(Gait Amp-Dom) - (Cycling Amp-Dom)	0.624
(Gait Amp-ND) - (Cycling Amp-Dom)	0.973
(Gait Con-Dom) - (Cycling Amp-Dom)	0.656
(Gait Con-ND) - (Cycling Amp-Dom)	0.398
(Cycling Con-Dom) - (Cycling Amp-ND)	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	1.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	1.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	0.975
(Elliptical Con-ND) - (Cycling Amp-ND)	0.585
(Gait Amp-Dom) - (Cycling Amp-ND)	0.992
(Gait Amp-ND) - (Cycling Amp-ND)	1.000
(Gait Con-Dom) - (Cycling Amp-ND)	0.994
(Gait Con-ND) - (Cycling Amp-ND)	0.946
(Cycling Con-ND) - (Cycling Con-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	1.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	1.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	0.961
(Elliptical Con-ND) - (Cycling Con-Dom)	0.529
(Gait Amp-Dom) - (Cycling Con-Dom)	0.996
(Gait Amp-ND) - (Cycling Con-Dom)	1.000
(Gait Con-Dom) - (Cycling Con-Dom)	0.997
(Gait Con-ND) - (Cycling Con-Dom)	0.963
(Elliptical Amp-Dom) - (Cycling Con-ND)	1.000
(Elliptical Amp-ND) - (Cycling Con-ND)	1.000
(Elliptical Con-Dom) - (Cycling Con-ND)	1.000
(Elliptical Con-ND) - (Cycling Con-ND)	0.961
(Gait Amp-Dom) - (Cycling Con-ND)	0.759
(Gait Amp-ND) - (Cycling Con-ND)	0.993
(Gait Con-Dom) - (Cycling Con-ND)	0.786
(Gait Con-ND) - (Cycling Con-ND)	0.537
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	0.988
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.671
(Gait Amp-Dom) - (Elliptical Amp-Dom)	0.982
(Gait Amp-ND) - (Elliptical Amp-Dom)	1.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	0.986
(Gait Con-ND) - (Elliptical Amp-Dom)	0.909
(Elliptical Con-Dom) - (Elliptical Amp-ND)	0.992
(Elliptical Con-ND) - (Elliptical Amp-ND)	0.709
(Gait Amp-Dom) - (Elliptical Amp-ND)	0.975
(Gait Amp-ND) - (Elliptical Amp-ND)	1.000
(Gait Con-Dom) - (Elliptical Amp-ND)	0.981
(Gait Con-ND) - (Elliptical Amp-ND)	0.887
(Elliptical Con-ND) - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	0.376
(Gait Amp-ND) - (Elliptical Con-Dom)	0.868
(Gait Con-Dom) - (Elliptical Con-Dom)	0.405
(Gait Con-ND) - (Elliptical Con-Dom)	0.200
(Gait Amp-Dom) - (Elliptical Con-ND)	0.057
(Gait Amp-ND) - (Elliptical Con-ND)	0.334
(Gait Con-Dom) - (Elliptical Con-ND)	0.064
(Gait Con-ND) - (Elliptical Con-ND)	0.022
(Gait Amp-ND) - (Gait Amp-Dom)	1.000
(Gait Con-Dom) - (Gait Amp-Dom)	1.000
(Gait Con-ND) - (Gait Amp-Dom)	1.000
(Gait Con-Dom) - (Gait Amp-ND)	1.000
(Gait Con-ND) - (Gait Amp-ND)	0.994
(Gait Con-Dom) - (Gait Con-Dom)	1.000

Figure F.46: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for maximum knee adduction moment time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MinAddAbdKneeMom versus ... e Type, Subject Method

Factor coding (-1, 0, +1)
Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	0.000419	0.000209	20.44	0.000
Subject	3	0.000063	0.000021	2.06	0.110
Exercise Type*Subject	6	0.000027	0.000004	0.44	0.853
Error	108	0.001106	0.000010		
Total	119	0.001614			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.73	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.05	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.65	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	-4.19	0.003
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-2.51	0.347
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-1.89	0.765
(Elliptical Con-ND) - (Cycling Amp-Dom)	-2.35	0.449
(Gait Amp-Dom) - (Cycling Amp-Dom)	-1.30	0.977
(Gait Amp-ND) - (Cycling Amp-Dom)	-0.11	1.000
(Gait Con-Dom) - (Cycling Amp-Dom)	-0.29	1.000
(Gait Con-ND) - (Cycling Amp-Dom)	-0.26	1.000
(Cycling Con-Dom) - (Cycling Amp-ND)	-0.68	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	0.08	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-4.93	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	-3.24	0.066
(Elliptical Con-Dom) - (Cycling Amp-ND)	-2.62	0.282
(Elliptical Con-ND) - (Cycling Amp-ND)	-3.08	0.100
(Gait Amp-Dom) - (Cycling Amp-ND)	-2.04	0.667
(Gait Amp-ND) - (Cycling Amp-ND)	-0.85	0.999
(Gait Con-Dom) - (Cycling Amp-ND)	-1.02	0.997
(Gait Con-ND) - (Cycling Amp-ND)	-0.99	0.998
(Cycling Con-Dom) - (Cycling Con-Dom)	0.60	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-4.25	0.003
(Elliptical Amp-ND) - (Cycling Con-Dom)	-2.56	0.316

(Elliptical Con-Dom) - (Cycling Con-Dom)	-1.94	0.732
(Elliptical Con-ND) - (Cycling Con-Dom)	-2.40	0.414
(Gait Amp-Dom) - (Cycling Con-Dom)	-1.36	0.969
(Gait Amp-ND) - (Cycling Con-Dom)	-0.16	1.000
(Gait Con-Dom) - (Cycling Con-Dom)	-0.34	1.000
(Gait Con-ND) - (Cycling Con-Dom)	-0.31	1.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	-4.85	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	-3.16	0.082
(Elliptical Con-Dom) - (Cycling Con-ND)	-2.54	0.327
(Elliptical Con-ND) - (Cycling Con-ND)	-3.06	0.122
(Gait Amp-Dom) - (Cycling Con-ND)	-1.96	0.720
(Gait Amp-ND) - (Cycling Con-ND)	-0.77	1.000
(Gait Con-Dom) - (Cycling Con-ND)	-0.95	0.998
(Gait Con-ND) - (Cycling Con-ND)	-0.91	0.999
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	1.69	0.870
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	2.31	0.478
(Elliptical Con-ND) - (Elliptical Amp-Dom)	1.84	0.790
(Gait Amp-Dom) - (Elliptical Amp-Dom)	2.89	0.159
(Gait Amp-ND) - (Elliptical Amp-Dom)	4.08	0.005
(Gait Con-Dom) - (Elliptical Amp-Dom)	3.90	0.009
(Gait Con-ND) - (Elliptical Amp-Dom)	3.93	0.008
(Elliptical Con-Dom) - (Elliptical Amp-ND)	0.62	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	0.16	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	1.20	0.988
(Gait Amp-ND) - (Elliptical Amp-ND)	2.39	0.419
(Gait Con-Dom) - (Elliptical Amp-ND)	2.22	0.542
(Gait Con-ND) - (Elliptical Amp-ND)	2.25	0.520
(Elliptical Con-Dom) - (Elliptical Con-Dom)	-0.46	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	0.58	1.000
(Gait Amp-ND) - (Elliptical Con-Dom)	1.77	0.828
(Gait Con-Dom) - (Elliptical Con-Dom)	1.60	0.907
(Gait Con-ND) - (Elliptical Con-Dom)	1.63	0.896
(Gait Amp-Dom) - (Elliptical Con-ND)	1.05	0.996
(Gait Amp-ND) - (Elliptical Con-ND)	2.24	0.527
(Gait Con-Dom) - (Elliptical Con-ND)	2.06	0.653
(Gait Con-ND) - (Elliptical Con-ND)	2.09	0.632
(Gait Amp-ND) - (Gait Amp-Dom)	1.19	0.989
(Gait Con-Dom) - (Gait Amp-Dom)	1.01	0.997
(Gait Con-ND) - (Gait Amp-Dom)	1.04	0.996
(Gait Con-Dom) - (Gait Amp-ND)	-0.18	1.000
(Gait Con-ND) - (Gait Amp-ND)	-0.15	1.000
(Gait Con-Dom) - (Gait Con-Dom)	0.09	1.000

Figure F.47: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test minimum knee adduction moment between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject
Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	1469	734.3	1.01	0.366
Subject	3	2091	697.0	0.96	0.414
Exercise Type*Subject	6	5183	863.8	1.19	0.316
Error	108	78273	724.8		
Total	119	87016			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.992
(Cycling Con-Dom) - (Cycling Amp-Dom)	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.993
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	1.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	0.999
(Elliptical Con-ND) - (Cycling Amp-Dom)	0.999
(Gait Amp-Dom) - (Cycling Amp-Dom)	1.000
(Gait Amp-ND) - (Cycling Amp-Dom)	1.000
(Gait Con-Dom) - (Cycling Amp-Dom)	1.000
(Gait Con-ND) - (Cycling Amp-Dom)	0.988
(Cycling Con-Dom) - (Cycling Amp-ND)	0.996
(Cycling Con-ND) - (Cycling Amp-ND)	0.523
(Elliptical Amp-Dom) - (Cycling Amp-ND)	1.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	0.994
(Elliptical Con-Dom) - (Cycling Amp-ND)	0.702
(Elliptical Con-ND) - (Cycling Amp-ND)	1.000
(Gait Amp-Dom) - (Cycling Amp-ND)	0.994
(Gait Amp-ND) - (Cycling Amp-ND)	0.954
(Gait Con-Dom) - (Cycling Amp-ND)	0.809
(Gait Con-ND) - (Cycling Amp-ND)	0.460
(Cycling Con-ND) - (Cycling Con-Dom)	0.988
(Elliptical Amp-Dom) - (Cycling Con-Dom)	1.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	1.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	0.998
(Elliptical Con-ND) - (Cycling Con-Dom)	1.000
(Gait Amp-Dom) - (Cycling Con-Dom)	1.000
(Gait Amp-ND) - (Cycling Con-Dom)	1.000
(Gait Con-Dom) - (Cycling Con-Dom)	1.000
(Gait Con-ND) - (Cycling Con-Dom)	0.978
(Elliptical Amp-Dom) - (Cycling Con-ND)	0.939
(Elliptical Amp-ND) - (Cycling Con-ND)	0.992
(Elliptical Con-Dom) - (Cycling Con-ND)	1.000
(Elliptical Con-ND) - (Cycling Con-ND)	0.674
(Gait Amp-Dom) - (Cycling Con-ND)	0.992
(Gait Amp-ND) - (Cycling Con-ND)	1.000
(Gait Con-Dom) - (Cycling Con-ND)	1.000
(Gait Con-ND) - (Cycling Con-ND)	1.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	0.985
(Elliptical Con-ND) - (Elliptical Amp-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	1.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	1.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	0.996
(Gait Con-ND) - (Elliptical Amp-Dom)	0.910
(Elliptical Con-Dom) - (Elliptical Amp-ND)	0.999
(Elliptical Con-ND) - (Elliptical Amp-ND)	0.999
(Gait Amp-Dom) - (Elliptical Amp-ND)	1.000
(Gait Amp-ND) - (Elliptical Amp-ND)	1.000
(Gait Con-Dom) - (Elliptical Amp-ND)	1.000
(Gait Con-ND) - (Elliptical Amp-ND)	0.985
(Elliptical Con-ND) - (Elliptical Con-Dom)	0.831
(Gait Amp-Dom) - (Elliptical Con-Dom)	0.999
(Gait Amp-ND) - (Elliptical Con-Dom)	1.000
(Gait Con-Dom) - (Elliptical Con-Dom)	1.000
(Gait Con-ND) - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-ND)	0.999
(Gait Amp-ND) - (Elliptical Con-ND)	0.987
(Gait Con-Dom) - (Elliptical Con-ND)	0.907
(Gait Con-ND) - (Elliptical Con-ND)	0.611
(Gait Amp-ND) - (Gait Amp-Dom)	1.000
(Gait Con-Dom) - (Gait Amp-Dom)	1.000
(Gait Con-ND) - (Gait Amp-Dom)	0.985
(Gait Con-Dom) - (Gait Amp-ND)	1.000
(Gait Con-ND) - (Gait Amp-ND)	0.999
(Gait Con-ND) - (Gait Con-Dom)	1.000

Figure F.48: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for minimum knee adduction moment time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MaxERiHipMom versus Exercise Type, Subject Method

Factor coding (-1, 0, +1)
Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	0.000747	0.000374	56.10	0.000
Subject	3	0.000100	0.000033	4.99	0.003
Exercise Type*Subject	6	0.000153	0.000025	3.82	0.002
Error	108	0.000719	0.000007		
Total	119	0.001719			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.41	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.28	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.85	0.999
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	1.29	0.979
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-0.05	1.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	0.09	1.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	0.07	1.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	7.05	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	1.48	0.942
(Gait Con-Dom) - (Cycling Amp-Dom)	5.41	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	5.58	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	-0.69	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	0.43	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	0.87	0.999
(Elliptical Amp-ND) - (Cycling Amp-ND)	-0.46	1.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	-0.33	1.000
(Elliptical Con-ND) - (Cycling Amp-ND)	-0.34	1.000
(Gait Amp-Dom) - (Cycling Amp-ND)	6.64	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	1.07	0.995
(Gait Con-Dom) - (Cycling Amp-ND)	5.00	0.000
(Gait Con-ND) - (Cycling Amp-ND)	5.17	0.000
(Cycling Con-ND) - (Cycling Con-Dom)	1.13	0.993
(Elliptical Amp-Dom) - (Cycling Con-Dom)	1.57	0.917
(Elliptical Amp-ND) - (Cycling Con-Dom)	0.24	1.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	0.37	1.000
(Elliptical Con-ND) - (Cycling Con-Dom)	0.35	1.000
(Gait Amp-Dom) - (Cycling Con-Dom)	7.33	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	1.76	0.834
(Gait Con-Dom) - (Cycling Con-Dom)	5.69	0.000
(Gait Con-ND) - (Cycling Con-Dom)	5.87	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	0.44	1.000
(Elliptical Amp-ND) - (Cycling Con-ND)	-0.89	0.999
(Elliptical Con-Dom) - (Cycling Con-ND)	-0.76	1.000
(Elliptical Con-ND) - (Cycling Con-ND)	-0.76	1.000
(Gait Amp-Dom) - (Cycling Con-ND)	6.21	0.000
(Gait Amp-ND) - (Cycling Con-ND)	0.63	1.000
(Gait Con-Dom) - (Cycling Con-ND)	4.57	0.001
(Gait Con-ND) - (Cycling Con-ND)	4.74	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	-1.32	0.972
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	-1.21	0.987
(Elliptical Con-ND) - (Elliptical Amp-Dom)	-1.21	0.987
(Gait Amp-Dom) - (Elliptical Amp-Dom)	5.77	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	0.20	1.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	4.13	0.004
(Gait Con-ND) - (Elliptical Amp-Dom)	4.30	0.002
(Elliptical Con-Dom) - (Elliptical Amp-ND)	0.13	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	0.12	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	7.10	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	1.53	0.930
(Gait Con-Dom) - (Elliptical Amp-ND)	5.46	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	5.63	0.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	-0.01	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	6.97	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	1.39	0.962
(Gait Con-Dom) - (Elliptical Con-Dom)	5.33	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	5.50	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	6.98	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	1.41	0.959
(Gait Con-Dom) - (Elliptical Con-ND)	5.34	0.000
(Gait Con-ND) - (Elliptical Con-ND)	5.51	0.000
(Gait Amp-ND) - (Gait Amp-Dom)	-5.57	0.000
(Gait Con-Dom) - (Gait Amp-Dom)	-1.64	0.891
(Gait Con-ND) - (Gait Amp-Dom)	-1.47	0.946
(Gait Con-Dom) - (Gait Amp-ND)	3.93	0.008
(Gait Con-ND) - (Gait Amp-ND)	4.10	0.004
(Gait Con-ND) - (Gait Con-Dom)	0.17	1.000

Figure F.49: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test maximum hip external rotation moment between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject
Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	6713	3356.7	4.28	0.016
Subject	3	1434	477.9	0.61	0.610
Exercise Type*Subject	6	13603	2267.2	2.89	0.012
Error	108	84651	783.8		
Total	119	106401			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.946
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.946
(Cycling Con-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	0.098
(Elliptical Amp-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	0.381
(Elliptical Con-ND) - (Cycling Amp-Dom)	0.573
(Gait Amp-Dom) - (Cycling Amp-Dom)	1.000
(Gait Amp-ND) - (Cycling Amp-Dom)	0.261
(Gait Con-Dom) - (Cycling Amp-Dom)	1.000
(Gait Con-ND) - (Cycling Amp-Dom)	1.000
(Cycling Con-Dom) - (Cycling Amp-ND)	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	0.998
(Elliptical Amp-Dom) - (Cycling Amp-ND)	0.891
(Elliptical Amp-ND) - (Cycling Amp-ND)	1.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	0.997
(Elliptical Con-ND) - (Cycling Amp-ND)	1.000
(Gait Amp-Dom) - (Cycling Amp-ND)	0.878
(Gait Amp-ND) - (Cycling Amp-ND)	0.987
(Gait Con-Dom) - (Cycling Amp-ND)	0.997
(Gait Con-ND) - (Cycling Amp-ND)	0.998
(Cycling Con-ND) - (Cycling Con-Dom)	0.992
(Elliptical Amp-Dom) - (Cycling Con-Dom)	0.897
(Elliptical Amp-ND) - (Cycling Con-Dom)	1.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	0.998
(Elliptical Con-ND) - (Cycling Con-Dom)	1.000
(Gait Amp-Dom) - (Cycling Con-Dom)	0.871
(Gait Amp-ND) - (Cycling Con-Dom)	0.989
(Gait Con-Dom) - (Cycling Con-Dom)	0.996
(Gait Con-ND) - (Cycling Con-Dom)	0.998
(Elliptical Amp-Dom) - (Cycling Con-ND)	0.211
(Elliptical Amp-ND) - (Cycling Con-ND)	1.000
(Elliptical Con-Dom) - (Cycling Con-ND)	0.607
(Elliptical Con-ND) - (Cycling Con-ND)	0.788
(Gait Amp-Dom) - (Cycling Con-ND)	1.000
(Gait Amp-ND) - (Cycling Con-ND)	0.461
(Gait Con-Dom) - (Cycling Con-ND)	1.000
(Gait Con-ND) - (Cycling Con-ND)	1.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	0.402
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.999
(Gait Amp-Dom) - (Elliptical Amp-Dom)	0.055
(Gait Amp-ND) - (Elliptical Amp-Dom)	1.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	0.261
(Gait Con-ND) - (Elliptical Amp-Dom)	0.304
(Elliptical Con-Dom) - (Elliptical Amp-ND)	0.825
(Elliptical Con-ND) - (Elliptical Amp-ND)	0.937
(Gait Amp-Dom) - (Elliptical Amp-ND)	0.999
(Gait Amp-ND) - (Elliptical Amp-ND)	0.700
(Gait Con-Dom) - (Elliptical Amp-ND)	1.000
(Gait Con-ND) - (Elliptical Amp-ND)	1.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	0.257
(Gait Amp-ND) - (Elliptical Con-Dom)	1.000
(Gait Con-Dom) - (Elliptical Con-Dom)	0.678
(Gait Con-ND) - (Elliptical Con-Dom)	0.731
(Gait Amp-Dom) - (Elliptical Con-ND)	0.423
(Gait Amp-ND) - (Elliptical Con-ND)	1.000
(Gait Con-Dom) - (Elliptical Con-ND)	0.845
(Gait Con-ND) - (Elliptical Con-ND)	0.881
(Gait Amp-ND) - (Gait Amp-Dom)	0.165
(Gait Con-Dom) - (Gait Amp-Dom)	1.000
(Gait Con-ND) - (Gait Amp-Dom)	1.000
(Gait Con-Dom) - (Gait Amp-ND)	0.533
(Gait Con-ND) - (Gait Amp-ND)	0.590
(Gait Con-ND) - (Gait Con-Dom)	1.000

Figure F.50: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for maximum hip external rotation moment time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MinERIRHipMom versus Exercise Type, Subject Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	0.000721	0.000361	76.39	0.000
Subject	3	0.000039	0.000013	2.78	0.045
Exercise Type*Subject	6	0.000015	0.000002	0.53	0.787
Error	108	0.000510	0.000005		
Total	119	0.001285			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	1.75	0.840
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.12	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.88	0.999
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	2.41	0.407
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-0.85	0.999
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-2.15	0.589
(Elliptical Con-ND) - (Cycling Amp-Dom)	-2.49	0.358
(Gait Amp-Dom) - (Cycling Amp-Dom)	-4.87	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	-4.68	0.001
(Gait Con-Dom) - (Cycling Amp-Dom)	-6.37	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	-5.96	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	-1.63	0.895
(Cycling Con-ND) - (Cycling Amp-ND)	0.87	0.999
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-4.16	0.004
(Elliptical Amp-ND) - (Cycling Amp-ND)	-2.60	0.292
(Elliptical Con-Dom) - (Cycling Amp-ND)	-3.90	0.009
(Elliptical Con-ND) - (Cycling Amp-ND)	-4.24	0.003
(Gait Amp-Dom) - (Cycling Amp-ND)	-6.62	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	-6.43	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	-8.12	0.000
(Gait Con-ND) - (Cycling Amp-ND)	-7.72	0.000
(Cycling Con-ND) - (Cycling Con-Dom)	0.76	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-2.54	0.329
(Elliptical Amp-ND) - (Cycling Con-Dom)	-0.97	0.998

(Elliptical Con-Dom) - (Cycling Con-Dom)	-2.27	0.501
(Elliptical Con-ND) - (Cycling Con-Dom)	-2.61	0.286
(Gait Amp-Dom) - (Cycling Con-Dom)	-5.00	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	-4.81	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	-6.49	0.000
(Gait Con-ND) - (Cycling Con-Dom)	-6.09	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	-3.30	0.057
(Elliptical Amp-ND) - (Cycling Con-ND)	-1.73	0.849
(Elliptical Con-Dom) - (Cycling Con-ND)	-3.03	0.114
(Elliptical Con-ND) - (Cycling Con-ND)	-3.37	0.046
(Gait Amp-Dom) - (Cycling Con-ND)	-5.76	0.000
(Gait Amp-ND) - (Cycling Con-ND)	-5.56	0.000
(Gait Con-Dom) - (Cycling Con-ND)	-7.25	0.000
(Gait Con-ND) - (Cycling Con-ND)	-6.85	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	1.56	0.919
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	0.26	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	-0.08	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	-2.46	0.376
(Gait Amp-ND) - (Elliptical Amp-Dom)	-2.27	0.505
(Gait Con-Dom) - (Elliptical Amp-Dom)	-3.96	0.007
(Gait Con-ND) - (Elliptical Amp-Dom)	-3.55	0.027
(Elliptical Con-Dom) - (Elliptical Amp-ND)	-1.30	0.978
(Elliptical Con-ND) - (Elliptical Amp-ND)	-1.64	0.890
(Gait Amp-Dom) - (Elliptical Amp-ND)	-4.02	0.006
(Gait Amp-ND) - (Elliptical Amp-ND)	-3.83	0.011
(Gait Con-Dom) - (Elliptical Amp-ND)	-5.52	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	-5.11	0.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	-0.34	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	-2.72	0.229
(Gait Amp-ND) - (Elliptical Con-Dom)	-2.53	0.333
(Gait Con-Dom) - (Elliptical Con-Dom)	-4.22	0.003
(Gait Con-ND) - (Elliptical Con-Dom)	-3.81	0.012
(Gait Amp-Dom) - (Elliptical Con-ND)	-2.38	0.426
(Gait Amp-ND) - (Elliptical Con-ND)	-2.19	0.559
(Gait Con-Dom) - (Elliptical Con-ND)	-3.88	0.009
(Gait Con-ND) - (Elliptical Con-ND)	-3.48	0.034
(Gait Amp-ND) - (Gait Amp-Dom)	0.19	1.000
(Gait Con-Dom) - (Gait Amp-Dom)	-1.50	0.939
(Gait Con-ND) - (Gait Amp-Dom)	-1.09	0.994
(Gait Con-Dom) - (Gait Amp-ND)	-1.69	0.870
(Gait Con-ND) - (Gait Amp-ND)	-1.26	0.980
(Gait Con-ND) - (Gait Con-Dom)	0.40	1.000

Figure F.51: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test minimum hip external rotation moment between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject
Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	8697.1	4348.5	9.29	0.000
Subject	3	357.5	119.2	0.25	0.858
Exercise Type*Subject	6	3430.3	571.7	1.22	0.301
Error	108	50539.3	468.0		
Total	119	63024.1			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.992
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	1.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	0.999
(Elliptical Con-Dom) - (Cycling Amp-Dom)	1.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	0.999
(Gait Amp-Dom) - (Cycling Amp-Dom)	0.860
(Gait Amp-ND) - (Cycling Amp-Dom)	0.926
(Gait Con-Dom) - (Cycling Amp-Dom)	0.618
(Gait Con-ND) - (Cycling Amp-Dom)	0.618
(Cycling Con-Dom) - (Cycling Amp-ND)	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	0.922
(Elliptical Amp-Dom) - (Cycling Amp-ND)	1.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	0.974
(Elliptical Con-Dom) - (Cycling Amp-ND)	1.000
(Elliptical Con-ND) - (Cycling Amp-ND)	1.000
(Gait Amp-Dom) - (Cycling Amp-ND)	0.611
(Gait Amp-ND) - (Cycling Amp-ND)	0.723
(Gait Con-Dom) - (Cycling Amp-ND)	0.338
(Gait Con-ND) - (Cycling Amp-ND)	0.338
(Cycling Con-ND) - (Cycling Con-Dom)	0.880
(Elliptical Amp-Dom) - (Cycling Con-Dom)	0.999
(Elliptical Amp-ND) - (Cycling Con-Dom)	0.958

(Elliptical Con-Dom) - (Cycling Con-Dom)	1.000
(Elliptical Con-ND) - (Cycling Con-Dom)	1.000
(Gait Amp-Dom) - (Cycling Con-Dom)	0.545
(Gait Amp-ND) - (Cycling Con-Dom)	0.661
(Gait Con-Dom) - (Cycling Con-Dom)	0.280
(Gait Con-ND) - (Cycling Con-Dom)	0.285
(Elliptical Amp-Dom) - (Cycling Con-ND)	1.000
(Elliptical Amp-ND) - (Cycling Con-ND)	1.000
(Elliptical Con-Dom) - (Cycling Con-ND)	0.832
(Elliptical Con-ND) - (Cycling Con-ND)	0.696
(Gait Amp-Dom) - (Cycling Con-ND)	1.000
(Gait Amp-ND) - (Cycling Con-ND)	1.000
(Gait Con-Dom) - (Cycling Con-ND)	0.998
(Gait Con-ND) - (Cycling Con-ND)	0.998
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	0.997
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.985
(Gait Amp-Dom) - (Elliptical Amp-Dom)	0.972
(Gait Amp-ND) - (Elliptical Amp-Dom)	0.990
(Gait Con-Dom) - (Elliptical Amp-Dom)	0.847
(Gait Con-ND) - (Elliptical Amp-Dom)	0.847
(Elliptical Con-Dom) - (Elliptical Amp-ND)	0.926
(Elliptical Con-ND) - (Elliptical Amp-ND)	0.832
(Gait Amp-Dom) - (Elliptical Amp-ND)	1.000
(Gait Amp-ND) - (Elliptical Amp-ND)	1.000
(Gait Con-Dom) - (Elliptical Amp-ND)	0.988
(Gait Con-ND) - (Elliptical Amp-ND)	0.988
(Elliptical Con-ND) - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	0.458
(Gait Amp-ND) - (Elliptical Con-Dom)	0.574
(Gait Con-Dom) - (Elliptical Con-Dom)	0.222
(Gait Con-ND) - (Elliptical Con-Dom)	0.222
(Gait Amp-Dom) - (Elliptical Con-ND)	0.314
(Gait Amp-ND) - (Elliptical Con-ND)	0.416
(Gait Con-Dom) - (Elliptical Con-ND)	0.133
(Gait Con-ND) - (Elliptical Con-ND)	0.133
(Gait Amp-ND) - (Gait Amp-Dom)	1.000
(Gait Con-Dom) - (Gait Amp-Dom)	1.000
(Gait Con-ND) - (Gait Amp-Dom)	1.000
(Gait Con-Dom) - (Gait Amp-ND)	1.000
(Gait Con-ND) - (Gait Amp-ND)	1.000

Figure F.52: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for minimum hip external rotation moment time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MaxERIRKneeMom versus ... rcise Type, Subject Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	0.000087	0.000043	36.83	0.000
Subject	3	0.000002	0.000001	0.70	0.551
Exercise Type*Subject	6	0.000002	0.000000	0.24	0.963
Error	108	0.000127	0.000001		
Total	119	0.000218			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	-0.29	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	-0.15	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	-0.39	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	4.57	0.001
(Elliptical Amp-ND) - (Cycling Amp-Dom)	3.42	0.039
(Elliptical Con-Dom) - (Cycling Amp-Dom)	4.10	0.004
(Elliptical Con-ND) - (Cycling Amp-Dom)	3.20	0.074
(Gait Amp-Dom) - (Cycling Amp-Dom)	3.55	0.027
(Gait Amp-ND) - (Cycling Amp-Dom)	2.67	0.254
(Gait Con-Dom) - (Cycling Amp-Dom)	2.82	0.187
(Gait Con-ND) - (Cycling Amp-Dom)	3.30	0.056
(Cycling Con-Dom) - (Cycling Amp-ND)	0.14	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	0.10	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	4.86	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	3.71	0.016
(Elliptical Con-Dom) - (Cycling Amp-ND)	4.39	0.002
(Elliptical Con-ND) - (Cycling Amp-ND)	3.49	0.033
(Gait Amp-Dom) - (Cycling Amp-ND)	3.84	0.011
(Gait Amp-ND) - (Cycling Amp-ND)	2.96	0.136
(Gait Con-Dom) - (Cycling Amp-ND)	3.11	0.095
(Gait Con-ND) - (Cycling Amp-ND)	3.58	0.024
(Cycling Con-ND) - (Cycling Con-Dom)	0.24	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	4.72	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	3.57	0.025

(Elliptical Con-Dom) - (Cycling Con-Dom)	4.25	0.003
(Elliptical Con-ND) - (Cycling Con-Dom)	3.35	0.049
(Gait Amp-Dom) - (Cycling Con-Dom)	3.70	0.017
(Gait Amp-ND) - (Cycling Con-Dom)	2.82	0.187
(Gait Con-Dom) - (Cycling Con-Dom)	2.97	0.133
(Gait Con-ND) - (Cycling Con-Dom)	3.45	0.037
(Elliptical Amp-Dom) - (Cycling Con-ND)	4.96	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	3.82	0.012
(Elliptical Con-Dom) - (Cycling Con-ND)	4.49	0.001
(Elliptical Con-ND) - (Cycling Con-ND)	3.59	0.024
(Gait Amp-Dom) - (Cycling Con-ND)	3.94	0.008
(Gait Amp-ND) - (Cycling Con-ND)	3.06	0.105
(Gait Con-Dom) - (Cycling Con-ND)	3.21	0.072
(Gait Con-ND) - (Cycling Con-ND)	3.69	0.018
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	-1.15	0.992
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	-0.47	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	-1.37	0.966
(Gait Amp-Dom) - (Elliptical Amp-Dom)	-1.02	0.997
(Gait Amp-ND) - (Elliptical Amp-Dom)	-1.90	0.757
(Gait Con-Dom) - (Elliptical Amp-Dom)	-1.75	0.839
(Gait Con-ND) - (Elliptical Amp-Dom)	-1.27	0.981
(Elliptical Con-Dom) - (Elliptical Amp-ND)	0.68	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	-0.25	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	0.13	1.000
(Gait Amp-ND) - (Elliptical Amp-ND)	-0.75	1.000
(Gait Con-Dom) - (Elliptical Amp-ND)	-0.61	1.000
(Gait Con-ND) - (Elliptical Amp-ND)	-0.13	1.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	-0.96	0.999
(Gait Amp-Dom) - (Elliptical Con-Dom)	-0.55	1.000
(Gait Amp-ND) - (Elliptical Con-Dom)	-1.43	0.955
(Gait Con-Dom) - (Elliptical Con-Dom)	-1.28	0.980
(Gait Con-ND) - (Elliptical Con-Dom)	-0.80	1.000
(Gait Amp-Dom) - (Elliptical Con-ND)	0.35	1.000
(Gait Amp-ND) - (Elliptical Con-ND)	-0.53	1.000
(Gait Con-Dom) - (Elliptical Con-ND)	-0.38	1.000
(Gait Con-ND) - (Elliptical Con-ND)	0.16	1.000
(Gait Amp-ND) - (Gait Amp-Dom)	-0.88	0.999
(Gait Con-Dom) - (Gait Amp-Dom)	-0.73	1.000
(Gait Con-ND) - (Gait Amp-Dom)	-0.25	1.000
(Gait Con-Dom) - (Gait Amp-ND)	0.15	1.000
(Gait Con-ND) - (Gait Amp-ND)	0.63	1.000
(Gait Con-ND) - (Gait Con-Dom)	0.46	1.000

Figure F.53: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test maximum knee external rotation moment between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject
Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	1568	784.1	0.59	0.556
Subject	3	1727	575.7	0.43	0.730
Exercise Type*Subject	6	13422	2237.0	1.68	0.132
Error	108	143592	1329.6		
Total	119	160309			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.995
(Cycling Con-Dom) - (Cycling Amp-Dom)	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	0.881
(Elliptical Amp-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	1.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	0.951
(Gait Amp-Dom) - (Cycling Amp-Dom)	1.000
(Gait Amp-ND) - (Cycling Amp-Dom)	0.942
(Gait Con-Dom) - (Cycling Amp-Dom)	1.000
(Gait Con-ND) - (Cycling Amp-Dom)	0.995
(Cycling Con-Dom) - (Cycling Amp-ND)	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	0.984
(Elliptical Amp-Dom) - (Cycling Amp-ND)	1.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	0.986
(Elliptical Con-Dom) - (Cycling Amp-ND)	1.000
(Elliptical Con-ND) - (Cycling Amp-ND)	1.000
(Gait Amp-Dom) - (Cycling Amp-ND)	0.926
(Gait Amp-ND) - (Cycling Amp-ND)	1.000
(Gait Con-Dom) - (Cycling Amp-ND)	0.983
(Gait Con-ND) - (Cycling Amp-ND)	1.000
(Cycling Con-ND) - (Cycling Con-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	0.990
(Elliptical Amp-ND) - (Cycling Con-Dom)	1.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	1.000
(Elliptical Con-ND) - (Cycling Con-Dom)	0.998
(Gait Amp-Dom) - (Cycling Con-Dom)	0.998
(Gait Amp-ND) - (Cycling Con-Dom)	0.997
(Gait Con-Dom) - (Cycling Con-Dom)	1.000
(Gait Con-ND) - (Cycling Con-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	0.803
(Elliptical Amp-ND) - (Cycling Con-ND)	1.000
(Elliptical Con-Dom) - (Cycling Con-ND)	1.000
(Elliptical Con-ND) - (Cycling Con-ND)	0.903
(Gait Amp-Dom) - (Cycling Con-ND)	1.000
(Gait Amp-ND) - (Cycling Con-ND)	0.889
(Gait Con-Dom) - (Cycling Con-ND)	1.000
(Gait Con-ND) - (Cycling Con-ND)	0.986
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	0.813
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	0.992
(Elliptical Con-ND) - (Elliptical Amp-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	0.609
(Gait Amp-ND) - (Elliptical Amp-Dom)	1.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	0.796
(Gait Con-ND) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	0.910
(Gait Amp-Dom) - (Elliptical Amp-ND)	1.000
(Gait Amp-ND) - (Elliptical Amp-ND)	0.856
(Gait Con-Dom) - (Elliptical Amp-ND)	1.000
(Gait Con-ND) - (Elliptical Amp-ND)	0.987
(Elliptical Con-ND) - (Elliptical Con-Dom)	0.999
(Gait Amp-Dom) - (Elliptical Con-Dom)	0.998
(Gait Amp-ND) - (Elliptical Con-Dom)	0.998
(Gait Con-Dom) - (Elliptical Con-Dom)	1.000
(Gait Con-ND) - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-ND)	0.752
(Gait Amp-ND) - (Elliptical Con-ND)	1.000
(Gait Con-Dom) - (Elliptical Con-ND)	0.898
(Gait Con-ND) - (Elliptical Con-ND)	1.000
(Gait Amp-ND) - (Gait Amp-Dom)	0.729
(Gait Con-Dom) - (Gait Amp-Dom)	1.000
(Gait Con-ND) - (Gait Amp-Dom)	0.930
(Gait Con-Dom) - (Gait Amp-ND)	0.884
(Gait Con-ND) - (Gait Amp-ND)	1.000
(Gait Con-ND) - (Gait Con-Dom)	0.984

Figure F.54: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for maximum knee external rotation moment time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MinERIRKneeMom versus Exercise ... e, Subject Method

Factor coding (-1, 0, +1)
Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	0.001629	0.000814	211.93	0.000
Subject	3	0.000061	0.000020	5.33	0.002
Exercise Type*Subject	6	0.000113	0.000019	4.91	0.000
Error	108	0.000415	0.000004		
Total	119	0.002219			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.38	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.27	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.02	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	-4.71	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-1.38	0.965
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-1.61	0.900
(Elliptical Con-ND) - (Cycling Amp-Dom)	-2.43	0.398
(Gait Amp-Dom) - (Cycling Amp-Dom)	-9.14	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	-6.92	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	-12.21	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	-10.88	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	-0.10	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	0.35	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-5.09	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	-1.76	0.838
(Elliptical Con-Dom) - (Cycling Amp-ND)	-1.99	0.699
(Elliptical Con-ND) - (Cycling Amp-ND)	-2.80	0.194
(Gait Amp-Dom) - (Cycling Amp-ND)	-9.51	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	-7.29	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	-12.58	0.000
(Gait Con-ND) - (Cycling Amp-ND)	-11.25	0.000
(Cycling Con-Dom) - (Cycling Con-Dom)	0.25	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-4.98	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	-1.65	0.884

(Elliptical Con-Dom) - (Cycling Con-Dom)	-1.88	0.764
(Elliptical Con-ND) - (Cycling Con-Dom)	-2.70	0.240
(Gait Amp-Dom) - (Cycling Con-Dom)	-9.41	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	-7.19	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	-12.48	0.000
(Gait Con-ND) - (Cycling Con-Dom)	-11.15	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	-4.73	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	-1.40	0.961
(Elliptical Con-Dom) - (Cycling Con-ND)	-1.64	0.892
(Elliptical Con-ND) - (Cycling Con-ND)	-2.45	0.384
(Gait Amp-Dom) - (Cycling Con-ND)	-9.16	0.000
(Gait Amp-ND) - (Cycling Con-ND)	-6.94	0.000
(Gait Con-Dom) - (Cycling Con-ND)	-12.23	0.000
(Gait Con-ND) - (Cycling Con-ND)	-10.90	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	9.33	0.052
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	9.10	0.057
(Elliptical Con-ND) - (Elliptical Amp-Dom)	2.28	0.494
(Gait Amp-Dom) - (Elliptical Amp-Dom)	-4.43	0.001
(Gait Amp-ND) - (Elliptical Amp-Dom)	-2.21	0.547
(Gait Con-Dom) - (Elliptical Amp-Dom)	-7.50	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	-6.17	0.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	-0.23	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	-1.05	0.994
(Gait Amp-Dom) - (Elliptical Amp-ND)	-7.76	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	-5.54	0.000
(Gait Con-Dom) - (Elliptical Amp-ND)	-10.83	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	-9.50	0.000
(Elliptical Con-Dom) - (Elliptical Con-Dom)	-0.81	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	-7.52	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	-5.30	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	-10.59	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	-9.26	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	-6.71	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	-4.49	0.001
(Gait Con-Dom) - (Elliptical Con-ND)	-9.78	0.000
(Gait Con-ND) - (Elliptical Con-ND)	-8.45	0.000
(Gait Amp-ND) - (Gait Amp-Dom)	9.22	0.540
(Gait Con-Dom) - (Gait Amp-Dom)	-3.07	0.104
(Gait Con-ND) - (Gait Amp-Dom)	-1.74	0.846
(Gait Con-Dom) - (Gait Amp-ND)	-5.29	0.000
(Gait Con-ND) - (Gait Amp-ND)	-3.96	0.007
(Gait Con-Dom) - (Gait Con-Dom)	1.33	0.972

Figure F.55: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test minimum knee external rotation moment between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	16147	8073.3	44.87	0.000
Subject	3	2740	913.5	5.08	0.003
Exercise Type*Subject	6	1719	286.6	1.59	0.156
Error	108	19432	179.9		
Total	119	40038			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	3.07	0.104
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.12	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	-0.28	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	-4.02	0.006
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-1.03	0.997
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-3.20	0.074
(Elliptical Con-ND) - (Cycling Amp-Dom)	-3.17	0.080
(Gait Amp-Dom) - (Cycling Amp-Dom)	1.90	0.756
(Gait Amp-ND) - (Cycling Amp-Dom)	1.58	0.911
(Gait Con-Dom) - (Cycling Amp-Dom)	1.50	0.937
(Gait Con-ND) - (Cycling Amp-Dom)	1.50	0.937
(Cycling Con-Dom) - (Cycling Amp-ND)	-2.95	0.138
(Cycling Con-ND) - (Cycling Amp-ND)	-3.35	0.049
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-7.08	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	-4.10	0.004
(Elliptical Con-Dom) - (Cycling Amp-ND)	-6.27	0.000
(Elliptical Con-ND) - (Cycling Amp-ND)	-6.23	0.000
(Gait Amp-Dom) - (Cycling Amp-ND)	-1.17	0.990
(Gait Amp-ND) - (Cycling Amp-ND)	-1.48	0.942
(Gait Con-Dom) - (Cycling Amp-ND)	-1.57	0.917
(Gait Con-ND) - (Cycling Amp-ND)	-1.57	0.917
(Cycling Con-ND) - (Cycling Con-Dom)	0.40	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-4.13	0.004
(Elliptical Amp-ND) - (Cycling Con-Dom)	-1.15	0.991

(Elliptical Con-Dom) - (Cycling Con-Dom)	-3.32	0.053
(Elliptical Con-ND) - (Cycling Con-Dom)	-3.28	0.059
(Gait Amp-Dom) - (Cycling Con-Dom)	1.78	0.823
(Gait Amp-ND) - (Cycling Con-Dom)	1.47	0.946
(Gait Con-Dom) - (Cycling Con-Dom)	1.38	0.964
(Gait Con-ND) - (Cycling Con-Dom)	1.38	0.964
(Elliptical Amp-Dom) - (Cycling Con-ND)	-3.73	0.015
(Elliptical Amp-ND) - (Cycling Con-ND)	-0.75	1.000
(Elliptical Con-Dom) - (Cycling Con-ND)	-2.92	0.150
(Elliptical Con-ND) - (Cycling Con-ND)	-2.88	0.162
(Gait Amp-Dom) - (Cycling Con-ND)	2.18	0.565
(Gait Amp-ND) - (Cycling Con-ND)	1.87	0.776
(Gait Con-Dom) - (Cycling Con-ND)	1.78	0.823
(Gait Con-ND) - (Cycling Con-ND)	1.78	0.823
(Elliptical Amp-Dom) - (Elliptical Amp-Dom)	2.98	0.128
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	0.82	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.85	0.999
(Gait Amp-Dom) - (Elliptical Amp-Dom)	5.92	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	5.60	0.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	5.52	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	5.52	0.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	-2.17	0.577
(Elliptical Con-ND) - (Elliptical Amp-ND)	-2.13	0.600
(Gait Amp-Dom) - (Elliptical Amp-ND)	2.93	0.144
(Gait Amp-ND) - (Elliptical Amp-ND)	2.62	0.284
(Gait Con-Dom) - (Elliptical Amp-ND)	2.53	0.331
(Gait Con-ND) - (Elliptical Amp-ND)	2.53	0.331
(Elliptical Con-Dom) - (Elliptical Con-Dom)	5.03	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	5.10	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	4.78	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	4.70	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	4.70	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	5.07	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	4.75	0.000
(Gait Con-Dom) - (Elliptical Con-ND)	4.67	0.001
(Gait Con-ND) - (Elliptical Con-ND)	4.67	0.001
(Gait Amp-ND) - (Gait Amp-Dom)	-0.32	1.000
(Gait Con-Dom) - (Gait Amp-Dom)	-0.40	1.000
(Gait Con-ND) - (Gait Amp-Dom)	-0.40	1.000
(Gait Con-Dom) - (Gait Con-Dom)	-0.08	1.000
(Gait Con-ND) - (Gait Con-Dom)	-0.08	1.000
(Gait Con-ND) - (Gait Con-ND)	-0.00	1.000

Figure F.56: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for minimum knee external rotation moment time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

F.4: Reaction Forces Two-Factor Repeated Measures ANOVA with Post-hoc Tukey Test

General Linear Model: MaxVRF versus Exercise Type, Subject
Method

Factor coding (-1, 0, +1)
Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	21.1673	10.5836	2561.32	0.000
Subject	3	0.0612	0.0204	4.93	0.003
Exercise Type*Subject	6	0.0884	0.0147	3.57	0.003
Error	108	0.4463	0.0041		
Total	119	21.7631			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	-0.64	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.33	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.10	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	29.39	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	26.67	0.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	25.91	0.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	25.74	0.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	34.39	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	31.43	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	35.53	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	33.84	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	0.97	0.998
(Cycling Con-ND) - (Cycling Amp-ND)	0.74	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	30.04	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	27.32	0.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	26.55	0.000
(Elliptical Con-ND) - (Cycling Amp-ND)	26.38	0.000
(Gait Amp-Dom) - (Cycling Amp-ND)	35.03	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	32.07	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	36.18	0.000
(Gait Con-ND) - (Cycling Amp-ND)	34.48	0.000
(Cycling Con-Dom) - (Cycling Con-Dom)	0.23	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	29.06	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	26.34	0.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	25.58	0.000
(Elliptical Con-ND) - (Cycling Con-Dom)	25.41	0.000
(Gait Amp-Dom) - (Cycling Con-Dom)	34.06	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	31.10	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	35.20	0.000
(Gait Con-ND) - (Cycling Con-Dom)	33.51	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	29.29	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	26.57	0.000
(Elliptical Con-Dom) - (Cycling Con-ND)	25.81	0.000
(Elliptical Con-ND) - (Cycling Con-ND)	25.64	0.000
(Gait Amp-Dom) - (Cycling Con-ND)	34.29	0.000
(Gait Amp-ND) - (Cycling Con-ND)	31.33	0.000
(Gait Con-Dom) - (Cycling Con-ND)	35.43	0.000
(Gait Con-ND) - (Cycling Con-ND)	33.74	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	-2.72	0.232
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	-3.49	0.033
(Elliptical Con-ND) - (Elliptical Amp-Dom)	-3.65	0.020
(Gait Amp-Dom) - (Elliptical Amp-Dom)	4.99	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	2.03	0.670
(Gait Con-Dom) - (Elliptical Amp-Dom)	6.14	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	4.44	0.001
(Elliptical Con-Dom) - (Elliptical Amp-ND)	-0.77	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	-0.93	0.999
(Gait Amp-Dom) - (Elliptical Amp-ND)	7.71	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	4.75	0.000
(Gait Con-Dom) - (Elliptical Amp-ND)	8.86	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	7.16	0.000
(Elliptical Con-Dom) - (Elliptical Con-Dom)	-0.17	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	8.48	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	5.52	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	9.63	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	7.93	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	8.65	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	5.69	0.000
(Gait Con-Dom) - (Elliptical Con-ND)	9.79	0.000
(Gait Con-ND) - (Elliptical Con-ND)	8.10	0.000
(Gait Amp-ND) - (Gait Amp-Dom)	-2.96	0.135
(Gait Con-Dom) - (Gait Amp-Dom)	1.15	0.992
(Gait Con-ND) - (Gait Amp-Dom)	-0.55	1.000
(Gait Con-Dom) - (Gait Amp-ND)	4.11	0.004
(Gait Con-ND) - (Gait Amp-ND)	2.41	0.408
(Gait Con-Dom) - (Gait Con-Dom)	-1.70	0.866

Figure F.57: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test maximum vertical reaction force between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	14016.0	7008.02	56.82	0.000
Subject	3	27.4	9.13	0.07	0.974
Exercise Type*Subject	6	482.0	80.33	0.65	0.689
Error	108	13319.4	123.33		
Total	119	27844.8			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	1.13	0.993
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.00	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	-0.26	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	-5.30	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-4.93	0.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-4.75	0.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	-4.73	0.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	0.64	1.000
(Gait Amp-ND) - (Cycling Amp-Dom)	-1.63	0.894
(Gait Con-Dom) - (Cycling Amp-Dom)	-1.49	0.940
(Gait Con-ND) - (Cycling Amp-Dom)	-0.83	1.000
(Cycling Con-Dom) - (Cycling Amp-ND)	-1.13	0.993
(Cycling Con-ND) - (Cycling Amp-ND)	-1.39	0.963
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-6.42	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	-6.06	0.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	-5.88	0.000
(Elliptical Con-ND) - (Cycling Amp-ND)	-5.86	0.000
(Gait Amp-Dom) - (Cycling Amp-ND)	-1.77	0.829
(Gait Amp-ND) - (Cycling Amp-ND)	-2.76	0.213
(Gait Con-Dom) - (Cycling Amp-ND)	-2.62	0.283
(Gait Con-ND) - (Cycling Amp-ND)	-1.95	0.723
(Cycling Con-ND) - (Cycling Con-Dom)	0.26	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-5.30	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	-4.93	0.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	-4.75	0.000
(Elliptical Con-ND) - (Cycling Con-Dom)	-4.73	0.000
(Gait Amp-Dom) - (Cycling Con-Dom)	-0.64	1.000
(Gait Amp-ND) - (Cycling Con-Dom)	-1.63	0.894
(Gait Con-Dom) - (Cycling Con-Dom)	-1.49	0.940
(Gait Con-ND) - (Cycling Con-Dom)	-0.83	1.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	-5.03	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	-4.67	0.001
(Elliptical Con-Dom) - (Cycling Con-ND)	-4.49	0.001
(Elliptical Con-ND) - (Cycling Con-ND)	-4.47	0.001
(Gait Amp-Dom) - (Cycling Con-ND)	-0.38	1.000
(Gait Amp-ND) - (Cycling Con-ND)	-1.37	0.967
(Gait Con-Dom) - (Cycling Con-ND)	-1.23	0.985
(Gait Con-ND) - (Cycling Con-ND)	-0.56	1.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	0.36	1.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	0.54	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.56	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	4.65	0.001
(Gait Amp-ND) - (Elliptical Amp-Dom)	3.66	0.019
(Gait Con-Dom) - (Elliptical Amp-Dom)	3.81	0.012
(Gait Con-ND) - (Elliptical Amp-Dom)	4.47	0.001
(Elliptical Con-Dom) - (Elliptical Amp-ND)	0.18	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	0.20	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	4.29	0.002
(Gait Amp-ND) - (Elliptical Amp-ND)	3.30	0.056
(Gait Con-Dom) - (Elliptical Amp-ND)	3.44	0.037
(Gait Con-ND) - (Elliptical Amp-ND)	4.11	0.004
(Elliptical Con-ND) - (Elliptical Con-Dom)	0.02	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	4.11	0.004
(Gait Amp-ND) - (Elliptical Con-Dom)	3.12	0.091
(Gait Con-Dom) - (Elliptical Con-Dom)	3.26	0.062
(Gait Con-ND) - (Elliptical Con-Dom)	3.93	0.008
(Gait Amp-Dom) - (Elliptical Con-ND)	4.09	0.005
(Gait Amp-ND) - (Elliptical Con-ND)	3.10	0.096
(Gait Con-Dom) - (Elliptical Con-ND)	3.24	0.066
(Gait Con-ND) - (Elliptical Con-ND)	3.91	0.009
(Gait Amp-ND) - (Gait Amp-Dom)	-0.99	0.998
(Gait Con-Dom) - (Gait Amp-Dom)	-0.84	0.999
(Gait Con-ND) - (Gait Amp-Dom)	-0.18	1.000
(Gait Con-Dom) - (Gait Amp-ND)	0.14	1.000
(Gait Con-ND) - (Gait Amp-ND)	0.81	1.000
(Gait Con-ND) - (Gait Con-Dom)	0.66	1.000

Figure F.58: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for maximum vertical reaction force time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MinVRF versus Exercise Type, Subject Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	0.352763	0.176382	136.17	0.000
Subject	3	0.003947	0.001316	1.02	0.389
Exercise Type*Subject	6	0.014332	0.002389	1.84	0.097
Error	108	0.139895	0.001295		
Total	119	0.510938			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.61	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.02	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.15	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	5.82	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	3.12	0.091
(Elliptical Con-Dom) - (Cycling Amp-Dom)	6.20	0.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	6.29	0.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	2.80	0.197
(Gait Amp-ND) - (Cycling Amp-Dom)	-2.80	0.197
(Gait Con-Dom) - (Cycling Amp-Dom)	-2.80	0.197
(Gait Con-ND) - (Cycling Amp-Dom)	-2.80	0.197
(Cycling Con-Dom) - (Cycling Amp-ND)	-0.63	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	0.46	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	5.21	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	2.51	0.346
(Elliptical Con-Dom) - (Cycling Amp-ND)	5.59	0.000
(Elliptical Con-ND) - (Cycling Amp-ND)	5.68	0.000
(Gait Amp-Dom) - (Cycling Amp-ND)	-3.41	0.041
(Gait Amp-ND) - (Cycling Amp-ND)	-3.41	0.041
(Gait Con-Dom) - (Cycling Amp-ND)	-3.41	0.041
(Gait Con-ND) - (Cycling Amp-ND)	-3.41	0.041
(Cycling Con-Dom) - (Cycling Con-Dom)	0.17	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	5.84	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	3.14	0.086

(Elliptical Con-Dom) - (Cycling Con-Dom)	6.22	0.000
(Elliptical Con-ND) - (Cycling Con-Dom)	6.31	0.000
(Gait Amp-Dom) - (Cycling Con-Dom)	-2.78	0.205
(Gait Amp-ND) - (Cycling Con-Dom)	-2.78	0.205
(Gait Con-Dom) - (Cycling Con-Dom)	-2.78	0.205
(Gait Con-ND) - (Cycling Con-Dom)	-2.78	0.205
(Elliptical Amp-Dom) - (Cycling Con-ND)	5.66	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	2.97	0.133
(Elliptical Con-Dom) - (Cycling Con-ND)	6.05	0.000
(Elliptical Con-ND) - (Cycling Con-ND)	6.14	0.000
(Gait Amp-Dom) - (Cycling Con-ND)	-2.95	0.139
(Gait Amp-ND) - (Cycling Con-ND)	-2.95	0.139
(Gait Con-Dom) - (Cycling Con-ND)	-2.95	0.139
(Gait Con-ND) - (Cycling Con-ND)	-2.95	0.139
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	2.70	0.243
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	0.35	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.47	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	-8.61	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	-8.61	0.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	-8.61	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	-8.61	0.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	3.08	0.100
(Elliptical Con-ND) - (Elliptical Amp-ND)	3.17	0.080
(Gait Amp-Dom) - (Elliptical Amp-ND)	-5.92	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	-5.92	0.000
(Gait Con-Dom) - (Elliptical Amp-ND)	-5.92	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	-5.92	0.000
(Elliptical Con-Dom) - (Elliptical Con-Dom)	0.00	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	-9.00	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	-9.00	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	-9.00	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	-9.00	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	-9.08	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	-9.08	0.000
(Gait Con-Dom) - (Elliptical Con-ND)	-9.08	0.000
(Gait Con-ND) - (Elliptical Con-ND)	-9.08	0.000
(Gait Amp-Dom) - (Gait Amp-Dom)	0.00	1.000
(Gait Amp-ND) - (Gait Amp-Dom)	0.00	1.000
(Gait Con-Dom) - (Gait Amp-Dom)	0.00	1.000
(Gait Con-ND) - (Gait Amp-Dom)	0.00	1.000
(Gait Amp-Dom) - (Gait Amp-ND)	0.00	1.000
(Gait Amp-ND) - (Gait Amp-ND)	0.00	1.000
(Gait Con-Dom) - (Gait Amp-ND)	0.00	1.000
(Gait Con-ND) - (Gait Amp-ND)	0.00	1.000

Figure F.59: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test minimum vertical reaction force between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject
Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	23030	11515.0	19.32	0.000
Subject	3	2214	738.0	1.24	0.299
Exercise Type*Subject	6	4944	824.0	1.38	0.228
Error	108	64362	595.9		
Total	119	94550			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
Cycling Amp-ND - (Cycling Amp-Dom)	1.000
Cycling Con-Dom - (Cycling Amp-Dom)	0.999
(Cycling Con-ND) - (Cycling Amp-Dom)	0.313
Elliptical Amp-Dom - (Cycling Amp-Dom)	0.664
(Elliptical Amp-ND) - (Cycling Amp-Dom)	0.736
(Elliptical Con-Dom) - (Cycling Amp-Dom)	0.695
(Elliptical Con-ND) - (Cycling Amp-Dom)	0.670
Gait Amp-Dom - (Cycling Amp-Dom)	0.580
(Gait Amp-ND) - (Cycling Amp-Dom)	0.781
(Gait Con-Dom) - (Cycling Amp-Dom)	0.707
(Gait Con-ND) - (Cycling Amp-Dom)	0.682
(Cycling Con-Dom) - (Cycling Amp-ND)	0.911
Cycling Con-ND - (Cycling Amp-ND)	0.063
(Elliptical Amp-Dom) - (Cycling Amp-ND)	0.971
Elliptical Amp-ND - (Cycling Amp-ND)	0.984
(Elliptical Con-Dom) - (Cycling Amp-ND)	0.977
(Elliptical Con-ND) - (Cycling Amp-ND)	0.972
(Gait Amp-Dom) - (Cycling Amp-ND)	0.947
Gait Amp-ND - (Cycling Amp-ND)	0.991
(Gait Con-Dom) - (Cycling Amp-ND)	0.980
(Gait Con-ND) - (Cycling Amp-ND)	0.975
Cycling Con-ND - (Cycling Con-Dom)	0.874
(Elliptical Amp-Dom) - (Cycling Con-Dom)	0.145
(Elliptical Amp-ND) - (Cycling Con-Dom)	0.186

Elliptical Con-Dom - (Cycling Con-Dom)	0.161
(Elliptical Con-ND) - (Cycling Con-Dom)	0.148
(Gait Amp-Dom) - (Cycling Con-Dom)	0.109
(Gait Amp-ND) - (Cycling Con-Dom)	0.218
Gait Con-Dom - (Cycling Con-Dom)	0.168
(Gait Con-ND) - (Cycling Con-Dom)	0.155
(Elliptical Amp-Dom) - (Cycling Con-ND)	0.001
(Elliptical Amp-ND) - (Cycling Con-ND)	0.001
(Elliptical Con-Dom) - (Cycling Con-ND)	0.001
Elliptical Con-ND - (Cycling Con-ND)	0.001
(Gait Amp-Dom) - (Cycling Con-ND)	0.000
(Gait Amp-ND) - (Cycling Con-ND)	0.001
(Gait Con-Dom) - (Cycling Con-ND)	0.001
Gait Con-ND - (Cycling Con-ND)	0.001
Elliptical Amp-ND - (Elliptical Amp-Dom)	1.000
Elliptical Con-Dom - (Elliptical Amp-Dom)	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	1.000
Gait Amp-Dom - (Elliptical Amp-Dom)	1.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	1.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	1.000
(Gait Con-ND) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	1.000
Elliptical Con-ND - (Elliptical Amp-ND)	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	1.000
Gait Amp-ND - (Elliptical Amp-ND)	1.000
(Gait Con-Dom) - (Elliptical Amp-ND)	1.000
(Gait Con-ND) - (Elliptical Amp-ND)	1.000
Elliptical Con-ND - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	1.000
(Gait Amp-ND) - (Elliptical Con-Dom)	1.000
Gait Con-Dom - (Elliptical Con-Dom)	1.000
(Gait Con-ND) - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-ND)	1.000
(Gait Amp-ND) - (Elliptical Con-ND)	1.000
(Gait Con-Dom) - (Elliptical Con-ND)	1.000
Gait Con-ND - (Elliptical Con-ND)	1.000
Gait Amp-ND - (Gait Amp-Dom)	1.000
Gait Con-Dom - (Gait Amp-Dom)	1.000
(Gait Con-ND) - (Gait Amp-Dom)	1.000
(Gait Con-Dom) - (Gait Amp-ND)	1.000
Gait Con-ND - (Gait Amp-ND)	1.000
Gait Con-ND - (Gait Con-Dom)	1.000

Figure F.60: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for minimum vertical reaction force time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MaxAPRF versus Exercise Type, Subject Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	1.06522	0.532610	1340.55	0.000
Subject	3	0.02373	0.007910	19.91	0.000
Exercise Type*Subject	6	0.02556	0.004260	10.72	0.000
Error	108	0.04291	0.000397		
Total	119	1.15742			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.92	0.999
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.58	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	-0.21	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	5.50	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	4.75	0.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	6.63	0.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	6.19	0.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	26.72	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	17.77	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	26.87	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	26.41	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	0.34	1.000
(Cycling Con-ND) - (Cycling Amp-ND)	0.71	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	6.42	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	5.66	0.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	7.55	0.000
(Elliptical Con-ND) - (Cycling Amp-ND)	7.11	0.000
(Gait Amp-Dom) - (Cycling Amp-ND)	27.63	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	18.68	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	27.79	0.000
(Gait Con-ND) - (Cycling Amp-ND)	27.32	0.000
(Cycling Con-ND) - (Cycling Con-Dom)	0.37	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	6.08	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	5.32	0.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	7.21	0.000
(Elliptical Con-ND) - (Cycling Con-Dom)	6.77	0.000
(Gait Amp-Dom) - (Cycling Con-Dom)	27.30	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	18.34	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	27.45	0.000
(Gait Con-ND) - (Cycling Con-Dom)	26.99	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	5.71	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	4.96	0.000
(Elliptical Con-Dom) - (Cycling Con-ND)	6.84	0.000
(Elliptical Con-ND) - (Cycling Con-ND)	6.40	0.000
(Gait Amp-Dom) - (Cycling Con-ND)	26.93	0.000
(Gait Amp-ND) - (Cycling Con-ND)	17.98	0.000
(Gait Con-Dom) - (Cycling Con-ND)	27.08	0.000
(Gait Con-ND) - (Cycling Con-ND)	26.62	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	0.75	1.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	1.13	0.999
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.69	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	21.22	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	12.26	0.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	21.37	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	20.91	0.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	1.88	0.767
(Elliptical Con-ND) - (Elliptical Amp-ND)	1.44	0.952
(Gait Amp-Dom) - (Elliptical Amp-ND)	21.97	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	13.02	0.000
(Gait Con-Dom) - (Elliptical Amp-ND)	22.12	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	21.66	0.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	0.44	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	20.09	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	11.14	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	20.24	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	19.78	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	20.53	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	11.58	0.000
(Gait Con-Dom) - (Elliptical Con-ND)	20.68	0.000
(Gait Con-ND) - (Elliptical Con-ND)	20.22	0.000
(Gait Amp-ND) - (Gait Amp-Dom)	-8.95	0.000
(Gait Con-Dom) - (Gait Amp-Dom)	0.15	1.000
(Gait Con-ND) - (Gait Amp-Dom)	-0.31	1.000
(Gait Con-Dom) - (Gait Amp-ND)	9.10	0.000
(Gait Con-ND) - (Gait Amp-ND)	8.64	0.000
(Gait Con-ND) - (Gait Con-Dom)	0.46	1.000

Figure F.61: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test maximum anterior reaction force between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject
Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	5624.7	2812.36	14.40	0.000
Subject	3	494.0	164.66	0.84	0.473
Exercise Type*Subject	6	351.9	58.65	0.30	0.935
Error	108	21087.4	195.25		
Total	119	27558.0			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.996
(Cycling Con-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	0.202
(Elliptical Amp-ND) - (Cycling Amp-Dom)	0.880
(Elliptical Con-Dom) - (Cycling Amp-Dom)	0.125
(Elliptical Con-ND) - (Cycling Amp-Dom)	0.514
(Gait Amp-Dom) - (Cycling Amp-Dom)	1.000
(Gait Amp-ND) - (Cycling Amp-Dom)	1.000
(Gait Con-Dom) - (Cycling Amp-Dom)	1.000
(Gait Con-ND) - (Cycling Amp-Dom)	1.000
(Cycling Con-Dom) - (Cycling Amp-ND)	0.995
(Cycling Con-ND) - (Cycling Amp-ND)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	0.195
(Elliptical Amp-ND) - (Cycling Amp-ND)	0.873
(Elliptical Con-Dom) - (Cycling Amp-ND)	0.120
(Elliptical Con-ND) - (Cycling Amp-ND)	0.502
(Gait Amp-Dom) - (Cycling Amp-ND)	1.000
(Gait Amp-ND) - (Cycling Amp-ND)	1.000
(Gait Con-Dom) - (Cycling Amp-ND)	1.000
(Gait Con-ND) - (Cycling Amp-ND)	1.000
(Cycling Con-ND) - (Cycling Con-Dom)	0.966
(Elliptical Amp-Dom) - (Cycling Con-Dom)	0.851
(Elliptical Amp-ND) - (Cycling Con-Dom)	1.000

(Elliptical Con-Dom) - (Cycling Con-Dom) 0.734

(Elliptical Con-ND) - (Cycling Con-Dom) 0.988

(Gait Amp-Dom) - (Cycling Con-Dom) 0.995

(Gait Amp-ND) - (Cycling Con-Dom) 0.994

(Gait Con-Dom) - (Cycling Con-Dom) 0.998

(Gait Con-ND) - (Cycling Con-Dom) 0.998

(Elliptical Amp-Dom) - (Cycling Con-ND) 0.095

(Elliptical Amp-ND) - (Cycling Con-ND) 0.703

(Elliptical Con-Dom) - (Cycling Con-ND) 0.054

(Elliptical Con-ND) - (Cycling Con-ND) 0.306

(Gait Amp-Dom) - (Cycling Con-ND) 1.000

(Gait Amp-ND) - (Cycling Con-ND) 1.000

(Gait Con-Dom) - (Cycling Con-ND) 1.000

(Gait Con-ND) - (Cycling Con-ND) 1.000

(Elliptical Amp-ND) - (Elliptical Amp-Dom) 0.992

(Elliptical Con-Dom) - (Elliptical Amp-Dom) 1.000

(Elliptical Con-ND) - (Elliptical Amp-Dom) 1.000

(Gait Amp-Dom) - (Elliptical Amp-Dom) 0.188

(Gait Amp-ND) - (Elliptical Amp-Dom) 0.182

(Gait Con-Dom) - (Elliptical Amp-Dom) 0.255

(Gait Con-ND) - (Elliptical Amp-Dom) 0.239

(Elliptical Con-Dom) - (Elliptical Amp-ND) 0.974

(Elliptical Con-ND) - (Elliptical Amp-ND) 1.000

(Gait Amp-Dom) - (Elliptical Amp-ND) 0.866

(Gait Amp-ND) - (Elliptical Amp-ND) 0.859

(Gait Con-Dom) - (Elliptical Amp-ND) 0.922

(Gait Con-ND) - (Elliptical Amp-ND) 0.911

(Elliptical Con-ND) - (Elliptical Con-Dom) 1.000

(Gait Amp-Dom) - (Elliptical Con-Dom) 0.116

(Gait Amp-ND) - (Elliptical Con-Dom) 0.111

(Gait Con-Dom) - (Elliptical Con-Dom) 0.163

(Gait Con-ND) - (Elliptical Con-Dom) 0.151

(Gait Amp-Dom) - (Elliptical Con-ND) 0.491

(Gait Amp-ND) - (Elliptical Con-ND) 0.480

(Gait Con-Dom) - (Elliptical Con-ND) 0.593

(Gait Con-ND) - (Elliptical Con-ND) 0.570

(Gait Amp-ND) - (Gait Amp-Dom) 1.000

(Gait Con-Dom) - (Gait Amp-Dom) 1.000

(Gait Con-ND) - (Gait Amp-Dom) 1.000

(Gait Con-ND) - (Gait Amp-ND) 1.000

(Gait Con-ND) - (Gait Con-Dom) 1.000

Figure F.62: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for maximum anterior reaction force time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MinAPRF versus Exercise Type, Subject
Method

Factor coding (-1, 0, +1)
Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	0.30618	0.153088	177.83	0.000
Subject	3	0.01611	0.005369	6.24	0.001
Exercise Type*Subject	6	0.01273	0.002122	2.46	0.028
Error	108	0.09297	0.000861		
Total	119	0.42799			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.82	1.000
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.28	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.76	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	-3.53	0.029
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-1.68	0.873
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-2.52	0.342
(Elliptical Con-ND) - (Cycling Amp-Dom)	-2.45	0.385
(Gait Amp-Dom) - (Cycling Amp-Dom)	-9.10	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	-5.77	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	-10.64	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	-10.04	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	-1.09	0.994
(Cycling Con-ND) - (Cycling Amp-ND)	0.06	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-4.35	0.002
(Elliptical Amp-ND) - (Cycling Amp-ND)	-2.50	0.353
(Elliptical Con-Dom) - (Cycling Amp-ND)	-3.33	0.051
(Elliptical Con-ND) - (Cycling Amp-ND)	-3.26	0.062
(Gait Amp-Dom) - (Cycling Amp-ND)	-9.92	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	-6.59	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	-11.45	0.000
(Gait Con-ND) - (Cycling Amp-ND)	-10.86	0.000
(Cycling Con-ND) - (Cycling Con-Dom)	1.04	0.996
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-3.25	0.064
(Elliptical Amp-ND) - (Cycling Con-Dom)	-1.40	0.960

(Elliptical Con-Dom) - (Cycling Con-Dom)	-2.24	0.525
(Elliptical Con-ND) - (Cycling Con-Dom)	-2.17	0.574
(Gait Amp-Dom) - (Cycling Con-Dom)	-8.82	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	-5.50	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	-10.36	0.000
(Gait Con-ND) - (Cycling Con-Dom)	-9.77	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	-4.29	0.002
(Elliptical Amp-ND) - (Cycling Con-ND)	-2.44	0.388
(Elliptical Con-Dom) - (Cycling Con-ND)	-3.28	0.060
(Elliptical Con-ND) - (Cycling Con-ND)	-3.21	0.072
(Gait Amp-Dom) - (Cycling Con-ND)	-9.86	0.000
(Gait Amp-ND) - (Cycling Con-ND)	-6.54	0.000
(Gait Con-Dom) - (Cycling Con-ND)	-11.40	0.000
(Gait Con-ND) - (Cycling Con-ND)	-10.80	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	1.85	0.787
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	1.01	0.997
(Elliptical Con-ND) - (Elliptical Amp-Dom)	1.08	0.995
(Gait Amp-Dom) - (Elliptical Amp-Dom)	-5.57	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	-2.25	0.521
(Gait Con-Dom) - (Elliptical Amp-Dom)	-7.11	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	-6.51	0.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	-0.84	0.999
(Elliptical Con-ND) - (Elliptical Amp-ND)	-0.77	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	-7.42	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	-4.09	0.005
(Gait Con-Dom) - (Elliptical Amp-ND)	-8.96	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	-8.36	0.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	0.07	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	-6.58	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	-3.26	0.063
(Gait Con-Dom) - (Elliptical Con-Dom)	-8.12	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	-7.53	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	-6.65	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	-3.33	0.052
(Gait Con-Dom) - (Elliptical Con-ND)	-8.19	0.000
(Gait Con-ND) - (Elliptical Con-ND)	-7.60	0.000
(Gait Amp-ND) - (Gait Amp-Dom)	3.32	0.052
(Gait Con-Dom) - (Gait Amp-Dom)	-1.54	0.927
(Gait Con-ND) - (Gait Amp-Dom)	-0.94	0.998
(Gait Con-Dom) - (Gait Amp-ND)	-4.86	0.000
(Gait Con-ND) - (Gait Amp-ND)	-4.27	0.002
(Gait Con-ND) - (Gait Con-Dom)	0.59	1.000

Figure F.63: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test minimum anterior reaction force between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	118819	59409.7	257.23	0.000
Subject	3	4177	1392.3	6.03	0.001
Exercise Type*Subject	6	3531	588.6	2.55	0.024
Error	108	24944	231.0		
Total	119	151471			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	3.85	0.010
(Cycling Con-Dom) - (Cycling Amp-Dom)	9.01	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.03	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	7.15	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	10.18	0.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	9.76	0.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	9.50	0.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	-1.82	0.801
(Gait Amp-ND) - (Cycling Amp-Dom)	-1.52	0.933
(Gait Con-Dom) - (Cycling Amp-Dom)	-1.80	0.817
(Gait Con-ND) - (Cycling Amp-Dom)	-1.85	0.784
(Cycling Con-Dom) - (Cycling Amp-ND)	-3.84	0.011
(Cycling Con-ND) - (Cycling Amp-ND)	-3.83	0.011
(Elliptical Amp-Dom) - (Cycling Amp-ND)	3.30	0.057
(Elliptical Amp-ND) - (Cycling Amp-ND)	6.33	0.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	5.90	0.000
(Elliptical Con-ND) - (Cycling Amp-ND)	5.65	0.000
(Gait Amp-Dom) - (Cycling Amp-ND)	-5.68	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	-5.37	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	-5.65	0.000
(Gait Con-ND) - (Cycling Amp-ND)	-5.71	0.000
(Cycling Con-ND) - (Cycling Con-Dom)	9.01	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	7.14	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	10.17	0.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	9.74	0.000
(Elliptical Con-ND) - (Cycling Con-Dom)	9.49	0.000
(Gait Amp-Dom) - (Cycling Con-Dom)	-1.84	0.793
(Gait Amp-ND) - (Cycling Con-Dom)	-1.53	0.929
(Gait Con-Dom) - (Cycling Con-Dom)	-1.81	0.809
(Gait Con-ND) - (Cycling Con-Dom)	-1.87	0.776
(Elliptical Amp-Dom) - (Cycling Con-ND)	7.12	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	10.15	0.000
(Elliptical Con-Dom) - (Cycling Con-ND)	9.73	0.000
(Elliptical Con-ND) - (Cycling Con-ND)	9.48	0.000
(Gait Amp-Dom) - (Cycling Con-ND)	-1.85	0.784
(Gait Amp-ND) - (Cycling Con-ND)	-1.54	0.924
(Gait Con-Dom) - (Cycling Con-ND)	-1.82	0.801
(Gait Con-ND) - (Cycling Con-ND)	-1.88	0.767
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	3.02	0.114
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	2.60	0.291
(Elliptical Con-ND) - (Elliptical Amp-Dom)	2.35	0.446
(Gait Amp-Dom) - (Elliptical Amp-Dom)	-8.98	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	-8.67	0.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	-8.95	0.000
(Gait Con-ND) - (Elliptical Amp-Dom)	-9.00	0.000
(Elliptical Con-Dom) - (Elliptical Amp-ND)	-0.43	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	-0.68	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	-12.01	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	-11.70	0.000
(Gait Con-Dom) - (Elliptical Amp-ND)	-11.98	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	-12.04	0.000
(Elliptical Con-ND) - (Elliptical Con-Dom)	-0.25	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	-11.58	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	-11.27	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	-11.55	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	-11.61	0.000
(Gait Amp-Dom) - (Elliptical Con-ND)	-11.33	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	-11.02	0.000
(Gait Con-Dom) - (Elliptical Con-ND)	-11.30	0.000
(Gait Con-ND) - (Elliptical Con-ND)	-11.36	0.000
(Gait Amp-ND) - (Gait Amp-Dom)	9.31	1.000
(Gait Con-Dom) - (Gait Amp-Dom)	9.03	1.000
(Gait Con-ND) - (Gait Amp-Dom)	-0.03	1.000
(Gait Con-Dom) - (Gait Amp-ND)	-0.28	1.000
(Gait Con-ND) - (Gait Amp-ND)	-0.34	1.000
(Gait Con-ND) - (Gait Con-Dom)	-0.06	1.000

Figure F.64: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for minimum anterior reaction force time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

Linear Model: MaxLMRF versus Exercise Type, Subject Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	0.013019	0.006509	84.92	0.000
Subject	3	0.001774	0.000591	7.72	0.000
Exercise Type*Subject	6	0.000758	0.000126	1.65	0.141
Error	108	0.008278	0.000077		
Total	119	0.023829			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	-1.05	0.996
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.29	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	-0.50	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	0.20	1.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-2.32	0.468
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-1.06	0.996
(Elliptical Con-ND) - (Cycling Amp-Dom)	-1.61	0.900
(Gait Amp-Dom) - (Cycling Amp-Dom)	7.72	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	3.79	0.013
(Gait Con-Dom) - (Cycling Amp-Dom)	4.60	0.001
(Gait Con-ND) - (Cycling Amp-Dom)	3.23	0.069
(Cycling Con-Dom) - (Cycling Amp-ND)	1.34	0.972
(Cycling Con-ND) - (Cycling Amp-ND)	0.54	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	1.24	0.984
(Elliptical Amp-ND) - (Cycling Amp-ND)	-1.28	0.980
(Elliptical Con-Dom) - (Cycling Amp-ND)	-0.02	1.000
(Elliptical Con-ND) - (Cycling Amp-ND)	-0.57	1.000
(Gait Amp-Dom) - (Cycling Amp-ND)	8.77	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	4.83	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	5.64	0.000
(Gait Con-ND) - (Cycling Amp-ND)	4.27	0.002
(Cycling Con-Dom) - (Cycling Con-Dom)	0.79	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-0.09	1.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	-2.61	0.286

(Elliptical Con-Dom) - (Cycling Con-Dom)	-1.36	0.969
(Elliptical Con-ND) - (Cycling Con-Dom)	-1.91	0.753
(Gait Amp-Dom) - (Cycling Con-Dom)	7.43	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	3.50	0.032
(Gait Con-Dom) - (Cycling Con-Dom)	4.31	0.002
(Gait Con-ND) - (Cycling Con-Dom)	2.93	0.144
(Elliptical Amp-Dom) - (Cycling Con-ND)	0.70	1.000
(Elliptical Amp-ND) - (Cycling Con-ND)	-1.82	0.804
(Elliptical Con-Dom) - (Cycling Con-ND)	-0.56	1.000
(Elliptical Con-ND) - (Cycling Con-ND)	-1.11	0.994
(Gait Amp-Dom) - (Cycling Con-ND)	8.23	0.000
(Gait Amp-ND) - (Cycling Con-ND)	4.29	0.002
(Gait Con-Dom) - (Cycling Con-ND)	5.10	0.000
(Gait Con-ND) - (Cycling Con-ND)	3.73	0.015
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	-2.52	0.339
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	-1.26	0.982
(Elliptical Con-ND) - (Elliptical Amp-Dom)	-1.81	0.807
(Gait Amp-Dom) - (Elliptical Amp-Dom)	7.52	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	3.59	0.024
(Gait Con-Dom) - (Elliptical Amp-Dom)	4.40	0.002
(Gait Con-ND) - (Elliptical Amp-Dom)	3.03	0.115
(Elliptical Con-Dom) - (Elliptical Amp-ND)	1.26	0.982
(Elliptical Con-ND) - (Elliptical Amp-ND)	0.71	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	10.04	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	6.11	0.000
(Gait Con-Dom) - (Elliptical Amp-ND)	6.92	0.000
(Gait Con-ND) - (Elliptical Amp-ND)	5.55	0.000
(Elliptical Con-Dom) - (Elliptical Con-Dom)	-0.55	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	8.79	0.000
(Gait Amp-ND) - (Elliptical Con-Dom)	4.85	0.000
(Gait Con-Dom) - (Elliptical Con-Dom)	5.66	0.000
(Gait Con-ND) - (Elliptical Con-Dom)	4.29	0.002
(Gait Amp-Dom) - (Elliptical Con-ND)	9.34	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	5.40	0.000
(Gait Con-Dom) - (Elliptical Con-ND)	6.21	0.000
(Gait Con-ND) - (Elliptical Con-ND)	4.84	0.000
(Gait Amp-ND) - (Gait Amp-Dom)	-3.93	0.008
(Gait Con-Dom) - (Gait Amp-Dom)	-3.12	0.096
(Gait Con-ND) - (Gait Amp-Dom)	-4.50	0.001
(Gait Con-Dom) - (Gait Amp-ND)	0.81	1.000
(Gait Con-ND) - (Gait Amp-ND)	-0.56	1.000
(Gait Con-Dom) - (Gait Con-Dom)	-1.37	0.966

Figure F.65: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test maximum lateral reaction force between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject
Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	42320	21159.9	28.94	0.000
Subject	3	921	306.9	0.42	0.739
Exercise Type*Subject	6	10349	1724.8	2.36	0.035
Error	108	78970	731.2		
Total	119	132559			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.855
(Cycling Con-Dom) - (Cycling Amp-Dom)	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.484
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	1.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	0.999
(Elliptical Con-ND) - (Cycling Amp-Dom)	1.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	0.363
(Gait Con-Dom) - (Cycling Amp-Dom)	0.001
(Gait Con-ND) - (Cycling Amp-Dom)	0.004
(Cycling Con-Dom) - (Cycling Amp-ND)	0.997
(Cycling Con-ND) - (Cycling Amp-ND)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-ND)	0.978
(Elliptical Amp-ND) - (Cycling Amp-ND)	0.993
(Elliptical Con-Dom) - (Cycling Amp-ND)	0.999
(Elliptical Con-ND) - (Cycling Amp-ND)	0.953
(Gait Amp-Dom) - (Cycling Amp-ND)	0.021
(Gait Amp-ND) - (Cycling Amp-ND)	1.000
(Gait Con-Dom) - (Cycling Amp-ND)	0.215
(Gait Con-ND) - (Cycling Amp-ND)	0.411
(Cycling Con-ND) - (Cycling Con-Dom)	0.907
(Elliptical Amp-Dom) - (Cycling Con-Dom)	1.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	1.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	1.000
(Elliptical Con-ND) - (Cycling Con-Dom)	1.000
(Gait Amp-Dom) - (Cycling Con-Dom)	0.001
(Gait Amp-ND) - (Cycling Con-Dom)	0.826
(Gait Con-Dom) - (Cycling Con-Dom)	0.013
(Gait Con-ND) - (Cycling Con-Dom)	0.039
(Elliptical Amp-Dom) - (Cycling Con-ND)	0.770
(Elliptical Amp-ND) - (Cycling Con-ND)	0.863
(Elliptical Con-Dom) - (Cycling Con-ND)	0.957
(Elliptical Con-ND) - (Cycling Con-ND)	0.681
(Gait Amp-Dom) - (Cycling Con-ND)	0.106
(Gait Amp-ND) - (Cycling Con-ND)	1.000
(Gait Con-Dom) - (Cycling Con-ND)	0.571
(Gait Con-ND) - (Cycling Con-ND)	0.799
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Amp-Dom)	0.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	0.652
(Gait Con-Dom) - (Elliptical Amp-Dom)	0.005
(Gait Con-ND) - (Elliptical Amp-Dom)	0.017
(Elliptical Con-Dom) - (Elliptical Amp-ND)	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	0.000
(Gait Amp-ND) - (Elliptical Amp-ND)	0.765
(Gait Con-Dom) - (Elliptical Amp-ND)	0.009
(Gait Con-ND) - (Elliptical Amp-ND)	0.029
(Elliptical Con-ND) - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	0.001
(Gait Amp-ND) - (Elliptical Con-Dom)	0.904
(Gait Con-Dom) - (Elliptical Con-Dom)	0.023
(Gait Con-ND) - (Elliptical Con-Dom)	0.064
(Gait Amp-Dom) - (Elliptical Con-ND)	0.000
(Gait Amp-ND) - (Elliptical Con-ND)	0.554
(Gait Con-Dom) - (Elliptical Con-ND)	0.003
(Gait Con-ND) - (Elliptical Con-ND)	0.011
(Gait Amp-ND) - (Gait Amp-Dom)	0.164
(Gait Con-Dom) - (Gait Amp-Dom)	0.999
(Gait Con-ND) - (Gait Amp-Dom)	0.985
(Gait Con-Dom) - (Gait Amp-ND)	0.697
(Gait Con-ND) - (Gait Amp-ND)	0.888
(Gait Con-ND) - (Gait Con-Dom)	1.000

Figure F.66: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for maximum lateral reaction force time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: MinLMRF versus Exercise Type, Subject Method

Factor coding (-1, 0, +1)
Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	0.053043	0.026521	128.59	0.000
Subject	3	0.001485	0.000495	2.40	0.072
Exercise Type*Subject	6	0.001434	0.000239	1.16	0.334
Error	108	0.022275	0.000206		
Total	119	0.078237			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	T-Value	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	1.82	0.803
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.56	1.000
(Cycling Con-ND) - (Cycling Amp-Dom)	0.27	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	-7.02	0.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	-7.05	0.000
(Elliptical Con-Dom) - (Cycling Amp-Dom)	-7.00	0.000
(Elliptical Con-ND) - (Cycling Amp-Dom)	-5.26	0.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	-7.12	0.000
(Gait Amp-ND) - (Cycling Amp-Dom)	-4.89	0.000
(Gait Con-Dom) - (Cycling Amp-Dom)	-6.26	0.000
(Gait Con-ND) - (Cycling Amp-Dom)	-5.48	0.000
(Cycling Con-Dom) - (Cycling Amp-ND)	-1.26	0.982
(Cycling Con-ND) - (Cycling Amp-ND)	1.55	0.921
(Elliptical Amp-Dom) - (Cycling Amp-ND)	-8.84	0.000
(Elliptical Amp-ND) - (Cycling Amp-ND)	-8.87	0.000
(Elliptical Con-Dom) - (Cycling Amp-ND)	-8.82	0.000
(Elliptical Con-ND) - (Cycling Amp-ND)	-7.08	0.000
(Gait Amp-Dom) - (Cycling Amp-ND)	-8.94	0.000
(Gait Amp-ND) - (Cycling Amp-ND)	-6.71	0.000
(Gait Con-Dom) - (Cycling Amp-ND)	-8.08	0.000
(Gait Con-ND) - (Cycling Amp-ND)	-7.30	0.000
(Cycling Con-ND) - (Cycling Con-Dom)	0.29	1.000
(Elliptical Amp-Dom) - (Cycling Con-Dom)	-7.57	0.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	-7.61	0.000

(Elliptical Con-Dom) - (Cycling Con-Dom)	-7.56	0.000
(Elliptical Con-ND) - (Cycling Con-Dom)	-5.82	0.000
(Gait Amp-Dom) - (Cycling Con-Dom)	-7.68	0.000
(Gait Amp-ND) - (Cycling Con-Dom)	-5.45	0.000
(Gait Con-Dom) - (Cycling Con-Dom)	-6.82	0.000
(Gait Con-ND) - (Cycling Con-Dom)	-6.04	0.000
(Elliptical Amp-Dom) - (Cycling Con-ND)	-7.28	0.000
(Elliptical Amp-ND) - (Cycling Con-ND)	-7.32	0.000
(Elliptical Con-Dom) - (Cycling Con-ND)	-7.27	0.000
(Elliptical Con-ND) - (Cycling Con-ND)	-5.53	0.000
(Gait Amp-Dom) - (Cycling Con-ND)	-7.38	0.000
(Gait Amp-ND) - (Cycling Con-ND)	-5.16	0.000
(Gait Con-Dom) - (Cycling Con-ND)	-6.52	0.000
(Gait Con-ND) - (Cycling Con-ND)	-5.75	0.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	-0.04	1.000
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	0.02	1.000
(Elliptical Con-ND) - (Elliptical Amp-Dom)	1.76	0.837
(Gait Amp-Dom) - (Elliptical Amp-Dom)	-0.10	1.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	2.12	0.607
(Gait Con-Dom) - (Elliptical Amp-Dom)	0.76	1.000
(Gait Con-ND) - (Elliptical Amp-Dom)	1.53	0.928
(Elliptical Con-Dom) - (Elliptical Amp-ND)	0.05	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	1.79	0.818
(Gait Amp-Dom) - (Elliptical Amp-ND)	-0.06	1.000
(Gait Amp-ND) - (Elliptical Amp-ND)	2.16	0.581
(Gait Con-Dom) - (Elliptical Amp-ND)	0.80	1.000
(Gait Con-ND) - (Elliptical Amp-ND)	1.57	0.916
(Elliptical Con-ND) - (Elliptical Con-Dom)	1.74	0.845
(Gait Amp-Dom) - (Elliptical Con-Dom)	-0.12	1.000
(Gait Amp-ND) - (Elliptical Con-Dom)	2.11	0.618
(Gait Con-Dom) - (Elliptical Con-Dom)	0.74	1.000
(Gait Con-ND) - (Elliptical Con-Dom)	1.52	0.932
(Gait Amp-Dom) - (Elliptical Con-ND)	-1.86	0.782
(Gait Amp-ND) - (Elliptical Con-ND)	0.37	1.000
(Gait Con-Dom) - (Elliptical Con-ND)	-1.00	0.997
(Gait Con-ND) - (Elliptical Con-ND)	-0.22	1.000
(Gait Amp-ND) - (Gait Amp-Dom)	2.22	0.536
(Gait Con-Dom) - (Gait Amp-Dom)	0.86	0.999
(Gait Con-ND) - (Gait Amp-Dom)	1.63	0.892
(Gait Con-Dom) - (Gait Amp-ND)	-1.36	0.968
(Gait Con-ND) - (Gait Amp-ND)	-0.56	1.000
(Gait Con-ND) - (Gait Con-Dom)	0.77	1.000

Figure F.67: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test minimum lateral reaction force between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

General Linear Model: % Cycle versus Exercise Type, Subject
Method

Factor coding (-1, 0, +1)

Factor Information

Factor	Type	Levels	Values
Exercise Type	Fixed	3	Cycling, Elliptical, Gait
Subject	Fixed	4	Amp-Dom, Amp-ND, Con-Dom, Con-ND

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Exercise Type	2	3065.8	1532.9	4.35	0.015
Subject	3	926.0	308.7	0.88	0.456
Exercise Type*Subject	6	3168.1	528.0	1.50	0.185
Error	108	38054.0	352.4		
Total	119	45214.0			

Tukey Simultaneous Tests for Differences of Means

Difference of Exercise Type*Subject Levels	Adjusted P-Value
(Cycling Amp-ND) - (Cycling Amp-Dom)	0.752
(Cycling Con-Dom) - (Cycling Amp-Dom)	0.997
(Cycling Con-ND) - (Cycling Amp-Dom)	1.000
(Elliptical Amp-Dom) - (Cycling Amp-Dom)	1.000
(Elliptical Amp-ND) - (Cycling Amp-Dom)	0.960
(Elliptical Con-Dom) - (Cycling Amp-Dom)	0.997
(Elliptical Con-ND) - (Cycling Amp-Dom)	1.000
(Gait Amp-Dom) - (Cycling Amp-Dom)	0.998
(Gait Amp-ND) - (Cycling Amp-Dom)	1.000
(Gait Con-Dom) - (Cycling Amp-Dom)	1.000
(Gait Con-ND) - (Cycling Amp-Dom)	1.000
(Cycling Con-Dom) - (Cycling Amp-ND)	0.999
(Cycling Con-ND) - (Cycling Amp-ND)	0.802
(Elliptical Amp-Dom) - (Cycling Amp-ND)	0.902
(Elliptical Amp-ND) - (Cycling Amp-ND)	0.054
(Elliptical Con-Dom) - (Cycling Amp-ND)	0.154
(Elliptical Con-ND) - (Cycling Amp-ND)	0.257
(Gait Amp-Dom) - (Cycling Amp-ND)	0.998
(Gait Amp-ND) - (Cycling Amp-ND)	0.692
(Gait Con-Dom) - (Cycling Amp-ND)	0.251
(Gait Con-ND) - (Cycling Amp-ND)	0.343
(Cycling Con-Dom) - (Cycling Con-Dom)	0.999
(Elliptical Amp-Dom) - (Cycling Con-Dom)	1.000
(Elliptical Amp-ND) - (Cycling Con-Dom)	0.411

(Elliptical Con-Dom) - (Cycling Con-Dom)	0.692
(Elliptical Con-ND) - (Cycling Con-Dom)	0.834
(Gait Amp-Dom) - (Cycling Con-Dom)	1.000
(Gait Amp-ND) - (Cycling Con-Dom)	0.994
(Gait Con-Dom) - (Cycling Con-Dom)	0.828
(Gait Con-ND) - (Cycling Con-Dom)	0.902
(Elliptical Amp-Dom) - (Cycling Con-ND)	1.000
(Elliptical Amp-ND) - (Cycling Con-ND)	0.941
(Elliptical Con-Dom) - (Cycling Con-ND)	0.995
(Elliptical Con-ND) - (Cycling Con-ND)	0.999
(Gait Amp-Dom) - (Cycling Con-ND)	0.999
(Gait Amp-ND) - (Cycling Con-ND)	1.000
(Gait Con-Dom) - (Cycling Con-ND)	0.999
(Gait Con-ND) - (Cycling Con-ND)	1.000
(Elliptical Amp-ND) - (Elliptical Amp-Dom)	0.862
(Elliptical Con-Dom) - (Elliptical Amp-Dom)	0.978
(Elliptical Con-ND) - (Elliptical Amp-Dom)	0.996
(Gait Amp-Dom) - (Elliptical Amp-Dom)	1.000
(Gait Amp-ND) - (Elliptical Amp-Dom)	1.000
(Gait Con-Dom) - (Elliptical Amp-Dom)	0.995
(Gait Con-ND) - (Elliptical Amp-Dom)	0.999
(Elliptical Con-Dom) - (Elliptical Amp-ND)	1.000
(Elliptical Con-ND) - (Elliptical Amp-ND)	1.000
(Gait Amp-Dom) - (Elliptical Amp-ND)	0.443
(Gait Amp-ND) - (Elliptical Amp-ND)	0.976
(Gait Con-Dom) - (Elliptical Amp-ND)	1.000
(Gait Con-ND) - (Elliptical Amp-ND)	1.000
(Elliptical Con-Dom) - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-Dom)	0.723
(Gait Amp-ND) - (Elliptical Con-Dom)	0.999
(Gait Con-Dom) - (Elliptical Con-Dom)	1.000
(Gait Con-ND) - (Elliptical Con-Dom)	1.000
(Gait Amp-Dom) - (Elliptical Con-ND)	0.857
(Gait Amp-ND) - (Elliptical Con-ND)	1.000
(Gait Con-Dom) - (Elliptical Con-ND)	1.000
(Gait Con-ND) - (Elliptical Con-ND)	1.000
(Gait Amp-ND) - (Gait Amp-Dom)	0.996
(Gait Con-Dom) - (Gait Amp-Dom)	0.852
(Gait Con-ND) - (Gait Amp-Dom)	0.919
(Gait Con-Dom) - (Gait Amp-ND)	1.000
(Gait Con-ND) - (Gait Amp-ND)	1.000

Figure F.68: Statistical summary of two-factor repeated measures ANOVA and post-hoc Tukey test for minimum lateral reaction force time in percent cycle between gait, cycling, and elliptical for the four participant types (Amp-Dom, Amp-NonDom, Con-Dom, Con-NonDom). Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

F.5: Equal Variance Tests and Two-Sample t-Tests

Test for Equal Variances: Knee FE Peak 1 versus Subject Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Subject	N	StDev	CI
Amp-Dom	10	4.12096	(2.57717, 8.4932)
Amp-ND	10	7.31688	(4.60851, 14.9730)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	2.84	0.092
Levene	3.68	0.071

Two-Sample T-Test and CI: Knee FE Peak 1, Subject Method

μ_1 : mean of Knee FE Peak 1 when Subject = Amp-Dom

μ_2 : mean of Knee FE Peak 1 when Subject = Amp-ND

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: Knee FE Peak 1

Subject	N	Mean	StDev	SE Mean
Amp-Dom	10	17.39	4.12	1.3
Amp-ND	10	10.92	7.32	2.3

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
6.48	5.94	(0.90, 12.05)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
2.44	18	0.025

Test for Equal Variances: Knee FE Peak 2 versus Subject Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Subject	N	StDev	CI
Amp-Dom	10	5.10351	(2.64540, 12.6901)
Amp-ND	10	5.84773	(2.89718, 15.2130)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	0.11	0.735
Levene	0.06	0.808

Two-Sample T-Test and CI: Knee FE Peak 2, Subject Method

μ_1 : mean of Knee FE Peak 2 when Subject = Amp-Dom

μ_2 : mean of Knee FE Peak 2 when Subject = Amp-ND

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: Knee FE Peak 2

Subject	N	Mean	StDev	SE Mean
Amp-Dom	10	54.76	5.10	1.6
Amp-ND	10	64.21	5.85	1.8

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
-9.45	5.49	(-14.60, -4.29)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
-3.85	18	0.001

Figure F.69: Equal variance tests and two-sample t-tests for amputee participant knee flexion angle peaks 1 (left) and 2 (right) in gait across the dominant and non-dominant legs. A Levene's test p-value greater than 0.05 indicates equal variance assumption is valid. Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

Test for Equal Variances: % Cycle Peak 1 versus Subject Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Subject	N	StDev	CI
Amp-Dom	10	1.72884	(1.16708, 3.30085)
Amp-ND	10	2.46982	(1.75623, 4.47677)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	1.93	0.164
Levene	1.92	0.183

Two-Sample T-Test and CI: % Cycle Peak 1, Subject Method

μ_1 : mean of % Cycle Peak 1 when Subject = Amp-Dom

μ_2 : mean of % Cycle Peak 1 when Subject = Amp-ND

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: % Cycle Peak 1

Subject	N	Mean	StDev	SE Mean
Amp-Dom	10	13.10	1.73	0.55
Amp-ND	10	17.90	2.47	0.78

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
-4.800	2.132	(-6.803, -2.797)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
-5.03	18	0.000

Test for Equal Variances: % Cycle Peak 2 versus Subject Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Subject	N	StDev	CI
Amp-Dom	10	1.07497	(0.39223, 3.7972)
Amp-ND	10	3.52924	(1.04131, 15.4170)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	1.86	0.173
Levene	1.70	0.208

Two-Sample T-Test and CI: % Cycle Peak 2, Subject Method

μ_1 : mean of % Cycle Peak 2 when Subject = Amp-Dom

μ_2 : mean of % Cycle Peak 2 when Subject = Amp-ND

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: % Cycle Peak 2

Subject	N	Mean	StDev	SE Mean
Amp-Dom	10	74.40	1.07	0.34
Amp-ND	10	72.30	3.53	1.1

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
2.10	2.61	(-0.35, 4.55)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
1.80	18	0.089

Figure F.70: Equal variance tests and two-sample t-tests for amputee participant knee flexion angle peak 1 time (left) and 2 time (right) in gait across the dominant and non-dominant legs. A Levene's test p-value greater than 0.05 indicates equal variance assumption is valid. Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

Test for Equal Variances: Knee FE Peak 1 versus Subject Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$
 95% Bonferroni Confidence Intervals for Standard Deviations

Subject	N	StDev	CI
Con-Dom	10	4.17009	(1.77806, 12.6055)
Con-ND	10	6.46475	(4.69436, 11.4748)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	2.04	0.153
Levene	3.68	0.071

Two-Sample T-Test and CI: Knee FE Peak 1, Subject Method

μ_1 : mean of Knee FE Peak 1 when Subject = Con-Dom
 μ_2 : mean of Knee FE Peak 1 when Subject = Con-ND
 Difference: $\mu_1 - \mu_2$
 Equal variances are assumed for this analysis.

Descriptive Statistics: Knee FE Peak 1

Subject	N	Mean	StDev	SE Mean
Con-Dom	10	19.43	4.17	1.3
Con-ND	10	20.07	6.46	2.0

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
-0.63	5.44	(-5.74, 4.48)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$
 Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
-0.26	18	0.798

Test for Equal Variances: Knee FE Peak 2 versus Subject Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$
 95% Bonferroni Confidence Intervals for Standard Deviations

Subject	N	StDev	CI
Con-Dom	10	3.35888	(1.93087, 7.53103)
Con-ND	10	4.50361	(2.84501, 9.18874)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	0.86	0.353
Levene	0.75	0.399

Two-Sample T-Test and CI: Knee FE Peak 2, Subject Method

μ_1 : mean of Knee FE Peak 2 when Subject = Con-Dom
 μ_2 : mean of Knee FE Peak 2 when Subject = Con-ND
 Difference: $\mu_1 - \mu_2$
 Equal variances are assumed for this analysis.

Descriptive Statistics: Knee FE Peak 2

Subject	N	Mean	StDev	SE Mean
Con-Dom	10	59.23	3.36	1.1
Con-ND	10	61.40	4.50	1.4

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
-2.18	3.97	(-5.91, 1.56)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$
 Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
-1.23	18	0.236

Figure F.71: Equal variance tests and two-sample t-tests for control participant knee flexion angle peaks 1 (left) and 2 (right) in gait across the dominant and non-dominant legs. A Levene's test p-value greater than 0.05 indicates equal variance assumption is valid. Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

Test for Equal Variances: % Cycle Peak 1 versus Subject Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Subject	N	StDev	CI
Con-Dom	10	1.39841	(0.931067, 2.70711)
Con-ND	10	1.41421	(0.705267, 3.65505)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	0.00	0.974
Levene	0.00	1.000

Two-Sample T-Test and CI: % Cycle Peak 1, Subject Method

μ_1 : mean of % Cycle Peak 1 when Subject = Con-Dom

μ_2 : mean of % Cycle Peak 1 when Subject = Con-ND

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: % Cycle Peak 1

Subject	N	Mean	StDev	SE Mean
Con-Dom	10	14.20	1.40	0.44
Con-ND	10	14.00	1.41	0.45

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
0.200	1.406	(-1.121, 1.521)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
0.32	18	0.754

Test for Equal Variances: % Cycle Peak 2 versus Subject Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Subject	N	StDev	CI
Con-Dom	10	1.52388	(0.814447, 3.67500)
Con-ND	10	1.34990	(0.732578, 3.20601)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	0.11	0.743
Levene	0.05	0.820

Two-Sample T-Test and CI: % Cycle Peak 2, Subject Method

μ_1 : mean of % Cycle Peak 2 when Subject = Con-Dom

μ_2 : mean of % Cycle Peak 2 when Subject = Con-ND

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: % Cycle Peak 2

Subject	N	Mean	StDev	SE Mean
Con-Dom	10	73.10	1.52	0.48
Con-ND	10	73.40	1.35	0.43

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
-0.300	1.440	(-1.653, 1.053)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
-0.47	18	0.647

Figure F.72: Equal variance tests and two-sample t-tests for control participant knee flexion angle peak 1 time (left) and 2 time (right) in gait across the dominant and non-dominant legs. A Levene's test p-value greater than 0.05 indicates equal variance assumption is valid. Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

Test for Equal Variances: Knee FE Peak 1 Dom versus Subject Method

Null hypothesis All variances are equal
Alternative hypothesis At least one variance is different
Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Subject	N	StDev	CI
Amp-Dom	10	4.12096	(2.57717, 8.4932)
Con-Dom	10	4.17009	(1.77806, 12.6055)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	0.00	0.976
Levene	0.07	0.788

Two-Sample T-Test and CI: Knee FE Peak 1 Dom, Subject Method

μ_1 : mean of Knee FE Peaks Dom when Subject = Amp-Dom

μ_2 : mean of Knee FE Peaks Dom when Subject = Con-Dom

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: Knee FE Peak 1 Dom

Subject	N	Mean	StDev	SE Mean
Amp-Dom	10	17.39	4.12	1.3
Con-Dom	10	19.43	4.17	1.3

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
-2.04	4.15	(-5.94, 1.85)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
-1.10	18	0.285

Test for Equal Variances: Knee FE Peak 1 ND versus Subject_1 Method

Null hypothesis All variances are equal
Alternative hypothesis At least one variance is different
Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Subject_1	N	StDev	CI
Amp-ND	10	7.31688	(4.60851, 14.9730)
Con-ND	10	6.46475	(4.69436, 11.4748)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	0.21	0.643
Levene	0.12	0.730

Two-Sample T-Test and CI: Knee FE Peak 1 ND, Subject_1 Method

μ_1 : mean of Knee FE Peaks ND when Subject_1 = Amp-ND

μ_2 : mean of Knee FE Peaks ND when Subject_1 = Con-ND

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: Knee FE Peak 2 ND

Subject_1	N	Mean	StDev	SE Mean
Amp-ND	10	10.92	7.32	2.3
Con-ND	10	20.07	6.46	2.0

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
-9.15	6.90	(-15.64, -2.66)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
-2.96	18	0.008

Figure F.73: Equal variance tests and two-sample t-tests for dominant (left) and non-dominant (right) first knee flexion angle peak in gait across participant type. A Levene's test p-value greater than 0.05 indicates equal variance assumption is valid. Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

Test for Equal Variances: % Cycle 1 Dom versus Subject Method

Null hypothesis All variances are equal
Alternative hypothesis At least one variance is different
Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Subject	N	StDev	CI
Amp-Dom	10	1.72884	(1.16708, 3.30085)
Con-Dom	10	1.39841	(0.93107, 2.70711)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	0.64	0.424
Levene	1.80	0.196

Two-Sample T-Test and CI: % Cycle 1 D, Subject Method

μ_1 : mean of % Cycle when Subject = Amp-Dom

μ_2 : mean of % Cycle when Subject = Con-Dom

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: % Cycle 1 D

Subject	N	Mean	StDev	SE Mean
Amp-Dom	10	13.10	1.73	0.55
Con-Dom	10	14.20	1.40	0.44

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
-1.100	1.572	(-2.577, 0.377)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
-1.56	18	0.135

Test for Equal Variances: % Cycle 1 ND versus Subject_1 Method

Null hypothesis All variances are equal
Alternative hypothesis At least one variance is different
Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Subject_1	N	StDev	CI
Amp-ND	10	2.46982	(1.75623, 4.47677)
Con-ND	10	1.41421	(0.70527, 3.65505)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	3.48	0.062
Levene	5.34	0.033

Two-Sample T-Test and CI: % Cycle 1 ND, Subject_1 Method

μ_1 : mean of % Cycle ND when Subject_1 = Amp-ND

μ_2 : mean of % Cycle ND when Subject_1 = Con-ND

Difference: $\mu_1 - \mu_2$

Equal variances are not assumed for this analysis.

Descriptive Statistics: % Cycle ND

Subject_1	N	Mean	StDev	SE Mean
Amp-ND	10	17.90	2.47	0.78
Con-ND	10	14.00	1.41	0.45

Estimation for Difference

Difference	95% CI for Difference
3.900	(1.970, 5.830)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
4.33	14	0.001

Figure F.74: Equal variance tests and two-sample t-tests for dominant (left) and non-dominant (right) first knee flexion angle peak time in gait across participant type. A Levene's test p-value greater than 0.05 indicates equal variance assumption is valid. Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

Test for Equal Variances: Knee FE Peak 2 Dom versus Subject Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$
95% Bonferroni Confidence Intervals for Standard Deviations

Subject	N	StDev	CI
Amp-Dom	10	5.10351	(2.64540, 12.6901)
Con-Dom	10	3.35888	(1.93087, 7.5310)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	1.03	0.310
Levene	1.15	0.297

Two-Sample T-Test and CI: Knee FE Peak 2 Dom, Subject Method

μ_1 : mean of Knee FE Peak 2 Dom when Subject = Amp-Dom
 μ_2 : mean of Knee FE Peak 2 Dom when Subject = Con-Dom
 Difference: $\mu_1 - \mu_2$
 Equal variances are assumed for this analysis.

Descriptive Statistics: Knee FE Peak 2 Dom

Subject	N	Mean	StDev	SE Mean
Amp-Dom	10	54.76	5.10	1.6
Con-Dom	10	59.23	3.36	1.1

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
-4.46	4.32	(-8.52, -0.40)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$
 Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
-2.31	18	0.033

Test for Equal Variances: Knee FE Peak 2 ND versus Subject_1 Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$
95% Bonferroni Confidence Intervals for Standard Deviations

Subject_1	N	StDev	CI
Amp-ND	10	5.84773	(2.89718, 15.2130)
Con-ND	10	4.50361	(2.84501, 9.1887)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	0.44	0.507
Levene	0.23	0.640

Two-Sample T-Test and CI: Knee FE Peak 2 ND, Subject_1 Method

μ_1 : mean of Knee FE Peak 2 ND when Subject_1 = Amp-ND
 μ_2 : mean of Knee FE Peak 2 ND when Subject_1 = Con-ND
 Difference: $\mu_1 - \mu_2$
 Equal variances are assumed for this analysis.

Descriptive Statistics: Knee FE Peak 2 ND

Subject_1	N	Mean	StDev	SE Mean
Amp-ND	10	64.21	5.85	1.8
Con-ND	10	61.40	4.50	1.4

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
2.81	5.22	(-2.10, 7.71)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$
 Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
1.20	18	0.245

Figure F.75: Equal variance tests and two-sample t-tests for dominant (left) and non-dominant (right) second knee flexion angle peak in gait across participant type. A Levene's test p-value greater than 0.05 indicates equal variance assumption is valid. Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

Test for Equal Variances: % Cycle 2 Dom versus Subject Method

Null hypothesis All variances are equal
Alternative hypothesis At least one variance is different
Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Subject	N	StDev	CI
Amp-Dom	10	1.07497	(0.392229, 3.79723)
Con-Dom	10	1.52388	(0.814447, 3.67500)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	0.63	0.428
Levene	1.30	0.269

Two-Sample T-Test and CI: % Cycle 2 Dom, Subject Method

μ_1 : mean of % Cycle Dom when Subject = Amp-Dom

μ_2 : mean of % Cycle Dom when Subject = Con-Dom

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: % Cycle 2 Dom

Subject	N	Mean	StDev	SE Mean
Amp-Dom	10	74.40	1.07	0.34
Con-Dom	10	73.10	1.52	0.48

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
1.300	1.319	(0.061, 2.539)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
2.20	18	0.041

Test for Equal Variances: % Cycle 2 ND versus Subject_1 Method

Null hypothesis All variances are equal
Alternative hypothesis At least one variance is different
Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Subject_1	N	StDev	CI
Amp-ND	10	3.52924	(1.04131, 15.4170)
Con-ND	10	1.34990	(0.73258, 3.2060)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	1.34	0.247
Levene	0.82	0.377

Two-Sample T-Test and CI: % Cycle 2 ND, Subject_1 Method

μ_1 : mean of % Cycle ND when Subject_1 = Amp-ND

μ_2 : mean of % Cycle ND when Subject_1 = Con-ND

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: % Cycle 2 ND

Subject_1	N	Mean	StDev	SE Mean
Amp-ND	10	72.30	3.53	1.1
Con-ND	10	73.40	1.35	0.43

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
-1.10	2.67	(-3.61, 1.41)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
-0.92	18	0.369

Figure F.76: Equal variance tests and two-sample t-tests for dominant (left) and non-dominant (right) second knee flexion angle peak time in gait across participant type. A Levene's test p-value greater than 0.05 indicates equal variance assumption is valid. Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

Test for Equal Variances: V RF Peak 1 versus Subject Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$
 95% Bonferroni Confidence Intervals for Standard Deviations

Subject	N	StDev	CI
Amp-Dom	10	0.0783718	(0.0396791, 0.199514)
Amp-ND	10	0.0884469	(0.0484237, 0.208221)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	0.10	0.747
Levene	0.18	0.681

Two-Sample T-Test and CI: V RF Peak 1, Subject Method

μ_1 : mean of V RF Peak 1 when Subject = Amp-Dom
 μ_2 : mean of V RF Peak 1 when Subject = Amp-ND
 Difference: $\mu_1 - \mu_2$
 Equal variances are assumed for this analysis.

Descriptive Statistics: V RF Peak 1

Subject	N	Mean	StDev	SE Mean
Amp-Dom	10	1.1260	0.0784	0.025
Amp-ND	10	1.0564	0.0884	0.028

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
0.0695	0.0836	(-0.0090, 0.1481)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$
 Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
1.86	18	0.079

Test for Equal Variances: V RF Peak 2 versus Subject Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$
 95% Bonferroni Confidence Intervals for Standard Deviations

Subject	N	StDev	CI
Amp-Dom	10	0.0922884	(0.0465799, 0.235675)
Amp-ND	10	0.0626952	(0.0364426, 0.139020)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	0.86	0.354
Levene	0.71	0.411

Two-Sample T-Test and CI: V RF Peak 2, Subject Method

μ_1 : mean of V RF Peak 2 when Subject = Amp-Dom
 μ_2 : mean of V RF Peak 2 when Subject = Amp-ND
 Difference: $\mu_1 - \mu_2$
 Equal variances are assumed for this analysis.

Descriptive Statistics: V RF Peak 2

Subject	N	Mean	StDev	SE Mean
Amp-Dom	10	1.1404	0.0923	0.029
Amp-ND	10	1.0275	0.0627	0.020

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
0.1128	0.0789	(0.0387, 0.1870)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$
 Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
3.20	18	0.005

Figure F.77: Equal variance tests and two-sample t-tests for amputee participant vertical reaction force peaks 1 (left) and 2 (right) in gait across the dominant and non-dominant legs. A Levene's test p-value greater than 0.05 indicates equal variance assumption is valid. Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

Test for Equal Variances: % Cycle Peak 1 versus Subject Method

Null hypothesis All variances are equal
Alternative hypothesis At least one variance is different
Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Subject	N	StDev	CI
Amp-Dom	10	1.05935	(0.73116, 1.97827)
Amp-ND	10	2.80674	(1.69424, 5.99301)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	5.58	0.018
Levene	4.42	0.050

Two-Sample T-Test and CI: % Cycle Peak 1, Subject Method

μ_1 : mean of % Cycle Peak 1 when Subject = Amp-Dom

μ_2 : mean of % Cycle Peak 1 when Subject = Amp-ND

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: % Cycle Peak 1

Subject	N	Mean	StDev	SE Mean
Amp-Dom	10	13.70	1.06	0.33
Amp-ND	10	15.10	2.81	0.89

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
-1.400	2.121	(-3.393, 0.593)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
-1.48	18	0.157

Test for Equal Variances: % Cycle Peak 2 versus Subject Method

Null hypothesis All variances are equal
Alternative hypothesis At least one variance is different
Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Subject	N	StDev	CI
Amp-Dom	10	2.94581	(0.90915, 12.3024)
Amp-ND	10	2.99815	(1.36109, 8.5121)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	0.00	0.974
Levene	0.15	0.700

Two-Sample T-Test and CI: % Cycle Peak 2, Subject Method

μ_1 : mean of % Cycle Peak 2 when Subject = Amp-Dom

μ_2 : mean of % Cycle Peak 2 when Subject = Amp-ND

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: % Cycle Peak 2

Subject	N	Mean	StDev	SE Mean
Amp-Dom	10	47.70	2.95	0.93
Amp-ND	10	45.10	3.00	0.95

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
2.60	2.97	(-0.19, 5.39)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
1.96	18	0.066

Figure F.78: Equal variance tests and two-sample t-tests for amputee participant vertical reaction force peak 1 time (left) and 2 time (right) in gait across the dominant and non-dominant legs. A Levene's test p-value greater than 0.05 indicates equal variance assumption is valid. Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

Test for Equal Variances: V RF Peak 1 versus Subject Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$
 95% Bonferroni Confidence Intervals for Standard Deviations

Subject	N	StDev	CI
Con-Dom	10	0.0688669	(0.0479824, 0.127396)
Con-ND	10	0.0868857	(0.0460710, 0.211196)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	0.44	0.509
Levene	0.13	0.725

Two-Sample T-Test and CI: V RF Peak 1, Subject Method

μ_1 : mean of V RF Peak 1 when Subject = Con-Dom

μ_2 : mean of V RF Peak 1 when Subject = Con-ND

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: V RF Peak 1

Subject	N	Mean	StDev	SE Mean
Con-Dom	10	1.1480	0.0689	0.022
Con-ND	10	1.0860	0.0869	0.027

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
0.0620	0.0784	(-0.0116, 0.1357)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
1.77	18	0.094

Test for Equal Variances: V RF Peak 2 versus Subject Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$
 95% Bonferroni Confidence Intervals for Standard Deviations

Subject	N	StDev	CI
Con-Dom	10	0.0612362	(0.0370489, 0.130454)
Con-ND	10	0.0504123	(0.0272169, 0.120352)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	0.34	0.561
Levene	0.22	0.647

Two-Sample T-Test and CI: V RF Peak 2, Subject Method

μ_1 : mean of V RF Peak 2 when Subject = Con-Dom

μ_2 : mean of V RF Peak 2 when Subject = Con-ND

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: V RF Peak 2

Subject	N	Mean	StDev	SE Mean
Con-Dom	10	1.1483	0.0612	0.019
Con-ND	10	1.1132	0.0504	0.016

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
0.0351	0.0561	(-0.0176, 0.0878)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
1.40	18	0.178

Figure F.79: Equal variance tests and two-sample t-tests for control participant vertical reaction force peaks 1 (left) and 2 (right) in gait across the dominant and non-dominant legs. A Levene's test p-value greater than 0.05 indicates equal variance assumption is valid. Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

Test for Equal Variances: % Cycle Peak 1 versus Subject Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Subject	N	StDev	CI
Con-Dom	10	1.35401	(0.805711, 2.93278)
Con-ND	10	1.42984	(0.616408, 4.27488)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	0.02	0.895
Levene	0.07	0.795

Two-Sample T-Test and CI: % Cycle Peak 1, Subject Method

μ_1 : mean of % Cycle Peak 1 when Subject = Con-Dom

μ_2 : mean of % Cycle Peak 1 when Subject = Con-ND

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: % Cycle Peak 1

Subject	N	Mean	StDev	SE Mean
Con-Dom	10	13.50	1.35	0.43
Con-ND	10	13.60	1.43	0.45

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
-0.100	1.392	(-1.408, 1.208)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
-0.16	18	0.874

Test for Equal Variances: % Cycle Peak 2 versus Subject Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Subject	N	StDev	CI
Con-Dom	10	0.78881	(0.489632, 1.63792)
Con-ND	10	1.47573	(0.957159, 2.93256)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	3.52	0.061
Levene	3.81	0.067

Two-Sample T-Test and CI: % Cycle Peak 2, Subject Method

μ_1 : mean of % Cycle Peak 2 when Subject = Con-Dom

μ_2 : mean of % Cycle Peak 2 when Subject = Con-ND

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: % Cycle Peak 2

Subject	N	Mean	StDev	SE Mean
Con-Dom	10	46.800	0.789	0.25
Con-ND	10	46.80	1.48	0.47

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
0.000	1.183	(-1.112, 1.112)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
0.00	18	1.000

Figure F.80: Equal variance tests and two-sample t-tests for control participant vertical reaction force peak 1 time (left) and 2 time (right) in gait across the dominant and non-dominant legs. A Levene's test p-value greater than 0.05 indicates equal variance assumption is valid. Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

Test for Equal Variances: V RF Peak 1 Dom versus Subject Dom Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Subject Dom	N	StDev	CI
Amp-Dom	10	0.0783718	(0.0396791, 0.199514)
Con-Dom	10	0.0688669	(0.0479824, 0.127396)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	0.14	0.711
Levene	0.00	0.979

Two-Sample T-Test and CI: V RF Peak 1 Dom, Subject Dom Method

μ_1 : mean of V RF Peak Dom when Subject Dom = Amp-Dom

μ_2 : mean of V RF Peak Dom when Subject Dom = Con-Dom

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: V RF Peak 1 Dom

Subject Dom	N	Mean	StDev	SE Mean
Amp-Dom	10	1.1260	0.0784	0.025
Con-Dom	10	1.1480	0.0689	0.022

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
-0.0220	0.0738	(-0.0913, 0.0473)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
-0.67	18	0.514

Test for Equal Variances: V RF Peak 1 ND versus Subject ND Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Subject ND	N	StDev	CI
Amp-ND	10	0.0884469	(0.0484237, 0.208221)
Con-ND	10	0.0868857	(0.0460710, 0.211196)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	0.00	0.961
Levene	0.01	0.926

Two-Sample T-Test and CI: V RF Peak 1 ND, Subject ND Method

μ_1 : mean of V RF Peak ND when Subject ND = Amp-ND

μ_2 : mean of V RF Peak ND when Subject ND = Con-ND

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: V RF Peak 1 ND

Subject ND	N	Mean	StDev	SE Mean
Amp-ND	10	1.0564	0.0884	0.028
Con-ND	10	1.0860	0.0869	0.027

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
-0.0295	0.0877	(-0.1119, 0.0529)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
-0.75	18	0.461

Figure F.81: Equal variance tests and two-sample t-tests for dominant (left) and non-dominant (right) first vertical reaction force peak in gait across participant type. A Levene's test p-value greater than 0.05 indicates equal variance assumption is valid. Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

Test for Equal Variances: % Cycle Peak 1 Dom versus Subject Dom Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Subject Dom	N	StDev	CI
Amp-Dom	10	1.05935	(0.731156, 1.97827)
Con-Dom	10	1.35401	(0.805711, 2.93278)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	0.63	0.429
Levene	0.53	0.476

Two-Sample T-Test and CI: % Cycle Peak 1 Dom, Subject Dom Method

μ_1 : mean of % Cycle Peak Dom when Subject Dom = Amp-Dom

μ_2 : mean of % Cycle Peak Dom when Subject Dom = Con-Dom

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: % Cycle Peak 1 Dom

Subject Dom	N	Mean	StDev	SE Mean
Amp-Dom	10	13.70	1.06	0.33
Con-Dom	10	13.50	1.35	0.43

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
0.200	1.216	(-0.942, 1.342)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
0.37	18	0.717

Test for Equal Variances: % Cycle Peak 1 ND versus Subject ND Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Subject ND	N	StDev	CI
Amp-ND	10	2.80674	(1.69424, 5.99301)
Con-ND	10	1.42984	(0.61641, 4.27488)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	2.97	0.085
Levene	3.08	0.096

Two-Sample T-Test and CI: % Cycle Peak 1 ND, Subject ND Method

μ_1 : mean of % Cycle Peak ND when Subject ND = Amp-ND

μ_2 : mean of % Cycle Peak ND when Subject ND = Con-ND

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: % Cycle Peak 1 ND

Subject ND	N	Mean	StDev	SE Mean
Amp-ND	10	15.10	2.81	0.89
Con-ND	10	13.60	1.43	0.45

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
1.500	2.227	(-0.593, 3.593)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
1.51	18	0.149

Figure F.82: Equal variance tests and two-sample t-tests for dominant (left) and non-dominant (right) first vertical reaction force peak time in gait across participant type. A Levene's test p-value greater than 0.05 indicates equal variance assumption is valid. Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

Test for Equal Variances: V RF Peak Dom versus Subject Dom Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$
95% Bonferroni Confidence Intervals for Standard Deviations

Subject Dom	N	StDev	CI
Amp-Dom	10	0.0922884	(0.0465799, 0.235675)
Con-Dom	10	0.0612362	(0.0370489, 0.130454)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	0.96	0.327
Levene	0.86	0.367

Two-Sample T-Test and CI: V RF Peak Dom, Subject Dom Method

μ_1 : mean of V RF Peak Dom when Subject Dom = Amp-Dom
 μ_2 : mean of V RF Peak Dom when Subject Dom = Con-Dom
 Difference: $\mu_1 - \mu_2$
Equal variances are assumed for this analysis.

Descriptive Statistics: V RF Peak Dom

Subject Dom	N	Mean	StDev	SE Mean
Amp-Dom	10	1.1404	0.0923	0.029
Con-Dom	10	1.1483	0.0612	0.019

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
-0.0079	0.0783	(-0.0815, 0.0657)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$
 Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
-0.23	18	0.824

Test for Equal Variances: V RF Peak 2 ND versus Subject ND Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$
95% Bonferroni Confidence Intervals for Standard Deviations

Subject ND	N	StDev	CI
Amp-ND	10	0.0626952	(0.0364426, 0.139020)
Con-ND	10	0.0504123	(0.0272169, 0.120352)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	0.39	0.532
Levene	0.35	0.562

Two-Sample T-Test and CI: V RF Peak 2 ND, Subject ND Method

μ_1 : mean of V RF Peak ND when Subject ND = Amp-ND
 μ_2 : mean of V RF Peak ND when Subject ND = Con-ND
 Difference: $\mu_1 - \mu_2$
Equal variances are assumed for this analysis.

Descriptive Statistics: V RF Peak 2 ND

Subject ND	N	Mean	StDev	SE Mean
Amp-ND	10	1.0275	0.0627	0.020
Con-ND	10	1.1132	0.0504	0.016

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
-0.0856	0.0569	(-0.1391, -0.0322)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$
 Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
-3.37	18	0.003

Figure F.83: Equal variance tests and two-sample t-tests for dominant (left) and non-dominant (right) second vertical reaction force peak in gait across participant type. A Levene's test p-value greater than 0.05 indicates equal variance assumption is valid. Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

Test for Equal Variances: % Cycle Peak Dom versus Subject Dom Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Subject Dom	N	StDev	CI
Amp-Dom	10	2.94581	(0.909151, 12.3024)
Con-Dom	10	0.78881	(0.489632, 1.6379)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	2.35	0.125
Levene	1.88	0.187

Two-Sample T-Test and CI: % Cycle Peak Dom, Subject Dom Method

μ_1 : mean of % Cycle Peak Dom when Subject Dom = Amp-Dom

μ_2 : mean of % Cycle Peak Dom when Subject Dom = Con-Dom

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: % Cycle Peak Dom

Subject Dom	N	Mean	StDev	SE Mean
Amp-Dom	10	47.70	2.95	0.93
Con-Dom	10	46.800	0.789	0.25

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
0.900	2.156	(-1.126, 2.926)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
0.93	18	0.363

Test for Equal Variances: % Cycle Peak 2 ND versus Subject ND Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Subject ND	N	StDev	CI
Amp-ND	10	2.99815	(1.36109, 8.51209)
Con-ND	10	1.47573	(0.95716, 2.93256)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	1.79	0.181
Levene	1.64	0.217

Two-Sample T-Test and CI: % Cycle Peak 2 ND, Subject ND Method

μ_1 : mean of % Cycle Peak ND when Subject ND = Amp-ND

μ_2 : mean of % Cycle Peak ND when Subject ND = Con-ND

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: % Cycle Peak 2 ND

Subject ND	N	Mean	StDev	SE Mean
Amp-ND	10	45.10	3.00	0.95
Con-ND	10	46.80	1.48	0.47

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
-1.70	2.36	(-3.92, 0.52)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
-1.61	18	0.125

Figure F.84: Equal variance tests and two-sample t-tests for dominant (left) and non-dominant (right) second vertical reaction force peak time in gait across participant type. A Levene's test p-value greater than 0.05 indicates equal variance assumption is valid. Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.

Test for Equal Variances: Walking Speed versus Subject Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Subject	N	StDev	CI
Amp	10	0.172838	(0.0571775, 0.673396)
Con	10	0.078673	(0.0471886, 0.169057)

Individual confidence level = 97.5%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	1.19	0.276
Levene	0.42	0.524

Two-Sample T-Test and CI: Walking Speed, Subject Method

μ_1 : mean of Walking Speed when Subject = Amp

μ_2 : mean of Walking Speed when Subject = Con

Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: Walking Speed

Subject	N	Mean	StDev	SE Mean
Amp	10	1.256	0.173	0.055
Con	10	1.2913	0.0787	0.025

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
-0.0351	0.1343	(-0.1613, 0.0910)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$

Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
-0.59	18	0.566

Figure F.85: Equal variance tests and two-sample t-tests for walking speed across participant type. A Levene's test p-value greater than 0.05 indicates equal variance assumption is valid. Significant p-values highlighted in yellow. P-values that are within 1% of the significance level are indicated in green.