AN ABSTRACT OF THE DISSERTATION OF

Garry L. Killgore for the degree of Doctor of Philosophy in Human Performance presented on July 21, 2003. Title: A Biomechanical and Physiological Comparison of Deep-Water Running Styles.

Abstract approved:

Redacted for Privacy

Anthony Wilcox

**Purpose:** The purpose of this investigation was to identify a deep-water running (DWR) style that most closely approximates terrestrial running. **Methods:** Twenty healthy male and female intercollegiate (NCAA III) distance runners were videotaped from the right sagittal view while running on a treadmill (TR) and in deep water at 55-60% of their TR $VO_{2max}$ using each of four DWR styles: shod cross-country (SCC), barefoot cross-country (BCC), shod high-knee (SHK), and barefoot high-knee (BHK). All biomechanical data were digitized and analyzed using the Peak Motus® system. Physiological variables of interest were oxygen consumption ($VO_2$), heart rate (HR), and rating of perceived exertion (RPE). Biomechanical variables of interest were horizontal (X) and vertical (Y) displacement of the knee and ankle, and stride rate (SR). An ANOVA with repeated measures was utilized to ascertain the differences across styles. The alpha significance level was set at .05, and a post hoc pairwise analysis was conducted with a Bonferonni adjustment of the alpha level. **Results:** Omnibus significant differences were found for all physiological variables: $VO_2$ ($<.025$), HR ($p<.042$), RPE ($p<.000$). However, the post hoc pairwise comparisons revealed that only TR vs. SHK $VO_2$ ($p<.005$), and the RPE responses for treadmill vs. all DWR styles exhibited significant differences ($p<.000$-.002). Omnibus tests for biomechanical variables exhibited statistical significance. The post hoc pairwise comparisons revealed significant differences in SR ($p<.000$) between TR (1.25 ± .08 Hz) and all DWR styles and also between the CC and HK styles of DWR (SCC: 0.78 ± .08 Hz, BCC: 0.81 ± .08 Hz, SHK: 1.13 ± .10 Hz, BHK: 1.14 ± .10 Hz). The CC style of DWR was found to be similar to TR with respect to linear ankle displacement, whereas the HK style was significantly different from TR in all but two of the 16 comparisons made for ankle and knee displacement. **Conclusion:** The CC style of DWR is recommended as an adjunct to distance running training if the goal is to mimic the ankle linear horizontal displacement of land-based running. However, if the goal is to mimic SR, the HK style is a closer approximation than the CC style.

A Biomechanical and Physiological Comparison
of Deep-Water Running Styles

by

Garry L. Killgore

A DISSERTATION

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I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

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Garry L. Killgore, Author

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## CONTRIBUTION OF AUTHORS

Dr. Brian Caster was involved in the biomechanical data analysis. Dr. Terry Wood was involved in the research design, statistical analysis, and the interpretation of the data.

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# A BIOMECHANICAL AND PHYSIOLOGICAL COMPARISON OF DEEP-WATER RUNNING STYLES

## INTRODUCTION

Approximately 30 million Americans participate in running as a form of general exercise for fitness and health (23). It has also been estimated that up to 70% of this population will incur a running-related injury (16, 82, 98). Running has been described as "essentially a series of collisions with the ground" (83), and these collisions typically exhibit vertical ground reaction forces (VGRF) of 1.5 to 3 times the runner's body weight (16, 25, 33, 37, 49). These impact forces, as well as training errors resulting from increasing the total volume of mileage too rapidly and/or excessive mileage, are at least partially responsible for the creation of many running-related injuries (1, 9, 10, 11, 16, 19, 30, 67, 71, 72, 76, 82, 108, 109, 113, 114).

A method of decreasing the volume of the running impact forces and the negative effects of excessive mileage is to supplement a runner's training program using deep-water running (DWR) in a pool (20, 32, 41, 42, 44, 50, 58, 65, 68, 85, 89, 101, 104, 116, 121, 122). This mode of training requires that the runner use a buoyancy device, e.g. AquaJogger®, while attempting to mimic the terrestrial running style (58, 85, 124, 126). This alternative training method has been reported to decrease spinal and joint compressive loading, which would decrease the likelihood of incurring running-related injuries (37, 54). A rationale for deep-water running (DWR) is that it allows the runner to train using a similar movement pattern to that found on land without incurring the impact forces, and thus greatly reducing the repetitive loading of the musculoskeletal system (27, 44, 76, 109). Injury rehabilitation rather than prevention is the most common use of deep water running (37, 39, 52, 55, 61, 68, 75, 76, 84, 93, 109, 123, 125, 126, 127, 133).

Despite the increasing use of DWR as a method of rehabilitation, and more recently, as supplementary training within a normal regimen, very little research focuses on the DWR technique. The specificity of training principle suggests that the movement pattern of running in deep water needs to be closely aligned with terrestrial running to maximize the benefit to the runner (15).

To date, most studies on DWR have focused on the physiological and metabolic responses to this mode of exercise (2, 12, 14, 17, 18, 20, 21, 22, 27, 32, 35, 37, 38, 42, 45, 46, 50, 53, 54, 58, 59, 65, 76, 85, 86, 87, 88, 89, 90, 91, 94, 95, 96, 104, 106, 109, 112, 115, 118, 121, 122, 124, 128, 132, 133). Based on these studies it is commonly reported that treadmill running (TR) exhibits higher maximal oxygen uptake and maximal heart rate values as compared to deep-water running (21, 22, 38, 45, 53, 86, 87, 89, 91, 95, 96, 115, 118, 122). However, Mercer and Jensen (86) provided evidence that during sub-maximal DWR, the HR values exhibit no significant differences between running in each medium. In contrast, it has been reported that lesser skilled runners in deep water exhibit higher heart rates for a given $VO_2$ (38). In general, rating of perceived exertion (RPE) comparisons between treadmill and deep-water running have indicated that, for experienced runners, the ratings tend to be similar (22, 45, 59).

Several sources describe proper DWR techniques. It appears, however, that the most commonly used DWR style is characterized by a high-knee or piston-like leg action (39, 41, 75, 84, 125, 126, 127). In contrast, the cross-country style is intended to be more like TR. Few studies have specifically examined the biomechanics of DWR (52, 55, 85, 93, 102). Several methodological problems exist among the studies, including 1) the studies contained an inadequate number of subjects (52, 55, 85, 93, 102), 2) the subjects had inadequate experience with DWR (52, 93), 3) no (93) or a non-standard (55) buoyancy device was worn, and 4) the style of DWR was primarily high-knee (52, 55, 93). As a result of these deficiencies in study design, the biomechanics of DWR is not well understood, and comparison of DWR to TR is quite limited. Therefore, this study conducted a biomechanical and physiological analysis comparing two styles of DWR, cross-country and high-knee, with TR at equivalent $VO_2$. The purpose was to determine which form of DWR was most similar to TR regarding physiological response and the biomechanics of the movement.

## MATERIAL AND METHODS

**Subjects.** Twenty experienced NCAA Division III distance runners participated in the study (12 females, 8 males). Subjects were recruited from the Linfield College, George Fox University, and Lewis and Clark College cross-country teams in the State of Oregon. All subjects completed a health and training questionnaire, had skinfold measurements (70, 8) recorded using a Lange skinfold caliper, discussed Borg's rating of perceived exertion (RPE) 6-20 category scale (15, 47, 79), and read and signed an informed consent document. The study was approved by the Institutional Review Boards for the Protection of Human Subjects of Oregon State University and Linfield College. In addition, each subject successfully completed a recent standardized health appraisal as per their respective institutions' guidelines for intercollegiate sport participation (Northwest Conference and NCAA III).

**Protocol.**

**Treadmill Maximal Oxygen Uptake Test ($VO_{2max}$).** Subjects performed a maximal oxygen uptake ($VO_{2max}$) test on a Trackmaster® TM215 Silver Series treadmill (JAS Manufacturing, Carrollton, TX). $VO_2$ was ascertained using a MedGraphics® CPX Express System (St. Paul, MN). Subjects began by warming up for approximately 5 minutes on the treadmill at an easy pace of 6 mph for men and 5 mph for women. The treadmill protocol consisted of starting at 7 mph for men and 6 mph for women, at O° elevation, progressing by 0.5 mph per minute until 11mph for men and 10 mph for women was achieved. At this point, the speed was held constant and treadmill elevation increased by 1% per minute until volitional exhaustion. Heart rate, rating of perceived exertion (Borg Category 6-20 scale), and $VO_2$ were recorded every 30 seconds. The highest recorded $VO_2$ value over a 1-min interval was accepted as $VO_{2max}$ when the subject met three out of four of the following criteria: failed to demonstrate an increase in HR, reached a plateau in oxygen uptake with further increases in exercise intensity, reached a RER of >1.15, and reached a RPE of >17 on Borg's 6-20 Scale (47).

**Treadmill Sub-Maximal Oxygen Uptake Test ($VO_{2max}$).** To establish the physiological and biomechanical response to treadmill running (TR) at 60% $VO_{2max}$, a separate treadmill session was conducted. The treadmill was set at an appropriate speed (5-7.5 mph) at 0° elevation to allow the subject to run for 5-6 minutes at 60% $VO_{2max}$, based upon the results from the $VO_{2max}$ test. The physiological and biomechanical test data from this test were subsequently used as the criterion values in the deep water running trials.

**Treadmill Biomechanical Data.** To collect the biomechanical data, the subjects were attired in comfortable running shorts with females wearing a jog bra, or other suitable garment, and males were shirtless. This allowed for proper placement of the Polar heart rate monitor and the biomechanical joint markers (3M highly reflective adhesive tape, approximately 2.5 cm in diameter) on the right side of each subject at the shoulder joint, elbow joint, wrist joint, hip joint at the head of the femur, knee joint, lateral malleolus, lateral calcaneus, and the 5th metatarsal head (60). A Panasonic AG-456 S-VHS Movie Camera was used for the collection of kinematic data while subjects ran on the treadmill. The camera specifications include more than 400 lines of resolution, 3 lux light sensitivity, and a F1.6 lens. Each subject was videotaped at 30 frames per second (fps) from the right sagittal view (130) with Sony VHS videotape throughout the complete trial. A scale factor of 1 m was determined via two highly reflective tape markers placed on the bottom of the treadmill perpendicular to the camera. These data were hand digitized on a Peak Motus© 2000 2-D system (Englewood, CO) using a Panasonic AG-1980P 4-head video cassette recorder.

**DWR Orientation.** Each subject completed a questionnaire regarding DWR experience, general water immersion comfort levels, weekly running mileage, and injury history. Subjects then viewed and discussed with the researcher a brief videotape of the DWR styles: barefoot high-knee (BHK), shod high-knee (SHK), barefoot cross-country (BCC), and shod cross-country (SCC). A brief description of each style follows and closely resembles those previously outlined by other investigators (96,122, 125, 126). In general, in both major styles (high-knee and cross-country), the water is at shoulder level with the head held in a neutral position facing forward. The body leans slightly forward of a vertical position. The arm carriage should be identical to land-based running with motion primarily moving from the shoulder joint. The hands are held in a slightly clenched fist position to decrease the likelihood of using a dog-paddling type motion. Hip flexion reaches a position of approximately 60-80°, followed by full extension of the leg. The foot moves from approximately 0° dorsiflexion at full hip flexion to approximately 50-70° of plantarflexion when the leg is fully extended. The major differences between the high-knee and cross-country styles of DWR are that the high-knee style leg action is primarily in a vertical plane with the legs moving straight up and down in a piston-like movement pattern with very little horizontal displacement present. The cross-country style looks qualitatively more like land-based running (85) due primarily to the increased horizontal displacement of the ankle. Since prior experience in DWR has been implicated as a factor in the metabolic responses to DWR (45, 85), three subsequent 30-minute technique practice sessions in a swimming pool were provided. During practice sessions each subject received underwater video visual feedback via a monitor connected to the underwater camera (AquaCam®) and verbal feedback from the researcher.

**Deep Water Running.** The deep water running tests took place in a swimming pool (25m x 20m) with a depth of 13 feet at an average temperature of 27.2°C (± .7°). The DWR session included 4 trials (BHK, SHK, BCC, SCC), each 5-6 min in length, with a rest period of at least 2-3 min between trials. Each trial was conducted at an intensity that was 60% of the subject's maximal treadmill $VO_2$, and steady-state physiological data were collected over the final 3 min of each trial. To insure subject compliance, a researcher provided verbal feedback regarding $VO_2$ from the metabolic cart's monitor and regarding technique from the camera monitor. $VO_2$, heart rate, and RPE were recorded every 30 seconds. The order of tests was counterbalanced according to the method described by Girden (51). This required that the subject change his or her shoes between trials, which had been practiced and was accomplished with the assistance of the researcher while the subject held onto the side of the pool. All male subjects were shirtless and attired in either running shorts or a swim suit. Females wore either running shorts and a jog bra or a bathing suit. This allowed for proper placement of the

Polar M52 heart rate monitor as well as the joint markers. The joint markers consisted of a circle approximately 2.5 cm drawn with a black indelible marker at the joints previously described for the treadmill test (60). The subject then proceeded to put the AquaJogger® (Excel Sports Sciences, Eugene, OR) flotation device around his or her waist and entered the pool where the next 5 to 10 minutes were spent warming up using a running motion at a self-determined level of moderate exertion. The subject was then tethered to the side of the pool using a commercial tether (Excel Sports Sciences). A surface flotation wave-limiting device was placed around the subject and affixed to the diving blocks on the pool deck. This device was designed to decrease the likelihood of getting the pneumotach or sampling line wet. All trials were recorded underwater via a color "AquaCam®" (Portsmouth, NH) underwater video camera that was positioned at the side of the pool perpendicular to the subject at a depth of 0.93 meter and at a distance of 6.74 meters from the subject. The camera specifications include 480 lines of resolution, Sony HyperHAD™ pick-up device, autoelectric iris with image enhance processor chip, 2 lux light sensitivity, and 4.3mm lens. Data were stored via a cable into the video input of a Panansonic AG 1980 VCR at 30 fps. A scale factor of 1 m was determined via a pole marked at a length of 1 m held in place underwater at the same distance as the subject and perpendicular to the camera. Data from 10 consecutive representative strides during the last three minutes of each trial were then digitized as previously described on a Peak Motus 2-D system.

**Statistics.** For each variable repeated measures analysis of variance (ANOVA) with a multivariate omnibus test of significance was used to determine mean differences across trials. Each variable found to be statistically significant in the multivariate tests was further subjected to a pairwise post hoc analysis using paired t-tests. To limit the likelihood of committing a Type I error to 0.05, a Bonferroni adjustment was performed; with 10 pairwise post hoc comparisons, the adjusted alpha for each pairwise comparison was 0.005. To determine confidence in the consistency of mean data for 10 representative strides, intraclass reliability coefficients were calculated on each individual stride within the 10 stride mean data (TR: 0.98 ± .01; SCC: 0.99 ± .01; BCC: 0.98 ± .01; SHK: 0.99 ± .01; BHK: 0.98 ± .03). Using a formula for estimating power in repeated measures designs (103), it was determined a priori that using 20 subjects with an alpha significance level of 0.05 resulted in estimated statistical power of 0.693-.980 for the physiological variables and 0.955-1.000 for the biomechanical variables. The statistical software utilized was SPSS 11.5 for all analyses.

## RESULTS

**Physiological Variables.** Subject characteristics are summarized in Table 1. The subjects in this study can be considered average NCAA Division III cross-country runners based on both their physiological data and their best 5-km race performance. Many of the subjects, particularly the males, were primarily middle distance runners in track and field. Only one subject had no prior experience with an AquaJogger®, with 93% having previously used an AquaJogger® more than 6-10 times. The study commenced at the beginning of the competitive collegiate cross-country season and concluded prior to the end of the season. Table 2 provides a summary of the physiological steady-state data averaged over all subjects under each experimental condition. The multivariate omnibus test for $VO_2$ was statistically significant ($p<.025$). However, with the exception of TR vs. SHK, the post hoc pairwise (Table 3) comparisons did not yield any significant differences in $VO_2$ between terrestrial and deep water running. Furthermore, the $VO_2$ effect sizes found in Table 3 demonstrate relatively small differences. The percent of $VO_2$ data (Table 2) showed that the trials fell within a narrow range of values (57.6%-60.2% ± 2.2%-4.2%). With only one statistically significant pairwise comparison and the low effect sizes, leads to the conclusion that the design objective to equalize $VO_2$ across trials was satisfied. Similar to the results with $VO_2$, there was a statistically significant main effect for HR ($p<.042$), but the post hoc pairwise comparisons (Table 3) did not produce any significant differences. There was a statistically significant ($p<.001$) main effect and large effect sizes (Table 3) for the RPE responses. The post hoc analysis revealed significant differences between RPE responses for TR compared to each style of DWR ($p<.000$). None of the pairwise RPE responses among the DWR styles was statistically significant. RPE averaged 1.77 higher during DWR than TR.

## Table 1 Subject Characteristics

| Subj # | Age | Gender | Ht | Wt | BF | $VO_{2max}$ | Mi/wk$_{min}$ | Mi/wk$_{max}$ | 5km | Number of previous DWR w/ |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cm) | (kg) | (%) | ($ml \cdot kg^{-1} \cdot min^{-1}$) | (est.) | (est.) | Best | AquaJogger® experiences* |
| 1 | 20 | Female | 175.3 | 66.9 | 18.6 | 48.3 | 35 | 40 | 19:10 | >20 |
| 2 | 20 | Female | 172.7 | 58.2 | 12.1 | 47.5 | 30 | 35 | 20:40 | 11-20 |
| 3 | 18 | Female | 169.6 | 57.5 | 17.5 | 51.1 | 35 | 40 | 19:43 | 6-10 |
| 4 | 18 | Female | 165.1 | 61.4 | 17.5 | 49.3 | 30 | | 19:15 | 11-20 |
| 6 | 21 | Female | 160.0 | 50.9 | 16.8 | 51.7 | 50 | 60 | 19:04 | 6-10 |
| 7 | 20 | Female | 170.2 | 59.3 | 15.4 | 46.9 | 30 | | 20:45 | 6-10 |
| 8 | 20 | Female | 165.1 | 56.1 | 16.5 | 53.3 | 40 | 50 | 18:59 | 1-5 |
| 11 | 20 | Female | 162.6 | 56.1 | 14.3 | 55.5 | 30 | 40 | 18:50 | >20 |
| 12 | 20 | Female | 165.1 | 56.1 | 16.5 | 44.9 | 50 | 60 | 19:33 | >20 |
| 17 | 20 | Female | 161.3 | 41.6 | 9.8 | 49.6 | 35 | 40 | 18:52 | >20 |
| 18 | 20 | Female | 167.6 | 67.7 | 24.0 | 43.5 | 20 | 30 | 21:17 | 6-10 |
| 19 | 20 | Female | 158.8 | 53.6 | 22.6 | 47.3 | 35 | 40 | 21:30 | 11-20 |
| **Mean** | **19.8** | | **166.1** | **57.1** | **16.8** | **49.1** | **35.0** | **43.5** | **19:48** | **>20=34%; 11-20=25%** |
| **SD** | **0.9** | | **5.1** | **6.9** | **3.9** | **3.4** | **8.5** | **10.0** | **58.7** | **6-10=34%; 1-5=8%** |
| 5 | 19 | Male | 190.5 | 75.7 | 8.3 | 59.8 | 40 | | 17:14 | >20 |
| 9 | 20 | Male | 182.9 | 75.7 | 11.0 | 56.9 | 40 | 50 | 17:04 | 1-5 |
| 10 | 20 | Male | 182.9 | 75.2 | 5.5 | 54.9 | 40 | | 17:15 | 6-10 |
| 13 | 19 | Male | 165.1 | 63.9 | 6.4 | 57.3 | 45 | 55 | 16:30 | Never |
| 14 | 18 | Male | 186.7 | 63.9 | 6.4 | 54.9 | 40 | 50 | 16:14 | >20 |
| 15 | 19 | Male | 177.8 | 69.3 | 6.4 | 51.9 | 40 | | 17:10 | >20 |
| 16 | 21 | Male | 182.9 | 74.8 | 6.4 | 61.2 | 70 | 80 | 15:40 | 6-10 |
| 20 | 21 | Male | 188 | 71.8 | 5.0 | 55.8 | 45 | 50 | 15:41 | 1-5 |
| **Mean** | **19.6** | | **182.1** | **71.3** | **6.9** | **56.6** | **45.0** | **57.0** | **16:36** | **>20=37.5%;11-20=0** |
| **SD** | **1.1** | | **7.9** | **5.1** | **1.9** | **2.9** | **10.4** | **13.0** | **40.7** | **6-10=25%; 1-5=25%** |
| **Grand M** | **19.7** | | **172.5** | **62.8** | **12.9** | **52.1** | **39** | **48** | **18:31** | **>20=35%; 11-20=15%** |
| **SD** | **0.9** | | **10.1** | **9.4** | **5.9** | **4.9** | **10.3** | **12.5** | **1:49.2** | **6-10=30%; 1-5=15%** |
| ***No subject had previously worn shoes while DWR.** | | | | | | | | | | **Never = 5%** |

**Table 2 Physiological Variables Summary (Mean ± SD)**

| | TR | SCC | BCC | SHK | BHK |
|---|---|---|---|---|---|
| **$VO_2$ (ml·kg$^{-1}$·min$^{-1}$)** | 31.1 ± 3.4 | 30.6 ± 4.0 | 31.4 ± 3.4 | 30.0 ± 3.5 | 30.2 ± 3.4 |
| **% of $VO_2$** | 59.7 ± 2.6 | 58.6 ± 2.9 | 60.2 ± 4.2 | 57.6 ± 2.2 | 58.0 ± 2.9 |
| **HR (beats·min)** | 137.9 ± 9.4 | 134.6 ± 12.0 | 135.1 ± 11.2 | 132.8 ± 8.6 | 132.6 ± 9.6 |
| **RPE (Borg's 6-20)** | 11.8 ± 1.2 | 13.3 ± 1.1 | 13.5 ± 1.2 | 13.3 ± .9 | 13.4 ± .8 |

**Table 3 Statistical Pairwise Comparisons and Effect Sizes for Physiological Data**

| | TR/ SCC | TR/ BCC | TR/ SHK | TR/ BHK | SCC/ BCC | SCC/ SHK | SCC/ BHK | BCC/ SHK | BCC/ BHK | SHK/ BHK |
|---|---|---|---|---|---|---|---|---|---|---|
| **$VO_2$** | 0.187 | 0.687 | **0.005a** | 0.035 | 0.171 | 0.062 | 0.328 | 0.013 | 0.022 | 0.541 |
| | (.15) | (-.07) | (.32) | (.28) | (-.22) | (.15) | (.11) | (.40) | (.36) | (-.05) |
| **HR** | 0.206 | 0.181 | 0.008 | 0.024 | 0.747 | 0.311 | 0.105 | 0.178 | 0.079 | 0.927 |
| | (.31) | (.27) | (.57) | (.62) | (-.05) | (.17) | (.18) | (.24) | (.24) | (.01) |
| **RPE** | **0.002a** | **0.000a** | **0.000a** | **0.000a** | 0.179 | 0.830 | 0.712 | 0.359 | 0.442 | 0.849 |
| | **(-1.30)** | **(-1.48)** | **(-1.48)** | **(-1.52)** | (-.19) | (-.05) | (-.08) | (.19) | (.17) | (-.04) |

**a=<.005: based on Bonferroni adjustment for post hoc analyses; ( ) = Effect Size**

**Biomechanical Variables.** Figures 1 and 2 graphically illustrate the knee and ankle horizontal (X) and vertical (Y) displacements respectively using the filtered (Butterworth for TR knee and ankle: 4.4-5.4 Fz; DWR knee and ankle: 3.8-4.6 Fz) scaled coordinates for all 10 strides of representative subjects. Figures 3 and 4 graphically illustrate the knee and ankle horizontal (X) and vertical (Y) displacements of a single stride from one representative subject with the hip as the zero point and the positive numbers indicating the knee and ankle anterior to the hip while the negative numbers are posterior to the hip.

These graphs illustrate that qualitative similarities between the horizontal displacements of the ankle during TR and the cross-country styles are more similar than those for the high-knee style of DWR. Conversely, the relative lack of horizontal displacement of the ankle and the more pronounced vertical displacements in the high-knee style of DWR is evident. These observations are consistent in both the shod and barefoot trials. In fact, wearing shoes had very little effect.

Table 4 provides means and standard deviations of the biomechanics variables of the lower extremities over 10 consecutive representative strides. All pairwise comparisons are presented in Table 5. Stride rate (SR) in this study was defined as maximum knee flexion to maximum knee flexion of one complete stride cycle for the right leg. The SR results demonstrated a statistically significant difference between styles of running ($p<0.000$) with an overall mean difference of 0.48 strides/second (Hz). A comparison of SR between the cross-country style of DWR and TR demonstrates that land-based running is accomplished at a much faster ($1.25 \pm .08$ Hz) rate than either SCC ($0.78 \pm .09$ Hz) or BCC ($0.81 \pm .08$ Hz). The very large effect sizes corroborate this observation (SCC: 5.22 and BCC: 5.50). The high-knee style exhibits a SR that is faster than the cross-country style, but is also significantly different than TR (SHK:$1.13 \pm .10$ Hz; BHK: $1.14 \pm .10$ Hz) with large effect sizes of 1.33 and 1.22 for SHK and BHK, respectively. All XY displacement data were found to be statistically significant ($p<0.000$-$0.003$). However, closer examination of the XY pairwise comparisons (Table 5) reveals quantitative similarities between the cross-country style (SCC, BCC) and the treadmill running data relative to the ankle

**Figure 1**

**Knee XY Filtered Scaled Coordinates Displacements of Representative Subjects in each Running Style**

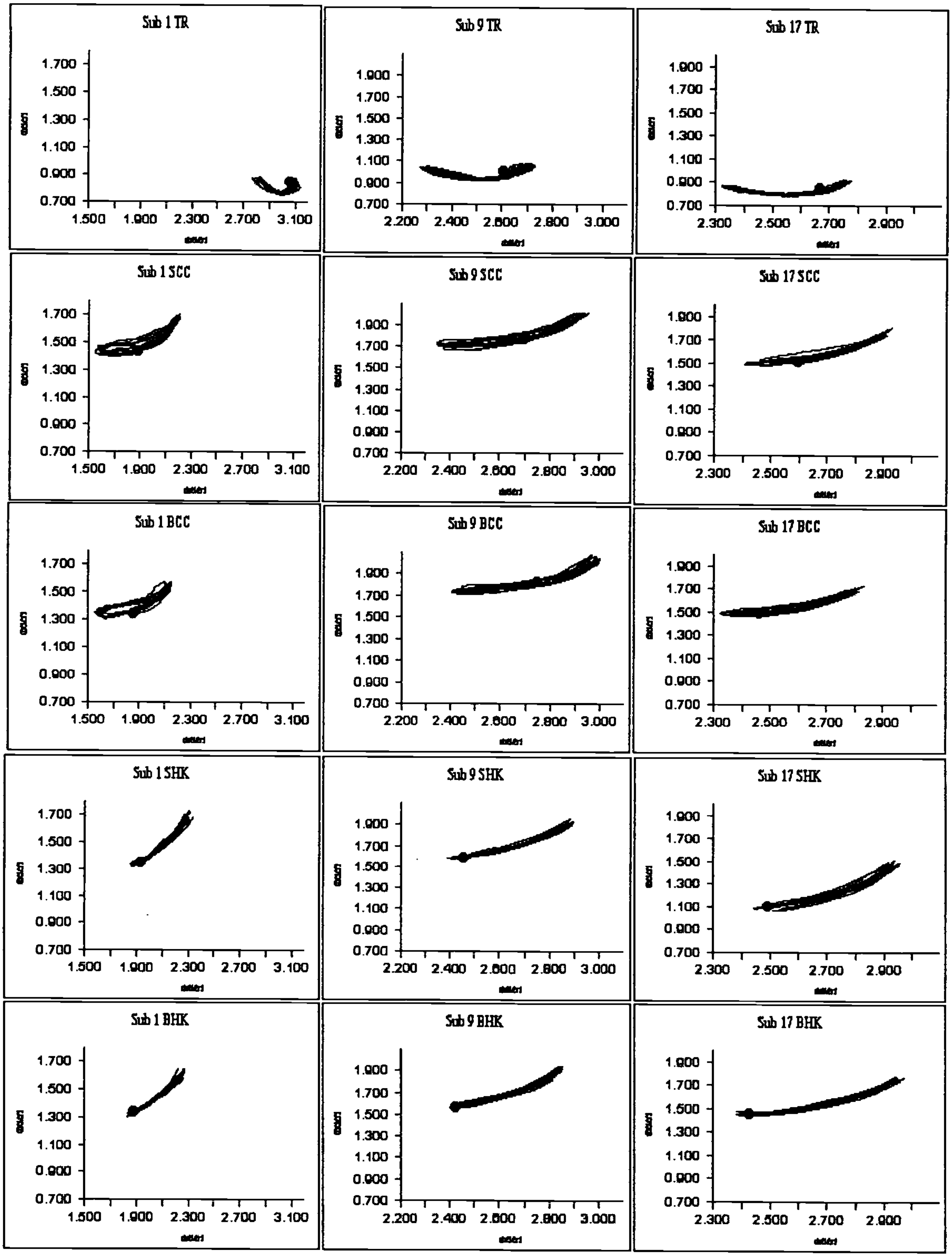


**Figure 2**
**Ankle XY Filtered Scaled Coordinates Displacements of Representative Subjects in each Running Style**

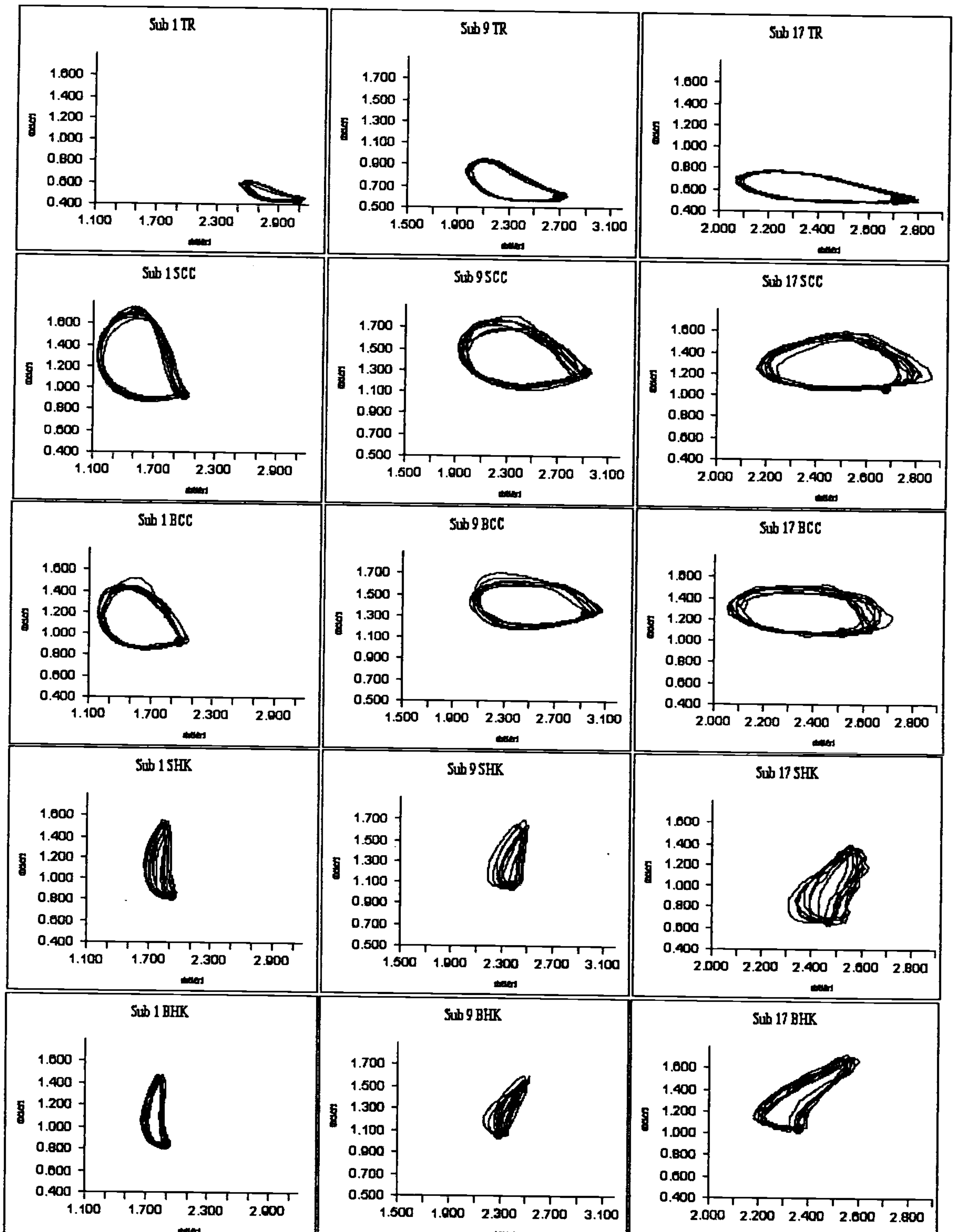


**Figure 3**
**Knee and ankle displacement relative to the hip as the zero point (transformed XY)**
**One Representative Stride for Subject 17**
**Treadmill vs. DWR Barefoot styles**

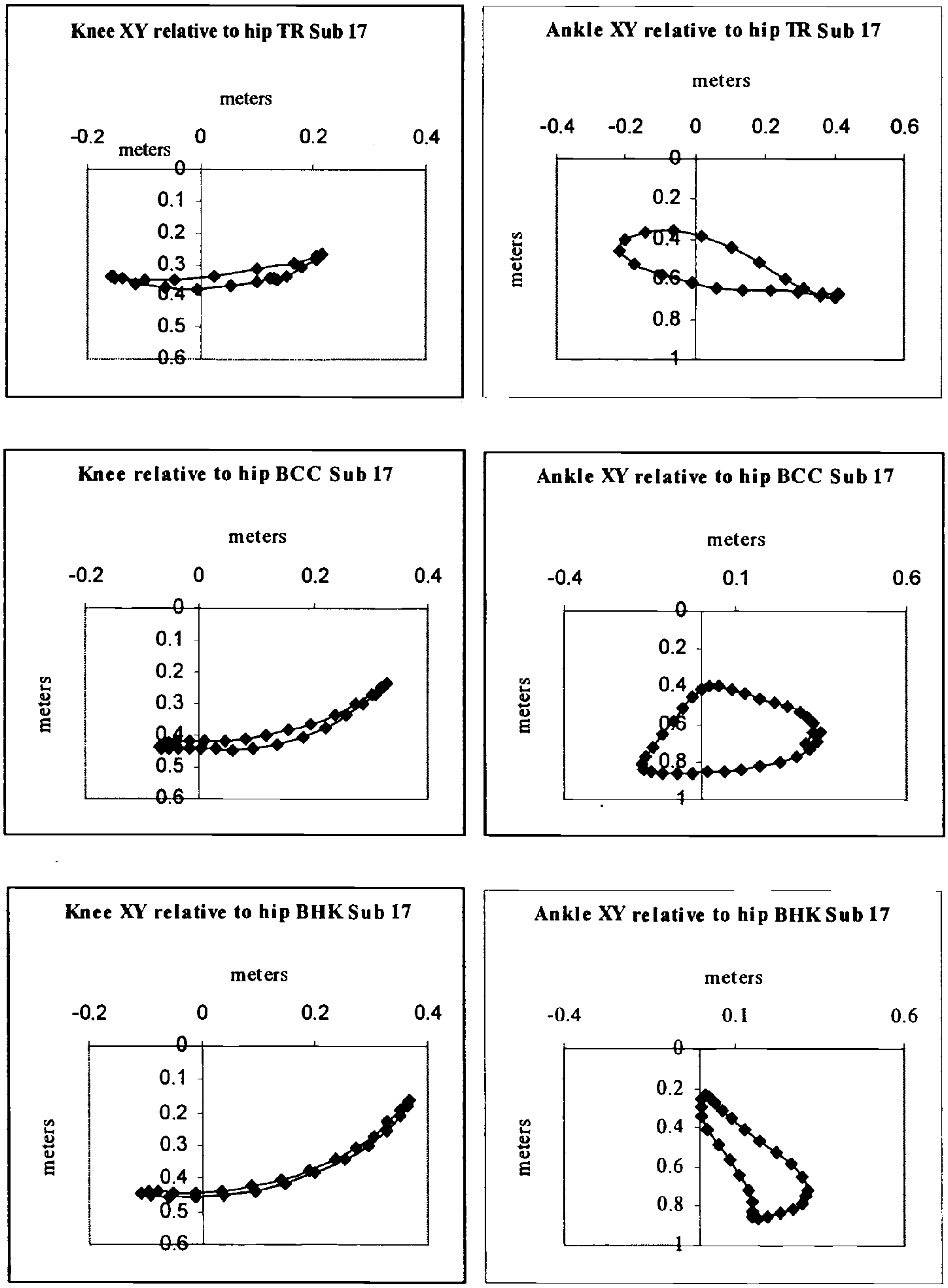
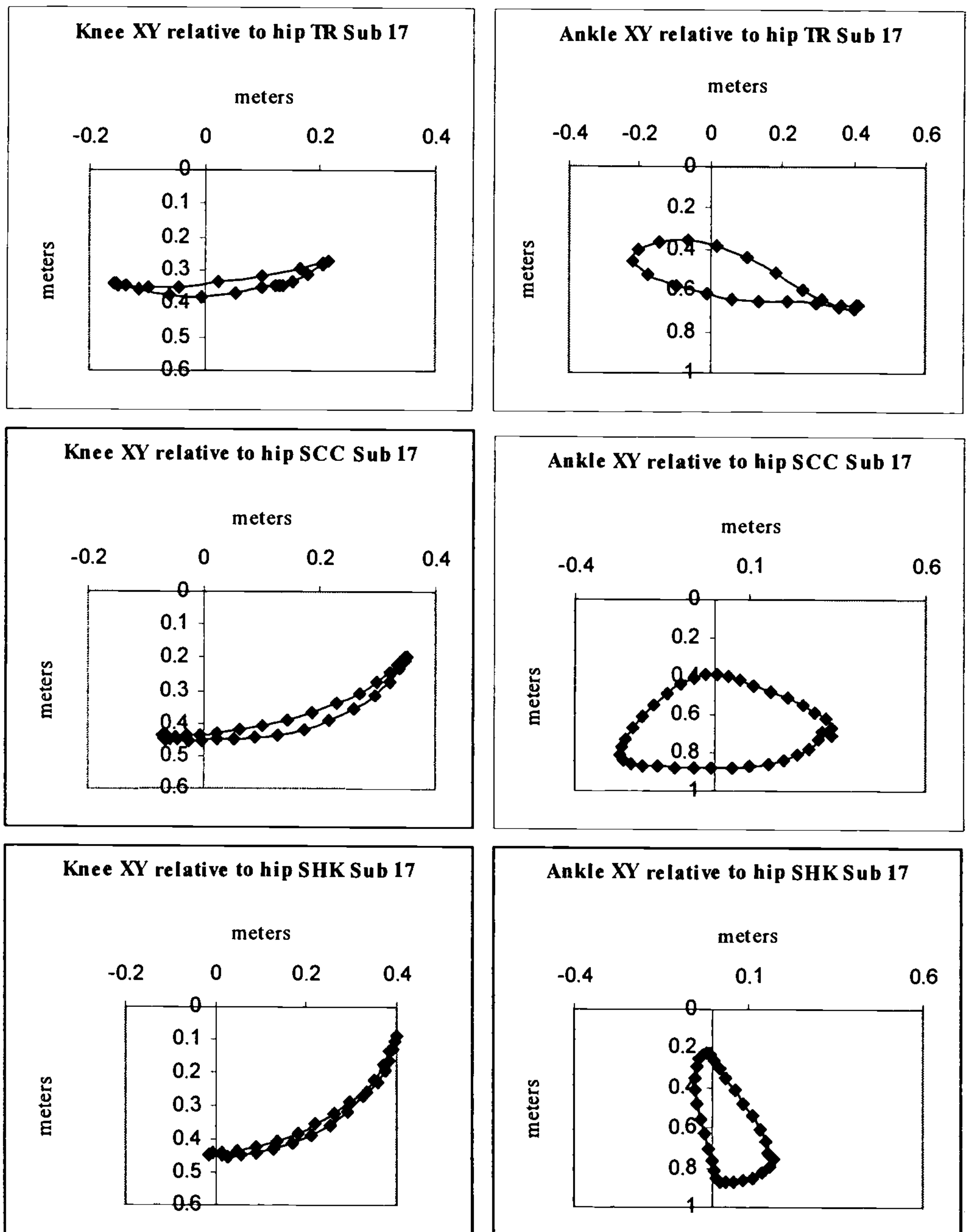


**Figure 4**
**Knee and ankle displacement relative to the hip as the zero point (transformed XY)**
**One Representative Stride for Subject 17**
**Treadmill vs. DWR Shod styles**



horizontal minimum and maximum (AXMN, AXMX), ankle vertical minimum (AYMN), and the knee horizontal maximum displacement (KXMX). Furthermore, BCC also exhibited no difference with TR for the knee vertical minimum displacement (KYMN). Conversely, all biomechanical variables demonstrated a statistically significant difference between TR and SHK ($p<.000$). BHK had two non-significant comparisons relative to TR (AXMN $p<.010$ and AYMN $p<.010$), but also exhibited large effect sizes of -1.36 and .84.

## DISCUSSION

The objective of this study was to determine which form of DWR, high knee or cross country, is most like the movement pattern of terrestrial running. Figures 1-4 provide qualitative evidence that ankle displacement during cross-country DWR bore distinct similarities to that during terrestrial running, while ankle displacement during high-knee DWR was not similar to TR or CC DWR. Statistical analyses of the biomechanical data support these observations. Both the minimum and maximum horizontal displacements for CC DWR did not differ from those for TR, while such was not the case for HK DWR. While CC DWR was more similar to TR than was HK DWR with respect to ankle displacement, CC DWR exhibited the greatest difference from TR with respect to stride rate.

## Table 4 Biomechanical Variables Summary (Mean ± SD)

| | TR | SCC | BCC | SHK | BHK |
|---|---|---|---|---|---|
| SR (hz) | 1.25 ± .08 | 0.78 ± .09 | 0.81 ± .08 | 1.13 ± .10 | 1.14 ± .10 |
| SR (per min) | 75.0 ± 4.6 | 46.8 ± 5.4 | 48.6 ± 4.8 | 67.8 ± 6.1 | 68.4 ± 6.5 |
| Knee $Hor_{disp}$ ($X_{min}$ in meters)* | 0.169 ± .03 | 0.325 ± .08 | 0.308 ± .08 | 0.378 ± .06 | 0.357 ± .05 |
| Knee $Hor_{disp}$ ($X_{max}$ in meters)* | -0.156 ± .03 | -0.110 ± .09 | -0.135 ± .06 | 0.020 ± .05 | 0.001 ± .08 |
| Knee $Vert_{disp}$ ($Y_{min}$ in meters)* | 0.304 ± .04 | 0.249 ± .09 | 0.271 ± .08 | 0.126 ± .08 | 0.154 ± .11 |
| Knee $Vert_{disp}$ ($Y_{max}$ in meters)* | 0.373 ± .03 | 0.462 ± .07 | 0.470 ± .05 | 0.466 ± .06 | 0.461 ± .05 |
| Ankle $Hor_{disp}$ ($X_{min}$ in meters)* | -0.186 ± .03 | -0.158 ± .21 | -0.165 ± .16 | -0.071 ± .09 | -0.037 ± .15 |
| Ankle $Hor_{disp}$ ($X_{max}$ in meters)* | 0.447 ± .05 | 0.431 ± .11 | 0.454 ± .08 | 0.172 ± .10 | 0.186 ± .11 |
| Ankle $Vert_{disp}$ ($Y_{min}$ in meters)* | 0.414 ± .11 | 0.345 ± .11 | 0.397 ± .11 | 0.308 ± .07 | 0.338 ± .07 |
| Ankle $Vert_{disp}$ ($Y_{max}$ in meters)* | 0.707 ± .09 | 0.933 ± .11 | 0.931 ± .11 | 0.923 ± .12 | 0.916 ± .11 |

* all displacement values are relative to the difference between the hip as a reference point and the joint center of interest

**Table 5 Statistical Pairwise Comparisons and Effect Sizes for Biomechanical Data**

| | TR/ SCC | TR/ BCC | TR/ SHK | TR/ BHK | SCC/ BCC | SCC/ SHK | SCC/ BHK | BCC/ SHK | BCC/ BHK | SHK/ BHK |
|---|---|---|---|---|---|---|---|---|---|---|
| **SR** | **0.000a** | **0.000a** | **0.000a** | **0.000a** | 0.010 | **0.000a** | **0.000a** | **0.000a** | **0.000a** | **0.000a** |
| | **(5.22)** | **(5.50)** | **(1.33)** | **(1.22)** | (-.33) | **(-3.50)** | **(-3.60)** | **(-3.56)** | **(-3.67)** | **(-.10)** |
| **KXMN** | **0.000a** | **0.000a** | **0.000a** | **0.000a** | 0.072 | **0.000a** | 0.010 | **0.000a** | **0.001a** | **0.002a** |
| | **(-2.60)** | **(-2.32)** | **(-4.18)** | **(-2.83)** | (.21) | **(-.76)** | (-.46) | **(1.00)** | **(-.41)** | **(.35)** |
| **KXMX** | 0.031 | 0.178 | **0.000a** | **0.000a** | 0.133 | **0.000a** | **0.000a** | **0.000a** | **0.000a** | 0.095 |
| | (-.66) | (-.35) | **(-4.40)** | **(-2.62)** | (.28) | **(-1.86)** | **(-1.23)** | **(-2.21)** | **(-1.70)** | (.27) |
| **KYMN** | **0.003a** | 0.044 | **0.000a** | **0.000a** | 0.099 | **0.000a** | **0.000a** | **0.000a** | **0.000a** | 0.020 |
| | **(.79)** | (.55) | **(2.97)** | **(1.88)** | (-.24) | **(1.37)** | **(.95)** | **(1.81)** | **(1.17)** | (-.28) |
| **KYMX** | **0.000a** | **0.000a** | **0.000a** | **0.000a** | 0.785 | 0.381 | 0.011 | 0.360 | 0.029 | 0.232 |
| | **(-1.78)** | **(-2.43)** | **(-1.03)** | **(-2.20)** | (-.13) | (-.06) | (.02) | (.67) | (.18) | (.08) |
| **AXMN** | 0.026 | 0.532 | **0.000a** | 0.010 | 0.816 | 0.079 | 0.019 | 0.036 | **0.004a** | 0.173 |
| | (-.19) | (-.18) | **(-1.64)** | (-1.36) | (.04) | (-.54) | (-.67) | (-.72) | **(-.80)** | (-.28) |
| **AXMX** | 0.556 | 0.761 | **0.000a** | **0.000a** | 0.341 | **0.000a** | **0.000a** | **0.000a** | **0.000a** | 0.458 |
| | (.18) | (-.10) | **(3.44)** | **(2.90)** | (-.23) | **(2.36)** | **(2.23)** | **(3.13)** | **(2.68)** | (-.13) |
| **AYMN** | 0.026 | 0.532 | **0.000a** | 0.010 | **0.002a** | 0.155 | 0.020 | **0.001a** | 0.021 | **0.002a** |
| | (.63) | (.16) | **(1.18)** | (.84) | **(-.47)** | (0.41) | (.08) | **(.99)** | (.66) | **(-.43)** |
| **AYMX** | **0.000a** | **0.000a** | **0.000a** | **0.000a** | 0.794 | 0.255 | 0.020 | 0.341 | 0.029 | 0.196 |
| | **(-2.26)** | **(-2.24)** | **(-1.96)** | **(-2.09)** | (.02) | (.08) | (.16) | (.07) | (.14) | (.06) |

**a=<.005: based on Bonferroni adjustment for post hoc analyses; ( ) = Effect Size**

A strength of this study was that the physiological and biomechanical responses to TR and the two most common forms of DWR were evaluated in the same project, and, in addition, they were compared at the same absolute level of oxygen consumption. Furthermore, this study advanced the biomechanical analysis of DWR by examining XY linear displacement values of the lower extremities, which provides a more informative representation of range of motion during the running gait than joint angle data, which has more typically been presented. The lack of electromyographical data is a limitation of this study. The kinematic data describes the movement patterns and rates, but the EMG data would be necessary to compare the timing and magnitude of muscle recruitment to accomplish the movements. This is relevant when comparing movements performed in air to those in water, which offers both assistance and resistance buoyancy effects. Another limitation is that the subjects' $VO_{2max}$ during DWR was not measured, so it is not known whether or not the subjects were performing at equivalent relative $VO_{2max}$ across the different trials.

This study was designed to conduct all trials at the same absolute $VO_2$. The main effect for $VO_2$ was statistically significant. However, the effect size was relatively small on the only pairwise comparisons (TR vs. SHK) that revealed significance. Based on the small effect sizes and the narrow range among the $\%VO_2$ (57.6%-60.2%) between trials, we are satisfied that the subjects were performing at equivalent $VO_2$ in all trials.

The results indicated that at similar levels of $VO_2$, the HR values were not statistically different. These findings are consistent with other sub-maximal studies reporting no difference (32, 86). In contrast, studies have reported maximal HR during TR to be approximately 15 bpm (± 5.5) higher than the maximal HR values found in DWR (21, 22, 38, 45, 53, 86, 87, 89, 115).

During all styles of DWR trials, the perception of the work intensity (RPE) was significantly higher than the TR responses. This suggests that the subjects in this study were performing at a higher percentage of maximal HR during DWR than TR. The RPE values were 1.5-1.7 points higher on the 20-point Borg Scale during DWR than those found during TR. The DWR RPE values (13.3-13.5) compare well with those provided by Baretta (3) for a moderate intensity of 50-74% of $VO_{2max}$ in DWR. Svedenhag and Seger (115), and other studies (17, 50, 53), also provide evidence that the RPE values are significantly higher in DWR as compared to TR at sub-maximal intensities. Since TR $VO_{2max}$ has been reported to be approximately 15.6% (± 6.5%) higher than DWR $VO_{2max}$ (21, 22, 38, 45, 53, 86, 87, 89, 115), the higher RPE responses reported may be reflective of the subject working at a higher relative percentage of their $VO_{2max}$ during DWR than during TR, even though the absolute $VO_2$ was controlled across all trials.

Another plausible explanation for the higher RPE responses during DWR may be the greater involvement of the relatively untrained arms in the task. During TR, the arms swing through the air, while during DWR they swing through water, which imposes far greater resistance to movement. The legs encounter greater resistance to movement too, but they are also relieved of a weight-bearing load. Thus, even though the subjects are working at the same absolute $VO_2$, it would be appropriate to conclude that the arms are contributing more to the oxygen cost, and the legs less, during DWR than during TR. This shift in the responsibilities of the arms and legs during DWR as compared to TR has also been described by Michaud, Rodriguez-Zayas, Andres, Flynn, and Lambert (91). The higher RPE may be due, in part, to a greater involvement of the less well-trained and smaller muscle groups of the arms.

The biomechanics of DWR is closely linked to the physiological and metabolic results observed. The density of water is 800 times that of air, which requires a larger energy expenditure to overcome the drag that is created (35). The drag and buoyancy forces affect the DWR gait pattern (61), but without an electromyographical (EMG) analysis of muscle fiber recruitment, it is difficult to quantitatively determine the extent of the differences with TR. Mercer (85), in an unpublished research project using one subject, utilized EMG and video to compare the cross-country and high-knee styles of DWR to TR. He found that while TR is different from DWR kinematically, the differences were primarily due to the absence of ground contact and no support phase in DWR. Furthermore, the EMG data indicated that at sub-maximal levels during DWR, muscle activity patterns are different from TR, but with increases in intensity the DWR movement patterns became more like TR.

Qualitatively, the cross-country style of DWR is more like TR (Figures 1-4). These figures illustrate ankle horizontal displacement excursions in the cross-country style that closely resemble those found in TR. The assistance force of buoyancy in DWR allows the knee to lift higher than would be normal in TR. Thus the statistically significant pairwise comparisons (Table 5) of vertical differences shown between land-based running and the cross-country style are explained. TR also has a ground contact period and is affected by gravity. This is apparent in the graphs of the knee where the displacement curve exhibits a minor depression in the middle of the curve, which corresponds with footstrike, whereas this is non-existent in the DWR curves. After full extension of the leg and prior to flexion, drag on the lower leg and the resistance force of buoyancy (61) acts on the distal end of the lower extremity during DWR to produce hyperextension of the knee during both the shod and barefoot cross-country styles of DWR (SCC: -5.99° ± 5.6° and BCC: -7.51° ± 5.4°). The hyperextension of the knee during the cross-country style of DWR is consistent with results reported by Mercer (85). This finding has ramifications primarily for DWR injury rehabilitation. It is advisable to caution the DWR to limit the full extension of the leg. This should decrease the likelihood of possibly causing more harm while using the CC style of DWR. Additionally, this knee hyperextension is also likely to be a manifestation of a longer period of the gait cycle occurring in front of the hip than is found while TR. This observation is corroborated by the descriptive joint angle data for the hip in this study (TR: -13.6° ± 5.6°; SCC: 14.01° ± 7.7°, BCC: 11.81° ± 9.6°).

The quantitative results found in Tables 4 and 5 help to substantiate the qualitative assessment of the similarities between cross-country DWR and TR. This is particularly true relative to the horizontal displacements, where there were no significant differences demonstrated between TR and the cross-country style for the ankle minimum (AXMN) and maximum (AXMX), and the knee maximum (KXMX) displacement values. Also, the ankle vertical minimum (AYMN) was not significantly different.

Nurse and Nigg (99) and others (120) have demonstrated that running and walking gait patterns are influenced by foot sensation, upon which shoes exert a major influence. For this reason, this study included DWR trials where shoes were worn to evaluate whether or not gait was affected when there is no ground contact.

The only difference demonstrated between the shod or barefoot condition in the cross-country style was that the TR/BCC comparison at the knee vertical minimum (KYMN) revealed no significant difference, while there was a difference in the TR/SCC comparison of the same variable; otherwise, it appears as if the shoes make very little or no difference in DWR styles.

The stride rates calculated for the cross-country style reveals more time spent completing the CC stride cycle than the SR for TR (SCC: .78 ± .09 Hz, BCC: .81 ± .08 Hz, TR: 1.25 ± .08). These findings are 62.4 % and 64.8% for SCC and BCC respectively of TR and are consistent with reported DWR SR of 60-65% of TR (44). This is likely indicative of the ankle encountering more resistance buoyancy and drag forces (61), and an increased linear horizontal ROM. Reported stride rates need to be evaluated with caution (131). Many authors (93, 123-128) either inaccurately report SR, when in fact they are reporting step rate (counting every single step), or they do not differentiate between DWR styles.

The high-knee style is the most commonly practiced and tested style of DWR. The high-knee style is more similar to marching in place (85) or using a stair stepping exercise machine. Both qualitatively (Figures 1-4) and quantitatively (Tables 4 and 5), the high-knee style is significantly different from TR. With this gait pattern, there is a more pronounced vertical component, due to the increase in assistance force of buoyancy, with very little horizontal displacement. Almost every aspect of the data analysis yields a statistical difference between TR and the high-knee style of DWR. The only exceptions are for the pairwise comparisons of the TR vs. barefoot high-knee (BHK) at the ankle horizontal and vertical minimums (AXMN, AYMN). The SR are faster in the high-knee style of DWR (SHK: 1.13 ± .10 Hz and BHK: 1.14 ± .10 Hz) compared to the cross-country style, but are not as fast as TR (1.25 ± .08). The SR during high-knee styles represented 90.4% and 91.2% of TR SR for SHK and BHK, respectively. Although this style has a SR that approaches that for TR, this rate is accomplished at the expense of horizontal displacement of the ankle and thus a much reduced linear ROM of the leg.

**Summary.**

The extent of the physiological differences between land-based running and DWR at a sub-maximal level appears to be minimal, with the exception of RPE responses. While many studies have focused on these physiological responses in DWR (2, 12, 14, 17, 18, 20, 21, 22, 27, 32, 36, 37, 38, 42, 44, 45, 53, 58, 76, 86, 87, 89, 91, 95, 104, 112, 115), the purpose of this investigation was to identify a style of DWR that would best satisfy the principle of specificity of training by providing a close approximation of TR and thus enhance the training effect (44, 85). This was the first investigation to focus on the linear horizontal and vertical displacement (XY) at the knee and ankle in DWR. The XY data verify that the movement pattern of the CC style is similar to TR. These data have been graphically illustrated in Figures 1-4. The graphs provide qualitative evidence that the cross-country styles are more like land-based running, particularly with respect to the linear horizontal displacement of the ankle. Furthermore, the quantitative results demonstrated this assertion as well. These conclusions were irrespective of DWR while shod or barefoot. SR was also examined with the CC style exhibiting a rate that was approximately 62-65% of TR, while HK was approximately 90% of TR.

As an adjunct form of distance running training or rehabilitation, the two forms of DWR styles (CC, HK) offer different forms of overload. If the desired effect of DWR is to best mimic TR relative to linear ROM movement specificity, and thus provide more specific biomechanical and muscular carry-over value to a runner, the CC style is recommended. However, if the desired effect is to emphasize stride cycle rate, irrespective of linear ROM, the HK style is a closer approximation of TR.

**Recommendations for future studies.**

1. Quantifying the differences in distribution and timing of underlying muscular recruitment patterns of each of these DWR styles.

2. A graded exercise test (GXT) will need to be developed using the CC style of DWR. The DWR CC style GXT will then need to be compared to a TR GXT to calculate at a mean difference. This should allow the person in the field to better evaluate the DWR's relative workout intensity.

3. Based on the CC DWR GXT, a CC DWR style cadence chart will need to be developed as a guide to workout intensities. This chart could also include mean RPE and HR values.

4. Study of the differences between DWR vs. TR energy substrate utilization.

5. Based on a post-test questionnaire, there is reason to believe that wearing shoes while DWR merits further investigation. It is likely that there was a perceptual motor, and/or, psychological response that was not readily discernible within the current analysis.

6. Possible gender differences, primarily associated with adjustment of buoyancy device placement and changes in center of buoyancy issues, merits further investigation.

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# APPENDICES

# APPENDIX A
# REVIEW OF LITERATURE

The review of literature for this study encompasses a review of water running exercise physiology including maximal and sub-maximal effort metabolic responses, rating of perceived exertion, graded exercise testing, and training adaptations, and finally the biomechanics of running in water.

**Water Running Exercise Physiology.** Before reviewing the specific research pertaining to deep water running exercise physiology, it is important to point out that there are several methodological differences exhibited in these studies. One of the more pronounced differences can be found relative to the flotation or buoyancy device worn by the subjects. This is an important consideration because, depending on the type of flotation device and where on the body it is worn, the runner's center of buoyancy and consequently the amount of work the runner experiences physiologically and biomechanically will be affected. For example, Town and Bradley (118), Ritchie and Hopkins (106), and Yamaji, Greenley, Northey, and Hughson (132) did not use <u>any</u> type of flotation or buoyancy device. Gehring, Keller, Brehm, and Smith (50) had one of their trials completed without any type of buoyancy device while their other two trials used a vest in deep water and on a treadmill. This is important relative to deep water running kinematics. Based on anecdotal and qualitative evidence, as well as this study's pilot data, this style of running in deep water creates an over-reliance on the upper body for propulsion and a degradation in the "natural" or "cyclic" running motion into more of a high knee ("piston") leg action with an arm action that more closely resembles "dog paddling". This contention is supported by Wilbur, Moffatt, Scott, Lee, and Cucuzzo (121), Frangolias and Rhodes (44), and Michaud, Brennan, Wilder, and Sherman (90). In fact, the last authors stated that their subjects reported that with fatigue there was a greater reliance on the upper body to accomplish the deep water running trials. Obviously, any physiological comparison then must take this important biomechanical difference into consideration, particularly with respect to the "specificity of training" principle. Furthermore, there are a variety of different buoyancy devices used, i.e. Eyestone, Fellingham, George, and Fisher (42) used a "life jacket"; Griffin (55) used flotation devices worn around the ankle; the "wet vest", a device designed to be worn around the chest area of the runner, was used in several studies (12, 20, 21, 22, 37, 38, 50, 52, 53, 58, 59, 95, 96, 104, 115). Lastly, the "AquaJogger®" is worn around the waist area of the runner and has been widely used as well (14, 17, 18, 44, 45, 46, 65, 76, 85, 86, 87, 88, 89, 90, 91, 94 102, 109, 112, 121, 128). Once again, the position of the buoyancy device may have important ramifications physiologically and/or biomechanically relative to changes in the center of buoyancy. This center of buoyancy change could further exacerbate the aforementioned over-reliance on the upper body as a means to increase propulsion. This switch in muscle group primary innervation would have a concomitant increase in the amount of work the weaker particular muscle group produces, i.e. upper body, and consequently an increase in metabolic cost to the runner.

A similar change in muscle group over-reliance can be seen in water of differing depths. Of interest to note, is that the upper body becomes much more important to the runner in water of approximately chest depth. Although Town and Bradley (118) reported that "shallow water running technique better simulates the on-land running movement", it is paramount to understand that this statement was more a reflection of the "push-off" similarities between shallow water and treadmill running. An important consideration is the depth in which the runner is accomplishing her/his task. Based on pilot work and years of anecdotal observations, there is evidence to support the notion that waist deep water does indeed provide a similar running motion as that found on land. However, it is important to realize though that when the runner moves into progressively deeper water (up to the chin), there is a concomitant change in kinematics to allow the upper body to provide more propulsive force. This running movement is more similar to a "piston" or "high knee" style running motion. Again, this is related to the change in center of buoyancy and the inability to "push off" of the pool bottom with as much force as can be seen in the shallow water.

Of particular interest to the present study is that only two other investigations utilized <u>any</u> type of shoe while running in the pool. Hamer and Morton (58) used a pair of "Dunlop Volley" tennis shoes to "provide optimal traction while running on the bottom of the pool". These shoes were only used during their shallow water running trials and were used to protect the feet as well as to gain traction. Dowzer, et al (37) used the "sprint aqua pool shoe" to afford their subjects with the same relative protection as Hamer and Morton. Similarly, "aqua shoes" or Nike's "aqua sock" (no longer in production) have been used in aquatic aerobics classes for this same purpose. Wearing these "aqua socks" or "aqua shoes" is a fairly common practice in shallow water exercise classes (39, pg. 270). However, the relative physiological or biomechanical consequences of using these "aqua shoes" has not been thoroughly investigated, especially while running in deep water. Running in shoes while in deep water, even though the fott never touches the bottom of the pool, may provide more neuromuscular feedback via the shoe and increase the runner's sensation of terrestrial running. This contention is perhaps corroborated by Nurse and Nigg (99) who found that changes in muscle activity on the plantar surface of the foot are associated with the amount of sensation. Furthermore, Wakeling, Von Tscharner, Nigg, and Stergiou (120), found that lower leg muscle activity is "tuned" in response to ground reaction forces. It would stand to reason then that it might be possible to increase the runner's sensation of running on land by wearing shoes while running in deep water and subsequently better mimic the terrestrial running pattern. This postulation may be supported by Brown, Chitwood, Beason, and McLemore (17) who stated "sensations from the working muscles are important contributing signals to perceptual responses (Cafarelli, 1982) and may be more important during exercise in water". In addition to the possible increase in the neuromuscular feedback, the shoe will also increase the amount of work the runner experiences. Martin (77) demonstrated that wearing shoes while running on land increases the load on the lower extremity, thereby increasing the oxygen consumption and heart rate. Martin further pointed out that other studies have consistently shown an approximate increase in energy costs of roughly 5-10% when shoes are added to the feet. It is expected that the addition of running shoes while deep water running will certainly increase drag forces and thus increase the resistance for the runner with a concomitant increase in metabolic cost.

Another physiological point to consider is the temperature of the water. McArdle, Magel, Lesmes, and Pechar (80) used six subjects on a cycle ergometer in shallow water to determine physiological adjustments ($VO_2$, Q, SV, and HR) made due to temperature. Their results indicated that the maximal heart rate was significantly ($p<0.05$) lower at 18 and 25 degrees celcius versus 33 degrees. This decrease in heart rate was offset though by the primary adjustment of increasing the stroke volume to allow similar cardiac output and energy expenditure between land and in the water. To note is that during work in 18° and 25°C water that the $VO_2$ averaged 25.3% and 9.0% higher values than those found in 33°C, with the largest differences not surprisingly found in leaner subjects. Nakanishi, Kimura, and Yokoo (95) point out that thermoneutral water temperature for water immersion at rest is considered to be 35°C or 95°F. They further relate that during exercise, water thermoneutrality is thought to be between 29° and 33°C (84.2°-91.4°F). Interestingly, recreational and competitive swimming pools are kept at a slightly lower temperature than this range, i.e. 25.6°-27.8°C (78°-82°F). Of the studies currently reviewed that used temperatures considered within this exercise thermoneutral range Yamaji, Greenley, Northey, and Hughson (132) used the highest recorded temperature (32.5°C) to test their healthy non-smoker males in deep water running. Gleim and Nicholas (54) used 30.5°C water to test their subjects while walking on a treadmill in shallow water. While Dowzer, et al (38; 29°) and Michaud, et al (91; 29°-30°) used a similar temperature. Lower temperatures ranged from 24-28.5° C relative to deep water running studies (104, 24-26°; 115, 25°; 122, 27°; 59, 27; 90, 27°-29; 45, 28; 12 and 38, 28°; and 106, 28.5°). Of these latter studies, Nakanishi et al (95) point out that "consequently, there would always be thermal effects of water, which cannot be ignored when investigating physiological responses."

**Maximal effort metabolic responses on the treadmill and in water running.** In physiological studies of running in water, one of the topics most often investigated is a comparison of treadmill running with shallow and/or deep water running, particularly relative to maximal oxygen uptake ($VO_{2max}$) and heart rate. Table 1 provides a summary of the research related to the deep-water area of investigation.

Upon examination of table A.1, it becomes apparent that throughout these studies there are significantly lower maximal heart rates and $VO_{2max}$ values associated with running in deep water. In fact, as can be identified in the summary section of this table, the mean percentage difference relative to $VO_{2max}$ values for females reveals a 17.99% (±4.7) greater value for the treadmill vs. the deep water running $VO_{2max}$. Similarly, the males exhibit a difference of 16.8% (±8.48) greater values on the treadmill. The combined mean difference was 15.58% (±6.53).

Interestingly, the maximal heart rates found in both sexes demonstrate a similar trend in greater values on the treadmill, but exhibit roughly ½ of the difference of that found in the $VO_{2max}$, i.e. the females exhibited a 7.46% (±3.1) difference with the males slightly higher at a 9.1% (±4.16) difference in favor of the treadmill values. In terms of the heart rate (bpm), this percentage difference represents an almost 14 bpm (13.97 ±5.3) difference greater on the treadmill for females and 16.1 (±7.7) bpm for males. The combined difference was 15.18 (±5.48) bpm representing a percent difference of 8.34% (±3.22). Of importance to note is that only one study obtained relatively no difference between the two media (TR vs. DWR) in terms of the $VO_{2max}$ and $HR_{max}$. Wilbur, et al (121) found a treadmill $VO_{2max}$ of 60.1±3.6 vs. a deep water running $VO_{2max}$ of 59.6±5.4 with a % difference of only .85. Of major interest however might be the fact that this is also the only study to find a higher DWR $HR_{max}$ (192.1±10.2) as compared to the treadmill value of 188.3 (±7.2). Interestingly, they only used well-trained male runners with a minimum $VO_{2max}$ of 55 $ml \cdot kg^{-1} \cdot min^{-1}$ who were currently running at least 5-7 days/week and had prior experience in running for more than 60 minutes at a time. One possible explanation for this anomaly might be found in the subjects' prior experience with DWR. These researchers collected their data after the subjects completed a two-week DWR technique orientation period. This observation might be strengthened by Mercer (85) and Frangolias and Rhodes (44, 45), who cite the need to control the DWR technique to insure proper form. Conversely, it should be pointed out though that this contention may not have provided that large of an influence considering that Frangolias and Rhodes (44), who used at least three DWR technique training sessions with "elite" runners, found a much greater $VO_{2max}$ difference of 8.5% in favor of the treadmill and a 7.9% difference relative to treadmill heart $rate_{max}$. While these percentage differences are certainly one of the lowest of the studies reviewed, they may not be able to provide the same provocative conclusion of virtually no difference between treadmill running and deep water running found in Wilbur, et al (121). However, it is important to point out that the highest differences found between the treadmill and the deep water running maximal values were a 26.88% greater treadmill $VO_{2max}$ (96) and a heart $rate_{max}$ percent difference of 14.59% in favor of the treadmill (118). It is important to note that Nakanishi, Kimura, and Yokoo (96) used middle-aged healthy non-smoker males. Obviously, this sample is not even remotely similar to the highly trained runners used in the Wilbur, et al (121) study. Similarly, Dowzer, et al (38) used a group of middle-aged (40yrs. ±9.8) male runners, but did not exclude any based on training status and/or their $VO_{2max}$, to record a large $VO_{2max}$ difference of 25.5% in favor of the treadmill. Furthermore, this study suggested that the "skill level" of the runner was an important consideration. These two studies suggest a trend in differences associated with a lack of experience with deep water running, but may also suggest an age-related trend. Just as importantly, Town and Bradley (1991) did not use any type of

Table A.1 $VO_{2max}$/HR TR vs.DWR

| Study | $VO_{2max}$ (TR) (ml·kg$^{-1}$·min$^{-1}$) | $VO_{2max}$ (DWR) (ml·kg$^{-1}$·min$^{-1}$) | difference (ml·kg$^{-1}$·min$^{-1}$) | % different | HR (TR) (beats/min) | HR (DWR) (beats/min) | difference (beats/min) | % different |
|---|---|---|---|---|---|---|---|---|
| Butts, Tucker, Greening | ♂ 64.5±2.8 | 58.4 ± 3.9 | TR>6.1 | TR>9.54 | 193.3 ± 5.8 | 183.4 ± 5.9 | TR>9.9 | TR>5.13 |
| | ♀55.7±4.8 | 46.8 ± 5.9 | TR>8.9 | TR>16.02 | 188.7 ± 9.3 | 179.5 ± 7.5 | TR>9.2 | TR>4.88 |
| Butts, Tucker, Smith | ♀54.7±7.0 | 46.8 ± 9.1 | TR>7.9 | TR>14.44 | 197.9 ± 9.4 | 180.3 ± 6.0 | TR>17.6 | TR>8.9 |
| Dowzer, Reilly, Cable, Nevill | ♀55.39±8.46 | 41.27 ± 6.37 | TR>14.12 | TR>25.5 | 176 ± 12 | 153 ± 16 | TR>23 | TR>13.07 |
| Frangolias & Rhodes | ♂ 63.4±4.2 | | | | | | | |
| | ♀53.7±4.2 | | | | | | | |
| (combinedVO2max) | 59.7 ± 6.4 | 54.6 ± 5.2 | TR>5.1 | TR>8.5 | 190 ± 11 | 175 ± 12 | TR>15 | TR>7.9 |
| Glass, Wilson, Blessing, & Miller | ♂ 56.8±6.5 | 51.2 ± 7.3 | TR>5.6 | TR>9.96 | 191 ± 13.4 | 173 ± 13.4 | TR>18 | TR>9.43 |
| | ♀49.3±7.0 | 43.1 ± 7.1 | TR>6.2 | TR>12.58 | 186 ± 11.3 | 174 ± 9.5 | TR>12 | TR>6.45 |
| (combinedVO2max) | 53.1 ± 7.6 | 47.1 ± 8.1 | TR>6 | TR>11.3 | 189 ± 12.3 | 174 ± 11.3 | TR>15 | TR>7.94 |
| Mercer & Jensen '98 | ♂ 60.3±13.9 | 49.9±9.9 | TR>10.4 | TR>17.25 | 188 ± 9 | 174 ± 9 | TR>14 | TR>7.45 |
| | ♀46.3±5.7 | 37.6±5.3 | TR>8.7 | TR>18.79 | 192 ± 7 | 180 ± 8 | TR>12 | TR>6.25 |
| Mercer & Jensen '97 | ♂ 63.0±11.96 | 51.2±11.32 | TR>11.8 | TR>18.73 | 187 ± 8.9 | 174 ± 9.1 | TR>13 | TR>6.95 |
| | ♀46.6±5.88 | 37.0±5.16 | TR>9.6 | TR>20.6 | 192 ± 7.3 | 182 ± 7.1 | TR>10 | TR>5.2 |
| Mercer, Jensen, & Fromme (combinedVO2max) | 54.51 ± 12.87 | 43.61± 11.06 | TR>10.9 | TR>10.9 | 189 ± 12.3 | N/A | N/A | N/A |
| Michaud, Brennan, Wilder, & Sherman'95 (combinedVO2max | (L·min-1) 2.49 ± 0.68 | (L·min-1) 2.15 ± 0.59 | TR>.34 | TR>13.6 | 189 ± 11.2 | 175 ± 13.9 | TR>14 | TR>7.4 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ) | | | | | | | | |
| Michaud, Rodriguez-Zayas, Andres, Flynn, & Lambert | (L·min-1) | (L·min-1) | | | | | | |
| | ♂ 4.3±.10 | 3.8±0.11 | TR>.5 | TR>11.6 | 184 ± 2.6 | 168.8 ± 5.2 | TR>15.2 | TR>8.26 |
| Nakanishi, Kimura, Yokoo '99 | ♂ 51.8±9.2 | 41.0±8.7 | TR>10.8 | TR>20.85 | 190.8 ± 9.1 | 171.5 ± 13.6 | TR>19.3 | TR>10.11 |
| Nakanishi, Kimura, | a.♂ 49.5±7.6 | 39.0±7.8 | TR>10.5 | TR>21.21 | 193.9 ± 6.7 | 169.2 ± 15.1 | TR>24.7 | TR>12.74 |
| Yokoo '99 | b.♂ 41.3±8.0 | 30.2±7.1 | TR>11.1 | TR>26.88 | 183.3 ± 13.4 | 158.4 ± 19.7 | TR>14.9 | TR>13.58 |
| a.=young, b.=mid aged | | | | | | | | |
| | (L·min-1) | (L·min-1) | | | | | | |
| Svedenhag & Seger | ♂ 4.6±0.14 | 4.03±0.13 | | TR>12.39 | 188 ± 2 | 172 ± 3 | TR>16 | TR>8.5 |
| Town & Bradley (approx. values) | ♂ 70 | 52 | TR>18 | TR>25.71 | 185 | 158 | TR>27 | TR>14.59 |
| Wilbur, Moffatt, Scott, Lee, & Cucuzzo | ♂ 60.1±3.6 | 59.6±5.4 | TR>.5 | TR>.85 | 188.3 ± 7.2 | 192.1 ± 10.2 | DWR>3.8 | DWR>1.98 |
| **Summary** | **$VO_{2max}$ (TR)** | **$VO_{2max}$ (DWR)** | **difference** | **% different** | **HR (TR)** | **HR (DWR)** | **difference** | **% different** |
| Female Mean±SD | 51.67±4.4 | 42.10±4.3 | 9.24±2.7 | 17.99±4.7 | 188.77±7.4 | 174.8±11.0 | 13.97±5.3 | 7.46±3.1 |
| Male Mean±SD | 58.1±8.44 | 48.0±9.6 | 9.4±4.89 | 16.8±8.48 | 189.0±3.6 | 172.6±10.77 | 16.1±7.17 | 9.1±4.16 |
| Difference | ♂>6.43 | ♂>5.9 | ♂>.16 | ♀>1.19 | ♂>.23 | ♀>2.2 | ♂>2.13 | ♂>1.64 |
| Combined Mean±SD | 55.26±7.15 | 46.13±7.79 | 10.6±6.9 | 15.58±6.53 | 189.15±4.72 | 173.36±9.12 | 15.18±5.48 | 8.34±3.22 |

buoyancy device and recorded the second highest $VO_{2max}$ difference in favor of the treadmill at 25.71%. They also recorded the highest heart $rate_{max}$ difference of 14.59% in favor of the treadmill. The determinant factor in this study quite likely though is due to not wearing any buoyancy device. Not wearing any type of flotation device has a marked effect on the running kinematics in deep water and subsequently metabolically the runner must work much harder to keep his/her head above water.

The statistically significant differences found between maximal treadmill running and deep water running relative to $VO_{2max}$ ($ml \cdot kg^{-1} \cdot min^{-1}$) and heart rate (beats per minute) are consistently found regardless of gender. Specifically, Butts, et al (21) in their study using male and female trained runners found that the males exhibited a 10% lower $VO_{2max}$ value in the deep water than those seen on the treadmill (Treadmill (TR) $VO_{2max}$ in $ml \cdot kg^{-1} \cdot min^{-1} = 64.5$ (± 2.8) vs. 58.4 (±3.9) for deep water running (DWR)) while the females exhibited approximately a 16% lower value (TR $VO_{2max}$ in $ml \cdot kg^{-1} \cdot min^{-1} = 55.7 \pm 4.8$ vs. $46.8 \pm 5.9$ for DWR). There were also approximately 10 beats per minute (BPM) lower heart rates exhibited while running in deep water (♀ TR = 188.7 ± 9.3 vs. DWR = 179.5 ± 7.5 and ♂ TR = 193.3 ± 5.8 vs. DWR = 183.4 ± 5.9). These were significant ($P > 0.05$) findings irrespective of gender.

These researchers also found that ventilation volumes ($L \cdot min^{-1}$) were significantly ($P < 0.01$) lower while running in deep water (♀ TR = 111.6 ± 7.0 vs. DWR = 97.7 ± 10.9 and ♂ TR = 150. ± 11.6 vs. DWR = 140.8 ± 17.8). Similarly, Butts, et al

(22) used high school female cross country runners and found that peak heart rates (17.6 BPM) and $VO_{2max}$ values (17%) were significantly ($P > 0.001$) lower in response to running in the water compared to the treadmill trials. Frangolias and Rhodes (45) found similar significant ($p<0.001$) differences irrespective of gender for $VO_{2max}$ and $HR_{max}$ and a significant difference for RER ($p<0.003$). Glass, et al (53) found the same results ($p<0.05$) as well as for lactate differences. Also, Mercer and Jensen (86) used 15 men and 13 women to determine that there were significant ($p<0.01$) differences between the treadmill and DWR. These same researchers in 1997 (87) used 12 women and 14 men to record a statistical ($p<0.05$) difference.

To summarize, based on the investigations cited it appears as if treadmill running exhibits a larger percent difference versus deep water running relative to maximal oxygen uptake (Mean TR<15.58% ± 6.53) and maximal heart rate (Mean TR<8.34% ± 3.22). This difference occurs in both genders and represents a female specific mean difference of 17.99% (± 4.7) for oxygen consumption ($VO_{2max}$) and 7.46% (± 3.1) for heart rate (BPM), and a male specific mean difference of 16.8% (± 8.48) for oxygen consumption and 9.1% (± 4.16) for heart rate. It does appear however, that there may be a relationship between the "skill level" of the runner and these physiological maximal variables of interest. To further corroborate this point, Dowzer, et al (38) relate that in their study "the less skilled in water running had higher heart rates for a given $VO_2$ during water running". Furthermore, these metabolic and physiological differences are commonly explained as a consequence of the increased hydrostatic chest compression causing a cephalad shift in blood volume from the lower extremities and abdomen and the associated central hypervolemia and viscosity friction promoting venous return. Additionally, there is an increase in stroke volume to offset the decrease in heart rate to maintain cardiac output (44, 124).

To date, there exists very little research related to the physiological effects of shallow water running. It would appear that this difference in research priorities may have more to do with the more accepted method of deep water running in injury rehabilitation and the larger benefits to the musculoskeletal system in terms of attenuation of loads. With that said, shallow water running (SWR) studies have produced perhaps less provocative findings relative to the differential between these same maximal physiological variables ($VO_2$ and HR), but just as with DWR nonetheless have been found to be significantly different from land running. Dowzer, et al (38) found a statistically significant difference ($p<0.05$) between both treadmill and shallow water $VO_{2max}$ (TR 55.39± 8.46 vs. SWR 45.94 ± 6.1) and heart rate$_{max}$ (TR 176 ± 12 vs. SWR 165 ± 16). Similar findings were reported by Town and Bradley (118). Using nine male collegiate cross country runners, they found that SWR heart rate$_{max}$ was 88.6% of that found on the treadmill. Additionally, $VO_{2max}$ values yielded a similar difference of 90.3%. Both were statistically significant ($p<0.05$).

**Sub-maximal effort metabolic responses on the treadmill and in water running.** Ancillary to maximal physiological differences are sub-maximal comparisons between treadmill and deep water running. Of importance to note is that comparisons between maximal and sub-maximal studies are complicated by the variability in methods used to separate intensities within the respective investigations. These methods to "control" intensity can be categorized as: "self-selected", percentages of either treadmill or DWR maximal efforts, cadences, ratings of perceived exertion (RPE) and combinations thereof. This section will deal primarily with sub-maximal "self-selected" and the percentage of either treadmill or DWR maximal efforts. Subsequent sections will include the other intensity methods as well as graded exercise testing (GXT).

An example of one of the more ambiguous and highly subjective methods can be found in one of the earliest studies on DWR. Bishop, et al (12) used seven "well-trained" runners (five men and two women) to compare a 45 minute treadmill steady state self-selected pace trial to a 45 minute deep water running trial at a "similar level of intensity". It is important to note that this study has some difficulties to say the least. For example, the "well-trained" runners ranged from one world-class competitor to two subjects who rarely ran competitively. Another problem might be the "self-selected" nature of controlling the intensity of each media's trials irrespective of a physiological marker other than a "Rating of Perceived Exertion". However, their rationale was to provide a trial that might more closely match true training conditions for the runners. Their results indicated a very large percent difference between the two media running trials, i.e. TR $VO_{2max}$ in ml·kg$^{-1}$·min$^{-1}$ (40.6 ± 2) exhibited a 36% greater value than those found in DWR (29.8 ± 3.5) with $HR_{max}$ in beats per minute differences demonstrating a slightly less percent difference of 29% (TR 157 ± 7.3 vs. DWR 122 ± 9.7). It would appear as if the combined data of males and females plus the large range in ability could have greatly influenced these data. In a very similar fashion, Yamaji, et al (132) also allowed their subjects to self-select "easy", "moderate", and "hard" efforts to determine their workloads. Importantly, just as in the previous study, their subjects exhibited a large range in abilities, i.e. recreational to international caliber marathoners, but were all males (N=10). Needless to say, their results indicated a considerable amount of between-subject variability. Ritchie and Hopkins (106) used a similar method to obtain their results. However, it is important to point out that these subjects completed their 30 minute "hard" and "normal" training paces in deep water without any type of flotation device. As previously suggested, it is very likely that these trials were not only difficult physiologically to complete without such a device, but also most probably completed without adequate attention to the biomechanics of the deep water gait pattern. This certainly would have elicited similar conclusions as those drawn from the aforementioned studies regarding no buoyancy device (118, 45). Not surprisingly, their results indicated that mean $VO_2$, RQ, perceived effort and perceived pain during the DWR trials were all significantly higher than those found in normal running (either treadmill or road). An opposing view in favor of using a "self-selected" method is provided by the research of Sherman and Michaud (112). They used 21 men and 19 women who were all healthy and physically active to determine if a sub-maximal deep water running bout could be used to estimate $VO_{2max}$. The subjects were tested on the treadmill to determine their $VO_{2max}$ and their cadence. Subsequently, the subjects' cadence was recorded to help control their intensity while running in the pool. Then, using the hierarchical sums of squares approach they found that cadence (strides · min), RPE, and body weight were significant ($p<0.05$) variables in estimating $VO_{2max}$. It was determined that their multiple regression model was highly accurate with a low standard error of estimate of 0.33 $L \cdot min^{-1}$. However, it is best to keep in mind that the generalizability of this study is inclusive of only this population.

In a perhaps more rigidly controlled study relative to the intensity of the running bouts, DeMaere and Ruby (32) used "seasonally trained college-aged male cross country runners (N=8)" to determine that $VO_2$, RPE, and energy expenditure were not statistically significantly different between running trials on a treadmill and in deep water. Furthermore, they found that DWR as compared to 80% of TMR $VO_{2max}$ yielded significantly higher carbohydrate oxidation and lower fat oxidation. It is plausible that this latter conclusion may yield supporting evidence to the notion that there is a shift to the relatively "weaker" (upper body) muscle groups and thus different energy substrate utilization, i.e. increased reliance on glycolysis and/or glycogenolysis in a less trained area of the body (pg. 180). This contention may be summarized by the author's statement that "DWR is a comparable form of sub-maximal intensity exercise as TMR in well-trained athletes. DWR does, however, maintain unique properties that differs it from TMR". As further evidence in support of this postulation, Svedenhag and Seger (115) and Michaud, et al (91) found not only greater blood lactate levels, but that DWR also elicited increased RER values. Svedenhag and Seger (115) further reported that for any given $VO_2$, HR was 8-11 beats per minute lower in DWR than TR, irrespective of intensity. These authors also related that running technique was altered due to the external hydrostatic load with a concomitant increase in anaerobic metabolism in DWR. Michaud, et al (91) further add that muscle fiber type recruitment, i.e. a shift from Type I to a higher usage of Type II, as well as the shift in primary responsibility of the larger better trained (for running) muscle groups of the lower body to the smaller more untrained muscle groups of the upper body, may also play a role in the differences between running in each media. Regardless of which muscles are used Michaud, et al (91) also found an important result relative to the currently proposed study; steady state (sub-maximal) oxygen consumption was not significantly different between deep water running at 75% of treadmill $VO_{2peak}$, nor likewise for running at 75% of treadmill $VO_{2peak}$. Similarly, Mercer and Jensen's (86) results provide evidence that during sub-maximal exercise the HR-$VO_2$ relationship is similar between running in each media. To arrive at their conclusions, they used 15 men and 13 women to compare heart rates to $VO_2$ levels at 60, 80, and 100% of both peak HR and $VO_2$ on the treadmill and in deep water. They found that although maximal TMR values were significantly higher ($p<0.01$), there were no significant differences in heart rates at equivalent sub-maximal $VO_2$ levels between trials for either gender ($p<0.10$).

**Rating of Perceived Exertion.** The rating of Perceived Exertion scale was developed by Gunnar Borg. Borg's scale was originally developed to allow the exerciser to make subjective evaluations of her/his feelings during exercise based on their current state of fatigue, the environment, and fitness level (47). This scale is typically used in graded exercise testing, but is also widely used in exercise classes and workouts to enable the student (athlete) and instructor (coach) to better monitor the intensity of exercise. Table A.2 contains the two most widely used scales, the original Borg Category Scale (6-20 points) and the modified Category-Ratio Scale (1-10 points). The RPE is considered a valid and reliable indicator of relative intensity for the subject on land with most subjects achieving their subjective limit at 18-19 or 9-10 (depending on the scale). Lately, the RPE scale and modifications have been used in DWR as another indicator of intensity. Baretta (3) offers the following scale specifically designed for the water and based on the wide range in heart rate and oxygen consumption values associated with running in water of varying depths, temperatures, and with various pieces of equipment which all influence the amount of resistance:

| %Max HR | %$VO_2$ max | RPE | Intensity |
|---|---|---|---|
| <35 | <30% | <9 | very light |
| 35-39 | 30-49 | 10-11 | light |
| 60-79 | 50-74 | 12-13 | moderate |
| 80-89 | 75-84 | 14-16 | heavy |
| >90 | >85 | >16 | very heavy |

Brennan (13) further offers the following deep water running cadence chart that identifies a RPE scale from 1-5:

| RPE | Water Tempo(CPM) | Land Based Equivalent |
|---|---|---|
| 1 | very light (50) | slow walk (>21 min/mile) |
| 2 | light (50-60) | medium paced walk (15-20 min/mile) |
| 3 | somewhat hard (60-75) | fast walk/jog (<15 min/mile) |
| 4 | hard (75-80) | run (5-10 min/mile) |
| 5 | very hard (>85) | very hard run (<5 min/mile |

Similarly, McWaters (84) offers a slight variation on the Borg RPE scale. The Borg/McWaters Scale, along with the aforementioned Borg Scales may also be found in table 2-2, but does not differ substantially from Borg's modified 10 point scale.

Regardless of the type of scale used there appears to be general agreement in the results that the RPE's for experienced runners between treadmill running (TR) and deep water running (DWR) tend to be similar. Hamer and Slocombe (59) determined Pearson product moment correlation coefficients for HR versus RPE (original Borg) to be $r = 0.75$ on the treadmill and $r = 0.72$ in DWR. Furthermore, of the studies that used the Borg Category Scale (6-20), Svedenhag and Seger (115) found that at maximal heart rate and oxygen consumption that both DWR and TR demonstrated identical RPE's of 17. However, they also found that at a sub-maximal level (calculated perceived exertion at $VO_2$ 3.5 $l \cdot min^{-1}$) that the DWR RPE was significantly higher ($p<0.01$) as compared to the treadmill running RPE. Frangolias and Rhodes (45) reported that at maximal $VO_2$ and HR in both TR and DWR that the reported RPE's were the same (20; non-significant).

**Table A.2 Ratings of Perceived Exertion Scales**

| Category Scale (Borg) | Description | Category-Ratio Scale | Description | Intensity (I) | Borg/ McWaters Scale | Description |
|---|---|---|---|---|---|---|
| 6 | | 0 | Nothing | No "I" | 0 | nothing |
| 7 | Very, very | 0.3 | at all | | 1 | very,very weak |
| 8 | light | 0.5 | Extremely | Just | 2 | very weak |
| 9 | Very light | 0.7 | weak | noticeable | 3 | weak |
| 10 | | 1 | Very Weak | | 4 | somewhat weak |
| 11 | | 1.5 | | | 5 | moderate |
| 12 | | 2 | Weak | Light | 6 | somewhat hard |
| 13 | Somewhat | 2.5 | | | 7 | hard |
| 14 | hard | 3 | Moderate | | 8 | very hard |
| 15 | Hard | 4 | | | 9 | very, very hard |
| 16 | | 5 | Strong | Heavy | 10 | maximal (all out) |
| 17 | Very hard | 6 | | | | |
| 18 | | 7 | | | | |
| 19 | Very, very | 8 | | | | |
| 20 | hard | 9 | | | | |
| | | | | Strongest | | |
| | | 10 | Extremely | "I" | | |
| | | 11 | Strong | Highest | | |
| | | | Absolute | | | |
| | | | Max | possible | | |

Similarly, Butts et al (22) found no significant difference between media when testing female cross country runners (TR 19.1 and DWR 19.3). Bishop, et al (12) reported a 6% greater, but non-significant difference on the treadmill at a self-selected pace. Likewise, DeMaere and Ruby (32) found no significant differences at 60% (TR 11.6 ± 2.1 vs. DWR 10.7 ± 1.9) and 80% (TR 15.7 ± 1.3 vs. DWR 14.0 ± 1.7) intensities. Dowzer et al (37) did not find a significant difference between shallow water running, DWR, and TR at 80% of maximum. Not surprisingly, Gehring et al (50) found that with seven female "non-competitive" runners there was a 21% higher RPE ($p<0.05$) in deep water with no vest as compared to the treadmill. Additionally, they reported a 14-24% higher VO2, HR, VE, and RPE compared to the vested condition. This certainly lends credibility to the aforementioned differences found with "inexperienced runners" (38).

Michaud, et al (89) used the 10 point Borg scale to determine that there was no significant difference in maximal values between the TR (9.1) and DWR (9.9) trials. Likewise, Michaud et al (91) report no difference between the TR (9.0) and DWR (9.0) results. These findings are consistent with Nakanishi et al (95) who reported a difference of only 0.05 for the breathing RPE between the treadmill ($9.65 \pm 0.67$) and DWR ($9.60 \pm 0.82$). They found a slightly higher, but still non-significant difference (0.55) relative to the legs only RPE (TR $9.10 \pm 1.86$ vs. DWR $9.65 \pm 0.59$). These same authors used young and middle-aged males to determine very similar results irrespective of age (96). Conversely, Glass et al (53) used this scale to control the intensity of the running trials on both the treadmill and in deep water. They found a significant ($p<0.01$) difference between media at both the 5-6 ("aerobic conditioning") and 9-10 (hard intervals) intensity levels relative to heart rate and $VO_2$ values. To further corroborate these contradictory findings, Brown et al (17) used the Borg scale and found that the mean RPE were statistically significantly higher in DWR than on a treadmill at equal leg speeds regardless of gender. However, two important points regarding this study may have influenced their results greatly: 1) The subjects were twenty four college-aged volunteers who were not trained athletes, 2) Stride rate on the treadmill is faster than that found in DWR ($p<0.001$, 59; Frangolias and Rhodes (45) indicated a significantly lower stride rate of 60-65% of the treadmill for DWR). This is somewhat confounded by their description of "strides/min" when in fact they were reporting "steps/min". Also, the style was "high knee" or more of a "piston" action. These same researchers in a subsequent article (44) pointed out that even though there was not a statistically significant difference found between genders, "there are important gender differences accompanying perception of effort during DWR". They felt that the women tended to have a slightly higher association between exercise intensity ($VO_2$ and HR) values and perceived exertion than men.

Ritchie and Hopkins (106) instead of using any of the aforementioned RPE scales, used a Perceived Effort (% max, 0-100) and a Perceived Pain (% max, 0-100) subjective subject evaluation. Their results with these eight male competitive runners indicated that only one of three thirty minute bouts of running produced a significant difference with the treadmill ($p<0.05$) relative to "Perceived Effort" with no differences found relative to "Perceived Pain".

To summarize, the rating of perceived exertion scale, irrespective of which version or gender, seem to indicate similar results relative to treadmill and DWR. Not surprisingly, there also appears to be more variability apparent with inexperienced or non-competitive runners. It appears then that the use of RPE in conjunction with other physiological factors certainly yields an important indication of work intensity in DWR.

**Graded Exercise Testing in DWR.** A study was conducted to specifically determine the reliability and validity of a deep-water running (DWR) graded exercise test (GXT) by Mercer and Jensen (87). These researchers used a system of pulleys and weights to incrementally increase the subjects' workload. They found that this system was reliable (repeated measure one-way ANOVA) for both male and female participants relative to $HR_{peak}$ and $VO_{2peak}$ during DWR (total group $VO_{2peak}$ relative $R = .96$, $R_{1,1} = .92$ and $VO_{2peak}$ absolute $R = .90$, $R_{1,1} = .82$; $HR_{peak}$ $R = .90$, $R_{1,1} = .82$). Similarly, there was a significant correlation between DWR and TR for the total group (total group $VO_{2peak}$ relative $R = .88$, $p = .001$; absolute $R = .93$, $p = .001$; $HR_{peak}$ $R = .64$, $p = .001$) suggesting that the GXT was valid. Furthermore, their results ($HR_{peak}$ and $VO_{2peak}$) demonstrated a significant correlation between DWR and TR. This indicates that if a subject had high peak values in DWR, they would also tend to have higher values on the treadmill. However, only $VO_{2peak}$ was significantly correlated for females. Not surprisingly, they further found significant differences ($p < .01$) between DWR and TMR for the means of $HR_{peak}$ (men: 174 vs. 187 bpm; women: 182 vs. 192 bpm) and $VO_{2peak}$ (relative men: 51.2 vs 63.0 $ml \cdot kg^{-1} \cdot min^{-1}$; women: 37.0 vs. 46.6 $ml \cdot kg^{-1} \cdot min^{-1}$ and absolute men: 4.1 vs. 5.0 $L \cdot min^{-1}$; women: 2.2 vs. 2.7 $L \cdot min^{-1}$). These latter findings are consistent with many of the aforementioned studies. They also found no significant differences ($p < .05$) for RER and RPE for either group between DWR and TMR. In a similar study, Mercer, Jensen, and Fromme (88) established the reliability of a DWR GXT by intra-class correlation for $VO_{2peak}$ and $HR_{peak}$ as

.94 and 0.50 ($p<.01$) respectively. They further suggested that if DWR is the mode of exercise that the prescribed HR should be based on a DWR GXT, otherwise the training HR may be over-predicted.

Another method to obtain information relative to the prescription of intensities for DWR is to use cadence. Wilder, Brennan, and Schotte (128) used the perhaps more practical method of the "Wilder/Brennan" protocol to determine that cadence and heart rate were highly correlated ($r = 0.73$. $p < 0.01$) in their study using 10 men and 10 women. This protocol consists of commencing with a cadence of 48 cycles (two steps/cycle or the more commonly accepted version of stride rate) for 4 minutes as a warm-up and then increasing every two-minutes by 3-4 cycles set by the metronome until volitional fatigue. However, it is important to note, that our pilot data and anecdotal evidence suggest that the many of the higher cadences cannot be achieved using a normal running motion.

**Training Effects of DWR.** One of the more compelling questions regarding deep water running and injured athletes is if this type of exercise modality helps to maintain appropriate levels of fitness; specifically, cardiovascular fitness which can significantly decrease within three weeks (42). An ancillary question is if DWR can be used to supplement training programs with similar benefits.

In an effort to answer these questions, Eyestone et al (42) completed a study on maximum oxygen consumption and two mile run performance over a six-week training period. They used thirty two male subjects from a population of student who successfully completed a fitness class at BYU and had finished in the "excellent" or "superior" category in a 1.5 mile run. The subjects were split into running, cycling, or aqua running groups. The frequency, duration, and intensity of exercise were kept constant. The results indicated that although there was a statistically significant decrease in $VO_{2max}$ values, the changes were not physiologically (practically) significant. All three groups decreased their 2-mile run times (statistically non-significant). They concluded that an injured runner could certainly maintain their cardiovascular fitness while running in the pool, provided the runner used the same duration, intensity, and frequency of training as he/she would normally. Similarly, a significant ($p<0.01$) increase in $VO_{2max}$ values were found by Brennan, et al (14) in an eight-week study using eight females and two males. Bushman, et al (20) used eleven well-trained competitive distance runners to determine that using four weeks of deep water running training maintained terrestrial running levels. No significant differences were found between 5,000 meter run times, pre and post-training (pre: 1142.7 ± 39.5 seconds; post: 1149.8 ± 36.9 seconds), sub-maximal oxygen consumption (pre: 44.8 ± 1.2 $ml \cdot kg^{-1} \cdot min^{-1}$; post: 45.3 ± 1.5), lactate threshold running velocity (pre: 249.1 ± 0.9 $m \cdot min^{-1}$; post: 253.6 ± 6.3), or maximal oxygen consumption (pre: 63.4 ± 1.3 $ml \cdot kg^{-1} \cdot min^{-1}$; post: 62.2 ± 1.3). Also, no differences were found relative to global Mood State during any of the training phases (pre, during, post). These findings are corroborated by Hertler et al (65) who used thirteen runners to determine that water training was a successful replacement training modality for maintenance of $VO_{2max}$ and leg strength, over a four-week period. Further corroboration is provided by Morrow, Jensen, and Peace (94) who found that with ten weeks of DWR training, improvements can be seen relative to treadmill $VO_{2max}$ and 2.4 kilometer run times. Hamer and Morton (58) offered that their study provided similar evidence that an eight-week water-running program not only satisfied the principle of specificity, and just as importantly was successful in improving aerobic and anaerobic fitness in their nine male subjects. Providing further evidence in the ability to maintain aerobic performance using DWR, the previously discussed study by Wilbur et al (122) provides results that indicated that with "trained runners" DWR can maintain their aerobic performance for up to six weeks. Quinn et al (104) provided slightly contrary evidence that a four week DWR training program that followed a ten week land based training program would only help to maintain $VO_2$ in untrained females. Their subjects demonstrated a 7% decrease over their post land based training VO2. This is still better than the 16% decrement associated with activity cessation reported by Coyle (1984). Lauder and Burns (76) provide evidence that DWR is a highly beneficial alternative for military personnel who could not engage in regular training activities due to injuries. Rudzki and Cunningham (109) further noted that when implementing DWR after high-impact activities, i.e. marches, etc. their injury incidence rates decreased markedly. Interestingly, the military experiences an incidence rate of stress fractures of 4-5% (1) to 8.8% (67). To the military, the use of DWR may have positive ramifications in terms of decreasing the loss of personnel hours and money (76, 109).

**Summary of Water Running Exercise Physiology.** A review of the relevant literature pertaining to water running exercise physiology reveals that: (a) temperature, type of buoyancy device, running style, and the use of any type of equipment, i.e. shoes, physiologically effects the deep water runner, (b) relative to maximal physiological differences there is a statistically greater difference in favor of treadmill running vs. deep water running relative to maximal oxygen uptake (Mean TR<15.58% ± 6.53) and maximal heart rate (Mean TR<8.34% ± 3.22), irrespective of gender. It appears as if there may be a relationship between the "skill level" of the runner and these physiological maximal variables of interest. Furthermore, these metabolic and physiological differences are commonly explained as a consequence of the increased hydrostatic chest compression causing a cephalad shift in blood volume from the lower extremities and abdomen and the associated central hypervolemia and viscosity friction promoting venous return. Additionally, there is an increase in stroke volume to offset the decrease in heart rate to maintain cardiac output, (c) there is a large amount of variability between the conclusions relative to sub-maximal efforts that may be in large part due to the large variation in subject pools and methodological differences in determining intensities, (d) the use of the rating of perceived exertion (RPE) scale, irrespective of which version or gender, seems to indicate similar results between the treadmill and DWR, (e) the use of a DWR graded exercise test may be indicated to provide a more accurate representation of monitoring maximal intensities, however, from a practical perspective, cadence may certainly be used, (f) training studies largely agree that there is physiological and metabolic benefit to the specificity of deep water running as a supplement to training and as a rehabilitation modality

**Biomechanics of water running.** To date, compared to the exercise physiology of running in water, there is a paucity of research related to the biomechanics of running in the pool. This is interesting when considering the possible affects of technique, i.e. style, and differences associated with equipment, i.e. buoyancy devices or shoes. Of particular interest to the present study are the differences in DWR style as a concern raised by researchers (44) relative to the possible conclusions that may be drawn from the data. Furthermore, several factors in an aquatic environment produce different physiological effects: 1) water is an accommodating resistance on the body that increases with intensity in DWR (32). In fact, di Prampero (35) states that water resistance (drag) is "the major force to overcome in aquatic locomotion", requiring a large energy expenditure (pg. 64). He further relates that this is in large part due to the density of water being approximately 800 times that of air, 2) buoyancy is a force that can assist, resist, or support movements in water (61). Gravity is counteracted by the upward lift of buoyancy. In fact, the in water approximate body weight differential of 1/10 that of on land provided by buoyancy, the heart does not have to pump as hard to circulate blood (3). It is therefore important to consider the type and location of any buoyancy device relative to the physiological consequences, and 3) Haralson (61) further relates that the hydrostatic pressure is directly proportional to the depth of the body part and offsets lower extremity pooling of blood. As previously mentioned this has been implicated in lower deep water maximal values exhibited in both heart rate and $VO_2$ relative to the land-based values (44).

Several of the previously described physiological studies mentioned running style as one of the variables they "controlled". However, it is important to note, that few specifically examined proper running technique relative to the physiological variables of interest. This is interesting when considering the following statement "water immersion (WI) running style is also a factor in the metabolic responses exhibited in the water medium and it is therefore critical that simulation of land-based running style be encouraged in future WI running studies" (44). Furthermore, Wilder and Brennan (124) asserted that the physiological responses can be maximized by proper attention to DWR technique. With this in mind, several studies either provided a cursory glance at running style or simply made no mention of the actual techniques employed. For example, Ritchie and Hopkins (106) do not describe the DWR technique, but instruction was provided by one of their subjects who had experience in DWR. Bishop et al (12) and Michaud et al (91) simply told their subjects to "simulate the running motion" (land-based) and provided two or three practice sessions respectively. Svedenhag and Seger (115) in a single session, allowed a coach to analyze and provide feedback in DWR mechanics to their group of athletes. Bushman et al (20) provided two "familiarization" sessions after their subjects viewed a videotape of DWR technique. However, no specific technical analysis of the DWR gait was provided by these researchers. Similarly, DeMaere and Ruby (32) related that

DWR technique varied, but did not mention specifics of the kinematic variability. Butts et al (21) allowed the commencement of data acquisition after their subjects developed "proper form". However, "proper form" was never described. Interestingly, one of the most common techniques that runners adopt in DWR is a "high knee" or piston style motion, particularly with the onset of fatigue. This high-knee drive style of DWR is probably more akin to the technique that might be employed on a stair-stepping machine or running up a very steep grade. Mercer (85) further relates that this piston style motion is similar to "marching in place". Quinn et al (104) specifically required their subjects to use this "bicycle motion". Hamer and Morton (58) and Hamer and Slocombe (59) allowed familiarization sessions of this high knee style. Town and Bradley (118) mentioned the high knee drive and over-reliance on the upper body more characteristic of this style. They further related that shallow water running was closer to that found on the treadmill due to a push-off phase. It is important to note, however, that this assertion is only true up to approximately waist depth water. In chest deep water, the runner experiences much more "floating", with a concomitant decrease in the ability to maintain a proper push-off phase. This subsequently leads to a degradation in proper running technique. In pilot work and from several anecdotal cases, this particular style is usually used by "inexperienced" runners. The importance of style of running in deep water commonly manifests as an increase in heart rate and oxygen consumption. Yamaji, et al (132) found a trend between the increase in these physiological variables and the less "skilled" runners within their study.

Specific kinematic details were described by Wilbur et al (122) who used a two-week orientation and instruction period on "proper form". An acceptable stride was one in which "a) the lead leg maintained at least 90 degrees of knee flexion through the swing phase with the succeeding footplant extending a minimum of 0.5 foot anterior to the coronal plane and b) the trail leg extended at least 0.5 foot posterior to the coronal plane". This same description of an "acceptable stride" was provided by Nakanishi et al (96). Wilder and Brennan (125, 126, 127) provide one of the most comprehensive analyses of DWR technique guidelines:

1. The water line should be at the shoulder level. The mouth should be comfortably out of the water without the head having to be tilted back. The head should be looking straight ahead, not down.
2. The body should assume a position slightly forward of the vertical, with the spine maintained in a neutral position.
3. Arm motion is identical to that used on land, with primary motion at the shoulder. Hands are held lightly clenched.
4. Hip flexion should reach approximately 60-80 degrees. As the hip is being flexed, the leg is extended at the knee (from the flexed position). When end hip flexion is reached, the lower leg should be perpendicular to the horizontal. The hip and knee then extend together, the knee reaching full extension when the hip is in neutral (0 degrees of flexion). As the hip is extended, the leg is flexed at the knee. These movements are repeated, and throughout the cycle the foot undergoes dorsiflexion and plantarflexion at the ankle. The ankle is in a position of dorsiflexion when the hip is in neutral and the leg is extended at the knee. Plantarflexion is assumed as the hip is extended and the leg flexed. Dorsiflexion is reassumed as the hip is flexed and the leg extended. Underwater viewing shows us that inversion and eversion accompanies dorsiflexion and plantarflexion, as it does in land-based running.

Lauder and Burns (76) provide a very similar description from the military's DWR program with the additional following common errors cited (pg. 255):

- using the hands to cup the water and propel the individual forward and to keep the head above water;
- moving the arms in a dog-paddle fashion with abduction at the shoulders;
- using uncharacteristic lower trunk mechanics, such as incomplete flexion at the knees and hips or a swim-style kick; and
- performing a cycling motion with the legs.

In one of the earliest attempts at comparing both the physiology and biomechanics of deep water running to that of terrestrial running, Glass (52) used ten male and ten female recreational runners, aerobic dancers, swimmers, and triathletes. Glass used ten in the deep water trials and the other ten on the treadmill, but only six subjects were used for the biomechanical analysis (joint angles). The subjects completed a graded exercise test protocol, using cadence to control the workload increases. However, it appears as if she used steps/min rather than the reported strides/min, or that the subjects used the "high knee" style to attain the very fast stride turnover rates reported (started at 80 RPM and went up to a maximum of 164 RPM). The style used is difficult to determine from the description of "DWR technique in the manner described by the manufacturer". Based on a 2 x 3 ANOVA on six joints (hip, knee, shoulder, elbow, ankle, and trunk) the results indicated statistically significant differences between deep water running (suspended and tethered) and treadmill running for trunk excursion, knee and trunk cross, hip and trunk maximum angle, and hip minimum angle at each RPE level (pg. 46). It is important to note that the subjects in this study may have been trying to attain too high a rate of turnover creating an "unnatural" running motion. This may have contributed to the statistically significant differences. This contention is perhaps best corroborated by the hip maximum angle values exhibited, i.e. treadmill @ RPE 3-4, 5-6, 9-10: 186°, 192°, 195° vs. DWR joint angles at the same RPE levels: 157°, 156°, 153°. This indicates that the subjects never reached full extension in DWR. It would appear then that most of the attention in this study was directed toward the actual physiological differences rather than the biomechanical differences. This contention is exemplified in a subsequent article (53).

In another "biomechanical differences" study, Moening, Scheidt, Shepardson, and Davies (93) used a single subject design in an effort to determine the mechanical relationship between deep water running and treadmill running. The subject was videotaped from the sagittal view in both media. Their results indicated large differences in style between the two types of running. The largest differences were exhibited at maximum hip flexion in knee drive (60° for treadmill and 120° for DWR), maximum knee flexion in knee drive (TR: 80° and DWR: 140°), and maximum knee flexion in backswing (TR: 140° and DWR: 25°). Also, it is very important to point out that they reported a much higher rate of turnover in DWR relative to the treadmill, i.e. 21 "strides/min" greater. This is contradictory to what is commonly reported. Stride rate on the treadmill is faster than that found in DWR (59). Similarly, Frangolias and Rhodes (44) indicated a significantly lower stride rate of 60-65% of the treadmill for DWR. Since no specific instructions seemed to have been given to the subject regarding the style of running, it would appear that this subject chose to adopt the "high knee" style of running that is more common with "inexperienced" runners.

Griffin (55) specifically examined the changes in biomechanics of running in deep and shallow water relative to land-based running on a treadmill. Just as was the case with the previously described Glass (52) study, RPE (Borg 13, 15, 18) was used to determine the relative workload for the six subjects (three women and three men). All subjects were runners from the local area who ran a minimum of 55 kilometers/week and were injury free. All subjects were filmed from the sagittal view and wore an ankle buoyancy device. The placement of the buoyancy device at the distal end of the body segment could have possibly affected the results due to "the difficulty of controlling the device" (85). With this in mind, it would be prudent to interpret the results somewhat cautiously. The results indicated that with an increase in RPE, each subject seemed to develop an individualized biomechanical strategy as to the best method to attain the new level. This was accomplished by increasing movement speed, increasing range of motion, or a combination of both. This variability is not surprising, and in fact fairly common relative to running kinematics (6, 23, 34,131). Interestingly, increases in the relative hip angle were exhibited in both the deep (RPE 13:55°, 15:54°, 18:56°) and shallow (RPE 13:63°, 15:63°, 18:62°) trials relative to the treadmill (RPE 13:45°, 15:48°, 18:48°). This would indicate a higher knee drive while in the water trials with the highest reported in the shallow water. This is consistent with the results previously reported by Moening, et al (93), and with the anecdotal qualitative, as well as pilot quantitative evidence. This is also likely indicative of the high knee style. It was further concluded that deep water running technique best duplicated running on land and was thought to be "a better choice for coaches and trainers" (pg. 72).

Mercer (85), in a currently unpublished preliminary study, provides insight into the actual muscle activity patterns associated with deep water running. A single subject was used to determine not only muscle activity (via electromyography (EMG)) levels between treadmill and deep water running, but also an analysis of the temporal relationships of the ankle, knee, and hip joints. One of the most interesting aspects of this study is that Mercer used two different running styles 1) the cross country style which he felt was qualitatively most similar to treadmill running, and 2) the high knee style which was more similar to "marching" and resembles more of a "piston-like" action. This is important relative to the currently proposed study in that, this is the first study to ever even recognize a qualitative, and very likely, a quantitative difference in DWR styles. Furthermore, a stride was defined properly as the time between consecutive right heel contact points. The results indicated that stride rate for a given heart rate was lower than those found on the treadmill. This is consistent with the reported literature (44, 59) Mercer further felt that the cross country style, even though it was most like treadmill running qualitatively, was different from treadmill running primarily due to the DWR style having no support phase (no ground contact). Furthermore, during this style there is a tendency to hyperextend at the knee joint. This is also due primarily to having no ground contact with the hamstring not being able to generate enough force to stabilize the joint, allowing the dominant force to be buoyancy.

Anecdotally, this over-striding is definitely a factor to be cognizant of in this particular style. The DWR EMG data, as compared to other published EMG data, indicated that at lower intensity levels there appears to be different muscle patterns. However, as the subject's intensity increased the muscle activity patterns became more similar to terrestrial running. Mercer further cautioned that this was only a preliminary investigation with more in depth studies required to confirm this observation. In a subsequent study (102) found that for the vastus lateralis the muscle patterns were similar between treadmill and deep water running. However, the biceps femoris exhibited a roughly 180° out of phase pattern. Additionally, while the treadmill pattern typically had a single dominant peak, the DWR biceps femoris pattern exhibited two distinct peaks. These results would support the notion of using DWR as a supplement to training, but hip extensors and/or knee flexors are recruited differently.

**Summary of the Biomechanics of Water Running.** With this relative paucity of scientific data regarding the biomechanics of deep water running it is difficult to provide a comprehensive training plan for the athlete. However, based on the reviewed studies and on anecdotal evidence, there are some differences associated with styles of running in water: 1) Qualitatively, the "cross country" or "natural" style may illicit more specific neuromuscular, biomechanical, and physiological responses as they relate to land based running, especially if "over-striding" is controlled, 2) The high knee style is the primary style used in shallow water. This is probably due to a ground contact phase with buoyancy forcing the runner's knee toward the surface, 3) DWR is thought to better mimic land-based (treadmill) running than shallow water running, and 4) the experience or skill level of the runner in DWR appears to be an important variable to control.

# APPENDIX B
## Informed Consent Document
## Oregon State University
## Department of Exercise and Sport Science

**Title of the research project:** A Biomechanical and Physiological Comparison of Running Styles in Deep Water.

**Principal Investigator:** Anthony Wilcox, Ph.D., Department of Exercise and Sport Science
**Co-Investigator:** Garry Killgore, M.S., Graduate Student, Department of Exercise and Sport Science; Associate Professor of Health and Human Performance, Head Cross Country and Track and Field Coach, Linfield College

**Purpose of the Research Project:** Deep water running (DWR) has been used for several years for injury rehabilitation and as a supplement to regular training programs. The aim of the present study is to look at the technique (biomechanical) and physiological responses in an effort to better understand which technique is most like land-based running. This should assist runners, athletes, coaches, athletic trainers, physical therapists, sports medicine physicians and chiropractors in determining appropriate running techniques to use in deep water.

**Procedures.**
My participation in this study entails the following activities:

**1) Orientation/Practice**
a) I will complete a one-page health questionnaire and a brief questionnaire to determine my average weekly mileage, personal best performances, and injury history. My body composition (percent body fat) will be assessed through skinfold measurements. The specifics of the study will be explained, and I will watch and discuss a brief (10-15 minute) videotape of deep water running technique with the researcher. This session will take place in the Linfield College Human Performance Lab (HHPA 106), and take approximately 30 minutes.
b) I will participate in three 30-minute deep water running technique practice sessions in the Linfield College pool. I understand it is possible that more practice sessions to insure proper "form" may be deemed necessary by the researcher, but will not exceed five sessions. These sessions will afford me the opportunity to get used to wearing the "aquajogger" flotation device around my waist, wearing shoes while running in deep water, and to practice each of the four running styles. This will also allow me to feel more comfortable and better acquainted with the testing procedures. I will receive video, visual (on a monitor on the pool deck), and verbal feedback from the researcher.

**2) Treadmill** (in the Linfield College Human Performance Lab (HHPA 106)
a) I will participate in a maximal oxygen carrying capacity test ($VO_{2max}$) on the treadmill. I will start the test with a 5-minute warm up of running at either 5 or 6 MPH (females and males, respectively). The test will begin at either 6 (females) or 7 MPH (males), and the speed will increase by 1/2 MPH per minute, until I reach the speed of 10 (females) or 11 MPH (males). From this point, the treadmill will be elevated by 1% per minute until I indicate that I am too fatigued to continue. The test usually takes 12-15 minutes with only the last few (3-5) minutes at a hard pace. During the test, I will be wearing a heart-rate monitor and a mask that holds a breathing valve through which I can inhale room air and which directs my exhaled air to the metabolic cart, where my oxygen consumption will be determined.
b) The treadmill test will be videotaped to analyze my running technique. For the video analysis, a quarter-sized reflective adhesive will be placed on my right shoulder, elbow, wrist, hip, knee, ankle, heel, and toes. To make sure that these are visible during the treadmill test, males will wear running shorts and shoes, and women will wear the same plus a jogbra. The treadmill session will take approximately 45-50 minutes.

**3) Deep Water Running (DWR)** (in the Linfield College swimming pool)
Approximately 24-72 hours after the treadmill test, I will perform the DWR trials. This session will take approximately 60-75 minutes. I will run in the pool while wearing a swimsuit and the "aquajogger" buoyancy device around my waist. I will be tethered to the side of the pool, and a wave-limiting device will be placed around my head and will float around me as I run, to make sure that the breathing apparatus and my head stays dry. The breathing apparatus is the same mask and breathing valve worn during the treadmill test, and I will have access to room air to breathe at all times. I will also be wearing a heart-rate monitor.

The DWR session consists of 4 trials, each of which is 5-6 minutes long and conducted at an intensity that is 55-60% of my $VO_{2max}$ (a moderate to moderately-hard effort). There will be 2-3 minutes of rest between each trial, during which I can hold onto the side of the pool. The researcher will use this time to take off or put on my running shoes when called for. The four DWR styles are:

1) barefoot high knee (a piston-like leg action)
2) barefoot cross country (a slightly larger range of motion in the legs that is similar to running on a cross country course)
3) shod high knee (same as barefoot high knee except I will be wearing running shoes), and
4) shod cross country (same as barefoot cross country except I will be wearing running shoes).

Each of the sessions will be videotaped with an underwater camera. My right shoulder, elbow, wrist, hip, knee, ankle, heel, and toes will be have a quarter-sized circle marked on the joint centers with an indelible pen for the video analysis of my DWR technique. After the DWR trials, I will complete a short questionnaire asking for my feedback on each style of running in deep water.

**Risks and Benefits.**

***Foreseeable risks or discomforts.***

a. I can expect to experience short term fatigue when completing the maximal treadmill test. This fatigue is similar to that felt after running a half-mile race.
b. There is a very remote chance that I may suffer a heart attack during the maximal effort on the treadmill. This is considered a low risk for me, since I am a highly trained endurance athlete who is accustomed to maximal efforts and who has been cleared by medical personnel to participate in intercollegiate athletics. I am aware that the researcher who will be administering the treadmill test is an American Red Cross-trained instructor in first aid and CPR.
c. There is a very remote chance of drowning in the pool. However, I know how to swim, and I will be wearing the "aquajogger" flotation device at all times that I am in the water in this study. I understand that an American Red Cross-trained lifeguard will be on deck at all times in the event that a water rescue is needed.
d. All electrical equipment will be secured to the pool deck to insure that no electrical current can make contact with the water. All electrical outlets are grounded and equipped to automatically shut off immediately if any water does make contact.

***Benefits to be expected from the research.***

a. I will be provided with information regarding my endurance capabilities ($VO_2$), body composition (amount of fat vs. lean mass), and running technique (both on land and in water).
b. I will be making contributions to the understanding of how to properly use running in the pool to promote better fitness and to decrease the time and/or number of times spent injured. However, the few sessions of DWR that I will perform is not expected to directly benefit my fitness.

**Compensation.**

Upon completion of the treadmill test, I will be provided with a t-shirt donated from Nike, Inc. (Beaverton, OR), with an approximate retail value of $20.00. Upon completion of the DWR tests, I will be provided with and an "AquaJogger" donated from Excel Sport Sciences (Eugene, OR), with a retail value of $44.95.

**Anonymity and Confidentiality.**

My name and identity will remain confidential in any written or oral communications of this study. Should there be any public presentation of data, my face will be blacked out on the treadmill videotape to prevent possible recognition. Furthermore, I understand that in the deep water running sessions, my face will be above the camera view and will not be visible on the videotape. Only the researchers will have access to my data, which will remain confidential to the extent permitted by law.

**Compensation for injury.**
Oregon State University and Linfield College do not provide a research subject with medical treatment or compensation in the event of an injury to a subject during participation in this research project.

**Voluntary Participation Statement.**
I affirm that participation in this study is completely voluntary. I understand that I may either refuse to participate or withdraw from the study at any time without penalty or loss of benefits to which I am otherwise entitled. I understand that if I choose to not participate or to withdraw from the study before it is completed, my status on my collegiate cross country team will not be affected in any way.

**If I have questions.**
If for any reason I have any questions and/or concerns about the procedures, I can contact: Dr. Anthony Wilcox, Oregon State University Department of Exercise and Sport Science, (541) 737-2643.

If I have any questions about my rights as a research subject or if I sustain a project-related injury, I should contact the IRB Coordinator, OSU Research Office, (541) 737-3437.

**My signature below indicates that I have read and that I understand the procedures described above, and I give my informed and voluntary consent to participate in this study. I understand that I will receive a signed copy of this consent form.**

Signature of subject ______________________ Name of subject______________
Date ______________

# APPENDIX C1
## Health History Questionnaire

**Full Name:** ______________________________ **Date:** ___/___/___
**Age:** _____ **Date of Birth:** ___/___/___ **I.D. #:** ________

The purpose of this questionnaire is to obtain information regarding your health necessary for the researchers in assisting you with your participation in this study. Please answer all questions to the best of your knowledge. Circle the correct answers.

1. Do you have high blood pressure? YES NO
2. Do you have high blood cholesterol? YES NO
3. Do you currently smoke? YES NO
4. Are you a former smoker? YES NO
5. If so, when did you quit? ______________
6. Have you ever had a heart attack? YES NO
7. Have you ever had chest pain (angina)? YES NO
8. Have any of your blood relatives had heart disease, heart surgery, or angina? YES NO
9. If so, what is the relation? _________What did they have?___________
10. Are you diabetic? YES NO
11. If so, list medications taken.______________________________
12. Do you have any respiratory problems (Example: asthma, emphysema)? YES NO
13. If so, list them. ______________________________
14. Do you have any orthopedic problems (Example: arthritis, low back pain)? YES NO
15. If so, list them. ______________________________
16. Have you had any recent illness, hospitalization, or surgical procedures? YES NO
17. If so, list them and when?______________________________
18. Are you currently taking any medications? YES NO
19. If so, list them. ______________________________
20. Do you have any allergies? YES NO
21. If so, list them. ______________________________
22. Do you have any other conditions or problems that may affect your ability to exercise? YES NO
23. If so, list them. ______________________________
24. Do you feel comfortable in the water (swimming pool)? YES NO
25. Can you swim? YES NO

Please provide us with emergency contact information.

Name: ______________________ Home Phone: ________________

Relation: _____________________ Work Phone: ________________

# APPENDIX C2
## Deep Water Running (DWR)
## Pre testing questionnaire

**Directions:** Please provide an evaluation of each of the following questions.

1. Approximately how many miles/week (avg.) are you currently running? An example range might be 20-30 mi/week, 50-60 min/week, etc.

2. How many days/week (avg.) are you currently running?

3. How many years or months have you been running?

4. Please list your current personal records (where appropriate or known) in each of the following:
Cross Country (with distance, e.g. 8K, 5K, 10K, 6K, etc.)________
10K________ 5K________ 3K________ Steeple________
1500m________
800m________ 400m________

5. Please list any running-related injuries you have had including approximate date and how long you were out of running as a result of that injury.

6. Have you ever run in the pool? If so, did you run in the pool for primarily injury rehabilitation or for conditioning?

7. How many times have you "run in the pool" while wearing an "aquajogger"? Please circle one response.

Never 1-5 6-10 11-20 more than 20

8. How many times have you "run in the pool" while wearing running shoes? Please circle one response.

Never 1-5 6-10 11-20 more than 20

**APPENDIX C3**
**Deep Water Running (DWR)**
**Post testing technical questionnaire**

**Directions:** I am very interested in your evaluation of each style of running in deep water. Please circle the one most appropriate response.

1. Overall, I felt that the barefoot high knee style felt like land-based running.

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |

2. Overall, I felt that the barefoot cross country style felt like land-based running.

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |

3. Overall, I felt that the shod high knee style felt like land-based running.

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |

4. Overall, I felt that the shod cross country style felt like land-based running.

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |

5. I felt that running with shoes on in the pool made me feel like I was running on land.

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |

6. I felt that running barefoot in the pool made me feel like I was running on land.

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |

7. I felt that using the high knee style felt more like I was running on land.

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |

8. I felt that using the cross country style felt more like I was running on land.

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |

9. Using the following rating scale, please rate the styles for feeling fatigue in your hips and thighs.
10 (very, very fatigued)
8-9 (very fatigued)
6-7 (fatigued)
5 (somewhat fatigued)
3-4 (lightly fatigued)
1-2 (none to very, very light fatigue)

Barefoot High Knee______ Barefoot Cross Country ______
High Knee with Shoes ______ Cross Country with Shoes ______

10. Using the same rating scale, please rate the styles for feeling fatigue in the arms and chest.

Barefoot High Knee______ Barefoot Cross Country _____
High Knee with Shoes ______ Cross Country with Shoes ______

**Comments.**

# APPENDIX D
## TABLE D.1
## Sub 1
## TR $VO_{2max}$ Record Sheet

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 6 | 0 | 147 | 13 | 30.1 | 0.84 | 69" |
| 1:00 MIN | 6.5 | 0 | 145 | 14 | 31.8 | 0.84 | 175.3cm |
| 1:30 MIN | 6.5 | 0 | 149 | 14 | 32.0 | 0.86 | |
| 2:00 MIN | 7 | 0 | 150 | 14 | 32.7 | 0.89 | **WT** |
| 2:30 MIN | 7 | 0 | 154 | 15 | 33.5 | 0.88 | 147 lbs |
| 3:00 MIN | 7.5 | 0 | 156 | 15 | 36.1 | 0.88 | 66.9 kg |
| 3:30 MIN | 7.5 | 0 | 159 | 15 | 35.5 | 0.91 | |
| 4:00 MIN | 8 | 0 | 162 | 16 | 38.1 | 0.91 | **DOB** |
| 4:30 MIN | 8 | 0 | 168 | 16 | 39.3 | 0.95 | 3/4/1982 |
| 5:00 MIN | 8.5 | 0 | 170 | 16 | 38.3 | 0.95 | **Age** |
| 5:30 MIN | 8.5 | 0 | 173 | 16 | 40.3 | 0.97 | 20 |
| 6:00 MIN | 9 | 0 | 175 | 17 | 40.7 | 0.98 | **DATE** |
| 6:30 MIN | 9 | 0 | 176 | 17 | 41.4 | 0.98 | 10/4/2002 |
| 7:00 MIN | 9.5 | 0 | 177 | 17 | 43.1 | 1.00 | |
| 7:30 MIN | 9.5 | 0 | 182 | 17 | 42.5 | 1.02 | |
| 8:00 MIN | 10 | 0 | 180 | 18 | 44.0 | 1.02 | |
| 8:30 MIN | 10 | 0 | 181 | 18 | 44.5 | 1.01 | |
| 9:00 MIN | 10 | 1 | 184 | 18 | 46.2 | 1.03 | |
| 9:30 MIN | 10 | 1 | 184 | 18 | 46.7 | 1.08 | |
| 10:00 MIN | 10 | 2 | 186 | 19 | 47.2 | 1.10 | |
| 10:30 MIN | 10 | 2 | 186 | 19 | 48.0 | 1.12 | |
| 11:00 MIN | 10 | 3 | 189 | 20 | 47.2 | 1.16 | |
| 11:30 MIN | 10 | 3 | 189 | 20 | 46.9 | 1.16 | |
| **Mean** | | | **170.52** | **16.61** | **40.27** | **0.98** | |
| **SD** | | | **14.68** | **1.97** | **5.72** | **0.10** | |

**TABLE D.2**
**Sub 2**
**TR $VO_{2max}$ Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 6 | 0 | 130 | 12 | 18.6 | 1.00 | 68" |
| 1:00 MIN | 6.5 | 0 | 136 | 12 | 25.6 | 0.91 | 172.72cm |
| 1:30 MIN | 6.5 | 0 | 142 | 12 | 27.2 | 0.91 | |
| 2:00 MIN | 7 | 0 | 140 | 13 | 29.1 | 0.91 | **WT** |
| 2:30 MIN | 7 | 0 | 147 | 13 | 28.6 | 0.93 | 128 lbs |
| 3:00 MIN | 7.5 | 0 | 148 | 13 | 29.7 | 0.94 | 58.18 kg |
| 3:30 MIN | 7.5 | 0 | 149 | 14 | 31.1 | 0.93 | |
| 4:00 MIN | 8 | 0 | 155 | 14 | 32.1 | 0.91 | **DOB** |
| 4:30 MIN | 8 | 0 | 158 | 15 | 33.6 | 0.96 | 1/19/1982 |
| 5:00 MIN | 8.5 | 0 | 164 | 15 | 34.8 | 0.95 | **Age** |
| 5:30 MIN | 8.5 | 0 | 165 | 15 | 35.3 | 0.97 | 20 |
| 6:00 MIN | 9 | 0 | 169 | 16 | 36.6 | 0.98 | **DATE** |
| 6:30 MIN | 9 | 0 | 171 | 16 | 37.9 | 0.96 | 9/23/2002 |
| 7:00 MIN | 9.5 | 0 | 174 | 17 | 40.0 | 0.99 | |
| 7:30 MIN | 9.5 | 0 | 176 | 17 | 39.7 | 1.00 | |
| 8:00 MIN | 10 | 0 | 177 | 17 | 40.5 | 1.03 | |
| 8:30 MIN | 10 | 0 | 179 | 18 | 43.0 | 1.02 | |
| 9:00 MIN | 10 | 1 | 183 | 18 | 43.2 | 1.06 | |
| 9:30 MIN | 10 | 1 | 185 | 19 | 44.3 | 1.10 | |
| 10:00 MIN | 10 | 2 | 187 | 19 | 46.1 | 1.14 | |
| 10:30 MIN | 10 | 2 | 189 | 20 | 47.1 | 1.17 | |
| **Mean** | | | **163.05** | **15.48** | **35.43** | **0.99** | |
| **SD** | | | **18.08** | **2.50** | **7.48** | **0.08** | |

**TABLE D.3**
**Sub 3**
**TR $VO_{2max}$ Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 6 | 0 | 151 | 10 | 29 | 0.79 | 66.75" |
| 1:00 MIN | 6.5 | 0 | 149 | 11 | 29 | 0.83 | 169.6cm |
| 1:30 MIN | 6.5 | 0 | 152 | 11 | 29.9 | 0.88 | |
| 2:00 MIN | 7 | 0 | 162 | 11 | 30.2 | 0.89 | **WT** |
| 2:30 MIN | 7 | 0 | 161 | 12 | 31.0 | 0.9 | 126.5 lbs |
| 3:00 MIN | 7.5 | 0 | 158 | 12 | 31.2 | 0.89 | 57.5 kg |
| 3:30 MIN | 7.5 | 0 | 167 | 13 | 33.3 | 0.90 | |
| 4:00 MIN | 8 | 0 | 165 | 13 | 34.5 | 0.90 | **DOB** |
| 4:30 MIN | 8 | 0 | 170 | 14 | 36.3 | 0.91 | 1/13/1984 |
| 5:00 MIN | 8.5 | 0 | 168 | 14 | 36.4 | 0.90 | **Age** |
| 5:30 MIN | 8.5 | 0 | 173 | 15 | 37.8 | 0.93 | 18 |
| 6:00 MIN | 9 | 0 | 179 | 15 | 39.3 | 0.96 | **DATE** |
| 6:30 MIN | 9 | 0 | 184 | 16 | 40.4 | 0.98 | 10/4/2002 |
| 7:00 MIN | 9.5 | 0 | 184 | 17 | 42.1 | 1.00 | |
| 7:30 MIN | 9.5 | 0 | 185 | 17 | 41.9 | 1.01 | |
| 8:00 MIN | 10 | 0 | 186 | 18 | 44.2 | 1.04 | |
| 8:30 MIN | 10 | 0 | 190 | 18 | 45.1 | 1.05 | |
| 9:00 MIN | 10 | 1 | 192 | 19 | 46.4 | 1.07 | |
| 9:30 MIN | 10 | 1 | 193 | 19 | 47.4 | 1.09 | |
| 10:00 MIN | 10 | 2 | 193 | 19 | 48.7 | 1.12 | |
| 10:30 MIN | 10 | 2 | 194 | 19 | 49.4 | 1.13 | |
| 11:00 MIN | 10 | 3 | 196 | 19 | 50.3 | 1.15 | |
| 11:30 MIN | 10 | 3 | 197 | 20 | 50.5 | 1.17 | |
| **Mean** | | | **176.04** | **15.30** | **39.32** | **0.98** | |
| **SD** | | | **15.81** | **3.24** | **7.46** | **0.11** | |

**TABLE D.4**
**Sub 4**
**TR $VO_{2max}$ Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 6 | 0 | 146 | 9 | 28.0 | 0.94 | 65" |
| 1:00 MIN | 6.5 | 0 | 149 | 10 | 29.6 | 0.93 | 165.1cm |
| 1:30 MIN | 6.5 | 0 | 149 | 11 | 29.7 | 0.97 | |
| 2:00 MIN | 7 | 0 | 154 | 12 | 30.6 | 0.97 | **WT** |
| 2:30 MIN | 7 | 0 | 156 | 13 | 31.2 | 0.97 | 135 lbs |
| 3:00 MIN | 7.5 | 0 | 152 | 13 | 31.9 | 0.98 | 61.37 kg |
| 3:30 MIN | 7.5 | 0 | 160 | 14 | 31.6 | 0.97 | |
| 4:00 MIN | 8 | 0 | 162 | 14 | 33.6 | 1.01 | **DOB** |
| 4:30 MIN | 8 | 0 | 170 | 14 | 37.3 | 0.97 | 3/8/1984 |
| 5:00 MIN | 8.5 | 0 | 168 | 15 | 36.3 | 1.02 | **Age** |
| 5:30 MIN | 8.5 | 0 | 169 | 15 | 36.9 | 0.98 | 18 |
| 6:00 MIN | 9 | 0 | 177 | 16 | 36.0 | 1.02 | **DATE** |
| 6:30 MIN | 9 | 0 | 166 | 16 | 39.2 | 1.01 | 9/24/2002 |
| 7:00 MIN | 9.5 | 0 | 180 | 16 | 39.4 | 1.01 | |
| 7:30 MIN | 9.5 | 0 | 186 | 17 | 40.7 | 1.01 | |
| 8:00 MIN | 10 | 0 | 185 | 17 | 42.8 | 1.06 | |
| 8:30 MIN | 10 | 0 | 190 | 18 | 43.7 | 1.06 | |
| 9:00 MIN | 10 | 1 | 188 | 18 | 42.1 | 1.09 | |
| 9:30 MIN | 10 | 1 | 192 | 18 | 42.9 | 1.09 | |
| 10:00 MIN | 10 | 2 | 193 | 18 | 45.3 | 1.13 | |
| 10:30 MIN | 10 | 2 | 194 | 19 | 46.3 | 1.13 | |
| 11:00 MIN | 10 | 3 | 197 | 19 | 47.2 | 1.15 | |
| 11:30 MIN | 10 | 3 | 198 | 20 | 48.0 | 1.19 | |
| **Mean** | | | **173.09** | **15.30** | **38.29** | **1.03** | |
| **SD** | | | **17.39** | **3.01** | **6.25** | **0.07** | |

**TABLE D.5**
**Sub 5**
**TR $VO_{2max}$ Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 7.0 | 0 | 137 | 12 | 36.5 | 0.87 | 75" |
| 1:00 MIN | 7.5 | 0 | 136 | 13 | 34.2 | 0.96 | 190.5 cm |
| 1:30 MIN | 7.5 | 0 | 140 | 13 | 39.6 | 0.87 | |
| 2:00 MIN | 8 | 0 | 143 | 13 | 38.9 | 0.87 | **WT** |
| 2:30 MIN | 8 | 0 | 148 | 14 | 39.6 | 0.89 | 166.5 lbs |
| 3:00 MIN | 8.5 | 0 | 145 | 15 | 40.4 | 0.85 | 75.68 kg |
| 3:30 MIN | 8.5 | 0 | 152 | 15 | 42.0 | 0.92 | |
| 4:00 MIN | 9 | 0 | 154 | 16 | 40.4 | 0.93 | **DOB** |
| 4:30 MIN | 9 | 0 | 154 | 16 | 45.1 | 0.91 | 4/2/1983 |
| 5:00 MIN | 9.5 | 0 | 156 | 16 | 43.4 | 0.91 | **Age** |
| 5:30 MIN | 9.5 | 0 | 160 | 17 | 44.9 | 0.90 | 19 |
| 6:00 MIN | 10 | 0 | 161 | 17 | 45.0 | 0.92 | **DATE** |
| 6:30 MIN | 10 | 0 | 163 | 18 | 45.1 | 0.92 | 9/26/2002 |
| 7:00 MIN | 10.5 | 0 | 165 | 18 | 48.1 | 0.95 | |
| 7:30 MIN | 10.5 | 0 | 172 | 18 | 47.8 | 0.94 | |
| 8:00 MIN | 11 | 0 | 172 | 19 | 50.7 | 0.96 | |
| 8:30 MIN | 11 | 0 | 174 | 20 | 50.5 | 0.97 | |
| 9:00 MIN | 11 | 1 | 172 | 20 | 52.1 | 0.97 | |
| 9:30 MIN | 11 | 1 | 179 | 20 | 53.1 | 0.99 | |
| 10:00 MIN | 11 | 2 | 181 | 20 | 53.9 | 1.00 | |
| 10:30 MIN | 11 | 2 | 180 | 21 | 55.7 | 0.99 | |
| 11:00 MIN | 11 | 3 | 184 | 21 | 55.9 | 1.02 | |
| 11:30 MIN | 11 | 3 | 185 | 21 | 56.3 | 1.03 | |
| 12:00 MIN | 11 | 4 | 188 | 21 | 58.4 | 1.06 | |
| 12:30 MIN | 11 | 4 | 188 | 21 | 58.7 | 1.11 | |
| 13:00 MIN | 11 | 5 | 190 | 21 | 60.5 | 1.14 | |
| 13:30 MIN | 11 | 5 | 192 | 21 | 59.3 | 1.15 | |
| **Mean** | | | **165.59** | **17.67** | **48.07** | **0.96** | |
| **SD** | | | **17.57** | **3.01** | **7.70** | **0.08** | |

**TABLE D.6**
**Sub 6**
**TR $VO_{2max}$ Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 6 | 0 | 134 | 11 | 28.5 | 0.91 | 63" |
| 1:00 MIN | 6.5 | 0 | 131 | 12 | 28.2 | 0.94 | 160 cm |
| 1:30 MIN | 6.5 | 0 | 133 | 12 | 29.5 | 0.93 | |
| 2:00 MIN | 7 | 0 | 140 | 12 | 29.8 | 0.93 | **WT** |
| 2:30 MIN | 7 | 0 | 147 | 12 | 32.3 | 0.95 | 112 lbs |
| 3:00 MIN | 7.5 | 0 | 145 | 13 | 32.5 | 0.96 | 50.91 kg |
| 3:30 MIN | 7.5 | 0 | 150 | 13 | 33.9 | 0.96 | |
| 4:00 MIN | 8 | 0 | 156 | 14 | 34.9 | 0.95 | **DOB** |
| 4:30 MIN | 8 | 0 | 157 | 14 | 35.8 | 0.96 | 7/17/1981 |
| 5:00 MIN | 8.5 | 0 | 159 | 15 | 34.6 | 1.04 | **Age** |
| 5:30 MIN | 8.5 | 0 | 160 | 15 | 38.5 | 0.96 | 21 |
| 6:00 MIN | 9 | 0 | 163 | 15 | 38.5 | 1.03 | **DATE** |
| 6:30 MIN | 9 | 0 | 171 | 15 | 40.4 | 0.99 | 9/26/2002 |
| 7:00 MIN | 9.5 | 0 | 170 | 16 | 41.3 | 1.00 | |
| 7:30 MIN | 9.5 | 0 | 171 | 16 | 43.0 | 1.05 | |
| 8:00 MIN | 10 | 0 | 176 | 16 | 43.2 | 1.08 | |
| 8:30 MIN | 10 | 0 | 178 | 17 | 44.9 | 1.09 | |
| 9:00 MIN | 10 | 1 | 180 | 17 | 46.6 | 1.06 | |
| 9:30 MIN | 10 | 1 | 181 | 18 | 46.9 | 1.11 | |
| 10:00 MIN | 10 | 2 | 182 | 18 | 48.9 | 1.11 | |
| 10:30 MIN | 10 | 2 | 184 | 19 | 49.6 | 1.13 | |
| 11:00 MIN | 10 | 3 | 185 | 19 | 49.8 | 1.13 | |
| 11:30 MIN | 10 | 3 | 187 | 19 | 49.8 | 1.18 | |
| 12:00 MIN | 10 | 4 | 189 | 19 | 51.2 | 1.20 | |
| 12:30 MIN | 10 | 4 | 192 | 20 | 49.4 | 1.22 | |
| **Mean** | | | **164.84** | **15.48** | **40.18** | **1.03** | |
| **SD** | | | **18.96** | **2.69** | **7.72** | **0.09** | |

# TABLE D.7
## Sub 7
## TR $VO_{2max}$ Record Sheet

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 6 | 0 | 157 | 11 | 26.9 | 0.91 | 67 in. |
| 1:00 MIN | 6.5 | 0 | 154 | 12 | 28.8 | 0.9 | 170.2 cm |
| 1:30 MIN | 6.5 | 0 | 153 | 12 | 29.1 | 0.91 | |
| 2:00 MIN | 7 | 0 | 157 | 13 | 33.7 | 0.94 | **WT** |
| 2:30 MIN | 7 | 0 | 157 | 13 | 31.8 | 0.95 | 130.5 |
| 3:00 MIN | 7.5 | 0 | 161 | 14 | 32.9 | 0.95 | 59.32 |
| 3:30 MIN | 7.5 | 0 | 163 | 14 | 33.9 | 0.95 | |
| 4:00 MIN | 8 | 0 | 163 | 15 | 35.5 | 0.94 | **DOB** |
| 4:30 MIN | 8 | 0 | 165 | 15 | 36.4 | 0.96 | 11/28/81 |
| 5:00 MIN | 8.5 | 0 | 169 | 16 | 37.0 | 0.98 | 20 |
| 5:30 MIN | 8.5 | 0 | 169 | 17 | 38.0 | 0.98 | **DATE** |
| 6:00 MIN | 9 | 0 | 168 | 17 | 38.1 | 0.99 | Oct. 9 |
| 6:30 MIN | 9 | 0 | 171 | 17 | 39.6 | 1.00 | |
| 7:00 MIN | 9.5 | 0 | 177 | 18 | 39.9 | 1.02 | |
| 7:30 MIN | 9.5 | 0 | 180 | 18 | 41.8 | 1.02 | |
| 8:00 MIN | 10 | 0 | 179 | 19 | 42.8 | 1.01 | |
| 8:30 MIN | 10 | 0 | 183 | 20 | 44.2 | 1.07 | |
| 9:00 MIN | 10 | 1 | 185 | 20 | 44.8 | 1.07 | |
| 9:30 MIN | 10 | 1 | 185 | 20 | 45.5 | 1.09 | |
| 10:00 MIN | 10 | 2 | 187 | 20 | 45.7 | 1.11 | |
| 10:30 MIN | 10 | 2 | 187 | 20 | 46.1 | 1.10 | |
| 11:00 MIN | 10 | 3 | 189 | 20 | 46.6 | 1.13 | |
| **Mean** | | | **170.86** | **16.41** | **38.14** | **1.00** | |
| **SD** | | | **12.02** | **3.07** | **6.09** | **0.07** | |

**TABLE D.8**
**Sub 8**
**TR $VO_{2max}$ Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 6 | 0 | 127 | 11 | 23.8 | 0.87 | 65" |
| 1:00 MIN | 6.5 | 0 | 125 | 11 | 28.4 | 0.90 | 165.1 cm |
| 1:30 MIN | 6.5 | 0 | 131 | 12 | 28.5 | 0.93 | |
| 2:00 MIN | 7 | 0 | 132 | 12 | 29.2 | 0.92 | **WT** |
| 2:30 MIN | 7 | 0 | 141 | 12 | 31.2 | 0.95 | 123.5 lbs |
| 3:00 MIN | 7.5 | 0 | 139 | 13 | 31.9 | 0.93 | 56.14 kg |
| 3:30 MIN | 7.5 | 0 | 151 | 13 | 32.7 | 0.96 | |
| 4:00 MIN | 8 | 0 | 143 | 13 | 34.4 | 0.95 | **DOB** |
| 4:30 MIN | 8 | 0 | 156 | 14 | 36.1 | 0.95 | 2/22/1982 |
| 5:00 MIN | 8.5 | 0 | 156 | 14 | 36.8 | 0.98 | **Age** |
| 5:30 MIN | 8.5 | 0 | 163 | 15 | 38.5 | 0.99 | 20 |
| 6:00 MIN | 9 | 0 | 163 | 16 | 39.4 | 0.99 | **DATE** |
| 6:30 MIN | 9 | 0 | 163 | 16 | 39.9 | 1.00 | 9/26/2002 |
| 7:00 MIN | 9.5 | 0 | 170 | 17 | 41.9 | 0.98 | |
| 7:30 MIN | 9.5 | 0 | 174 | 17 | 43.1 | 1.02 | |
| 8:00 MIN | 10 | 0 | 175 | 18 | 44.2 | 1.03 | |
| 8:30 MIN | 10 | 0 | 178 | 18 | 45.4 | 1.06 | |
| 9:00 MIN | 10 | 1 | 181 | 18 | 46.5 | 1.07 | |
| 9:30 MIN | 10 | 1 | 181 | 19 | 47.4 | 1.09 | |
| 10:00 MIN | 10 | 2 | 182 | 19 | 48.5 | 1.09 | |
| 10:30 MIN | 10 | 2 | 181 | 20 | 50.0 | 1.12 | |
| 11:00 MIN | 10 | 3 | 182 | 20 | 50.8 | 1.12 | |
| 11:30 MIN | 10 | 3 | 185 | 20 | 51.8 | 1.17 | |
| 12:00 MIN | 10 | 4 | 187 | 21 | 49.2 | 1.14 | |
| 12:30 MIN | 10 | 4 | 189 | 21 | 53.3 | 1.24 | |
| **Mean** | | | **162.20** | **16.00** | **40.25** | **1.02** | |
| **SD** | | | **20.80** | **3.32** | **8.53** | **0.09** | |

**TABLE D.9**
**Sub 9**
**TR $VO_{2max}$ Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 7 | 0 | 137 | 8 | 30.0 | 0.89 | 72" |
| 1:00 MIN | 7.5 | 0 | 137 | 9 | 30.8 | 0.87 | 182.9 cm |
| 1:30 MIN | 7.5 | 0 | 147 | 10 | 30.2 | 0.89 | |
| 2:00 MIN | 8 | 0 | 148 | 12 | 31.2 | 0.89 | **WT** |
| 2:30 MIN | 8 | 0 | 151 | 12 | 33.1 | 0.90 | 165.5 lbs |
| 3:00 MIN | 8.5 | 0 | 157 | 13 | 33.6 | 0.89 | 75.23 kg |
| 3:30 MIN | 8.5 | 0 | 158 | 13 | 35.8 | 0.93 | |
| 4:00 MIN | 9 | 0 | 159 | 14 | 35.2 | 0.90 | **DOB** |
| 4:30 MIN | 9 | 0 | 158 | 14 | 35.7 | 0.90 | 7/23/1982 |
| 5:00 MIN | 9.5 | 0 | 164 | 15 | 39.2 | 0.90 | **Age** |
| 5:30 MIN | 9.5 | 0 | 166 | 15 | 38.4 | 0.94 | 20 |
| 6:00 MIN | 10 | 0 | 169 | 15 | 39.1 | 0.93 | **DATE** |
| 6:30 MIN | 10 | 0 | 168 | 16 | 40.0 | 0.93 | 9/26/2002 |
| 7:00 MIN | 10.5 | 0 | 169 | 16 | 41.6 | 0.94 | |
| 7:30 MIN | 10.5 | 0 | 176 | 16 | 42.9 | 0.96 | |
| 8:00 MIN | 11 | 0 | 174 | 16 | 43.6 | 0.97 | |
| 8:30 MIN | 11 | 0 | 178 | 17 | 45.4 | 0.99 | |
| 9:00 MIN | 11 | 1 | 178 | 17 | 46.5 | 0.99 | |
| 9:30 MIN | 11 | 1 | 179 | 17 | 47.5 | 0.98 | |
| 10:00 MIN | 11 | 2 | 181 | 18 | 49.3 | 1.00 | |
| 10:30 MIN | 11 | 2 | 181 | 18 | 51.1 | 1.04 | |
| 11:00 MIN | 11 | 3 | 184 | 18 | 50.5 | 1.05 | |
| 11:30 MIN | 11 | 3 | 186 | 19 | 52.2 | 1.06 | |
| 12:00 MIN | 11 | 4 | 189 | 19 | 52.9 | 1.07 | |
| 12:30 MIN | 11 | 4 | 188 | 20 | 54.9 | 1.10 | |
| 13:00 MIN | 11 | 5 | 190 | 20 | 54.6 | 1.10 | |
| 13:30 MIN | 11 | 5 | 191 | 21 | 56.0 | 1.14 | |
| 14:00 MIN | 11 | 6 | 193 | 22 | 55.8 | 1.16 | |
| 14:30 MIN | 11 | 6 | 195 | 22 | 57.4 | 1.19 | |
| **Mean** | | | **170.72** | **15.93** | **43.26** | **0.98** | |
| **SD** | | | **16.70** | **3.64** | **8.93** | **0.09** | |

**TABLE D.10**
**Sub 10**
**TR $VO_{2max}$ Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 7 | 0 | 157 | 11 | 30.2 | 0.82 | 72" |
| 1:00 MIN | 7.5 | 0 | 162 | 11 | 35.3 | 0.84 | 182.9 cm |
| 1:30 MIN | 7.5 | 0 | 159 | 13 | 34.7 | 0.85 | |
| 2:00 MIN | 8 | 0 | 164 | 13 | 36.0 | 0.85 | **WT** |
| 2:30 MIN | 8 | 0 | 169 | 14 | 36.4 | 0.87 | 165.5 lbs |
| 3:00 MIN | 8.5 | 0 | 175 | 15 | 39.7 | 0.89 | 75.23 kg |
| 3:30 MIN | 8.5 | 0 | 175 | 15 | 38.1 | 0.90 | |
| 4:00 MIN | 9 | 0 | 177 | 15 | 40.3 | 0.89 | **DOB** |
| 4:30 MIN | 9 | 0 | 178 | 16 | 41.1 | 0.95 | 7/23/1982 |
| 5:00 MIN | 9.5 | 0 | 182 | 16 | 41.6 | 0.93 | **Age** |
| 5:30 MIN | 9.5 | 0 | 184 | 16 | 43.1 | 0.96 | 20 |
| 6:00 MIN | 10 | 0 | 187 | 16 | 44.7 | 0.98 | **DATE** |
| 6:30 MIN | 10 | 0 | 186 | 17 | 44.0 | 0.96 | 9/26/2002 |
| 7:00 MIN | 10.5 | 0 | 189 | 18 | 45.8 | 0.97 | |
| 7:30 MIN | 10.5 | 0 | 189 | 18 | 46.3 | 1.01 | |
| 8:00 MIN | 11 | 0 | 192 | 19 | 48.2 | 1.04 | |
| 8:30 MIN | 11 | 0 | 194 | 20 | 49.3 | 1.08 | |
| 9:00 MIN | 11 | 1 | 195 | 20 | 48.1 | 1.07 | |
| 9:30 MIN | 11 | 1 | 197 | 21 | 49.8 | 1.09 | |
| 10:00 MIN | 11 | 2 | 200 | 22 | 52.1 | 1.11 | |
| 10:30 MIN | 11 | 2 | 201 | 22 | 52.9 | 1.15 | |
| 11:00 MIN | 11 | 3 | 202 | 22 | 52.1 | 1.16 | |
| 11:30 MIN | 11 | 3 | 203 | 22 | 55.2 | 1.06 | |
| **Mean** | | | **183.35** | **17.04** | **43.70** | **0.98** | |
| **SD** | | | **14.22** | **3.50** | **6.73** | **0.10** | |

# TABLE D.11
## Sub 11
## TR $VO_{2max}$ Record Sheet

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 6 | 0 | 146 | 10 | 30.3 | 0.87 | 64" |
| 1:00 MIN | 6.5 | 0 | 149 | 11 | 29.9 | 0.79 | 162.6 cm |
| 1:30 MIN | 6.5 | 0 | 150 | 12 | 34.4 | 0.86 | |
| 2:00 MIN | 7 | 0 | 157 | 13 | 34.0 | 0.87 | **WT** |
| 2:30 MIN | 7 | 0 | 162 | 13 | 35.6 | 0.92 | 123.5 lbs |
| 3:00 MIN | 7.5 | 0 | 163 | 14 | 37.2 | 0.91 | 56.14 kg |
| 3:30 MIN | 7.5 | 0 | 167 | 14 | 38.1 | 0.92 | |
| 4:00 MIN | 8 | 0 | 169 | 15 | 39.1 | 0.90 | **DOB** |
| 4:30 MIN | 8 | 0 | 172 | 15 | 41.0 | 0.91 | 8/13/1982 |
| 5:00 MIN | 8.5 | 0 | 179 | 15 | 43.1 | 0.92 | **Age** |
| 5:30 MIN | 8.5 | 0 | 180 | 15 | 43.6 | 0.94 | 20 |
| 6:00 MIN | 9 | 0 | 181 | 16 | 44.1 | 0.94 | **DATE** |
| 6:30 MIN | 9 | 0 | 183 | 16 | 45.5 | 0.95 | 9/30/2002 |
| 7:00 MIN | 9.5 | 0 | 187 | 16 | 47.3 | 0.97 | |
| 7:30 MIN | 9.5 | 0 | 189 | 16 | 47.8 | 1.01 | |
| 8:00 MIN | 10 | 0 | 190 | 17 | 49.2 | 1.01 | |
| 8:30 MIN | 10 | 0 | 192 | 17 | 50.2 | 1.06 | |
| 9:00 MIN | 10 | 1 | 193 | 17 | 51.1 | 1.07 | |
| 9:30 MIN | 10 | 1 | 194 | 18 | 51.1 | 1.09 | |
| 10:00 MIN | 10 | 2 | 195 | 19 | 52.4 | 1.09 | |
| 10:30 MIN | 10 | 2 | 197 | 19 | 52.7 | 1.11 | |
| 11:00 MIN | 10 | 3 | 200 | 20 | 54.4 | 1.13 | |
| 11:30 MIN | 10 | 3 | 201 | 20 | 54.3 | 1.15 | |
| 12:00 MIN | 10 | 4 | 202 | 20 | 55.3 | 1.17 | |
| 12:30 MIN | 10 | 4 | 203 | 20 | 55.5 | 1.18 | |
| **Mean** | | | **180.04** | **15.92** | **44.84** | **0.99** | |
| **SD** | | | **17.83** | **2.86** | **8.08** | **0.11** | |

**TABLE D.12**
**Sub 12**
**TR $VO_{2max}$ Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 6 | 0 | 138 | 11 | 26.5 | 0.86 | 63" |
| 1:00 MIN | 6.5 | 0 | 141 | 11 | 26.2 | 0.87 | 160.0 cm |
| 1:30 MIN | 6.5 | 0 | 140 | 11 | 27.4 | 0.87 | |
| 2:00 MIN | 7 | 0 | 146 | 12 | 28.7 | 0.89 | **WT** |
| 2:30 MIN | 7 | 0 | 148 | 13 | 30.3 | 0.90 | 121.5 lbs |
| 3:00 MIN | 7.5 | 0 | 152 | 13 | 31.1 | 0.90 | 55.23 kg |
| 3:30 MIN | 7.5 | 0 | 160 | 14 | 32.7 | 0.93 | |
| 4:00 MIN | 8 | 0 | 157 | 14 | 33.0 | 0.97 | **DOB** |
| 4:30 MIN | 8 | 0 | 165 | 14 | 34.3 | 0.97 | 3/20/1983 |
| 5:00 MIN | 8.5 | 0 | 165 | 15 | 32.4 | 0.97 | **Age** |
| 5:30 MIN | 8.5 | 0 | 169 | 15 | 35.6 | 1.01 | 19 |
| 6:00 MIN | 9 | 0 | 170 | 16 | 35.8 | 1.02 | **DATE** |
| 6:30 MIN | 9 | 0 | 174 | 16 | 37.5 | 1.04 | 9/30/2002 |
| 7:00 MIN | 9.5 | 0 | 171 | 16 | 37.7 | 1.06 | |
| 7:30 MIN | 9.5 | 0 | 177 | 17 | 38.2 | 1.08 | |
| 8:00 MIN | 10 | 0 | 179 | 18 | 40.2 | 1.12 | |
| 8:30 MIN | 10 | 0 | 180 | 18 | 40.7 | 1.16 | |
| 9:00 MIN | 10 | 1 | 181 | 19 | 41.4 | 1.18 | |
| 9:30 MIN | 10 | 1 | 183 | 19 | 42.2 | 1.21 | |
| 10:00 MIN | 10 | 2 | 183 | 20 | 42.9 | 1.22 | |
| 10:30 MIN | 10 | 2 | 184 | 20 | 43.7 | 1.26 | |
| 11:00 MIN | 10 | 3 | 185 | 20 | 43.6 | 1.28 | |
| 11:30 MIN | 10 | 3 | 186 | 20 | 45.3 | 1.32 | |
| **Mean** | | | **166.70** | **15.74** | **36.40** | **1.05** | |
| **SD** | | | **15.96** | **3.11** | **5.93** | **0.15** | |

**TABLE D.13**
**Sub 13**
**TR $VO_{2max}$ Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 7 | 0 | 160 | 6 | 33.4 | 0.98 | 65" |
| 1:00 MIN | 7.5 | 0 | 159 | 6 | 34.3 | 0.96 | 165.1 cm |
| 1:30 MIN | 7.5 | 0 | 160 | 6 | 36.3 | 0.96 | |
| 2:00 MIN | 8 | 0 | 162 | 7 | 38.7 | 0.94 | **WT** |
| 2:30 MIN | 8 | 0 | 166 | 7 | 38.5 | 0.95 | 140.5 lbs |
| 3:00 MIN | 8.5 | 0 | 163 | 8 | 44.1 | 0.94 | 63.86 kg |
| 3:30 MIN | 8.5 | 0 | 165 | 8 | 39.9 | 0.94 | |
| 4:00 MIN | 9 | 0 | 169 | 9 | 42.1 | 0.93 | **DOB** |
| 4:30 MIN | 9 | 0 | 172 | 9 | 43.9 | 0.96 | 9/19/1983 |
| 5:00 MIN | 9.5 | 0 | 171 | 10 | 44.5 | 0.95 | **Age** |
| 5:30 MIN | 9.5 | 0 | 173 | 11 | 44.4 | 0.96 | 19 |
| 6:00 MIN | 10 | 0 | 177 | 12 | 47.9 | 0.98 | **DATE** |
| 6:30 MIN | 10 | 0 | 180 | 13 | 46.6 | 1.03 | 10/3/2002 |
| 7:00 MIN | 10.5 | 0 | 180 | 14 | 48.7 | 1.02 | |
| 7:30 MIN | 10.5 | 0 | 184 | 14 | 48.5 | 1.03 | |
| 8:00 MIN | 11 | 0 | 186 | 14 | 49.7 | 1.05 | |
| 8:30 MIN | 11 | 0 | 187 | 15 | 52.8 | 1.08 | |
| 9:00 MIN | 11 | 1 | 189 | 15 | 51.8 | 1.07 | |
| 9:30 MIN | 11 | 1 | 191 | 15 | 53.7 | 1.09 | |
| 10:00 MIN | 11 | 2 | 192 | 16 | 52.8 | 1.13 | |
| 10:30 MIN | 11 | 2 | 193 | 16 | 54.0 | 1.13 | |
| 11:00 MIN | 11 | 3 | 195 | 16 | 56.9 | 1.14 | |
| 11:30 MIN | 11 | 3 | 196 | 17 | 55.5 | 1.15 | |
| 12:00 MIN | 11 | 4 | 197 | 17 | 56.6 | 1.18 | |
| 12:30 MIN | 11 | 4 | 198 | 18 | 57.2 | 1.19 | |
| 13:00 MIN | 11 | 5 | 198 | 19 | 57.2 | 1.20 | |
| 13:30 MIN | 11 | 5 | 200 | 19 | 56.4 | 1.22 | |
| **Mean** | | | **180.11** | **12.48** | **47.64** | **1.04** | |
| **SD** | | | **13.91** | **4.29** | **7.47** | **0.10** | |

**TABLE D.14**
**Sub 14**
**TR $VO_{2max}$ Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 7 | 0 | 141 | 7 | 30.5 | 0.97 | 73.5" |
| 1:00 MIN | 7.5 | 0 | 141 | 7 | 32.9 | 0.94 | 186.7 cm |
| 1:30 MIN | 7.5 | 0 | 147 | 8 | 34.1 | 0.96 | |
| 2:00 MIN | 8 | 0 | 148 | 8 | 35.5 | 1.01 | **WT** |
| 2:30 MIN | 8 | 0 | 151 | 9 | 36.0 | 0.97 | 140.5 lbs |
| 3:00 MIN | 8.5 | 0 | 154 | 9 | 38.0 | 0.98 | 63.86 kg |
| 3:30 MIN | 8.5 | 0 | 157 | 9 | 38.6 | 0.99 | |
| 4:00 MIN | 9 | 0 | 162 | 10 | 39.6 | 0.99 | **DOB** |
| 4:30 MIN | 9 | 0 | 165 | 10 | 41.8 | 1.01 | 4/29/1984 |
| 5:00 MIN | 9.5 | 0 | 165 | 11 | 42.2 | 1.03 | **Age** |
| 5:30 MIN | 9.5 | 0 | 167 | 11 | 42.8 | 1.05 | 18 |
| 6:00 MIN | 10 | 0 | 171 | 12 | 44.4 | 1.05 | **DATE** |
| 6:30 MIN | 10 | 0 | 172 | 13 | 45.4 | 1.04 | 9/30/2002 |
| 7:00 MIN | 10.5 | 0 | 174 | 14 | 48.1 | 1.03 | |
| 7:30 MIN | 10.5 | 0 | 167 | 14 | 48.0 | 1.07 | |
| 8:00 MIN | 11 | 0 | 180 | 15 | 48.6 | 1.07 | |
| 8:30 MIN | 11 | 0 | 180 | 15 | 50.0 | 1.11 | |
| 9:00 MIN | 11 | 1 | 181 | 16 | 50.9 | 1.14 | |
| 9:30 MIN | 11 | 1 | 185 | 17 | 51.9 | 1.16 | |
| 10:00 MIN | 11 | 2 | 185 | 17 | 52.6 | 1.16 | |
| 10:30 MIN | 11 | 2 | 189 | 18 | 53.6 | 1.17 | |
| 11:00 MIN | 11 | 3 | 189 | 18 | 54.2 | 1.19 | |
| 11:30 MIN | 11 | 3 | 191 | 19 | 53.0 | 1.22 | |
| 12:00 MIN | 11 | 4 | 190 | 19 | 54.8 | 1.22 | |
| 12:30 MIN | 11 | 4 | 194 | 20 | 56.2 | 1.24 | |
| **Mean** | | | **169.84** | **13.04** | **44.95** | **1.07** | |
| **SD** | | | **16.51** | **4.18** | **7.72** | **0.09** | |

**TABLE D.15**
**Sub 15**
**TR $VO_{2max}$ Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 7 | 0 | 151 | 10 | 32.3 | 0.92 | 70" |
| 1:00 MIN | 7.5 | 0 | 153 | 11 | 32.1 | 0.87 | 177.8 cm |
| 1:30 MIN | 7.5 | 0 | 154 | 12 | 35.7 | 0.88 | |
| 2:00 MIN | 8 | 0 | 159 | 14 | 33.5 | 0.92 | **WT** |
| 2:30 MIN | 8 | 0 | 161 | 15 | 37.2 | 0.92 | 152.5 lbs |
| 3:00 MIN | 8.5 | 0 | 158 | 15 | 34.8 | 0.92 | 69.32 kg |
| 3:30 MIN | 8.5 | 0 | 158 | 15 | 36.7 | 0.91 | |
| 4:00 MIN | 9 | 0 | 165 | 15 | 37.0 | 0.94 | **DOB** |
| 4:30 MIN | 9 | 0 | 171 | 16 | 40.0 | 0.95 | 12/30/1982 |
| 5:00 MIN | 9.5 | 0 | 174 | 17 | 40.5 | 0.98 | **Age** |
| 5:30 MIN | 9.5 | 0 | 175 | 17 | 41.6 | 1.00 | 19 |
| 6:00 MIN | 10 | 0 | 178 | 17 | 43.1 | 0.99 | **DATE** |
| 6:30 MIN | 10 | 0 | 179 | 17 | 44.8 | 1.00 | 9/30/2002 |
| 7:00 MIN | 10.5 | 0 | 179 | 18 | 44.8 | 1.00 | |
| 7:30 MIN | 10.5 | 0 | 182 | 18 | 47.0 | 1.04 | |
| 8:00 MIN | 11 | 0 | 180 | 19 | 46.7 | 1.02 | |
| 8:30 MIN | 11 | 0 | 185 | 18 | 48.2 | 1.03 | |
| 9:00 MIN | 11 | 1 | 184 | 19 | 48.2 | 1.07 | |
| 9:30 MIN | 11 | 1 | 186 | 19 | 48.7 | 1.08 | |
| 10:00 MIN | 11 | 2 | 187 | 20 | 49.5 | 1.11 | |
| 10:30 MIN | 11 | 2 | 188 | 20 | 50.9 | 1.13 | |
| 11:00 MIN | 11 | 3 | 190 | 20 | 49.5 | 1.12 | |
| 11:30 MIN | 11 | 3 | 188 | 20 | 55.1 | 1.19 | |
| 12:00 MIN | 11 | 4 | 194 | 20 | 52.3 | 1.23 | |
| **Mean** | | | **174.13** | **16.75** | **42.93** | **1.01** | |
| **SD** | | | **13.38** | **2.91** | **6.83** | **0.10** | |

# TABLE D.16
# Sub 16
# TR $VO_{2max}$ Record Sheet

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 7 | 0 | 134 | 12 | 32.3 | 0.88 | 72" |
| 1:00 MIN | 7.5 | 0 | 134 | 12 | 35.0 | 0.85 | 182.9 cm |
| 1:30 MIN | 7.5 | 0 | 134 | 12 | 36.7 | 0.90 | |
| 2:00 MIN | 8 | 0 | 136 | 13 | 36.7 | 0.89 | **WT** |
| 2:30 MIN | 8 | 0 | 143 | 13 | 39.0 | 0.89 | 164.5 lbs |
| 3:00 MIN | 8.5 | 0 | 143 | 13 | 39.6 | 0.89 | 74.77 kg |
| 3:30 MIN | 8.5 | 0 | 146 | 13 | 41.4 | 0.85 | |
| 4:00 MIN | 9 | 0 | 152 | 14 | 42.5 | 0.88 | **DOB** |
| 4:30 MIN | 9 | 0 | 152 | 14 | 44.6 | 0.91 | 12/10/1980 |
| 5:00 MIN | 9.5 | 0 | 159 | 15 | 44.9 | 0.88 | **Age** |
| 5:30 MIN | 9.5 | 0 | 158 | 15 | 46.3 | 0.89 | 21 |
| 6:00 MIN | 10 | 0 | 167 | 15 | 47.7 | 0.91 | **DATE** |
| 6:30 MIN | 10 | 0 | 164 | 15 | 46.6 | 0.92 | 10/3/2002 |
| 7:00 MIN | 10.5 | 0 | 169 | 16 | 49.7 | 0.93 | |
| 7:30 MIN | 10.5 | 0 | 171 | 16 | 48.7 | 0.95 | |
| 8:00 MIN | 11 | 0 | 175 | 16 | 50.6 | 0.96 | |
| 8:30 MIN | 11 | 0 | 178 | 17 | 51.3 | 0.98 | |
| 9:00 MIN | 11 | 1 | 178 | 17 | 54.1 | 1.01 | |
| 9:30 MIN | 11 | 1 | 178 | 17 | 55.0 | 1.02 | |
| 10:00 MIN | 11 | 2 | 181 | 17 | 54.8 | 1.03 | |
| 10:30 MIN | 11 | 2 | 178 | 18 | 56.4 | 1.02 | |
| 11:00 MIN | 11 | 3 | 180 | 18 | 56.9 | 1.04 | |
| 11:30 MIN | 11 | 3 | 178 | 18 | 57.7 | 1.06 | |
| 12:00 MIN | 11 | 4 | 181 | 19 | 58.1 | 1.08 | |
| 12:30 MIN | 11 | 4 | 178 | 19 | 59.2 | 1.08 | |
| 13:00 MIN | 11 | 5 | 180 | 20 | 60.4 | 1.10 | |
| 13:30 MIN | 11 | 5 | 182 | 20 | 60.2 | 1.13 | |
| 14:00 MIN | 11 | 6 | 183 | 20 | 61.4 | 1.15 | |
| **Mean** | | | **164.00** | **15.86** | **48.85** | **0.97** | |
| **SD** | | | **17.42** | **2.56** | **8.63** | **0.09** | |

# TABLE D.17
## Sub 17
## TR $VO_{2max}$ Record Sheet

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 6 | 0 | 128 | 9 | 16.0 | 0.87 | 63.5" |
| 1:00 MIN | 6.5 | 0 | 117 | 10 | 18.0 | 0.89 | 161.3 cm |
| 1:30 MIN | 6.5 | 0 | 122 | 12 | 16.9 | 0.93 | |
| 2:00 MIN | 7 | 0 | 121 | 12 | 18.5 | 0.91 | **WT** |
| 2:30 MIN | 7 | 0 | 130 | 14 | 18.2 | 0.97 | 91.5 lbs |
| 3:00 MIN | 7.5 | 0 | 130 | 15 | 18.2 | 0.97 | 41.6 kg |
| 3:30 MIN | 7.5 | 0 | 141 | 15 | 19.9 | 0.98 | |
| 4:00 MIN | 8 | 0 | 144 | 15 | 22.2 | 1.02 | **DOB** |
| 4:30 MIN | 8 | 0 | 148 | 15 | 23.0 | 0.99 | 12/16/1981 |
| 5:00 MIN | 8.5 | 0 | 152 | 16 | 28.1 | 1.01 | **Age** |
| 5:30 MIN | 8.5 | 0 | 157 | 16 | 31.6 | 1.04 | 20 |
| 6:00 MIN | 9 | 0 | 159 | 17 | 32.3 | 1.04 | **DATE** |
| 6:30 MIN | 9 | 0 | 161 | 17 | 32.4 | 1.06 | 10/10/2002 |
| 7:00 MIN | 9.5 | 0 | 163 | 18 | 33.1 | 1.03 | |
| 7:30 MIN | 9.5 | 0 | 170 | 18 | 38.2 | 1.04 | |
| 8:00 MIN | 10 | 0 | 170 | 19 | 39.8 | 1.08 | |
| 8:30 MIN | 10 | 0 | 179 | 19 | 40.1 | 1.09 | |
| 9:00 MIN | 10 | 1 | 175 | 19 | 42.0 | 1.07 | |
| 9:30 MIN | 10 | 1 | 183 | 19 | 44.0 | 1.15 | |
| 10:00 MIN | 10 | 2 | 180 | 20 | 45.4 | 1.15 | |
| 10:30 MIN | 10 | 2 | 181 | 20 | 45.3 | 1.12 | |
| 11:00 MIN | 10 | 3 | 177 | 20 | 48.0 | 1.18 | |
| 11:30 MIN | 10 | 3 | 187 | 20 | 49.5 | 1.20 | |
| 12:00 MIN | 10 | 4 | 185 | 20 | 48.8 | 1.21 | |
| 12:30 MIN | 10 | 4 | 183 | 20 | 49.7 | 1.23 | |
| **Mean** | | | **157.72** | **16.60** | **32.76** | **1.05** | |
| **SD** | | | **22.99** | **3.28** | **12.06** | **0.10** | |

**TABLE D.18**
**Sub 18**
**TR $VO_{2max}$ Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 6 | 0 | 141 | 8 | 27.8 | 0.87 | 66" |
| 1:00 MIN | 6.5 | 0 | 141 | 9 | 27.7 | 0.90 | 167.6 cm |
| 1:30 MIN | 6.5 | 0 | 146 | 9 | 28.4 | 0.91 | |
| 2:00 MIN | 7 | 0 | 150 | 10 | 28.9 | 0.90 | **WT** |
| 2:30 MIN | 7 | 0 | 155 | 10 | 30.1 | 0.90 | 149 lbs |
| 3:00 MIN | 7.5 | 0 | 163 | 11 | 31.8 | 0.92 | 67.73 kg |
| 3:30 MIN | 7.5 | 0 | 169 | 11 | 33.3 | 0.93 | |
| 4:00 MIN | 8 | 0 | 171 | 13 | 33.6 | 0.95 | **DOB** |
| 4:30 MIN | 8 | 0 | 172 | 13 | 34.7 | 0.96 | 2/1/1982 |
| 5:00 MIN | 8.5 | 0 | 176 | 14 | 36.9 | 0.97 | **Age** |
| 5:30 MIN | 8.5 | 0 | 180 | 14 | 37.0 | 1.01 | 20 |
| 6:00 MIN | 9 | 0 | 182 | 15 | 38.2 | 0.99 | **DATE** |
| 6:30 MIN | 9 | 0 | 184 | 16 | 38.6 | 1.03 | 10/10/2002 |
| 7:00 MIN | 9.5 | 0 | 185 | 17 | 39.3 | 1.04 | |
| 7:30 MIN | 9.5 | 0 | 187 | 17 | 39.7 | 1.08 | |
| 8:00 MIN | 10 | 0 | 190 | 18 | 39.6 | 1.10 | |
| 8:30 MIN | 10 | 0 | 191 | 19 | 41.0 | 1.12 | |
| 9:00 MIN | 10 | 1 | 192 | 19 | 41.8 | 1.14 | |
| 9:30 MIN | 10 | 1 | 194 | 19 | 42.5 | 1.17 | |
| 10:00 MIN | 10 | 2 | 196 | 20 | 43.4 | 1.20 | |
| **Mean** | | | **173.25** | **14.10** | **35.72** | **1.00** | |
| **SD** | | | **18.20** | **3.89** | **5.02** | **0.10** | |

**TABLE D.19**
**Sub 19**
**TR $VO_{2max}$ Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 6 | 0 | 144 | 12 | 30.9 | 0.97 | 62.5" |
| 1:00 MIN | 6.5 | 0 | 145 | 12 | 30.9 | 0.97 | 158.8 cm |
| 1:30 MIN | 6.5 | 0 | 147 | 12 | 30.9 | 0.96 | |
| 2:00 MIN | 7 | 0 | 151 | 12 | 33.0 | 0.95 | **WT** |
| 2:30 MIN | 7 | 0 | 152 | 13 | 33.7 | 0.97 | 118 lbs |
| 3:00 MIN | 7.5 | 0 | 154 | 13 | 35.1 | 0.97 | 53.64 kg |
| 3:30 MIN | 7.5 | 0 | 157 | 14 | 36.2 | 1.00 | |
| 4:00 MIN | 8 | 0 | 159 | 14 | 36.8 | 1.01 | **DOB** |
| 4:30 MIN | 8 | 0 | 159 | 14 | 37.5 | 1.00 | 4/14/1982 |
| 5:00 MIN | 8.5 | 0 | 160 | 15 | 38.8 | 1.00 | **Age** |
| 5:30 MIN | 8.5 | 0 | 163 | 16 | 39.7 | 1.05 | 20 |
| 6:00 MIN | 9 | 0 | 162 | 17 | 39.5 | 1.04 | **DATE** |
| 6:30 MIN | 9 | 0 | 166 | 17 | 41.0 | 1.07 | Oct 15/2002 |
| 7:00 MIN | 9.5 | 0 | 169 | 18 | 43.0 | 1.10 | |
| 7:30 MIN | 9.5 | 0 | 167 | 19 | 43.4 | 1.15 | |
| 8:00 MIN | 10 | 0 | 171 | 19 | 43.5 | 1.16 | |
| 8:30 MIN | 10 | 0 | 171 | 19 | 44.7 | 1.19 | |
| 9:00 MIN | 10 | 1 | 173 | 20 | 45.5 | 1.19 | |
| 9:30 MIN | 10 | 1 | 174 | 20 | 46.7 | 1.23 | |
| 10:00 MIN | 10 | 2 | 176 | 20 | 46.7 | 1.25 | |
| 10:30 MIN | 10 | 2 | 175 | 21 | 46.9 | 1.29 | |
| **Mean** | | | **161.67** | **16.05** | **39.26** | **1.07** | |
| **SD** | | | **10.13** | **3.17** | **5.50** | **0.11** | |

# TABLE D.20
## Sub 20
## TR $VO_{2max}$ Record Sheet

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 7 | 0 | 153 | 12 | 31.7 | 0.96 | 74" |
| 1:00 MIN | 7.5 | 0 | 149 | 12 | 29.9 | 0.98 | 188 cm |
| 1:30 MIN | 7.5 | 0 | 151 | 12 | 33.0 | 0.97 | |
| 2:00 MIN | 8 | 0 | 153 | 13 | 33.7 | 0.99 | **WT** |
| 2:30 MIN | 8 | 0 | 153 | 13 | 34.6 | 0.96 | 158 lbs |
| 3:00 MIN | 8.5 | 0 | 155 | 13 | 35.8 | 0.96 | 71.8 kg |
| 3:30 MIN | 8.5 | 0 | 157 | 13 | 37.3 | 0.97 | |
| 4:00 MIN | 9 | 0 | 159 | 14 | 37.4 | 0.98 | **DOB** |
| 4:30 MIN | 9 | 0 | 161 | 14 | 39.1 | 0.97 | 1/22/1981 |
| 5:00 MIN | 9.5 | 0 | 166 | 14 | 38.1 | 0.95 | **Age** |
| 5:30 MIN | 9.5 | 0 | 165 | 14 | 41.5 | 0.99 | 21 |
| 6:00 MIN | 10 | 0 | 166 | 15 | 42.2 | 0.97 | **DATE** |
| 6:30 MIN | 10 | 0 | 164 | 15 | 43.7 | 0.97 | 10/15/2002 |
| 7:00 MIN | 10.5 | 0 | 165 | 15 | 41.0 | 0.98 | |
| 7:30 MIN | 10.5 | 0 | 170 | 16 | 43.3 | 1.01 | |
| 8:00 MIN | 11 | 0 | 172 | 16 | 46.8 | 0.99 | |
| 8:30 MIN | 11 | 0 | 171 | 17 | 46.0 | 1.02 | |
| 9:00 MIN | 11 | 1 | 176 | 17 | 48.9 | 1.03 | |
| 9:30 MIN | 11 | 1 | 174 | 18 | 50.3 | 1.03 | |
| 10:00 MIN | 11 | 2 | 176 | 18 | 50.7 | 1.04 | |
| 10:30 MIN | 11 | 2 | 178 | 18 | 49.6 | 1.04 | |
| 11:00 MIN | 11 | 3 | 177 | 19 | 51.5 | 1.07 | |
| 11:30 MIN | 11 | 3 | 180 | 19 | 51.4 | 1.08 | |
| 12:00 MIN | 11 | 4 | 179 | 19 | 54.6 | 1.09 | |
| 12:30 MIN | 11 | 4 | 178 | 20 | 54.4 | 1.12 | |
| 13:00 MIN | 11 | 5 | 178 | 21 | 54.9 | 1.13 | |
| 13:30 MIN | 11 | 5 | 176 | 21 | 54.1 | 1.15 | |
| **Mean** | | | **166.74** | **15.85** | **43.54** | **1.01** | |
| **SD** | | | **10.09** | **2.84** | **7.84** | **0.06** | |

# TABLE D.21
## Sub 1
## TR $VO_2$ Steady State Record Sheet

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 6 | 0 | 130 | 12 | 27.8 | 0.95 | 69" |
| 1:00 MIN | 6 | 0 | 136 | 12 | 29.6 | 0.92 | 175.3cm |
| 1:30 MIN | 6 | 0 | 136 | 12 | 29.6 | 0.97 | |
| 2:00 MIN | 6 | 0 | 135 | 12 | 31.5 | 0.93 | **WT** |
| 2:30 MIN | 6 | 0 | 136 | 12 | 30.0 | 1.00 | 147 lbs |
| 3:00 MIN | 6 | 0 | 139 | 12 | 30.0 | 1.01 | 66.9 kg |
| 3:30 MIN | 6 | 0 | 136 | 12 | 29.8 | 0.99 | |
| 4:00 MIN | 6 | 0 | 140 | 13 | 31.0 | 1.00 | **DOB** |
| 4:30 MIN | 6 | 0 | 137 | 13 | 30.1 | 1.01 | 3/4/1982 |
| 5:00 MIN | 6 | 0 | 137 | 13 | 29.4 | 0.98 | **Age** |
| 5:30 MIN | 6 | 0 | 134 | 13 | 31.6 | 0.97 | 20 |
| 6:00 MIN | 6 | 0 | 135 | 13 | 29.8 | 0.98 | **DATE** |
| **Last** | | | | | | | 10/4/2002 |
| **3 min** | | | | | | | |
| **Mean** | | | **136.50** | **12.83** | **30.28** | **0.99** | |
| **SD** | | | **2.07** | **0.41** | **0.84** | **0.01** | |

**TABLE D.22**
**Sub 2**
**TR $VO_2$ Steady State Record Sheet**

| **TIME** | **SPEED** | **GRADE** | **HR** | **RPE** | **VO2** | **RER** | **HT** |
|---|---|---|---|---|---|---|---|
| | **(mph)** | **(degrees)** | **(beats/min)** | **(6-20)** | **(ml·kg·min)** | | |
| 30 SEC | 6.5 | 0 | 130 | 11 | 27.0 | 0.78 | 68 in. |
| 1:00 MIN | 6.5 | 0 | 130 | 11 | 26.4 | 0.86 | 172.72 cm |
| 1:30 MIN | 6.5 | 0 | 132 | 12 | 24.7 | 0.85 | |
| 2:00 MIN | 6.5 | 0 | 131 | 12 | 26.5 | 0.85 | **WT** |
| 2:30 MIN | 6.5 | 0 | 131 | 12 | 29.0 | 0.87 | 128 lbs. |
| 3:00 MIN | 6.5 | 0 | 133 | 13 | 28.6 | 0.86 | 58.18 kg. |
| 3:30 MIN | 6.5 | 0 | 133 | 13 | 29.6 | 0.91 | |
| 4:00 MIN | 6.5 | 0 | 133 | 13 | 28.5 | 0.89 | **DOB** |
| 4:30 MIN | 6.5 | 0 | 133 | 13 | 29.9 | 0.91 | 1/19/1982 |
| 5:00 MIN | 6.5 | 0 | 132 | 13 | 29.8 | 0.87 | 20 |
| 5:30 MIN | 6.5 | 0 | 135 | 14 | 31.6 | 0.89 | **DATE** |
| 6:00 MIN | 6.5 | 0 | 129 | 14 | 29.9 | 0.90 | Oct. 16 |
| **Last** | | | | | | | |
| **3 min** | | | | | | | |
| **Mean** | | | **132.50** | **13.33** | **29.88** | **0.90** | |
| **SD** | | | **1.97** | **0.64** | **0.98** | **0.02** | |

**TABLE D.23**
**Sub 3**
**TR $VO_2$ Steady State Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 6.5 | 0 | 156 | 12 | 30.1 | 0.95 | 66.75 in. |
| 1:00 MIN | 6.5 | 0 | 153 | 12 | 30.7 | 0.92 | 169.6 cm |
| 1:30 MIN | 6.5 | 0 | 153 | 12 | 32.0 | 0.93 | |
| 2:00 MIN | 6.5 | 0 | 160 | 12 | 32.1 | 0.92 | **WT** |
| 2:30 MIN | 6.5 | 0 | 158 | 12 | 32.2 | 0.93 | 126.5 lbs. |
| 3:00 MIN | 6.5 | 0 | 158 | 12 | 32.2 | 0.92 | 57.5 kg. |
| 3:30 MIN | 6.5 | 0 | 162 | 12 | 32.2 | 0.93 | |
| 4:00 MIN | 6.5 | 0 | 162 | 12.5 | 32.3 | 0.94 | **DOB** |
| 4:30 MIN | 6.5 | 0 | 162 | 12.5 | 32.5 | 0.95 | 1/13/1984 |
| 5:00 MIN | 6.5 | 0 | 161 | 12.5 | 31.9 | 0.96 | 18 |
| 5:30 MIN | 6.5 | 0 | 160 | 12.5 | 32.8 | 0.96 | **DATE** |
| 6:00 MIN | 6.5 | 0 | 161 | 12.5 | 32.1 | 0.95 | Oct. 4 |
| **Last** | | | | | | | |
| **3 min** | | | | | | | |
| **Mean** | | | **161.33** | **12.42** | **32.30** | **0.95** | |
| **SD** | | | **0.82** | **0.20** | **0.32** | **0.01** | |

**TABLE D.24**
**Sub 4**
**TR $VO_2$ Steady State Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 6.0 | 0 | 139 | 10 | 30.8 | 0.91 | 65 in. |
| 1:00 MIN | 6.0 | 0 | 135 | 10 | 30.1 | 0.91 | 165.1 cm |
| 1:30 MIN | 6.0 | 0 | 136 | 11 | 31.5 | 0.93 | |
| 2:00 MIN | 6.0 | 0 | 139 | 11 | 30.2 | 0.92 | **WT** |
| 2:30 MIN | 6.0 | 0 | 133 | 11 | 30.0 | 0.94 | 135 lbs. |
| 3:00 MIN | 6.0 | 0 | 134 | 11 | 30.5 | 0.93 | 61.37 kg. |
| 3:30 MIN | 6.0 | 0 | 135 | 11 | 29.4 | 0.96 | |
| 4:00 MIN | 6.0 | 0 | 139 | 11 | 30.9 | 0.94 | **DOB** |
| 4:30 MIN | 6.0 | 0 | 130 | 11 | 29.1 | 0.93 | 3/8/1984 |
| 5:00 MIN | 6.0 | 0 | 136 | 11 | 29.1 | 0.91 | 18 |
| 5:30 MIN | 6.0 | 0 | 135 | 11 | 29.3 | 0.93 | **DATE** |
| 6:00 MIN | 6.0 | 0 | 131 | 11 | 31.4 | 0.94 | Oct. 9 |
| **Last** | | | | | | | |
| **3 min** | | | | | | | |
| **Mean** | | | **134.33** | **11.00** | **29.87** | **0.94** | |
| **SD** | | | **3.33** | **0.00** | **1.01** | **0.02** | |

**TABLE D.25**
**Sub 5**
**TR $VO_2$ Steady State Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 7.0 | 0 | 140 | 10 | 37.0 | 0.86 | 75 in. |
| 1:00 MIN | 7.0 | 0 | 142 | 10 | 34.8 | 0.89 | 190.5 cm |
| 1:30 MIN | 7.0 | 0 | 140 | 10 | 35.7 | 0.86 | |
| 2:00 MIN | 7.0 | 0 | 140 | 11 | 37.2 | 0.90 | **WT** |
| 2:30 MIN | 7.0 | 0 | 141 | 11 | 35.3 | 0.87 | 166.5 lbs. |
| 3:00 MIN | 7.0 | 0 | 141 | 11 | 34.2 | 0.91 | 75.68 kg. |
| 3:30 MIN | 7.0 | 0 | 141 | 11 | 37.4 | 0.89 | |
| 4:00 MIN | 7.0 | 0 | 147 | 11 | 36.0 | 0.91 | **DOB** |
| 4:30 MIN | 7.0 | 0 | 142 | 11 | 38.8 | 0.88 | 4/2/1983 |
| 5:00 MIN | 7.0 | 0 | 147 | 11 | 34.7 | 0.93 | 19 |
| 5:30 MIN | 7.0 | 0 | 144 | 11 | 36.7 | 0.92 | **DATE** |
| 6:00 MIN | 7.0 | 0 | 146 | 11 | 37.3 | 0.93 | Oct. 11 |
| **Last** | | | | | | | |
| **3 min** | | | | | | | |
| **Mean** | | | **144.50** | **11.00** | **36.82** | **0.91** | |
| **SD** | | | **2.59** | **0.00** | **1.39** | **0.02** | |

**TABLE D.26**
**Sub 6**
**TR $VO_2$ Steady State Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 6.5 | 0 | 129 | 12 | 31.0 | 0.95 | 63 in. |
| 1:00 MIN | 6.5 | 0 | 129 | 12 | 28.3 | 0.98 | 160 cm |
| 1:30 MIN | 6.5 | 0 | 126 | 12 | 28.3 | 0.92 | |
| 2:00 MIN | 6.5 | 0 | 130 | 12 | 29.1 | 0.91 | **WT** |
| 2:30 MIN | 6.5 | 0 | 127 | 12 | 30.4 | 0.94 | 113 lbs. |
| 3:00 MIN | 6.5 | 0 | 128 | 12 | 29.7 | 0.96 | 51.4 kg. |
| 3:30 MIN | 6.5 | 0 | 126 | 12 | 28.5 | 0.96 | |
| 4:00 MIN | 6.5 | 0 | 128 | 12 | 29.3 | 0.95 | **DOB** |
| 4:30 MIN | 6.5 | 0 | 128 | 12.5 | 28.8 | 0.93 | 7/17/1981 |
| 5:00 MIN | 6.5 | 0 | 124 | 12.5 | 28.1 | 0.99 | 21 |
| 5:30 MIN | 6.5 | 0 | 124 | 12.5 | 28.6 | 0.96 | **DATE** |
| 6:00 MIN | 6.5 | 0 | 129 | 12.5 | 30.4 | 0.94 | Oct. 4 |
| **Last** | | | | | | | |
| **3 min** | | | | | | | |
| **Mean** | | | **126.50** | **12.33** | **28.95** | **0.96** | |
| **SD** | | | **2.17** | **0.26** | **0.81** | **0.02** | |

**TABLE D.27**
**Sub 7**
**TR $VO_2$ Steady State Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 6.0 | 0 | 141 | 12 | 27.5 | 0.93 | 67 in. |
| 1:00 MIN | 6.0 | 0 | 139 | 12 | 28.0 | 0.91 | 170.2 cm |
| 1:30 MIN | 6.0 | 0 | 141 | 12 | 28.1 | 0.93 | |
| 2:00 MIN | 6.0 | 0 | 141 | 12 | 27.7 | 0.92 | **WT** |
| 2:30 MIN | 6.0 | 0 | 141 | 12 | 27.4 | 0.93 | 130.5 |
| 3:00 MIN | 6.0 | 0 | 142 | 12 | 28.4 | 0.93 | 59.32 |
| 3:30 MIN | 6.0 | 0 | 142 | 12 | 27.7 | 0.93 | |
| 4:00 MIN | 6.0 | 0 | 140 | 12 | 27.4 | 0.93 | **DOB** |
| 4:30 MIN | 6.0 | 0 | 142 | 12 | 27.5 | 0.95 | 11/28/1981 |
| 5:00 MIN | 6.0 | 0 | 145 | 12 | 27.9 | 0.94 | 20 |
| 5:30 MIN | 6.0 | 0 | 141 | 12 | 26.7 | 0.92 | **DATE** |
| 6:00 MIN | 6.0 | 0 | 143 | 12 | 29.1 | 0.92 | Oct. 9 |
| **Last** | | | | | | | |
| **3 min** | | | | | | | |
| **Mean** | | | **142.17** | **12.00** | **27.72** | **0.93** | |
| **SD** | | | **1.72** | **0.00** | **0.79** | **0.01** | |

**TABLE D.28**
**Sub 8**
**TR $VO_2$ Steady State Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 7.0 | 0 | 133 | 12 | 32.1 | 0.91 | 65 in. |
| 1:00 MIN | 7.0 | 0 | 130 | 12 | 31.5 | 0.93 | 165.1 cm |
| 1:30 MIN | 7.0 | 0 | 133 | 12 | 31.5 | 0.93 | |
| 2:00 MIN | 7.0 | 0 | 133 | 12 | 31.0 | 0.96 | **WT** |
| 2:30 MIN | 7.0 | 0 | 133 | 12 | 31.7 | 0.93 | 123.5 lbs |
| 3:00 MIN | 7.0 | 0 | 131 | 12 | 31.6 | 0.95 | 56.14 kg |
| 3:30 MIN | 7.0 | 0 | 131 | 12 | 32.2 | 0.93 | |
| 4:00 MIN | 7.0 | 0 | 130 | 12 | 31.5 | 0.94 | **DOB** |
| 4:30 MIN | 7.0 | 0 | 130 | 13 | 30.5 | 0.89 | 2/22/1982 |
| 5:00 MIN | 7.0 | 0 | 129 | 13 | 31.3 | 0.95 | 20 |
| 5:30 MIN | 7.0 | 0 | 130 | 13 | 31.9 | 0.95 | **DATE** |
| 6:00 MIN | 7.0 | 0 | 130 | 13 | 30.8 | 0.97 | Oct.6 |
| **Last** | | | | | | | |
| **3 min** | | | | | | | |
| **Mean** | | | **130.00** | **12.67** | **31.37** | **0.94** | |
| **SD** | | | **0.63** | **0.52** | **0.64** | **0.03** | |

**TABLE D.29**
**Sub 9**
**TR $VO_2$ Steady State Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 8.0 | 0 | 132 | 11 | 33.1 | 0.89 | 72 in. |
| 1:00 MIN | 8.0 | 0 | 133 | 11 | 31.3 | 0.89 | 182.9 cm |
| 1:30 MIN | 8.0 | 0 | 135 | 12 | 33.5 | 0.88 | |
| 2:00 MIN | 8.0 | 0 | 135 | 12 | 32.5 | 0.86 | **WT** |
| 2:30 MIN | 8.0 | 0 | 135 | 12 | 33.9 | 0.91 | 166.5 lbs. |
| 3:00 MIN | 8.0 | 0 | 135 | 12 | 34.5 | 0.90 | 75.68 kg. |
| 3:30 MIN | 8.0 | 0 | 141 | 12 | 32.8 | 0.90 | |
| 4:00 MIN | 8.0 | 0 | 140 | 12 | 32.8 | 0.89 | **DOB** |
| 4:30 MIN | 8.0 | 0 | 137 | 13 | 32.1 | 0.91 | 7/23/1982 |
| 5:00 MIN | 8.0 | 0 | 137 | 13 | 33.8 | 0.90 | 20 |
| 5:30 MIN | 8.0 | 0 | 141 | 13 | 32.2 | 0.94 | **DATE** |
| 6:00 MIN | 8.0 | 0 | 141 | 13 | 31.8 | 0.91 | Oct. 6 |
| **Last** | | | | | | | |
| **3 min** | | | | | | | |
| **Mean** | | | **139.50** | **12.67** | **32.58** | **0.91** | |
| **SD** | | | **1.97** | **0.52** | **0.72** | **0.02** | |

**TABLE D.30**
**Sub 10**
**TR $VO_2$ Steady State Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 7.0 | 0 | 131 | 11 | 31.6 | 0.87 | 71.5 in. |
| 1:00 MIN | 7.0 | 0 | 134 | 11 | 34.3 | 0.85 | 181.61 cm |
| 1:30 MIN | 7.0 | 0 | 135 | 11 | 30.9 | 0.84 | |
| 2:00 MIN | 7.0 | 0 | 135 | 11 | 32.1 | 0.83 | **WT** |
| 2:30 MIN | 7.0 | 0 | 132 | 11 | 32.0 | 0.84 | 158 lbs. |
| 3:00 MIN | 7.0 | 0 | 139 | 11 | 32.7 | 0.87 | 71.81 kg. |
| 3:30 MIN | 7.0 | 0 | 135 | 11 | 28.7 | 0.86 | |
| 4:00 MIN | 7.0 | 0 | 140 | 11 | 34.0 | 0.85 | **DOB** |
| 4:30 MIN | 7.0 | 0 | 138 | 11 | 34.3 | 0.87 | 9/20/1983 |
| 5:00 MIN | 7.0 | 0 | 139 | 11 | 30.8 | 0.86 | 19 |
| 5:30 MIN | 7.0 | 0 | 142 | 11 | 31.5 | 0.83 | **DATE** |
| 6:00 MIN | 7.0 | 0 | 139 | 11 | 30.9 | 0.87 | Oct. 6 |
| **Last** | | | | | | | |
| **3 min** | | | | | | | |
| **Mean** | | | **138.83** | **11.00** | **31.70** | **0.86** | |
| **SD** | | | **2.32** | **0.00** | **2.12** | **0.02** | |

**TABLE D.31**
**Sub 11**
**TR $VO_2$ Steady State Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 7.0 | 0 | 155 | 10 | 31.4 | 0.96 | 64 in. |
| 1:00 MIN | 7.0 | 0 | 158 | 10 | 32.2 | 0.92 | 162.6 cm |
| 1:30 MIN | 7.0 | 0 | 155 | 11 | 33.9 | 0.94 | |
| 2:00 MIN | 7.0 | 0 | 160 | 11 | 34.1 | 0.95 | **WT** |
| 2:30 MIN | 7.0 | 0 | 159 | 11 | 34.4 | 0.93 | 124 lbs |
| 3:00 MIN | 7.0 | 0 | 157 | 11 | 35.5 | 0.98 | 56.36 kg |
| 3:30 MIN | 7.0 | 0 | 159 | 11 | 34.2 | 0.95 | |
| 4:00 MIN | 7.0 | 0 | 159 | 11 | 35.4 | 0.97 | **DOB** |
| 4:30 MIN | 7.0 | 0 | 156 | 12 | 35.1 | 0.99 | 8/13/1982 |
| 5:00 MIN | 7.0 | 0 | 162 | 12 | 34.6 | 0.96 | 20 |
| 5:30 MIN | 7.0 | 0 | 158 | 12 | 34.4 | 0.96 | **DATE** |
| 6:00 MIN | 7.0 | 0 | 159 | 12 | 34.9 | 0.96 | Oct.9 |
| **Last** | | | | | | | |
| **3 min** | | | | | | | |
| **Mean** | | | **158.83** | **11.67** | **34.77** | **0.97** | |
| **SD** | | | **1.94** | **0.52** | **0.45** | **0.01** | |

**TABLE D.32**
**Sub 12**
**TR $VO_2$ Steady State Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 5.5 | 0 | 130 | 11 | 26.7 | 0.94 | 65 in. |
| 1:00 MIN | 5.5 | 0 | 132 | 11 | 26.1 | 0.91 | 165.1 cm |
| 1:30 MIN | 5.5 | 0 | 132 | 11 | 26.5 | 0.92 | |
| 2:00 MIN | 5.5 | 0 | 132 | 11 | 26.4 | 0.97 | **WT** |
| 2:30 MIN | 5.5 | 0 | 135 | 11 | 26.7 | 0.97 | 123.5 lbs |
| 3:00 MIN | 5.5 | 0 | 136 | 11 | 27.0 | 0.98 | 56.14 kg |
| 3:30 MIN | 5.5 | 0 | 134 | 11 | 26.2 | 0.96 | |
| 4:00 MIN | 5.5 | 0 | 132 | 11 | 27.3 | 1.01 | **DOB** |
| 4:30 MIN | 5.5 | 0 | 131 | 11 | 26.1 | 0.98 | 2/22/1982 |
| 5:00 MIN | 5.5 | 0 | 133 | 11 | 26.2 | 0.96 | 20 |
| 5:30 MIN | 5.5 | 0 | 136 | 11 | 27.0 | 0.96 | **DATE** |
| 6:00 MIN | 5.5 | 0 | 133 | 11 | 25.8 | 0.96 | Oct.6 |
| **Last** | | | | | | | |
| **3 min** | | | | | | | |
| **Mean** | | | **133.17** | **11.00** | **26.43** | **0.97** | |
| **SD** | | | **1.72** | **0.00** | **0.58** | **0.02** | |

**TABLE D.33**
**Sub 13**
**TR $VO_2$ Steady State Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 6.5 | 0 | 141 | 8 | 34.5 | 0.92 | 65 in. |
| 1:00 MIN | 6.5 | 0 | 142 | 8 | 36.2 | 0.93 | 165.1 cm |
| 1:30 MIN | 6.5 | 0 | 142 | 8 | 37.1 | 0.92 | |
| 2:00 MIN | 6.5 | 0 | 142 | 8 | 36.8 | 0.94 | **WT** |
| 2:30 MIN | 6.5 | 0 | 142 | 8 | 38.3 | 1.00 | 141 lbs |
| 3:00 MIN | 6.5 | 0 | 142 | 8 | 33.8 | 0.97 | 63.86 kg |
| 3:30 MIN | 6.5 | 0 | 139 | 8 | 36.5 | 0.95 | |
| 4:00 MIN | 6.5 | 0 | 139 | 8 | 35.9 | 0.95 | **DOB** |
| 4:30 MIN | 6.5 | 0 | 139 | 8 | 35.4 | 0.95 | 9/19/1983 |
| 5:00 MIN | 6.5 | 0 | 139 | 8 | 35.1 | 0.97 | 19 |
| 5:30 MIN | 6.5 | 0 | 139 | 9 | 35.5 | 0.95 | **DATE** |
| 6:00 MIN | 6.5 | 0 | 139 | 9 | 35.0 | 0.97 | Oct.11 |
| **Last** | | | | | | | |
| **3 min** | | | | | | | |
| **Mean** | | | **139.00** | **8.33** | **35.57** | **0.96** | |
| **SD** | | | **0.00** | **0.52** | **0.56** | **0.01** | |

**TABLE D.34**
**Sub 14**
**TR $VO_2$ Steady State Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 6.5 | 0 | 129 | 10 | 29.7 | 0.88 | 73.5 in. |
| 1:00 MIN | 6.5 | 0 | 127 | 10 | 32.5 | 0.86 | 186.7 cm |
| 1:30 MIN | 6.5 | 0 | 129 | 10 | 33.1 | 0.90 | |
| 2:00 MIN | 6.5 | 0 | 130 | 10 | 32.8 | 0.91 | **WT** |
| 2:30 MIN | 6.5 | 0 | 129 | 11 | 34.0 | 0.94 | 140.5 lbs |
| 3:00 MIN | 6.5 | 0 | 131 | 11 | 33.0 | 0.93 | 63.9 kg |
| 3:30 MIN | 6.5 | 0 | 131 | 11 | 33.8 | 0.95 | |
| 4:00 MIN | 6.5 | 0 | 133 | 11 | 33.6 | 0.96 | **DOB** |
| 4:30 MIN | 6.5 | 0 | 130 | 11 | 34.0 | 0.96 | 4/29/1984 |
| 5:00 MIN | 6.5 | 0 | 131 | 11 | 33.1 | 0.96 | 18 |
| 5:30 MIN | 6.5 | 0 | 131 | 11 | 33.2 | 0.97 | **DATE** |
| 6:00 MIN | 6.5 | 0 | 131 | 11 | 33.2 | 0.95 | Oct.11 |
| **Last** | | | | | | | |
| **3 min** | | | | | | | |
| **Mean** | | | **131.17** | **11.00** | **33.48** | **0.96** | |
| **SD** | | | **0.98** | **0.00** | **0.37** | **0.01** | |

# TABLE D.35
# Sub 15
# TR $VO_2$ Steady State Record Sheet

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 6.5 | 0 | 139 | 13 | 28.7 | 0.87 | 70 in. |
| 1:00 MIN | 6.5 | 0 | 138 | 13 | 30.0 | 0.88 | 177.8 cm |
| 1:30 MIN | 6.5 | 0 | 137 | 13 | 31.0 | 0.87 | |
| 2:00 MIN | 6.5 | 0 | 142 | 13 | 31.3 | 0.92 | **WT** |
| 2:30 MIN | 6.5 | 0 | 140 | 13 | 31.3 | 0.89 | 152.5 lbs |
| 3:00 MIN | 6.5 | 0 | 142 | 13 | 32.2 | 0.91 | 69.32 kg |
| 3:30 MIN | 6.5 | 0 | 138 | 14 | 30.0 | 0.87 | |
| 4:00 MIN | 6.5 | 0 | 142 | 14 | 29.4 | 0.90 | **DOB** |
| 4:30 MIN | 6.5 | 0 | 141 | 14 | 30.2 | 0.91 | 12/30/1982 |
| 5:00 MIN | 6.5 | 0 | 142 | 14 | 31.6 | 0.89 | 19 |
| 5:30 MIN | 6.5 | 0 | 146 | 14 | 32.2 | 0.93 | **DATE** |
| 6:00 MIN | 6.5 | 0 | 144 | 14 | 26.7 | 0.86 | Oct.17 |
| **Last** | | | | | | | |
| **3 min** | | | | | | | |
| **Mean** | | | **142.17** | **14.00** | **30.02** | **0.89** | |
| **SD** | | | **2.71** | **0.00** | **1.93** | **0.03** | |

**TABLE D.36**
**Sub 16**
**TR $VO_2$ Steady State Record Sheet**

| **TIME** | **SPEED** | **GRADE** | **HR** | **RPE** | **VO2** | **RER** | **HT** |
|---|---|---|---|---|---|---|---|
| | **(mph)** | **(degrees)** | **(beats/min)** | **(6-20)** | **(ml·kg·min)** | | |
| 30 SEC | 7.0 | 0 | 124 | 10 | 37.9 | 0.84 | 72 in. |
| 1:00 MIN | 7.0 | 0 | 122 | 11 | 36.2 | 0.82 | 182.9 cm |
| 1:30 MIN | 7.0 | 0 | 120 | 11 | 37.1 | 0.84 | |
| 2:00 MIN | 7.0 | 0 | 122 | 11 | 37.2 | 0.85 | **WT** |
| 2:30 MIN | 7.0 | 0 | 122 | 11 | 36.4 | 0.85 | 164.5 lbs |
| 3:00 MIN | 7.0 | 0 | 125 | 11 | 36.5 | 0.82 | 74.77 kg |
| 3:30 MIN | 7.0 | 0 | 124 | 11 | 37.9 | 0.84 | |
| 4:00 MIN | 7.0 | 0 | 124 | 11 | 37.3 | 0.86 | **DOB** |
| 4:30 MIN | 7.0 | 0 | 124 | 11 | 38.7 | 0.88 | 12/10/1980 |
| 5:00 MIN | 7.0 | 0 | 124 | 11 | 36.2 | 0.88 | 21 |
| 5:30 MIN | 7.0 | 0 | 124 | 11 | 36.5 | 0.86 | **DATE** |
| 6:00 MIN | 7.0 | 0 | 125 | 11 | 37.7 | 0.86 | Oct.25 |
| **Last** | | | | | | | |
| **3 min** | | | | | | | |
| **Mean** | | | **124.17** | **11.00** | **37.38** | **0.86** | |
| **SD** | | | **0.41** | **0.00** | **0.93** | **0.02** | |

# TABLE D.37
## Sub 17
## TR $VO_2$ Steady State Record Sheet

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 7.5 | 0 | 140 | 11 | 27.6 | 0.98 | 63.5 in. |
| 1:00 MIN | 7.5 | 0 | 139 | 11 | 29.9 | 0.94 | 161.3 cm |
| 1:30 MIN | 7.5 | 0 | 143 | 11 | 31.0 | 0.97 | |
| 2:00 MIN | 7.5 | 0 | 143 | 11 | 31.7 | 0.95 | **WT** |
| 2:30 MIN | 7.5 | 0 | 144 | 11 | 32.7 | 0.94 | 91.5 lbs |
| 3:00 MIN | 7.5 | 0 | 143 | 11 | 30.7 | 0.96 | 41.6 kg |
| 3:30 MIN | 7.5 | 0 | 141 | 11 | 27.6 | 0.94 | |
| 4:00 MIN | 7.5 | 0 | 143 | 11 | 27.2 | 0.95 | **DOB** |
| 4:30 MIN | 7.5 | 0 | 141 | 11 | 26.1 | 0.96 | Dec16/81 |
| 5:00 MIN | 7.5 | 0 | 144 | 11 | 27.0 | 0.97 | 20 |
| 5:30 MIN | 7.5 | 0 | 142 | 11 | 24.9 | 0.94 | **DATE** |
| 6:00 MIN | 7.5 | 0 | 140 | 11 | 26.6 | 0.98 | Oct.13 |
| **Last** | | | | | | | |
| **3 min** | | | | | | | |
| **Mean** | | | **141.83** | **11.00** | **26.57** | **0.96** | |
| **SD** | | | **1.47** | **0.00** | **0.96** | **0.02** | |

**TABLE D.38**
**Sub 18**
**TR $VO_2$ Steady State Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 5.0 | 0 | 136 | 10 | 24.8 | 0.86 | 66 in. |
| 1:00 MIN | 5.0 | 0 | 138 | 10 | 24.9 | 0.85 | 167.6 cm |
| 1:30 MIN | 5.0 | 0 | 139 | 11 | 25.1 | 0.89 | |
| 2:00 MIN | 5.0 | 0 | 140 | 11 | 25.9 | 0.86 | **WT** |
| 2:30 MIN | 5.0 | 0 | 138 | 11 | 25.6 | 0.87 | 149 lbs |
| 3:00 MIN | 5.0 | 0 | 134 | 11 | 24.6 | 0.87 | 67.73 kg |
| 3:30 MIN | 5.0 | 0 | 139 | 11 | 25.1 | 0.87 | |
| 4:00 MIN | 5.0 | 0 | 140 | 11 | 25.3 | 0.88 | **DOB** |
| 4:30 MIN | 5.0 | 0 | 141 | 11 | 25.2 | 0.87 | 2/1/1982 |
| 5:00 MIN | 5.0 | 0 | 141 | 11 | 25.1 | 0.91 | 20 |
| 5:30 MIN | 5.0 | 0 | 139 | 11 | 25.0 | 0.88 | **DATE** |
| 6:00 MIN | 5.0 | 0 | 140 | 11 | 25.3 | 0.88 | Oct.17 |
| **Last** | | | | | | | |
| **3 min** | | | | | | | |
| **Mean** | | | **140.00** | **11.00** | **25.17** | **0.88** | |
| **SD** | | | **0.89** | **0.00** | **0.12** | **0.01** | |

# TABLE D.39
## Sub 19
## TR $VO_2$ Steady State Record Sheet

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 5.5 | 0 | 136 | 11 | 28.9 | 0.94 | 62.5 in. |
| 1:00 MIN | 5.5 | 0 | 129 | 11 | 29.0 | 0.97 | 158.8 cm |
| 1:30 MIN | 5.5 | 0 | 130 | 11 | 28.7 | 0.95 | |
| 2:00 MIN | 5.5 | 0 | 130 | 11 | 28.5 | 0.92 | **WT** |
| 2:30 MIN | 5.5 | 0 | 131 | 11 | 28.7 | 0.93 | 118 lbs |
| 3:00 MIN | 5.5 | 0 | 134 | 12 | 28.7 | 0.95 | 53.64 kg |
| 3:30 MIN | 5.5 | 0 | 133 | 12 | 29.0 | 0.96 | |
| 4:00 MIN | 5.5 | 0 | 134 | 12 | 28.7 | 0.94 | **DOB** |
| 4:30 MIN | 5.5 | 0 | 134 | 12 | 28.8 | 0.98 | 4/14/1982 |
| 5:00 MIN | 5.5 | 0 | 133 | 12 | 28.7 | 0.98 | 20 |
| 5:30 MIN | 5.5 | 0 | 133 | 12 | 30.4 | 0.94 | **DATE** |
| 6:00 MIN | 5.5 | 0 | 133 | 12 | 28.9 | 0.98 | Oct.16 |
| **Last** | | | | | | | |
| **3 min** | | | | | | | |
| **Mean** | | | **133.33** | **12.00** | **29.08** | **0.96** | |
| **SD** | | | **0.52** | **0.00** | **0.66** | **0.02** | |

**TABLE D.40**
**Sub 20**
**TR $VO_2$ Steady State Record Sheet**

| TIME | SPEED | GRADE | HR | RPE | VO2 | RER | HT |
|---|---|---|---|---|---|---|---|
| | (mph) | (degrees) | (beats/min) | (6-20) | (ml·kg·min) | | |
| 30 SEC | 6.5 | 0 | 127 | 12 | 33.6 | 0.93 | 74 in. |
| 1:00 MIN | 6.5 | 0 | 126 | 12 | 32.1 | 0.91 | 188 cm |
| 1:30 MIN | 6.5 | 0 | 127 | 13 | 32.9 | 0.91 | |
| 2:00 MIN | 6.5 | 0 | 127 | 13 | 29.2 | 0.91 | **WT** |
| 2:30 MIN | 6.5 | 0 | 127 | 13 | 32.8 | 0.92 | 158 lbs |
| 3:00 MIN | 6.5 | 0 | 125 | 13 | 32.2 | 0.90 | 71.8 kg |
| 3:30 MIN | 6.5 | 0 | 126 | 13 | 32.6 | 0.90 | |
| 4:00 MIN | 6.5 | 0 | 128 | 13 | 33.5 | 0.94 | **DOB** |
| 4:30 MIN | 6.5 | 0 | 129 | 13 | 34.0 | 0.92 | 1/22/1981 |
| 5:00 MIN | 6.5 | 0 | 129 | 13 | 30.8 | 0.92 | 21 |
| 5:30 MIN | 6.5 | 0 | 130 | 13 | 32.3 | 0.93 | **DATE** |
| 6:00 MIN | 6.5 | 0 | 130 | 13 | 33.9 | 0.95 | Oct.21 |
| **Last** | | | | | | | |
| **3 min** | | | | | | | |
| **Mean** | | | **128.67** | **13.00** | **32.85** | **0.93** | |
| **SD** | | | **1.51** | **0.00** | **1.22** | **0.02** | |

**TABLE D.41**
**TR $VO_2$ Steady State Summary**

| Subject | Gender | HR | RPE | VO2 | % of VO2 | RER | SR |
|---|---|---|---|---|---|---|---|
| | | (beats/min) | (6-20) | (ml·kg·min) | (%) | | (/min) |
| 1 | Female | 135.9 | 12.4 | 30.0 | 62.1 | 0.98 | 74.4 |
| 2 | Female | 131.8 | 12.6 | 28.5 | 60.0 | 0.87 | 85.2 |
| 3 | Female | 158.8 | 12.2 | 31.9 | 62.4 | 0.94 | 81.0 |
| 4 | Female | 135.2 | 10.8 | 30.2 | 61.3 | 0.93 | 75.6 |
| 5 | Male | 142.6 | 10.8 | 36.2 | 60.5 | 0.90 | 76.8 |
| 6 | Female | 127.3 | 12.2 | 29.2 | 56.5 | 0.95 | 85.8 |
| 7 | Female | 141.5 | 12.0 | 27.8 | 59.3 | 0.93 | 77.4 |
| 8 | Female | 131.1 | 12.3 | 31.5 | 59.1 | 0.94 | 85.2 |
| 9 | Male | 136.8 | 12.2 | 32.9 | 57.8 | 0.90 | 80.4 |
| 10 | Male | 136.6 | 11.0 | 32.0 | 58.3 | 0.85 | 85.2 |
| 11 | Female | 158.1 | 11.2 | 34.2 | 61.6 | 0.96 | 76.8 |
| 12 | Female | 133.0 | 11.0 | 26.5 | 59.0 | 0.96 | 86.4 |
| 13 | Male | 140.4 | 8.2 | 35.8 | 62.5 | 0.95 | 81.6 |
| 14 | Male | 130.2 | 10.7 | 33.0 | 60.1 | 0.93 | 81.6 |
| 15 | Male | 140.9 | 13.5 | 30.4 | 58.6 | 0.89 | 79.2 |
| 16 | Male | 123.3 | 10.9 | 37.1 | 60.6 | 0.85 | 82.8 |
| 17 | Female | 141.9 | 11.0 | 28.6 | 57.7 | 0.96 | 85.2 |
| 18 | Female | 138.8 | 10.8 | 25.2 | 57.9 | 0.87 | 78.6 |
| 19 | Female | 132.5 | 11.6 | 28.9 | 57.3 | 0.95 | 80.4 |
| 20 | Male | 127.6 | 12.8 | 32.5 | 58.2 | 0.92 | 69.0 |
| | | | | | | | |
| **Mean** | | **137.2** | **11.5** | **31.1** | **59.5** | **0.92** | **80.4** |
| **SD** | | **9.0** | **1.1** | **3.2** | **1.80** | **0.04** | **4.56** |

**TABLE D.42**
**Sub 1**
**DWR: SCC $VO_2$ Steady State Record Sheet**

| **TIME** | **HR** (beats/min) | **RPE** (6-20) | **$VO_2$** (ml·kg·min) | **RER** | **TEMP** |
|---|---|---|---|---|---|
| 30 SEC | 128 | 13 | 24.3 | 0.87 | 26° C |
| 1:00 MIN | 140 | 13 | 30.5 | 0.87 | |
| 1:30 MIN | 142 | 14 | 34.0 | 0.95 | |
| 2:00 MIN | 140 | 14 | 32.8 | 0.95 | |
| 2:30 MIN | 131 | 13 | 30.6 | 0.96 | |
| 3:00 MIN | 128 | 13 | 29.3 | 0.94 | |
| 3:30 MIN | 134 | 13 | 28.7 | 0.93 | |
| 4:00 MIN | 133 | 13 | 28.8 | 0.90 | |
| 4:30 MIN | 129 | 13 | 27.0 | 0.93 | |
| 5:00 MIN | 134 | 13 | 27.5 | 0.94 | |
| | | | | | |
| **Mean** | **133.9** | **13.2** | **29.35** | **0.92** | |
| **SD** | **5.20** | **0.42** | **2.82** | **0.03** | |

**TABLE D.43**
**Sub 2**
**DWR: SCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 115 | 12 | 23.9 | 0.88 | 27° C |
| 1:00 MIN | 116 | 12 | 24.6 | 0.88 | |
| 1:30 MIN | 115 | 12 | 29.3 | 0.86 | |
| 2:00 MIN | 110 | 12 | 24.1 | 0.85 | |
| 2:30 MIN | 111 | 12 | 25.0 | 0.90 | |
| 3:00 MIN | 113 | 12 | 23.2 | 0.86 | |
| 3:30 MIN | 114 | 12 | 25.1 | 0.90 | |
| 4:00 MIN | 112 | 12 | 25.9 | 0.88 | |
| 4:30 MIN | 111 | 12 | 26.0 | 0.90 | |
| 5:00 MIN | 110 | 12 | 24.0 | 0.89 | |
| 5:30 MIN | 120 | 12 | 26.2 | 0.88 | |
| 6:00 MIN | 121 | 12 | 26.5 | 0.89 | |
| | | | | | |
| **Mean** | **114.00** | **12.00** | **25.32** | **0.88** | |
| **SD** | **3.64** | **0.00** | **1.63** | **0.02** | |

**TABLE D.44**
**Sub 3**
**DWR: SCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 139 | 13 | 25.2 | 0.88 | 26° C |
| 1:00 MIN | 138 | 13 | 27.7 | 0.89 | |
| 1:30 MIN | 144 | 13 | 25.9 | 0.87 | |
| 2:00 MIN | 147 | 13 | 29.9 | 0.89 | |
| 2:30 MIN | 147 | 13 | 29.6 | 0.88 | |
| 3:00 MIN | 148 | 13 | 30.8 | 0.89 | |
| 3:30 MIN | 150 | 14 | 30.4 | 0.89 | |
| 4:00 MIN | 151 | 14 | 30.6 | 0.91 | |
| 4:30 MIN | 151 | 14 | 30.0 | 0.94 | |
| 5:00 MIN | 152 | 14 | 30.1 | 0.92 | |
| | | | | | |
| **Mean** | **146.70** | **13.40** | **29.02** | **0.90** | |
| **SD** | **4.95** | **0.52** | **2.02** | **0.02** | |

**TABLE D.45**
**Sub 4**
**DWR: SCC $VO_2$ Steady State Record Sheet**

| **TIME** | **HR** (beats/min) | **RPE** (6-20) | **$VO_2$** (ml·kg·min) | **RER** | **TEMP** |
|---|---|---|---|---|---|
| 30 SEC | 126 | 11 | 24.5 | 0.94 | 27.5° C |
| 1:00 MIN | 133 | 11 | 27.1 | 0.97 | |
| 1:30 MIN | 135 | 12 | 26.8 | 0.96 | |
| 2:00 MIN | 130 | 12 | 26.8 | 1.03 | |
| 2:30 MIN | 127 | 12 | 24.7 | 1.00 | |
| 3:00 MIN | 127 | 12 | 27.9 | 1.00 | |
| 3:30 MIN | 134 | 12 | 27.7 | 0.97 | |
| 4:00 MIN | 128 | 12 | 26.6 | 0.97 | |
| 4:30 MIN | 130 | 12 | 24.7 | 1.00 | |
| 5:00 MIN | 127 | 12 | 26.1 | 0.96 | |
| 5:30 MIN | 127 | 12 | 26.5 | 0.95 | |
| 6:00 MIN | 130 | 12 | 27.4 | 0.97 | |
| | | | | | |
| **Mean** | **129.50** | **11.83** | **26.40** | **0.98** | |
| **SD** | **3.06** | **0.39** | **1.18** | **0.03** | |

**TABLE D.46**
**Sub 5**
**DWR: SCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 143 | 14 | 36.2 | 0.94 | 27.5° C |
| 1:00 MIN | 144 | 14 | 34.5 | 0.96 | |
| 1:30 MIN | 143 | 14 | 31.6 | 0.95 | |
| 2:00 MIN | 147 | 15 | 35.7 | 0.93 | |
| 2:30 MIN | 146 | 15 | 37.9 | 0.92 | |
| 3:00 MIN | 143 | 15 | 36.8 | 0.97 | |
| 3:30 MIN | 145 | 15 | 35.4 | 0.97 | |
| 4:00 MIN | 144 | 15 | 36.7 | 0.95 | |
| 4:30 MIN | 147 | 15 | 38.8 | 0.94 | |
| 5:00 MIN | 150 | 15 | 38.9 | 0.98 | |
| | | | | | |
| **Mean** | **145.20** | **14.70** | **36.25** | **0.95** | |
| **SD** | **2.30** | **0.48** | **2.17** | **0.02** | |

**TABLE D.47**
**Sub 6**
**DWR: SCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 123 | 13 | 25.4 | 1.04 | 26° C |
| 1:00 MIN | 129 | 13 | 27.2 | 1.00 | |
| 1:30 MIN | 131 | 14 | 27.5 | 0.90 | |
| 2:00 MIN | 136 | 14 | 29.0 | 1.01 | |
| 2:30 MIN | 135 | 14 | 28.4 | 0.99 | |
| 3:00 MIN | 135 | 15 | 30.8 | 0.93 | |
| 3:30 MIN | 137 | 15 | 30.3 | 1.01 | |
| 4:00 MIN | 140 | 15 | 30.9 | 1.03 | |
| 4:30 MIN | 141 | 15 | 30.5 | 1.03 | |
| 5:00 MIN | 140 | 15 | 31.3 | 0.99 | |
| | | | | | |
| **Mean** | **134.70** | **14.30** | **29.13** | **0.99** | |
| **SD** | **5.64** | **0.82** | **1.96** | **0.04** | |

**TABLE D.48**
**Sub 7**
**DWR: SCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | VO2 (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 124 | 14 | 23.4 | 0.92 | 25.5° C |
| 1:00 MIN | 125 | 14 | 24.3 | 0.92 | |
| 1:30 MIN | 127 | 14 | 25.3 | 0.93 | |
| 2:00 MIN | 132 | 15 | 26.4 | 0.97 | |
| 2:30 MIN | 131 | 15 | 25.5 | 0.99 | |
| 3:00 MIN | 129 | 15 | 26.7 | 0.97 | |
| 3:30 MIN | 136 | 15 | 26.1 | 1.02 | |
| 4:00 MIN | 136 | 15 | 25.7 | 1.01 | |
| 4:30 MIN | 130 | 15 | 25.9 | 0.98 | |
| 5:00 MIN | 132 | 15 | 26.2 | 0.97 | |
| 5:30 MIN | 137 | 15 | 27.4 | 0.99 | |
| 6:00 MIN | 144 | 15 | 27.7 | 1.03 | |
| | | | | | |
| **Mean** | **131.92** | **14.75** | **25.88** | **0.98** | |
| **SD** | **5.66** | **0.45** | **1.20** | **0.04** | |

**TABLE D.49**
**Sub 8**
**DWR: SCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 122 | 12 | 28.2 | 0.98 | 27.5° C |
| 1:00 MIN | 123 | 12 | 28.5 | 0.93 | |
| 1:30 MIN | 120 | 12 | 27.6 | 0.98 | |
| 2:00 MIN | 120 | 12 | 27.4 | 0.96 | |
| 2:30 MIN | 124 | 12 | 27.8 | 0.93 | |
| 3:00 MIN | 127 | 12 | 29.4 | 0.90 | |
| 3:30 MIN | 126 | 12 | 30.3 | 0.96 | |
| 4:00 MIN | 126 | 12 | 30.2 | 0.94 | |
| 4:30 MIN | 125 | 13 | 30.3 | 0.92 | |
| 5:00 MIN | 130 | 13 | 31.5 | 0.92 | |
| 5:30 MIN | 125 | 13 | 30.2 | 1.00 | |
| 6:00 MIN | 127 | 13 | 31.2 | 0.96 | |
| | | | | | |
| **Mean** | **124.58** | **12.33** | **29.38** | **0.95** | |
| **SD** | **2.97** | **0.49** | **1.43** | **0.03** | |

**TABLE D.50**
**Sub 9**
**DWR: SCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 133 | 12 | 35.0 | 0.85 | 27.5° C |
| 1:00 MIN | 130 | 12 | 34.2 | 0.86 | |
| 1:30 MIN | 133 | 13 | 33.9 | 0.90 | |
| 2:00 MIN | 129 | 13 | 33.4 | 0.88 | |
| 2:30 MIN | 129 | 13 | 32.7 | 0.90 | |
| 3:00 MIN | 133 | 13 | 35.9 | 0.90 | |
| 3:30 MIN | 129 | 13 | 33.5 | 0.91 | |
| 4:00 MIN | 134 | 13 | 34.7 | 0.88 | |
| 4:30 MIN | 134 | 13 | 33.5 | 0.84 | |
| 5:00 MIN | 135 | 13 | 34.3 | 0.90 | |
| 5:30 MIN | 136 | 13 | 35.0 | 0.91 | |
| 6:00 MIN | 131 | 13 | 34.7 | 0.91 | |
| | | | | | |
| **Mean** | **132.17** | **12.83** | **34.23** | **0.89** | |
| **SD** | **2.48** | **0.39** | **0.89** | **0.02** | |

**TABLE D.51**
**Sub 10**
**DWR: SCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | VO2 (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 156 | 12 | 32.8 | 0.93 | 27.5° C |
| 1:00 MIN | 155 | 12 | 39.6 | 0.92 | |
| 1:30 MIN | 153 | 11 | 33.8 | 0.95 | |
| 2:00 MIN | 151 | 11 | 33.0 | 0.95 | |
| 2:30 MIN | 154 | 11 | 31.8 | 0.96 | |
| 3:00 MIN | 156 | 12 | 34.9 | 0.91 | |
| 3:30 MIN | 154 | 12 | 34.9 | 0.98 | |
| 4:00 MIN | 156 | 12 | 33.1 | 0.96 | |
| 4:30 MIN | 158 | 12 | 35.8 | 0.98 | |
| 5:00 MIN | 158 | 12 | 33.5 | 0.95 | |
| 5:30 MIN | 159 | 12 | 35.1 | 0.97 | |
| 6:00 MIN | 156 | 12 | 35.2 | 0.93 | |
| | | | | | |
| **Mean** | **155.50** | **11.75** | **34.46** | **0.95** | |
| **SD** | **2.28** | **0.45** | **2.02** | **0.02** | |

**TABLE D.52**
**Sub 11**
**DWR: SCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 145 | 12 | 30.1 | 0.93 | 27.5° C |
| 1:00 MIN | 148 | 13 | 34.5 | 0.93 | |
| 1:30 MIN | 150 | 13 | 33.7 | 0.94 | |
| 2:00 MIN | 147 | 13 | 33.5 | 0.92 | |
| 2:30 MIN | 150 | 13 | 35.3 | 0.94 | |
| 3:00 MIN | 146 | 13 | 34.5 | 0.95 | |
| 3:30 MIN | 147 | 13 | 35.2 | 0.94 | |
| 4:00 MIN | 146 | 13 | 34.3 | 0.94 | |
| 4:30 MIN | 147 | 13 | 34.4 | 0.92 | |
| 5:00 MIN | 142 | 13 | 33.3 | 0.95 | |
| 5:30 MIN | 147 | 13 | 33.3 | 0.91 | |
| 6:00 MIN | 146 | 13 | 32.4 | 0.94 | |
| | | | | | |
| **Mean** | **146.75** | **12.92** | **33.71** | **0.93** | |
| **SD** | **2.14** | **0.29** | **1.41** | **0.01** | |

**TABLE D.53**
**Sub 12**
**DWR: SCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 145 | 12 | 30.1 | 0.93 | 27.5° C |
| 1:00 MIN | 148 | 13 | 34.5 | 0.93 | |
| 1:30 MIN | 150 | 13 | 33.7 | 0.94 | |
| 2:00 MIN | 147 | 13 | 33.5 | 0.92 | |
| 2:30 MIN | 150 | 13 | 35.3 | 0.94 | |
| 3:00 MIN | 146 | 13 | 34.5 | 0.95 | |
| 3:30 MIN | 147 | 13 | 35.2 | 0.94 | |
| 4:00 MIN | 146 | 13 | 34.3 | 0.94 | |
| 4:30 MIN | 147 | 13 | 34.4 | 0.92 | |
| 5:00 MIN | 142 | 13 | 33.3 | 0.95 | |
| 5:30 MIN | 147 | 13 | 33.3 | 0.91 | |
| 6:00 MIN | 146 | 13 | 32.4 | 0.94 | |
| | | | | | |
| **Mean** | **146.75** | **12.92** | **33.71** | **0.93** | |
| **SD** | **2.14** | **0.29** | **1.41** | **0.01** | |

**TABLE D.54**
**Sub 13**
**DWR: SCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 140 | 14 | 32.8 | 0.93 | 27.5° C |
| 1:00 MIN | 141 | 14 | 33.4 | 0.92 | |
| 1:30 MIN | 144 | 14 | 33.2 | 0.94 | |
| 2:00 MIN | 142 | 14 | 29.6 | 0.95 | |
| 2:30 MIN | 143 | 14 | 31.0 | 0.96 | |
| 3:00 MIN | 148 | 15 | 37.0 | 0.95 | |
| 3:30 MIN | 146 | 15 | 38.4 | 0.95 | |
| 4:00 MIN | 149 | 15 | 37.6 | 0.98 | |
| 4:30 MIN | 144 | 15 | 36.9 | 0.95 | |
| 5:00 MIN | 144 | 15 | 35.4 | 0.95 | |
| 5:30 MIN | 139 | 15 | 35.0 | 0.93 | |
| 6:00 MIN | 145 | 15 | 33.8 | 0.94 | |
| | | | | | |
| **Mean** | **143.75** | **14.58** | **34.51** | **0.95** | |
| **SD** | **3.02** | **0.51** | **2.70** | **0.02** | |

**TABLE D.55**
**Sub 14**
**DWR: SCC $VO_2$ Steady State Record Sheet**

| **TIME** | **HR** (beats/min) | **RPE** (6-20) | **$VO_2$** (ml·kg·min) | **RER** | **TEMP** |
|---|---|---|---|---|---|
| 30 SEC | 119 | 12 | 33.0 | 0.87 | 27.5° C |
| 1:00 MIN | 120 | 12 | 28.2 | 0.93 | |
| 1:30 MIN | 123 | 13 | 33.0 | 0.92 | |
| 2:00 MIN | 127 | 13 | 29.5 | 0.90 | |
| 2:30 MIN | 127 | 13 | 36.1 | 0.93 | |
| 3:00 MIN | 126 | 13 | 33.8 | 0.97 | |
| 3:30 MIN | 125 | 13 | 33.1 | 0.98 | |
| 4:00 MIN | 127 | 14 | 35.0 | 0.90 | |
| 4:30 MIN | 127 | 14 | 33.3 | 0.98 | |
| 5:00 MIN | 129 | 14 | 31.6 | 0.91 | |
| 5:30 MIN | 127 | 14 | 35.8 | 0.95 | |
| 6:00 MIN | 127 | 14 | 37.7 | 0.90 | |
| | | | | | |
| **Mean** | **125.33** | **13.25** | **33.34** | **0.93** | |
| **SD** | **3.08** | **0.75** | **2.70** | **0.04** | |

**TABLE D.56**
**Sub 15**
**DWR: SCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 125 | 12 | 25.0 | 0.98 | 27.5° C |
| 1:00 MIN | 125 | 12 | 28.2 | 0.88 | |
| 1:30 MIN | 128 | 12 | 29.1 | 0.87 | |
| 2:00 MIN | 131 | 13 | 28.8 | 0.89 | |
| 2:30 MIN | 132 | 13 | 28.2 | 0.90 | |
| 3:00 MIN | 128 | 13 | 28.9 | 0.92 | |
| 3:30 MIN | 132 | 13 | 28.4 | 0.90 | |
| 4:00 MIN | 133 | 13 | 26.9 | 0.95 | |
| 4:30 MIN | 131 | 13 | 28.1 | 0.91 | |
| 5:00 MIN | 132 | 13 | 30.8 | 0.93 | |
| 5:30 MIN | 133 | 13 | 30.5 | 0.97 | |
| 6:00 MIN | 136 | 14 | 30.9 | 0.95 | |
| | | | | | |
| **Mean** | **130.50** | **12.83** | **28.65** | **0.92** | |
| **SD** | **3.34** | **0.58** | **1.67** | **0.04** | |

**TABLE D.57**
**Sub 16**
**DWR: SCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 127 | 12 | 36.4 | 1.03 | 27.5° C |
| 1:00 MIN | 129 | 12 | 36.2 | 1.04 | |
| 1:30 MIN | 129 | 13 | 36.2 | 1.01 | |
| 2:00 MIN | 129 | 13 | 37.6 | 1.01 | |
| 2:30 MIN | 126 | 13 | 35.9 | 1.00 | |
| 3:00 MIN | 128 | 13 | 36.0 | 1.03 | |
| 3:30 MIN | 133 | 14 | 35.2 | 1.04 | |
| 4:00 MIN | 135 | 14 | 38.4 | 1.00 | |
| 4:30 MIN | 137 | 14 | 38.4 | 1.03 | |
| 5:00 MIN | 129 | 14 | 37.8 | 1.03 | |
| 5:30 MIN | 126 | 14 | 34.7 | 1.07 | |
| 6:00 MIN | 127 | 14 | 33.6 | 1.05 | |
| | | | | | |
| **Mean** | **129.58** | **13.33** | **36.37** | **1.03** | |
| **SD** | **3.55** | **0.78** | **1.48** | **0.02** | |

**TABLE D.58**
**Sub 17**
**DWR: SCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 109 | 11 | 29.0 | 0.86 | 27.5° C |
| 1:00 MIN | 110 | 11 | 31.3 | 0.86 | |
| 1:30 MIN | 112 | 12 | 32.7 | 0.88 | |
| 2:00 MIN | 112 | 12 | 32.0 | 0.91 | |
| 2:30 MIN | 105 | 11 | 30.3 | 0.92 | |
| 3:00 MIN | 104 | 11 | 29.7 | 0.91 | |
| 3:30 MIN | 107 | 11 | 29.6 | 0.91 | |
| 4:00 MIN | 110 | 11 | 28.2 | 0.95 | |
| 4:30 MIN | 106 | 11 | 28.7 | 0.90 | |
| 5:00 MIN | 106 | 11 | 27.5 | 0.89 | |
| 5:30 MIN | 107 | 11 | 27.8 | 0.91 | |
| 6:00 MIN | 108 | 11 | 28.6 | 0.92 | |
| | | | | | |
| **Mean** | **108.00** | **11.17** | **29.62** | **0.90** | |
| **SD** | **2.63** | **0.39** | **1.67** | **0.03** | |

**TABLE D.59**
**Sub 18**
**DWR: SCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 135 | 12 | 23.2 | 0.93 | 27.5° C |
| 1:00 MIN | 134 | 13 | 24.3 | 0.95 | |
| 1:30 MIN | 133 | 13 | 24.4 | 0.97 | |
| 2:00 MIN | 132 | 13 | 24.0 | 0.96 | |
| 2:30 MIN | 132 | 13 | 23.9 | 0.92 | |
| 3:00 MIN | 131 | 13 | 23.7 | 0.95 | |
| 3:30 MIN | 134 | 13 | 23.9 | 0.96 | |
| 4:00 MIN | 138 | 13 | 21.9 | 0.92 | |
| 4:30 MIN | 141 | 13 | 22.6 | 0.91 | |
| 5:00 MIN | 151 | 13 | 25.1 | 0.89 | |
| 5:30 MIN | 153 | 13 | 24.6 | 0.90 | |
| 6:00 MIN | 154 | 13 | 26.9 | 0.94 | |
| | | | | | |
| **Mean** | **139.00** | **12.92** | **24.04** | **0.93** | |
| **SD** | **8.71** | **0.29** | **1.26** | **0.03** | |

**TABLE D.60**
**Sub 19**
**DWR: SCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 131 | 12 | 24.6 | 0.99 | 27.5° C |
| 1:00 MIN | 137 | 13 | 25.6 | 0.96 | |
| 1:30 MIN | 136 | 13 | 25.7 | 1.00 | |
| 2:00 MIN | 136 | 13 | 25.5 | 0.97 | |
| 2:30 MIN | 139 | 13 | 26.3 | 0.99 | |
| 3:00 MIN | 131 | 13 | 25.9 | 0.97 | |
| 3:30 MIN | 130 | 13 | 25.9 | 0.95 | |
| 4:00 MIN | 140 | 13 | 26.9 | 0.97 | |
| 4:30 MIN | 139 | 13 | 27.1 | 0.99 | |
| 5:00 MIN | 138 | 13 | 27.7 | 0.95 | |
| 5:30 MIN | 135 | 13 | 27.8 | 0.99 | |
| 6:00 MIN | 132 | 13 | 27.1 | 0.97 | |
| | | | | | |
| **Mean** | **135.33** | **12.92** | **26.34** | **0.98** | |
| **SD** | **3.52** | **0.29** | **0.98** | **0.02** | |

**TABLE D.61**
**Sub 20**
**DWR: SCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 129 | 12 | 32.8 | 0.98 | 27.5° C |
| 1:00 MIN | 121 | 12 | 31.8 | 1.01 | |
| 1:30 MIN | 122 | 12 | 30.3 | 0.98 | |
| 2:00 MIN | 115 | 12 | 30.1 | 0.96 | |
| 2:30 MIN | 127 | 13 | 30.8 | 0.94 | |
| 3:00 MIN | 119 | 13 | 31.3 | 0.94 | |
| 3:30 MIN | 127 | 13 | 31.5 | 0.97 | |
| 4:00 MIN | 125 | 13 | 32.4 | 1.00 | |
| 4:30 MIN | 119 | 13 | 32.3 | 0.97 | |
| 5:00 MIN | 111 | 13 | 30.1 | 0.94 | |
| 5:30 MIN | 124 | 13 | 29.6 | 0.98 | |
| 6:00 MIN | 121 | 14 | 28.8 | 0.95 | |
| | | | | | |
| **Mean** | **121.67** | **12.75** | **30.98** | **0.97** | |
| **SD** | **5.23** | **0.62** | **1.24** | **0.02** | |

**TABLE D.62**
**Sub 1**
**DWR: BCC $VO_2$ Steady State Record Sheet**

| **TIME** | **HR** (beats/min) | **RPE** (6-20) | **$VO_2$** (ml·kg·min) | **RER** | **TEMP** |
|---|---|---|---|---|---|
| 30 SEC | 137 | 13 | 30.4 | 0.92 | 26° C |
| 1:00 MIN | 136 | 13 | 31.7 | 0.94 | |
| 1:30 MIN | 135 | 13 | 30.8 | 0.96 | |
| 2:00 MIN | 135 | 13 | 30.1 | 0.97 | |
| 2:30 MIN | 135 | 13 | 29.2 | 0.98 | |
| 3:00 MIN | 133 | 13 | 29.9 | 0.97 | |
| 3:30 MIN | 141 | 13 | 30.4 | 0.98 | |
| 4:00 MIN | 138 | 14 | 31.3 | 0.94 | |
| 4:30 MIN | 137 | 14 | 30.5 | 0.98 | |
| 5:00 MIN | 136 | 14 | 31.8 | 0.99 | |
| | | | | | |
| **Mean** | **136.3** | **13.3** | **30.61** | **0.96** | |
| **SD** | **2.16** | **0.48** | **0.81** | **0.02** | |

**TABLE D.63**
**Sub 2**
**DWR: BCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 126 | 12 | 25.8 | 0.89 | 27° C |
| 1:00 MIN | 129 | 13 | 27.6 | 0.89 | |
| 1:30 MIN | 130 | 13 | 27.6 | 1.01 | |
| 2:00 MIN | 131 | 14 | 29.5 | 0.97 | |
| 2:30 MIN | 130 | 14 | 29.8 | 0.95 | |
| 3:00 MIN | 135 | 14 | 31.7 | 1.03 | |
| 3:30 MIN | 135 | 14 | 28.9 | 1.03 | |
| 4:00 MIN | 138 | 14 | 30.0 | 0.99 | |
| 4:30 MIN | 135 | 14 | 30.4 | 1.03 | |
| 5:00 MIN | 133 | 14 | 29.0 | 0.94 | |
| 5:30 MIN | 130 | 14 | 30.7 | 1.00 | |
| 6:00 MIN | 129 | 14 | 29.8 | 0.95 | |
| | | | | | |
| **Mean** | **131.75** | **13.67** | **29.23** | **0.97** | |
| **SD** | **3.44** | **0.65** | **1.60** | **0.05** | |

**TABLE D.64**
**Sub 3**
**DWR: BCC $VO_2$ Steady State Record Sheet**

| **TIME** | **HR** (beats/min) | **RPE** (6-20) | **VO2** (ml·kg·min) | **RER** | **TEMP** |
|---|---|---|---|---|---|
| 30 SEC | 139 | 13 | 28.9 | 0.84 | 26° C |
| 1:00 MIN | 141 | 13 | 29.0 | 0.83 | |
| 1:30 MIN | 147 | 13 | 29.5 | 0.87 | |
| 2:00 MIN | 150 | 14 | 30.4 | 0.89 | |
| 2:30 MIN | 150 | 14 | 30.1 | 0.93 | |
| 3:00 MIN | 156 | 14 | 31.8 | 0.92 | |
| 3:30 MIN | 158 | 14 | 31.3 | 0.94 | |
| 4:00 MIN | 155 | 14 | 31.7 | 0.94 | |
| 4:30 MIN | 156 | 14 | 31.3 | 0.93 | |
| 5:00 MIN | 154 | 14 | 30.3 | 0.93 | |
| | | | | | |
| **Mean** | **150.60** | **13.70** | **30.43** | **0.90** | |
| **SD** | **6.54** | **0.48** | **1.07** | **0.04** | |

**TABLE D.65**
**Sub 4**
**DWR: BCC $VO_2$ Steady State Record Sheet**

| **TIME** | **HR** (beats/min) | **RPE** (6-20) | **$VO_2$** (ml·kg·min) | **RER** | **TEMP** |
|---|---|---|---|---|---|
| 30 SEC | 125 | 12 | 25.5 | 0.92 | 27.5° C |
| 1:00 MIN | 125 | 12 | 25.5 | 0.94 | |
| 1:30 MIN | 125 | 12 | 24.3 | 0.93 | |
| 2:00 MIN | 132 | 12 | 25.0 | 0.95 | |
| 2:30 MIN | 119 | 12 | 24.6 | 0.94 | |
| 3:00 MIN | 119 | 12 | 24.5 | 0.91 | |
| 3:30 MIN | 121 | 12 | 24.1 | 0.96 | |
| 4:00 MIN | 125 | 12 | 23.7 | 0.90 | |
| 4:30 MIN | 125 | 12 | 25.3 | 0.88 | |
| 5:00 MIN | 125 | 12 | 25.2 | 0.93 | |
| | | | | | |
| **Mean** | **124.10** | **12.00** | **24.77** | **0.93** | |
| **SD** | **3.78** | **0.00** | **0.62** | **0.02** | |

**TABLE D.66**
**Sub 5**
**DWR: BCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 143 | 14 | 36.2 | 0.94 | 27.5° C |
| 1:00 MIN | 144 | 14 | 34.5 | 0.96 | |
| 1:30 MIN | 143 | 14 | 31.6 | 0.95 | |
| 2:00 MIN | 147 | 15 | 35.7 | 0.93 | |
| 2:30 MIN | 146 | 15 | 37.9 | 0.92 | |
| 3:00 MIN | 143 | 15 | 36.8 | 0.97 | |
| 3:30 MIN | 145 | 15 | 35.4 | 0.97 | |
| 4:00 MIN | 144 | 15 | 36.7 | 0.95 | |
| 4:30 MIN | 147 | 15 | 38.8 | 0.94 | |
| 5:00 MIN | 150 | 15 | 38.9 | 0.98 | |
| | | | | | |
| **Mean** | **145.20** | **14.70** | **36.25** | **0.95** | |
| **SD** | **2.30** | **0.48** | **2.17** | **0.02** | |

**TABLE D.67**
**Sub 6**
**DWR: BCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 143 | 14 | 36.2 | 0.94 | 27.5° C |
| 1:00 MIN | 144 | 14 | 34.5 | 0.96 | |
| 1:30 MIN | 143 | 14 | 31.6 | 0.95 | |
| 2:00 MIN | 147 | 15 | 35.7 | 0.93 | |
| 2:30 MIN | 146 | 15 | 37.9 | 0.92 | |
| 3:00 MIN | 143 | 15 | 36.8 | 0.97 | |
| 3:30 MIN | 145 | 15 | 35.4 | 0.97 | |
| 4:00 MIN | 144 | 15 | 36.7 | 0.95 | |
| 4:30 MIN | 147 | 15 | 38.8 | 0.94 | |
| 5:00 MIN | 150 | 15 | 38.9 | 0.98 | |
| | | | | | |
| **Mean** | **145.20** | **14.70** | **36.25** | **0.95** | |
| **SD** | **2.30** | **0.48** | **2.17** | **0.02** | |

**TABLE D.68**
**Sub 7**
**DWR: BCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 136 | 14 | 22.8 | 0.92 | 25.5° C |
| 1:00 MIN | 140 | 14 | 25.1 | 0.97 | |
| 1:30 MIN | 142 | 15 | 26.2 | 0.99 | |
| 2:00 MIN | 143 | 15 | 28.7 | 1.05 | |
| 2:30 MIN | 145 | 15 | 29.4 | 1.03 | |
| 3:00 MIN | 142 | 16 | 29.8 | 1.06 | |
| 3:30 MIN | 146 | 16 | 30.1 | 1.05 | |
| 4:00 MIN | 148 | 16 | 30.8 | 1.05 | |
| 4:30 MIN | 148 | 16 | 31.0 | 1.06 | |
| 5:00 MIN | 148 | 16 | 31.6 | 1.02 | |
| 5:30 MIN | 152 | 16 | 33.3 | 1.07 | |
| 6:00 MIN | 149 | 16 | 32.0 | 1.06 | |
| | | | | | |
| **Mean** | **144.92** | **15.42** | **29.23** | **1.03** | |
| **SD** | **4.48** | **0.79** | **3.08** | **0.05** | |

**TABLE D.69**
**Sub 8**
**DWR: BCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 129 | 13 | 28.9 | 0.94 | 27.5° C |
| 1:00 MIN | 132 | 13 | 30.7 | 0.96 | |
| 1:30 MIN | 127 | 13 | 30.7 | 1.00 | |
| 2:00 MIN | 126 | 13 | 29.4 | 0.98 | |
| 2:30 MIN | 123 | 13 | 29.8 | 0.97 | |
| 3:00 MIN | 125 | 13 | 30.4 | 0.94 | |
| 3:30 MIN | 125 | 13 | 30.5 | 0.95 | |
| 4:00 MIN | 123 | 13 | 29.5 | 0.97 | |
| 4:30 MIN | 122 | 13 | 29.4 | 0.95 | |
| 5:00 MIN | 120 | 13 | 28.2 | 0.95 | |
| 5:30 MIN | 121 | 13 | 28.3 | 0.96 | |
| 6:00 MIN | 121 | 13 | 28.3 | 0.94 | |
| | | | | | |
| **Mean** | **124.50** | **13.00** | **29.51** | **0.96** | |
| **SD** | **3.58** | **0.00** | **0.94** | **0.02** | |

**TABLE D.70**
**Sub 9**
**DWR: BCC $VO_2$ Steady State Record Sheet**

| **TIME** | **HR** (beats/min) | **RPE** (6-20) | **$VO_2$** (ml·kg·min) | **RER** | **TEMP** |
|---|---|---|---|---|---|
| 30 SEC | 139 | 12 | 34.7 | 0.95 | 27.5° C |
| 1:00 MIN | 142 | 13 | 37.3 | 0.94 | |
| 1:30 MIN | 140 | 13 | 39.7 | 0.94 | |
| 2:00 MIN | 136 | 13 | 39.7 | 0.95 | |
| 2:30 MIN | 135 | 13 | 34.7 | 0.97 | |
| 3:00 MIN | 137 | 13 | 35.6 | 0.94 | |
| 3:30 MIN | 136 | 14 | 37.9 | 0.93 | |
| 4:00 MIN | 132 | 14 | 35.0 | 0.89 | |
| 4:30 MIN | 136 | 14 | 37.1 | 0.94 | |
| 5:00 MIN | 134 | 14 | 35.3 | 0.92 | |
| 5:30 MIN | 135 | 14 | 38.0 | 0.93 | |
| 6:00 MIN | 133 | 14 | 34.1 | 0.90 | |
| | | | | | |
| **Mean** | **136.25** | **13.42** | **36.59** | **0.93** | |
| **SD** | **2.90** | **0.67** | **1.96** | **0.02** | |

**TABLE D.71**
**Sub 10**
**DWR: BCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | VO2 (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 146 | 11 | 35.6 | 0.99 | 27.5° C |
| 1:00 MIN | 150 | 11 | 38.5 | 0.96 | |
| 1:30 MIN | 140 | 11 | 34.6 | 0.95 | |
| 2:00 MIN | 142 | 11 | 32.5 | 0.94 | |
| 2:30 MIN | 149 | 11 | 34.7 | 0.98 | |
| 3:00 MIN | 143 | 11 | 33.4 | 0.95 | |
| 3:30 MIN | 140 | 11 | 31.7 | 0.97 | |
| 4:00 MIN | 145 | 11 | 33.8 | 0.95 | |
| 4:30 MIN | 141 | 11 | 32.4 | 0.95 | |
| 5:00 MIN | 146 | 11 | 33.3 | 0.95 | |
| | | | | | |
| **Mean** | **144.20** | **11.00** | **34.05** | **0.96** | |
| **SD** | **3.58** | **0.00** | **1.96** | **0.02** | |

**TABLE D.72**
**Sub 11**
**DWR: BCC $VO_2$ Steady State Record Sheet**

| **TIME** | **HR** (beats/min) | **RPE** (6-20) | **$VO_2$** (ml·kg·min) | **RER** | **TEMP** |
|---|---|---|---|---|---|
| 30 SEC | 139 | 12 | 30.2 | 0.89 | 27.5° C |
| 1:00 MIN | 147 | 13 | 33.9 | 0.88 | |
| 1:30 MIN | 151 | 13 | 33.0 | 0.93 | |
| 2:00 MIN | 150 | 13 | 33.7 | 0.93 | |
| 2:30 MIN | 144 | 13 | 33.8 | 0.93 | |
| 3:00 MIN | 142 | 13 | 33.3 | 0.93 | |
| 3:30 MIN | 140 | 13 | 31.7 | 0.92 | |
| 4:00 MIN | 148 | 13 | 31.8 | 0.92 | |
| 4:30 MIN | 142 | 13 | 32.2 | 0.91 | |
| 5:00 MIN | 143 | 13 | 32.1 | 0.91 | |
| 5:30 MIN | 144 | 13 | 32.7 | 0.92 | |
| 6:00 MIN | 144 | 13 | 33.4 | 0.93 | |
| | | | | | |
| **Mean** | **144.50** | **12.92** | **32.65** | **0.92** | |
| **SD** | **3.78** | **0.29** | **1.10** | **0.02** | |

**TABLE D.73**
**Sub 12**
**DWR: BCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 150 | 13 | 26.3 | 0.85 | 28.0° C |
| 1:00 MIN | 149 | 13 | 28.3 | 0.91 | |
| 1:30 MIN | 150 | 13 | 28.6 | 0.94 | |
| 2:00 MIN | 141 | 12 | 27.6 | 0.95 | |
| 2:30 MIN | 140 | 12 | 26.2 | 0.94 | |
| 3:00 MIN | 143 | 13 | 26.2 | 0.94 | |
| 3:30 MIN | 144 | 13 | 26.7 | 0.92 | |
| 4:00 MIN | 146 | 13 | 27.0 | 0.95 | |
| 4:30 MIN | 149 | 13 | 26.9 | 0.96 | |
| 5:00 MIN | 146 | 13 | 26.6 | 0.95 | |
| 5:30 MIN | 146 | 13 | 26.6 | 0.96 | |
| 6:00 MIN | 148 | 13 | 28.1 | 0.94 | |
| | | | | | |
| **Mean** | **146.00** | **12.83** | **27.09** | **0.93** | |
| **SD** | **3.41** | **0.39** | **0.85** | **0.03** | |

**TABLE D.74**
**Sub 13**
**DWR: BCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 130 | 13 | 28.7 | 1.02 | 27.5° C |
| 1:00 MIN | 134 | 13 | 30.3 | 0.93 | |
| 1:30 MIN | 137 | 14 | 30.8 | 0.95 | |
| 2:00 MIN | 137 | 14 | 33.0 | 0.96 | |
| 2:30 MIN | 138 | 14 | 31.6 | 0.94 | |
| 3:00 MIN | 140 | 14 | 33.6 | 0.97 | |
| 3:30 MIN | 142 | 15 | 35.1 | 0.95 | |
| 4:00 MIN | 140 | 15 | 35.1 | 0.94 | |
| 4:30 MIN | 138 | 15 | 33.8 | 0.94 | |
| 5:00 MIN | 139 | 15 | 34.1 | 0.94 | |
| 5:30 MIN | 139 | 15 | 32.8 | 0.96 | |
| 6:00 MIN | 141 | 15 | 34.5 | 0.95 | |
| | | | | | |
| **Mean** | **137.92** | **14.33** | **32.78** | **0.95** | |
| **SD** | **3.26** | **0.78** | **2.03** | **0.02** | |

**TABLE D.75**
**Sub 14**
**DWR: BCC $VO_2$ Steady State Record Sheet**

| **TIME** | **HR** (beats/min) | **RPE** (6-20) | **$VO_2$** (ml·kg·min) | **RER** | **TEMP** |
|---|---|---|---|---|---|
| 30 SEC | 117 | 11 | 28.4 | 1.05 | 27.5° C |
| 1:00 MIN | 117 | 11 | 28.9 | 1.06 | |
| 1:30 MIN | 119 | 12 | 31.5 | 1.06 | |
| 2:00 MIN | 117 | 12 | 31.2 | 1.10 | |
| 2:30 MIN | 118 | 12 | 29.1 | 1.06 | |
| 3:00 MIN | 123 | 13 | 30.8 | 1.01 | |
| 3:30 MIN | 123 | 13 | 32.7 | 1.08 | |
| 4:00 MIN | 119 | 13 | 30.6 | 1.02 | |
| 4:30 MIN | 118 | 14 | 32.3 | 1.08 | |
| 5:00 MIN | 121 | 14 | 30.7 | 1.07 | |
| 5:30 MIN | 119 | 14 | 30.9 | 0.99 | |
| 6:00 MIN | 122 | 14 | 32.2 | 1.04 | |
| | | | | | |
| **Mean** | **119.42** | **12.75** | **30.78** | **1.05** | |
| **SD** | **2.27** | **1.14** | **1.37** | **0.03** | |

**TABLE D.76**
**Sub 15**
**DWR: BCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 128 | 12 | 27.9 | 0.85 | 27.5° C |
| 1:00 MIN | 132 | 13 | 30.1 | 0.9 | |
| 1:30 MIN | 135 | 13 | 34.5 | 0.85 | |
| 2:00 MIN | 135 | 14 | 33.1 | 0.90 | |
| 2:30 MIN | 137 | 14 | 33.7 | 0.92 | |
| 3:00 MIN | 138 | 14 | 34.7 | 0.94 | |
| 3:30 MIN | 139 | 14 | 31.4 | 0.88 | |
| 4:00 MIN | 140 | 14 | 36.0 | 0.92 | |
| 4:30 MIN | 139 | 14 | 36.7 | 0.94 | |
| 5:00 MIN | 138 | 15 | 37.4 | 0.94 | |
| 5:30 MIN | 138 | 15 | 33.6 | 0.97 | |
| 6:00 MIN | 140 | 15 | 35.3 | 0.94 | |
| | | | | | |
| **Mean** | **136.58** | **13.92** | **33.70** | **0.91** | |
| **SD** | **3.58** | **0.90** | **2.77** | **0.04** | |

**TABLE D.77**
**Sub 16**
**DWR: BCC $VO_2$ Steady State Record Sheet**

| **TIME** | **HR** (beats/min) | **RPE** (6-20) | **$VO_2$** (ml·kg·min) | **RER** | **TEMP** |
|---|---|---|---|---|---|
| 30 SEC | 124 | 13 | 38.5 | 0.96 | 27.5° C |
| 1:00 MIN | 130 | 13 | 39.3 | 1.00 | |
| 1:30 MIN | 130 | 13 | 37.7 | 1.03 | |
| 2:00 MIN | 126 | 13 | 37.1 | 1.00 | |
| 2:30 MIN | 126 | 12 | 36.1 | 1.04 | |
| 3:00 MIN | 125 | 13 | 35.9 | 1.00 | |
| 3:30 MIN | 127 | 13 | 35.5 | 0.95 | |
| 4:00 MIN | 128 | 13 | 36.0 | 0.98 | |
| 4:30 MIN | 128 | 13 | 36.2 | 1.00 | |
| 5:00 MIN | 127 | 13 | 35.3 | 0.96 | |
| 5:30 MIN | 124 | 13 | 36.1 | 0.99 | |
| 6:00 MIN | 125 | 12 | 34.4 | 0.98 | |
| | | | | | |
| **Mean** | **126.67** | **12.83** | **36.51** | **0.99** | |
| **SD** | **2.06** | **0.39** | **1.40** | **0.03** | |

**TABLE D.78**
**Sub 17**
**DWR: BCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 121 | 12 | 31.7 | 0.91 | 27.5° C |
| 1:00 MIN | 121 | 12 | 32.3 | 0.90 | |
| 1:30 MIN | 120 | 12 | 32.0 | 0.92 | |
| 2:00 MIN | 120 | 12 | 32.4 | 0.93 | |
| 2:30 MIN | 118 | 12 | 32.2 | 0.92 | |
| 3:00 MIN | 113 | 12 | 29.5 | 0.92 | |
| 3:30 MIN | 113 | 12 | 29.0 | 0.91 | |
| 4:00 MIN | 117 | 12 | 31.3 | 0.91 | |
| 4:30 MIN | 118 | 12 | 32.7 | 0.92 | |
| 5:00 MIN | 117 | 12 | 32.5 | 0.91 | |
| | | | | | |
| **Mean** | **117.80** | **12.00** | **31.56** | **0.92** | |
| **SD** | **2.94** | **0.00** | **1.29** | **0.01** | |

**TABLE D.79**
**Sub 18**
**DWR: BCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 133 | 12 | 25.1 | 0.99 | 27.5° C |
| 1:00 MIN | 130 | 12 | 24.3 | 0.98 | |
| 1:30 MIN | 131 | 12 | 23.3 | 1.00 | |
| 2:00 MIN | 135 | 12 | 24.2 | 0.99 | |
| 2:30 MIN | 142 | 12 | 25.7 | 0.94 | |
| 3:00 MIN | 144 | 12 | 27.1 | 0.97 | |
| 3:30 MIN | 145 | 13 | 27.6 | 0.97 | |
| 4:00 MIN | 142 | 13 | 27.2 | 1.00 | |
| 4:30 MIN | 140 | 13 | 26.4 | 1.01 | |
| 5:00 MIN | 138 | 13 | 26.5 | 0.99 | |
| 5:30 MIN | 139 | 13 | 26.2 | 0.98 | |
| 6:00 MIN | 139 | 13 | 26.8 | 0.98 | |
| | | | | | |
| **Mean** | **138.17** | **12.50** | **25.87** | **0.98** | |
| **SD** | **4.95** | **0.52** | **1.36** | **0.02** | |

**TABLE D.80**
**Sub 19**
**DWR: BCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 131 | 13 | 24.9 | 0.93 | 27.5° C |
| 1:00 MIN | 134 | 13 | 26.0 | 0.94 | |
| 1:30 MIN | 137 | 13 | 27.5 | 0.93 | |
| 2:00 MIN | 137 | 13 | 28.2 | 0.98 | |
| 2:30 MIN | 138 | 13 | 27.7 | 0.95 | |
| 3:00 MIN | 138 | 13 | 28.6 | 0.99 | |
| 3:30 MIN | 140 | 13 | 29.5 | 0.97 | |
| 4:00 MIN | 139 | 13 | 30.8 | 0.95 | |
| 4:30 MIN | 136 | 13 | 30.3 | 0.99 | |
| 5:00 MIN | 138 | 13 | 29.7 | 0.96 | |
| 5:30 MIN | 132 | 13 | 30.0 | 0.97 | |
| 6:00 MIN | 127 | 13 | 28.6 | 0.96 | |
| | | | | | |
| **Mean** | **135.58** | **13.00** | **28.48** | **0.96** | |
| **SD** | **3.85** | **0.00** | **1.76** | **0.02** | |

**TABLE D.81**
**Sub 20**
**DWR: BCC $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 128 | 13 | 34.2 | 0.98 | 27.5° C |
| 1:00 MIN | 128 | 13 | 33.4 | 0.96 | |
| 1:30 MIN | 124 | 14 | 32.4 | 0.96 | |
| 2:00 MIN | 125 | 14 | 32.9 | 0.96 | |
| 2:30 MIN | 123 | 14 | 34.7 | 0.95 | |
| 3:00 MIN | 122 | 14 | 31.8 | 0.91 | |
| 3:30 MIN | 121 | 14 | 32.4 | 0.92 | |
| 4:00 MIN | 120 | 14 | 32.1 | 0.92 | |
| 4:30 MIN | 122 | 14 | 33.0 | 0.92 | |
| 5:00 MIN | 122 | 14 | 32.7 | 0.95 | |
| 5:30 MIN | 117 | 14 | 30.8 | 0.92 | |
| 6:00 MIN | 115 | 14 | 29.5 | 0.93 | |
| | | | | | |
| **Mean** | **122.25** | **13.83** | **32.49** | **0.94** | |
| **SD** | **3.86** | **0.39** | **1.40** | **0.02** | |

**TABLE D.82**
**Sub 1**
**DWR: SHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 133 | 13 | 24.9 | 0.98 | 26° C |
| 1:00 MIN | 133 | 13 | 29.3 | 0.91 | |
| 1:30 MIN | 136 | 13 | 32.6 | 0.93 | |
| 2:00 MIN | 133 | 13 | 29.1 | 0.93 | |
| 2:30 MIN | 135 | 13 | 28.1 | 0.94 | |
| 3:00 MIN | 137 | 13 | 30.1 | 0.93 | |
| 3:30 MIN | 135 | 13 | 28.9 | 0.93 | |
| 4:00 MIN | 131 | 13 | 28.1 | 0.94 | |
| 4:30 MIN | 133 | 13 | 27.7 | 0.93 | |
| 5:00 MIN | 130 | 13 | 26.6 | 0.94 | |
| | | | | | |
| **Mean** | **133.6** | **13** | **28.54** | **0.94** | |
| **SD** | **2.17** | **0.00** | **2.06** | **0.02** | |

**TABLE D.83**
**Sub 2**
**DWR: SHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 115 | 12 | 25.8 | 0.93 | 27° C |
| 1:00 MIN | 114 | 12 | 25.4 | 0.88 | |
| 1:30 MIN | 116 | 13 | 27.1 | 0.90 | |
| 2:00 MIN | 122 | 13 | 26.8 | 0.92 | |
| 2:30 MIN | 125 | 13 | 28.8 | 0.90 | |
| 3:00 MIN | 124 | 13 | 27.6 | 0.93 | |
| 3:30 MIN | 123 | 13 | 27.3 | 0.94 | |
| 4:00 MIN | 122 | 13 | 26.3 | 0.93 | |
| 4:30 MIN | 117 | 13 | 26.7 | 0.96 | |
| 5:00 MIN | 127 | 13 | 28.5 | 0.93 | |
| 5:30 MIN | 128 | 13 | 27.8 | 0.91 | |
| 6:00 MIN | 124 | 13 | 26.3 | 0.91 | |
| | | | | | |
| **Mean** | **121.42** | **12.83** | **27.03** | **0.92** | |
| **SD** | **4.76** | **0.39** | **1.03** | **0.02** | |

**TABLE D.84**
**Sub 3**
**DWR: SHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 139 | 13 | 24.3 | 0.88 | 26° C |
| 1:00 MIN | 147 | 13 | 28.2 | 0.97 | |
| 1:30 MIN | 148 | 14 | 28.0 | 1.04 | |
| 2:00 MIN | 149 | 14 | 28.2 | 1.03 | |
| 2:30 MIN | 151 | 14 | 29.2 | 1.04 | |
| 3:00 MIN | 153 | 14 | 28.9 | 1.06 | |
| 3:30 MIN | 150 | 15 | 28.4 | 1.04 | |
| 4:00 MIN | 151 | 15 | 27.9 | 1.04 | |
| 4:30 MIN | 151 | 15 | 28.0 | 1.02 | |
| 5:00 MIN | 152 | 15 | 28.8 | 0.98 | |
| 5:30 MIN | 151 | 15 | 29.4 | 0.98 | |
| | | | | | |
| **Mean** | **149.27** | **14.27** | **28.12** | **1.01** | |
| **SD** | **3.82** | **0.79** | **1.37** | **0.05** | |

**TABLE D.85**
**Sub 4**
**DWR: SHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 125 | 12 | 27.7 | 0.9 | 27.5° C |
| 1:00 MIN | 123 | 12 | 27.1 | 0.91 | |
| 1:30 MIN | 124 | 12 | 27.6 | 0.93 | |
| 2:00 MIN | 125 | 12 | 26.5 | 0.93 | |
| 2:30 MIN | 126 | 12 | 27.7 | 0.95 | |
| 3:00 MIN | 123 | 12 | 27.4 | 0.97 | |
| 3:30 MIN | 122 | 12 | 26.0 | 0.97 | |
| 4:00 MIN | 122 | 12 | 27.2 | 0.95 | |
| 4:30 MIN | 127 | 12 | 26.1 | 0.95 | |
| 5:00 MIN | 130 | 12 | 25.0 | 0.92 | |
| 5:30 MIN | 120 | 12 | 24.9 | 0.93 | |
| 6:00 MIN | 120 | 12 | 23.9 | 0.94 | |
| | | | | | |
| **Mean** | **123.92** | **12.00** | **26.43** | **0.94** | |
| **SD** | **2.91** | **0.00** | **1.27** | **0.02** | |

**TABLE D.86**
**Sub 5**
**DWR: SHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 145 | 14 | 32.2 | 0.99 | 27.5° C |
| 1:00 MIN | 148 | 14 | 37.6 | 1.03 | |
| 1:30 MIN | 150 | 14 | 36.2 | 1.01 | |
| 2:00 MIN | 150 | 14 | 38.8 | 1.07 | |
| 2:30 MIN | 145 | 15 | 35.9 | 1.00 | |
| 3:00 MIN | 145 | 15 | 37.1 | 1.00 | |
| 3:30 MIN | 137 | 15 | 36.0 | 0.97 | |
| 4:00 MIN | 141 | 15 | 35.4 | 0.97 | |
| 4:30 MIN | 144 | 15 | 36.8 | 1.01 | |
| 5:00 MIN | 146 | 15 | 36.7 | 0.98 | |
| | | | | | |
| **Mean** | **145.10** | **14.60** | **36.27** | **1.00** | |
| **SD** | **3.96** | **0.52** | **1.73** | **0.03** | |

# TABLE D.87
## Sub 6
## DWR: SHK $VO_2$ Steady State Record Sheet

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 124 | 13 | 30.8 | 1.00 | 26° C |
| 1:00 MIN | 127 | 13 | 32.5 | 0.97 | |
| 1:30 MIN | 125 | 13 | 30.7 | 0.98 | |
| 2:00 MIN | 128 | 13 | 30.6 | 1.01 | |
| 2:30 MIN | 122 | 14 | 30.2 | 0.97 | |
| 3:00 MIN | 125 | 14 | 31.2 | 0.97 | |
| 3:30 MIN | 127 | 14 | 30.6 | 1.00 | |
| 4:00 MIN | 132 | 14 | 31.6 | 1.00 | |
| 4:30 MIN | 131 | 14 | 31.0 | 0.93 | |
| 5:00 MIN | 128 | 14 | 29.7 | 1.01 | |
| | | | | | |
| **Mean** | **126.90** | **13.60** | **30.89** | **0.98** | |
| **SD** | **3.07** | **0.52** | **0.77** | **0.03** | |

**TABLE D.88**
**Sub 7**
**DWR: SHK $VO_2$ Steady State Record Sheet**

| **TIME** | **HR** (beats/min) | **RPE** (6-20) | **$VO_2$** (ml·kg·min) | **RER** | **TEMP** |
|---|---|---|---|---|---|
| 30 SEC | 123 | 13 | 26 | 0.92 | 25.5° C |
| 1:00 MIN | 120 | 13 | 25.4 | 0.95 | |
| 1:30 MIN | 123 | 13 | 24.7 | 0.96 | |
| 2:00 MIN | 120 | 13 | 25.6 | 0.96 | |
| 2:30 MIN | 116 | 13 | 23.8 | 0.97 | |
| 3:00 MIN | 122 | 13 | 26.2 | 0.96 | |
| 3:30 MIN | 122 | 13 | 25.0 | 0.98 | |
| 4:00 MIN | 126 | 13 | 25.8 | 0.97 | |
| 4:30 MIN | 127 | 13 | 26.7 | 1.00 | |
| 5:00 MIN | 127 | 13 | 26.1 | 0.99 | |
| 5:30 MIN | 131 | 13 | 26.5 | 1.04 | |
| 6:00 MIN | 129 | 13 | 26.6 | 1.02 | |
| | | | | | |
| **Mean** | **123.83** | **13.00** | **25.70** | **0.98** | |
| **SD** | **4.28** | **0.00** | **0.86** | **0.03** | |

**TABLE D.89**
**Sub 8**
**DWR: SHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 122 | 12 | 27.5 | 0.90 | 27.5° C |
| 1:00 MIN | 127 | 12 | 29.6 | 0.93 | |
| 1:30 MIN | 130 | 12 | 31.8 | 0.95 | |
| 2:00 MIN | 130 | 12 | 31.8 | 0.93 | |
| 2:30 MIN | 134 | 13 | 32.7 | 0.93 | |
| 3:00 MIN | 131 | 13 | 33.3 | 0.95 | |
| 3:30 MIN | 128 | 13 | 33.1 | 0.96 | |
| 4:00 MIN | 121 | 13 | 30.8 | 1.01 | |
| 4:30 MIN | 119 | 13 | 29.1 | 0.97 | |
| 5:00 MIN | 123 | 13 | 29.9 | 0.93 | |
| 5:30 MIN | 125 | 13 | 29.9 | 0.95 | |
| 6:00 MIN | 127 | 13 | 31.8 | 0.94 | |
| | | | | | |
| **Mean** | **126.42** | **12.67** | **30.94** | **0.95** | |
| **SD** | **4.52** | **0.49** | **1.78** | **0.03** | |

**TABLE D.90**
**Sub 9**
**DWR: SHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 135 | 13 | 33.7 | 0.94 | 27.5° C |
| 1:00 MIN | 136 | 13 | 32.9 | 0.94 | |
| 1:30 MIN | 132 | 13 | 32.9 | 0.92 | |
| 2:00 MIN | 132 | 13 | 33.2 | 0.90 | |
| 2:30 MIN | 129 | 13 | 34.7 | 0.91 | |
| 3:00 MIN | 130 | 13 | 33.0 | 0.89 | |
| 3:30 MIN | 131 | 13 | 32.2 | 0.88 | |
| 4:00 MIN | 130 | 14 | 33.5 | 0.87 | |
| 4:30 MIN | 129 | 14 | 33.3 | 0.92 | |
| 5:00 MIN | 130 | 14 | 33.3 | 0.90 | |
| 5:30 MIN | 132 | 14 | 32.2 | 0.90 | |
| 6:00 MIN | 130 | 14 | 32.0 | 0.89 | |
| | | | | | |
| **Mean** | **131.33** | **13.42** | **33.08** | **0.91** | |
| **SD** | **2.23** | **0.51** | **0.74** | **0.02** | |

**TABLE D.91**
**Sub 10**
**DWR: SHK $VO_2$ Steady State Record Sheet**

| **TIME** | **HR** (beats/min) | **RPE** (6-20) | **$VO_2$** (ml·kg·min) | **RER** | **TEMP** |
|---|---|---|---|---|---|
| 30 SEC | 147 | 13 | 33.1 | 1.02 | 27.5° C |
| 1:00 MIN | 152 | 13 | 33.2 | 1.01 | |
| 1:30 MIN | 148 | 12 | 33.8 | 1.02 | |
| 2:00 MIN | 150 | 12 | 33.3 | 1.01 | |
| 2:30 MIN | 153 | 12 | 32.3 | 0.99 | |
| 3:00 MIN | 147 | 11 | 33.8 | 0.96 | |
| 3:30 MIN | 147 | 11 | 30.8 | 0.95 | |
| 4:00 MIN | 143 | 11 | 26.8 | 0.96 | |
| 4:30 MIN | 142 | 11 | 30.2 | 0.95 | |
| 5:00 MIN | 149 | 12 | 33.8 | 0.97 | |
| 5:30 MIN | 153 | 12 | 33.6 | 1.02 | |
| 6:00 MIN | 155 | 13 | 34.6 | 1.01 | |
| | | | | | |
| **Mean** | **148.83** | **11.92** | **32.44** | **0.99** | |
| **SD** | **4.00** | **0.79** | **2.19** | **0.03** | |

**TABLE D.92**
**Sub 11**
**DWR: SHK $VO_2$ Steady State Record Sheet**

| **TIME** | **HR** (beats/min) | **RPE** (6-20) | **$VO_2$** (ml·kg·min) | **RER** | **TEMP** |
|---|---|---|---|---|---|
| 30 SEC | 124 | 12 | 30.4 | 0.93 | 27.5° C |
| 1:00 MIN | 140 | 12 | 31.7 | 0.92 | |
| 1:30 MIN | 140 | 12 | 32.6 | 0.95 | |
| 2:00 MIN | 140 | 12 | 31.7 | 0.98 | |
| 2:30 MIN | 141 | 13 | 33.7 | 0.97 | |
| 3:00 MIN | 143 | 13 | 34.1 | 0.95 | |
| 3:30 MIN | 139 | 13 | 34.6 | 0.97 | |
| 4:00 MIN | 139 | 13 | 33.5 | 0.95 | |
| 4:30 MIN | 135 | 13 | 32.7 | 0.96 | |
| 5:00 MIN | 134 | 13 | 32.5 | 0.94 | |
| 5:30 MIN | 138 | 13 | 32.7 | 0.93 | |
| 6:00 MIN | 134 | 13 | 31.8 | 0.94 | |
| | | | | | |
| **Mean** | **137.25** | **12.67** | **32.67** | **0.95** | |
| **SD** | **5.03** | **0.49** | **1.18** | **0.02** | |

**TABLE D.93**
**Sub 12**
**DWR: SHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 131 | 11 | 26.0 | 0.85 | 28.0° C |
| 1:00 MIN | 141 | 12 | 28.0 | 0.92 | |
| 1:30 MIN | 146 | 12 | 27.4 | 0.97 | |
| 2:00 MIN | 146 | 13 | 27.0 | 0.98 | |
| 2:30 MIN | 150 | 13 | 27.6 | 0.98 | |
| 3:00 MIN | 140 | 13 | 29.3 | 0.96 | |
| 3:30 MIN | 139 | 13 | 25.1 | 0.96 | |
| 4:00 MIN | 138 | 12 | 24.9 | 0.98 | |
| 4:30 MIN | 136 | 12 | 25.2 | 0.94 | |
| 5:00 MIN | 136 | 12 | 24.2 | 0.95 | |
| 5:30 MIN | 142 | 13 | 24.9 | 0.93 | |
| 6:00 MIN | 140 | 13 | 25.7 | 0.91 | |
| | | | | | |
| **Mean** | **140.42** | **12.42** | **26.28** | **0.94** | |
| **SD** | **5.16** | **0.67** | **1.56** | **0.04** | |

**TABLE D.94**
**Sub 13**
**DWR: SHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 141 | 13 | 34.2 | 1.00 | 27.5° C |
| 1:00 MIN | 141 | 13 | 32.2 | 0.95 | |
| 1:30 MIN | 141 | 13 | 32.7 | 0.94 | |
| 2:00 MIN | 139 | 14 | 34.3 | 0.94 | |
| 2:30 MIN | 141 | 14 | 31.7 | 0.92 | |
| 3:00 MIN | 144 | 14 | 35.3 | 0.93 | |
| 3:30 MIN | 143 | 14 | 34.1 | 0.93 | |
| 4:00 MIN | 141 | 14 | 34.0 | 0.94 | |
| 4:30 MIN | 140 | 14 | 33.8 | 0.94 | |
| 5:00 MIN | 138 | 14 | 32.4 | 0.90 | |
| | | | | | |
| **Mean** | **140.90** | **13.70** | **33.47** | **0.94** | |
| **SD** | **1.73** | **0.48** | **1.15** | **0.03** | |

**TABLE D.95**
**Sub 14**
**DWR: SHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 124 | 13 | 33.0 | 1.10 | 27.5° C |
| 1:00 MIN | 127 | 13 | 33.6 | 1.09 | |
| 1:30 MIN | 126 | 14 | 33.6 | 1.05 | |
| 2:00 MIN | 127 | 14 | 33.3 | 1.02 | |
| 2:30 MIN | 132 | 14 | 35.0 | 1.04 | |
| 3:00 MIN | 133 | 14 | 35.8 | 1.10 | |
| 3:30 MIN | 131 | 14 | 35.1 | 1.07 | |
| 4:00 MIN | 129 | 14 | 33.4 | 0.99 | |
| 4:30 MIN | 128 | 14 | 33.9 | 1.04 | |
| 5:00 MIN | 127 | 14 | 33.0 | 1.03 | |
| | | | | | |
| **Mean** | **128.40** | **13.80** | **33.97** | **1.05** | |
| **SD** | **2.84** | **0.42** | **0.98** | **0.04** | |

**TABLE D.96**
**Sub 15**
**DWR: SHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 121 | 12 | 30.8 | 0.93 | 27.5° C |
| 1:00 MIN | 124 | 12 | 30.9 | 0.92 | |
| 1:30 MIN | 128 | 12 | 29.8 | 0.97 | |
| 2:00 MIN | 129 | 12 | 29.8 | 0.98 | |
| 2:30 MIN | 127 | 12 | 30.9 | 0.96 | |
| 3:00 MIN | 127 | 13 | 30.0 | 1.01 | |
| 3:30 MIN | 126 | 13 | 29.2 | 0.92 | |
| 4:00 MIN | 129 | 14 | 29.8 | 0.97 | |
| 4:30 MIN | 131 | 13 | 27.9 | 0.91 | |
| 5:00 MIN | 134 | 13 | 30.8 | 0.92 | |
| 5:30 MIN | 134 | 14 | 33.1 | 0.93 | |
| 6:00 MIN | 132 | 14 | 30.2 | 0.92 | |
| | | | | | |
| **Mean** | **128.50** | **12.83** | **30.27** | **0.95** | |
| **SD** | **3.90** | **0.83** | **1.24** | **0.03** | |

**TABLE D.97**
**Sub 16**
**DWR: SHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 137 | 14 | 40.2 | 0.91 | 27.5° C |
| 1:00 MIN | 130 | 13 | 42.5 | 0.95 | |
| 1:30 MIN | 124 | 13 | 37.7 | 0.99 | |
| 2:00 MIN | 117 | 12 | 33.5 | 0.99 | |
| 2:30 MIN | 128 | 13 | 29.7 | 0.97 | |
| 3:00 MIN | 124 | 13 | 33.0 | 0.95 | |
| 3:30 MIN | 127 | 13 | 33.2 | 1.00 | |
| 4:00 MIN | 130 | 13 | 35.8 | 0.96 | |
| 4:30 MIN | 124 | 12 | 38.7 | 0.95 | |
| 5:00 MIN | 121 | 13 | 34.0 | 0.91 | |
| 5:30 MIN | 120 | 12 | 32.9 | 0.96 | |
| 6:00 MIN | 118 | 12 | 32.9 | 1.00 | |
| | | | | | |
| **Mean** | **125.00** | **12.75** | **35.34** | **0.96** | |
| **SD** | **5.75** | **0.62** | **3.70** | **0.03** | |

**TABLE D.98**
**Sub 17**
**DWR: SHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 99 | 11 | 24.4 | 0.91 | 27.5° C |
| 1:00 MIN | 102 | 11 | 23.2 | 0.91 | |
| 1:30 MIN | 105 | 11 | 18.3 | 0.93 | |
| 2:00 MIN | 123 | 12 | 20.4 | 0.93 | |
| 2:30 MIN | 125 | 13 | 23.1 | 0.94 | |
| 3:00 MIN | 127 | 13 | 26.2 | 0.95 | |
| 3:30 MIN | 130 | 14 | 29.0 | 0.97 | |
| 4:00 MIN | 127 | 13 | 27.8 | 0.95 | |
| 4:30 MIN | 126 | 14 | 25.7 | 0.96 | |
| 5:00 MIN | 128 | 14 | 25.7 | 0.95 | |
| 5:30 MIN | 131 | 14 | 26.6 | 0.96 | |
| 6:00 MIN | 135 | 14 | 30.7 | 0.95 | |
| | | | | | |
| **Mean** | **121.50** | **12.83** | **25.09** | **0.94** | |
| **SD** | **12.21** | **1.27** | **3.50** | **0.02** | |

**TABLE D.99**
**Sub 18**
**DWR: SHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 131 | 13 | 24.2 | 1.01 | 27.5° C |
| 1:00 MIN | 130 | 13 | 22.5 | 1.00 | |
| 1:30 MIN | 131 | 13 | 24.0 | 0.98 | |
| 2:00 MIN | 136 | 13 | 24.3 | 0.97 | |
| 2:30 MIN | 136 | 13 | 24.6 | 0.97 | |
| 3:00 MIN | 135 | 13 | 24.2 | 1.00 | |
| 3:30 MIN | 136 | 13 | 25.4 | 0.96 | |
| 4:00 MIN | 133 | 13 | 24.5 | 0.98 | |
| 4:30 MIN | 130 | 13 | 24.8 | 0.98 | |
| 5:00 MIN | 129 | 13 | 22.7 | 0.94 | |
| 5:30 MIN | 136 | 13 | 24.6 | 0.96 | |
| 6:00 MIN | 140 | 13 | 26.8 | 0.94 | |
| | | | | | |
| **Mean** | **133.58** | **13.00** | **24.38** | **0.97** | |
| **SD** | **3.40** | **0.00** | **1.12** | **0.02** | |

**TABLE D.100**
**Sub 19**
**DWR: SHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 133 | 12 | 25.5 | 1.07 | 27.5° C |
| 1:00 MIN | 138 | 12 | 26.1 | 1.05 | |
| 1:30 MIN | 138 | 12 | 28.3 | 1.07 | |
| 2:00 MIN | 137 | 12 | 28.9 | 1.03 | |
| 2:30 MIN | 138 | 12 | 29.1 | 1.06 | |
| 3:00 MIN | 140 | 13 | 28.2 | 1.04 | |
| 3:30 MIN | 139 | 13 | 27.2 | 1.06 | |
| 4:00 MIN | 135 | 13 | 26.7 | 1.05 | |
| 4:30 MIN | 137 | 13 | 26.7 | 1.01 | |
| 5:00 MIN | 139 | 13 | 27.4 | 1.00 | |
| 5:30 MIN | 141 | 13 | 27.4 | 1.03 | |
| 6:00 MIN | 142 | 13 | 28.6 | 0.99 | |
| | | | | | |
| **Mean** | **138.08** | **12.58** | **27.51** | **1.04** | |
| **SD** | **2.47** | **0.51** | **1.14** | **0.03** | |

# TABLE D.101
## Sub 20
## DWR: SHK $VO_2$ Steady State Record Sheet

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 126 | 13 | 35.6 | 0.92 | 27.5° C |
| 1:00 MIN | 125 | 13 | 35.7 | 0.95 | |
| 1:30 MIN | 116 | 13 | 33.9 | 0.99 | |
| 2:00 MIN | 120 | 14 | 31.9 | 0.98 | |
| 2:30 MIN | 124 | 14 | 33.0 | 0.97 | |
| 3:00 MIN | 123 | 14 | 33.0 | 0.96 | |
| 3:30 MIN | 121 | 14 | 31.8 | 0.95 | |
| 4:00 MIN | 121 | 14 | 32.3 | 0.97 | |
| 4:30 MIN | 122 | 14 | 31.7 | 0.92 | |
| 5:00 MIN | 122 | 14 | 33.1 | 0.93 | |
| 5:30 MIN | 122 | 14 | 34.0 | 0.94 | |
| 6:00 MIN | 118 | 14 | 31.3 | 0.93 | |
| | | | | | |
| **Mean** | **121.67** | **13.75** | **33.11** | **0.95** | |
| **SD** | **2.81** | **0.45** | **1.46** | **0.02** | |

**TABLE D.102**
**Sub 1**
**DWR: BHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 131 | 12 | 28.6 | 1.02 | 26° C |
| 1:00 MIN | 128 | 12 | 29.7 | 0.97 | |
| 1:30 MIN | 125 | 12 | 30.4 | 0.93 | |
| 2:00 MIN | 127 | 12 | 28.3 | 1.00 | |
| 2:30 MIN | 125 | 12 | 28.0 | 0.98 | |
| 3:00 MIN | 124 | 12 | 28.5 | 0.97 | |
| 3:30 MIN | 122 | 12 | 27.8 | 0.98 | |
| 4:00 MIN | 121 | 12 | 26.5 | 0.99 | |
| 4:30 MIN | 126 | 12 | 25.5 | 0.99 | |
| 5:00 MIN | 126 | 12 | 27.5 | 0.99 | |
| | | | | | |
| **Mean** | **125.5** | **12** | **28.08** | **0.98** | |
| **SD** | **2.88** | **0.00** | **1.42** | **0.02** | |

**TABLE D.103**
**Sub 2**
**DWR: BHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 124 | 13 | 26.9 | 0.86 | 27° C |
| 1:00 MIN | 122 | 13 | 29.2 | 0.87 | |
| 1:30 MIN | 123 | 13 | 28.1 | 0.92 | |
| 2:00 MIN | 131 | 14 | 29.2 | 0.89 | |
| 2:30 MIN | 132 | 14 | 30.1 | 0.94 | |
| 3:00 MIN | 131 | 14 | 29.9 | 0.92 | |
| 3:30 MIN | 127 | 14 | 28.9 | 0.92 | |
| 4:00 MIN | 125 | 14 | 29.3 | 0.93 | |
| 4:30 MIN | 127 | 14 | 31.0 | 0.95 | |
| 5:00 MIN | 124 | 13 | 27.8 | 0.91 | |
| 5:30 MIN | 122 | 14 | 28.8 | 0.88 | |
| 6:00 MIN | 118 | 13 | 30.0 | 0.90 | |
| | | | | | |
| **Mean** | **125.50** | **13.58** | **29.10** | **0.91** | |
| **SD** | **4.25** | **0.51** | **1.12** | **0.03** | |

**TABLE D.104**
**Sub 3**
**DWR: BHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 147 | 13 | 27.4 | 0.93 | 26° C |
| 1:00 MIN | 150 | 14 | 29.5 | 0.96 | |
| 1:30 MIN | 148 | 14 | 29.7 | 0.99 | |
| 2:00 MIN | 145 | 14 | 28.6 | 1.00 | |
| 2:30 MIN | 142 | 14 | 26.3 | 1.00 | |
| 3:00 MIN | 139 | 14 | 27.3 | 0.98 | |
| 3:30 MIN | 150 | 14 | 27.8 | 0.94 | |
| 4:00 MIN | 157 | 14 | 31.6 | 0.94 | |
| 4:30 MIN | 160 | 15 | 33.2 | 0.98 | |
| 5:00 MIN | 147 | 15 | 33.1 | 1.00 | |
| | | | | | |
| **Mean** | **148.50** | **14.10** | **29.45** | **0.97** | |
| **SD** | **6.31** | **0.57** | **2.46** | **0.03** | |

**TABLE D.105**
**Sub 4**
**DWR: BHK $VO_2$ Steady State Record Sheet**

| **TIME** | **HR** (beats/min) | **RPE** (6-20) | **$VO_2$** (ml·kg·min) | **RER** | **TEMP** |
|---|---|---|---|---|---|
| 30 SEC | 127 | 12 | 25.2 | 0.91 | 27.5° C |
| 1:00 MIN | 125 | 12 | 25.2 | 0.94 | |
| 1:30 MIN | 123 | 12 | 27.6 | 0.93 | |
| 2:00 MIN | 122 | 12 | 25.8 | 0.97 | |
| 2:30 MIN | 123 | 12 | 26.1 | 0.96 | |
| 3:00 MIN | 117 | 12 | 26.1 | 0.96 | |
| 3:30 MIN | 121 | 12 | 25.3 | 0.96 | |
| 4:00 MIN | 123 | 12 | 22.3 | 0.96 | |
| 4:30 MIN | 122 | 12 | 25.7 | 0.93 | |
| 5:00 MIN | 125 | 12 | 23.3 | 0.94 | |
| 5:30 MIN | 129 | 12 | 26.1 | 0.91 | |
| 6:00 MIN | 119 | 12 | 25.7 | 0.93 | |
| | | | | | |
| **Mean** | **123.00** | **12.00** | **25.37** | **0.94** | |
| **SD** | **3.28** | **0.00** | **1.37** | **0.02** | |

**TABLE D.106**
**Sub 5**
**DWR: BHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 126 | 11 | 24.5 | 0.94 | 27.5° C |
| 1:00 MIN | 133 | 11 | 27.1 | 0.97 | |
| 1:30 MIN | 135 | 12 | 26.8 | 0.96 | |
| 2:00 MIN | 130 | 12 | 26.8 | 1.03 | |
| 2:30 MIN | 127 | 12 | 24.7 | 1.00 | |
| 3:00 MIN | 127 | 12 | 27.9 | 1.00 | |
| 3:30 MIN | 134 | 12 | 27.7 | 0.97 | |
| 4:00 MIN | 128 | 12 | 26.6 | 0.97 | |
| 4:30 MIN | 130 | 12 | 24.7 | 1.00 | |
| 5:00 MIN | 127 | 12 | 26.1 | 0.96 | |
| 5:30 MIN | 127 | 12 | 26.5 | 0.95 | |
| 6:00 MIN | 130 | 12 | 27.4 | 0.97 | |
| | | | | | |
| **Mean** | **129.50** | **11.83** | **26.40** | **0.98** | |
| **SD** | **3.06** | **0.39** | **1.18** | **0.03** | |

**TABLE D.107**
**Sub 6**
**DWR: BHK $VO_2$ Steady State Record Sheet**

| **TIME** | **HR** (beats/min) | **RPE** (6-20) | **$VO_2$** (ml·kg·min) | **RER** | **TEMP** |
|---|---|---|---|---|---|
| 30 SEC | 119 | 13 | 30.1 | 0.99 | 26° C |
| 1:00 MIN | 115 | 13 | 26.8 | 0.89 | |
| 1:30 MIN | 119 | 13 | 27.5 | 0.94 | |
| 2:00 MIN | 124 | 13 | 25.8 | 1.02 | |
| 2:30 MIN | 131 | 13 | 29.0 | 1.02 | |
| 3:00 MIN | 132 | 14 | 31.1 | 1.03 | |
| 3:30 MIN | 133 | 14 | 31.2 | 1.00 | |
| 4:00 MIN | 139 | 14 | 31.8 | 1.02 | |
| 4:30 MIN | 142 | 15 | 32.5 | 1.00 | |
| 5:00 MIN | 142 | 15 | 34.1 | 0.98 | |
| | | | | | |
| **Mean** | **129.60** | **13.70** | **29.99** | **0.99** | |
| **SD** | **9.91** | **0.82** | **2.67** | **0.04** | |

**TABLE D.108**
**Sub 7**
**DWR: BHK $VO_2$ Steady State Record Sheet**

| **TIME** | **HR** (beats/min) | **RPE** (6-20) | **$VO_2$** (ml·kg·min) | **RER** | **TEMP** |
|---|---|---|---|---|---|
| 30 SEC | 146 | 15 | 29.6 | 0.91 | 25.5° C |
| 1:00 MIN | 149 | 15 | 30.4 | 0.96 | |
| 1:30 MIN | 145 | 15 | 31.0 | 1.00 | |
| 2:00 MIN | 144 | 15 | 31.8 | 0.97 | |
| 2:30 MIN | 136 | 14 | 29.4 | 0.99 | |
| 3:00 MIN | 136 | 14 | 27.3 | 0.98 | |
| 3:30 MIN | 130 | 14 | 26.2 | 0.96 | |
| 4:00 MIN | 137 | 14 | 25.4 | 0.95 | |
| 4:30 MIN | 136 | 14 | 26.4 | 0.92 | |
| 5:00 MIN | 139 | 14 | 26.2 | 0.93 | |
| | | | | | |
| **Mean** | **139.80** | **14.40** | **28.37** | **0.96** | |
| **SD** | **5.92** | **0.52** | **2.32** | **0.03** | |

**TABLE D.109**
**Sub 8**
**DWR: BHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 122 | 12 | 26.8 | 0.94 | 27.5° C |
| 1:00 MIN | 128 | 12 | 29.8 | 0.93 | |
| 1:30 MIN | 129 | 13 | 31.2 | 0.93 | |
| 2:00 MIN | 128 | 13 | 31.6 | 0.95 | |
| 2:30 MIN | 129 | 13 | 31.2 | 0.96 | |
| 3:00 MIN | 121 | 13 | 30.2 | 0.97 | |
| 3:30 MIN | 127 | 13 | 30.3 | 0.93 | |
| 4:00 MIN | 128 | 13 | 30.6 | 0.98 | |
| 4:30 MIN | 127 | 13 | 30.1 | 0.96 | |
| 5:00 MIN | 128 | 13 | 30.2 | 0.94 | |
| 5:30 MIN | 134 | 13 | 31.9 | 0.93 | |
| 6:00 MIN | 132 | 13 | 32.3 | 0.94 | |
| | | | | | |
| **Mean** | **127.75** | **12.83** | **30.52** | **0.95** | |
| **SD** | **3.57** | **0.39** | **1.41** | **0.02** | |

**TABLE D.110**
**Sub 9**
**DWR: BHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 131 | 12 | 28.0 | 0.97 | 27.5° C |
| 1:00 MIN | 129 | 13 | 28.1 | 0.95 | |
| 1:30 MIN | 130 | 13 | 28.4 | 0.97 | |
| 2:00 MIN | 131 | 14 | 31.5 | 1.00 | |
| 2:30 MIN | 132 | 14 | 31.3 | 0.99 | |
| 3:00 MIN | 133 | 14 | 30.9 | 0.96 | |
| 3:30 MIN | 137 | 15 | 34.1 | 1.00 | |
| 4:00 MIN | 136 | 15 | 33.3 | 1.00 | |
| 4:30 MIN | 135 | 15 | 34.7 | 0.99 | |
| 5:00 MIN | 133 | 15 | 35.7 | 1.00 | |
| 5:30 MIN | 134 | 15 | 34.6 | 0.98 | |
| 6:00 MIN | 136 | 15 | 35.4 | 1.00 | |
| | | | | | |
| **Mean** | **133.08** | **14.17** | **32.17** | **0.98** | |
| **SD** | **2.57** | **1.03** | **2.88** | **0.02** | |

**TABLE D.111**
**Sub 10**
**DWR: BHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 156 | 12 | 32.8 | 0.93 | 27.5° C |
| 1:00 MIN | 155 | 12 | 39.6 | 0.92 | |
| 1:30 MIN | 153 | 11 | 33.8 | 0.95 | |
| 2:00 MIN | 151 | 11 | 33.0 | 0.95 | |
| 2:30 MIN | 154 | 11 | 31.8 | 0.96 | |
| 3:00 MIN | 156 | 12 | 34.9 | 0.91 | |
| 3:30 MIN | 154 | 12 | 34.9 | 0.98 | |
| 4:00 MIN | 156 | 12 | 33.1 | 0.96 | |
| 4:30 MIN | 158 | 12 | 35.8 | 0.98 | |
| 5:00 MIN | 158 | 12 | 33.5 | 0.95 | |
| 5:30 MIN | 159 | 12 | 35.1 | 0.97 | |
| 6:00 MIN | 156 | 12 | 35.2 | 0.93 | |
| | | | | | |
| **Mean** | **155.50** | **11.75** | **34.46** | **0.95** | |
| **SD** | **2.28** | **0.45** | **2.02** | **0.02** | |

**TABLE D.112**
**Sub 11**
**DWR: BHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 142 | 12 | 30.8 | 0.98 | 27.5° C |
| 1:00 MIN | 144 | 13 | 32.1 | 0.94 | |
| 1:30 MIN | 142 | 13 | 31.9 | 0.95 | |
| 2:00 MIN | 144 | 13 | 31.7 | 0.95 | |
| 2:30 MIN | 134 | 13 | 31.8 | 0.94 | |
| 3:00 MIN | 136 | 13 | 30.3 | 0.94 | |
| 3:30 MIN | 138 | 13 | 29.6 | 0.93 | |
| 4:00 MIN | 132 | 13 | 30.2 | 0.92 | |
| 4:30 MIN | 138 | 13 | 28.5 | 0.92 | |
| 5:00 MIN | 150 | 13 | 31.7 | 0.90 | |
| 5:30 MIN | 142 | 13 | 32.1 | 0.93 | |
| 6:00 MIN | 137 | 13 | 31.4 | 0.93 | |
| | | | | | |
| **Mean** | **139.92** | **12.92** | **31.01** | **0.94** | |
| **SD** | **5.02** | **0.29** | **1.14** | **0.02** | |

**TABLE D.113**
**Sub 12**
**DWR: BHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 152 | 12 | 24.0 | 0.97 | 28.0° C |
| 1:00 MIN | 144 | 13 | 28.9 | 0.93 | |
| 1:30 MIN | 138 | 13 | 27.5 | 0.97 | |
| 2:00 MIN | 135 | 13 | 24.9 | 0.97 | |
| 2:30 MIN | 136 | 13 | 24.4 | 0.97 | |
| 3:00 MIN | 136 | 13 | 24.0 | 0.95 | |
| 3:30 MIN | 144 | 13 | 24.5 | 0.96 | |
| 4:00 MIN | 148 | 13 | 27.9 | 0.91 | |
| 4:30 MIN | 142 | 13 | 27.7 | 0.94 | |
| 5:00 MIN | 140 | 13 | 26.2 | 0.96 | |
| 5:30 MIN | 140 | 13 | 25.4 | 0.95 | |
| 6:00 MIN | 142 | 13 | 25.6 | 0.93 | |
| | | | | | |
| **Mean** | **141.42** | **12.92** | **25.92** | **0.95** | |
| **SD** | **5.09** | **0.29** | **1.70** | **0.02** | |

**TABLE D.114**
**Sub 13**
**DWR: BHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 136 | 13 | 31.6 | 0.98 | 27.5° C |
| 1:00 MIN | 135 | 13 | 31.8 | 1.01 | |
| 1:30 MIN | 134 | 13 | 31.5 | 0.99 | |
| 2:00 MIN | 136 | 13 | 32.5 | 0.99 | |
| 2:30 MIN | 137 | 14 | 33.4 | 0.98 | |
| 3:00 MIN | 138 | 14 | 35.1 | 1.01 | |
| 3:30 MIN | 140 | 14 | 36.2 | 0.99 | |
| 4:00 MIN | 141 | 14 | 36.1 | 0.98 | |
| 4:30 MIN | 134 | 14 | 33.5 | 0.99 | |
| 5:00 MIN | 134 | 14 | 32.5 | 0.97 | |
| | | | | | |
| **Mean** | **136.50** | **13.60** | **33.42** | **0.99** | |
| **SD** | **2.51** | **0.52** | **1.80** | **0.01** | |

**TABLE D.115**
**Sub 14**
**DWR: BHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 124 | 13 | 32.1 | 0.95 | 27.5° C |
| 1:00 MIN | 125 | 13 | 33.9 | 0.96 | |
| 1:30 MIN | 127 | 13 | 34.4 | 0.98 | |
| 2:00 MIN | 128 | 13 | 33.9 | 1.02 | |
| 2:30 MIN | 127 | 14 | 34.3 | 1.02 | |
| 3:00 MIN | 127 | 14 | 37.1 | 1.02 | |
| 3:30 MIN | 129 | 14 | 32.7 | 1.00 | |
| 4:00 MIN | 129 | 14 | 34.1 | 1.03 | |
| 4:30 MIN | 128 | 14 | 33.3 | 1.00 | |
| 5:00 MIN | 129 | 14 | 33.5 | 0.97 | |
| | | | | | |
| **Mean** | **127.30** | **13.60** | **33.93** | **1.00** | |
| **SD** | **1.70** | **0.52** | **1.33** | **0.03** | |

**TABLE D.116**
**Sub 15**
**DWR: BHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 134 | 11 | 32.0 | 0.93 | 27.5° C |
| 1:00 MIN | 135 | 11 | 33.2 | 0.96 | |
| 1:30 MIN | 133 | 12 | 33.0 | 0.98 | |
| 2:00 MIN | 129 | 12 | 31.1 | 0.95 | |
| 2:30 MIN | 127 | 12 | 29.6 | 0.93 | |
| 3:00 MIN | 131 | 12 | 28.6 | 0.96 | |
| 3:30 MIN | 128 | 12 | 29.9 | 0.96 | |
| 4:00 MIN | 127 | 12 | 29.7 | 0.97 | |
| 4:30 MIN | 132 | 12 | 29.7 | 0.96 | |
| 5:00 MIN | 136 | 13 | 31.5 | 0.94 | |
| 5:30 MIN | 133 | 13 | 31.4 | 0.96 | |
| 6:00 MIN | 135 | 13 | 31.2 | 0.96 | |
| | | | | | |
| **Mean** | **131.67** | **12.08** | **30.91** | **0.96** | |
| **SD** | **3.23** | **0.67** | **1.43** | **0.02** | |

**TABLE D.117**
**Sub 16**
**DWR: BHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 131 | 12 | 42.6 | 0.99 | 27.5° C |
| 1:00 MIN | 123 | 12 | 37.4 | 1.01 | |
| 1:30 MIN | 128 | 13 | 33.7 | 1.02 | |
| 2:00 MIN | 130 | 13 | 33.8 | 1.01 | |
| 2:30 MIN | 139 | 13 | 38.1 | 1.01 | |
| 3:00 MIN | 130 | 13 | 37.9 | 1.03 | |
| 3:30 MIN | 130 | 13 | 34.5 | 1.03 | |
| 4:00 MIN | 126 | 13 | 34.4 | 1.03 | |
| 4:30 MIN | 128 | 13 | 34.7 | 0.99 | |
| 5:00 MIN | 125 | 13 | 34.4 | 0.96 | |
| 5:30 MIN | 127 | 13 | 35.7 | 0.98 | |
| 6:00 MIN | 130 | 13 | 35.9 | 0.97 | |
| | | | | | |
| **Mean** | **128.92** | **12.83** | **36.09** | **1.00** | |
| **SD** | **3.99** | **0.39** | **2.57** | **0.02** | |

**TABLE D.118**
**Sub 17**
**DWR: BHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 129 | 13 | 28.6 | 1.01 | 27.5° C |
| 1:00 MIN | 127 | 13 | 28.8 | 0.98 | |
| 1:30 MIN | 123 | 12 | 32.0 | 0.98 | |
| 2:00 MIN | 120 | 12 | 30.6 | 0.97 | |
| 2:30 MIN | 114 | 12 | 30.3 | 0.97 | |
| 3:00 MIN | 114 | 12 | 28.3 | 0.94 | |
| 3:30 MIN | 113 | 12 | 27.6 | 0.92 | |
| 4:00 MIN | 111 | 12 | 26.5 | 0.90 | |
| 4:30 MIN | 111 | 13 | 26.7 | 0.91 | |
| 5:00 MIN | 117 | 13 | 25.6 | 0.91 | |
| 5:30 MIN | 113 | 13 | 26.8 | 0.92 | |
| 6:00 MIN | 119 | 13 | 25.4 | 0.94 | |
| | | | | | |
| **Mean** | **117.58** | **12.50** | **28.10** | **0.95** | |
| **SD** | **6.11** | **0.52** | **2.07** | **0.04** | |

**TABLE D.119**
**Sub 18**
**DWR: BHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 137 | 13 | 24.9 | 0.93 | 27.5° C |
| 1:00 MIN | 134 | 13 | 24.7 | 0.97 | |
| 1:30 MIN | 130 | 13 | 23.5 | 0.99 | |
| 2:00 MIN | 133 | 13 | 23.8 | 0.95 | |
| 2:30 MIN | 140 | 13 | 25.8 | 0.93 | |
| 3:00 MIN | 140 | 13 | 26.0 | 0.93 | |
| 3:30 MIN | 139 | 13 | 27.1 | 0.95 | |
| 4:00 MIN | 139 | 13 | 25.5 | 0.94 | |
| 4:30 MIN | 131 | 13 | 25.2 | 0.97 | |
| 5:00 MIN | 136 | 13 | 23.9 | 0.95 | |
| 5:30 MIN | 137 | 13 | 24.5 | 0.93 | |
| 6:00 MIN | 135 | 13 | 25.0 | 0.92 | |
| | | | | | |
| **Mean** | **135.92** | **13.00** | **24.99** | **0.95** | |
| **SD** | **3.40** | **0.00** | **1.03** | **0.02** | |

**TABLE D.120**
**Sub 19**
**DWR: BHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | $VO_2$ (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 132 | 13 | 27.2 | 0.91 | 27.5° C |
| 1:00 MIN | 133 | 13 | 28.6 | 0.98 | |
| 1:30 MIN | 133 | 13 | 28.7 | 0.94 | |
| 2:00 MIN | 133 | 13 | 27.8 | 1.00 | |
| 2:30 MIN | 133 | 13 | 29.2 | 0.96 | |
| 3:00 MIN | 129 | 13 | 28.5 | 0.96 | |
| 3:30 MIN | 123 | 13 | 27.2 | 0.94 | |
| 4:00 MIN | 124 | 13 | 28.8 | 0.92 | |
| 4:30 MIN | 126 | 13 | 27.7 | 0.92 | |
| 5:00 MIN | 131 | 13 | 28.1 | 0.92 | |
| 5:30 MIN | 132 | 13 | 29.9 | 0.98 | |
| 6:00 MIN | 130 | 13 | 28.1 | 0.95 | |
| | | | | | |
| **Mean** | **129.92** | **13.00** | **28.32** | **0.95** | |
| **SD** | **3.65** | **0.00** | **0.80** | **0.03** | |

**TABLE D.121**
**Sub 20**
**DWR: BHK $VO_2$ Steady State Record Sheet**

| TIME | HR (beats/min) | RPE (6-20) | VO2 (ml·kg·min) | RER | TEMP |
|---|---|---|---|---|---|
| 30 SEC | 125 | 13 | 33.1 | 0.95 | 27.5° C |
| 1:00 MIN | 125 | 13 | 33.1 | 0.98 | |
| 1:30 MIN | 125 | 14 | 31.8 | 0.96 | |
| 2:00 MIN | 125 | 14 | 32.6 | 0.94 | |
| 2:30 MIN | 119 | 14 | 32.5 | 0.95 | |
| 3:00 MIN | 113 | 14 | 31.2 | 0.94 | |
| 3:30 MIN | 113 | 14 | 31.3 | 0.94 | |
| 4:00 MIN | 120 | 14 | 31.7 | 0.92 | |
| 4:30 MIN | 115 | 14 | 32.1 | 0.93 | |
| 5:00 MIN | 129 | 14 | 32.2 | 0.92 | |
| 5:30 MIN | 118 | 14 | 32.1 | 0.91 | |
| 6:00 MIN | 118 | 14 | 31.9 | 0.95 | |
| | | | | | |
| **Mean** | **120.42** | **13.83** | **32.13** | **0.94** | |
| **SD** | **5.32** | **0.39** | **0.61** | **0.02** | |

# TABLE D.122
## DWR: SCC $VO_2$ Steady State Summary Record Sheet

| Sub | Gender | HR | RPE | VO2 | % of VO2 | RER | TEMP | SR |
|---|---|---|---|---|---|---|---|---|
| | | (beats/min) | (6-20) | (ml·kg·min) | (%) | | (C°) | (/min) |
| 1 | Female | 133.9 | 13.2 | 29.4 | 60.8 | 0.92 | 26.0 | 56.4 |
| 2 | Female | 114.0 | 12.0 | 25.3 | 53.3 | 0.88 | 27.0 | 50.4 |
| 3 | Female | 146.7 | 13.4 | 29.0 | 56.8 | 0.90 | 26.0 | 57.6 |
| 4 | Female | 129.5 | 11.8 | 26.4 | 53.6 | 0.98 | 27.5 | 49.2 |
| 5 | Male | 145.4 | 14.6 | 34.7 | 58.0 | 0.93 | 27.5 | 41.4 |
| 6 | Female | 134.7 | 14.3 | 29.1 | 56.3 | 0.99 | 26.0 | 52.8 |
| 7 | Female | 131.9 | 14.8 | 25.9 | 55.2 | 0.98 | 25.5 | 57.0 |
| 8 | Female | 124.6 | 12.3 | 29.4 | 55.1 | 0.95 | 27.5 | 49.2 |
| 9 | Male | 132.2 | 12.8 | 34.2 | 60.1 | 0.89 | 27.5 | 42.6 |
| 10 | Male | 155.5 | 11.8 | 34.5 | 62.8 | 0.95 | 27.5 | 43.2 |
| 11 | Female | 146.8 | 12.9 | 33.7 | 60.7 | 0.93 | 27.5 | 49.2 |
| 12 | Female | 140.3 | 12.5 | 26.7 | 59.4 | 0.94 | 28.0 | 57.0 |
| 13 | Male | 143.8 | 14.6 | 34.5 | 60.2 | 0.95 | 27.5 | 57.0 |
| 14 | Male | 125.3 | 13.3 | 33.3 | 60.7 | 0.93 | 27.5 | 48.6 |
| 15 | Male | 130.5 | 12.8 | 28.7 | 55.2 | 0.92 | 27.5 | 56.4 |
| 16 | Male | 129.6 | 13.3 | 36.4 | 59.4 | 1.03 | 27.5 | 60.0 |
| 17 | Female | 108.0 | 11.2 | 29.6 | 59.7 | 0.92 | 27.5 | 53.4 |
| 18 | Female | 139.0 | 12.9 | 24.0 | 55.3 | 0.93 | 27.5 | 48.6 |
| 19 | Female | 135.3 | 12.9 | 26.3 | 55.7 | 0.98 | 27.5 | 55.2 |
| 20 | Male | 121.7 | 12.8 | 31.0 | 55.5 | 0.97 | 27.5 | 46.8 |
| | | | | | | | | |
| **Mean** | | **133.4** | **13.0** | **30.1** | **57.7** | **0.94** | **27.2** | **51.6** |
| **SD** | | **11.5** | **1.0** | **3.7** | **2.8** | **0.04** | **0.7** | **5.49** |

## TABLE D.123
## DWR: BCC $VO_2$ Steady State Summary Record Sheet

| Sub | Gender | HR | RPE | VO2 | % of VO2 | RER | TEMP | SR |
|---|---|---|---|---|---|---|---|---|
| | | (beats/min) | (6-20) | (ml·kg·min) | (%) | | (C°) | (/min) |
| 1 | Female | 133.6 | 13.0 | 28.5 | 59.1 | 0.94 | 26.0 | 48.6 |
| 2 | Female | 131.8 | 13.7 | 29.2 | 61.5 | 0.97 | 27.0 | 55.8 |
| 3 | Female | 150.6 | 13.7 | 30.4 | 59.6 | 0.90 | 26.0 | 56.4 |
| 4 | Female | 124.1 | 12.0 | 24.8 | 50.2 | 0.93 | 27.5 | 56.4 |
| 5 | Male | 145.2 | 14.7 | 36.3 | 61.1 | 0.95 | 27.5 | 43.8 |
| 6 | Female | 133.3 | 13.8 | 28.2 | 54.6 | 1.08 | 26.0 | 48.6 |
| 7 | Female | 144.9 | 15.4 | 29.2 | 62.3 | 1.03 | 25.5 | 54.0 |
| 8 | Female | 124.5 | 13.0 | 29.5 | 55.4 | 0.96 | 27.5 | 52.8 |
| 9 | Male | 136.3 | 13.4 | 36.6 | 64.3 | 0.93 | 27.5 | 52.8 |
| 10 | Male | 144.2 | 11.0 | 34.1 | 62.0 | 0.96 | 27.5 | 45.6 |
| 11 | Female | 144.5 | 12.9 | 32.7 | 58.8 | 0.92 | 27.5 | 51.0 |
| 12 | Female | 146.0 | 12.8 | 27.1 | 60.3 | 0.93 | 28.0 | 59.4 |
| 13 | Male | 137.9 | 14.3 | 32.8 | 57.2 | 0.95 | 27.5 | 49.8 |
| 14 | Male | 119.4 | 12.8 | 30.8 | 56.1 | 1.05 | 27.5 | 54.0 |
| 15 | Male | 136.6 | 13.9 | 33.7 | 64.9 | 0.91 | 27.5 | 61.8 |
| 16 | Male | 126.7 | 12.8 | 36.5 | 59.7 | 0.99 | 27.5 | 59.4 |
| 17 | Female | 117.8 | 12.0 | 31.6 | 63.6 | 0.92 | 27.5 | 59.4 |
| 18 | Female | 138.2 | 12.5 | 25.9 | 59.5 | 0.98 | 27.5 | 54.0 |
| 19 | Female | 135.6 | 13.0 | 28.5 | 60.2 | 0.96 | 27.5 | 58.2 |
| 20 | Male | 122.3 | 13.8 | 32.5 | 58.2 | 0.94 | 27.5 | 53.4 |
| | | | | | | | | |
| **Mean** | | **134.7** | **13.2** | **31.1** | **59.5** | **0.96** | **27.2** | **53.8** |
| **SD** | | **9.9** | **1.0** | **3.5** | **3.6** | **0.05** | **0.7** | **4.83** |

## TABLE D.124
## DWR: SHK $VO_2$ Steady State Summary Record Sheet

| Sub | Gender | HR | RPE | VO2 | % of VO2 | RER | TEMP | SR |
|---|---|---|---|---|---|---|---|---|
| | | (beats/min) | (6-20) | (ml·kg·min) | (%) | | (C°) | (/min) |
| 1 | Female | 136.3 | 13.3 | 30.6 | 63.4 | 0.96 | 26.0 | 67.8 |
| 2 | Female | 121.4 | 12.8 | 27.0 | 56.9 | 0.92 | 27.0 | 30.6 |
| 3 | Female | 149.3 | 14.3 | 28.1 | 55.0 | 1.01 | 26.0 | 67.8 |
| 4 | Female | 123.9 | 12.0 | 26.4 | 53.6 | 0.94 | 27.5 | 60.0 |
| 5 | Male | 145.1 | 14.6 | 36.3 | 60.7 | 1.00 | 27.5 | 58.2 |
| 6 | Female | 126.9 | 13.6 | 30.9 | 59.8 | 0.98 | 26.0 | 65.4 |
| 7 | Female | 123.8 | 13.0 | 25.7 | 54.8 | 0.98 | 25.5 | 64.8 |
| 8 | Female | 126.4 | 12.7 | 30.9 | 58.1 | 0.95 | 27.5 | 63.6 |
| 9 | Male | 131.3 | 13.4 | 33.1 | 58.1 | 0.91 | 27.5 | 73.2 |
| 10 | Male | 148.9 | 11.9 | 32.4 | 59.1 | 0.99 | 27.5 | 63.0 |
| 11 | Female | 137.3 | 12.7 | 32.7 | 58.9 | 0.95 | 27.5 | 67.8 |
| 12 | Female | 140.4 | 12.4 | 26.3 | 58.5 | 0.94 | 28.0 | 77.4 |
| 13 | Male | 140.9 | 13.7 | 33.5 | 58.4 | 0.94 | 27.5 | 77.4 |
| 14 | Male | 128.4 | 13.8 | 34.0 | 61.9 | 1.05 | 27.5 | 51.6 |
| 15 | Male | 128.5 | 12.8 | 30.3 | 58.3 | 0.95 | 27.5 | 60.6 |
| 16 | Male | 125.0 | 12.8 | 35.3 | 57.8 | 0.96 | 27.5 | 66.6 |
| 17 | Female | 121.5 | 12.8 | 25.1 | 50.6 | 0.94 | 27.5 | 58.8 |
| 18 | Female | 133.6 | 13.0 | 24.4 | 56.1 | 0.97 | 27.5 | 64.8 |
| 19 | Female | 138.1 | 12.6 | 27.5 | 58.2 | 1.04 | 27.5 | 66.6 |
| 20 | Male | 121.7 | 13.8 | 33.1 | 59.3 | 0.95 | 27.5 | 60.6 |
| | | | | | | | | |
| **Mean** | | **132.4** | **13.1** | **30.2** | **57.9** | **0.97** | **27.2** | **63.3** |
| **SD** | | **9.1** | **0.7** | **3.6** | **2.9** | **0.04** | **0.7** | **9.91** |

**TABLE D.125**
**DWR: BHK $VO_2$ Steady State Summary Record Sheet**

| Sub | Gender | HR | RPE | VO2 | % of VO2 | RER | TEMP | SR |
|---|---|---|---|---|---|---|---|---|
| | | (beats/min) | (6-20) | (ml·kg·min) | (%) | | (C°) | (/min) |
| 1 | Female | 125.5 | 12.0 | 28.1 | 58.1 | 0.98 | 26.0 | 67.8 |
| 2 | Female | 125.5 | 13.6 | 29.1 | 61.3 | 0.91 | 27.0 | 71.4 |
| 3 | Female | 148.5 | 14.1 | 29.5 | 57.6 | 0.97 | 26.0 | 72.0 |
| 4 | Female | 123.0 | 12.0 | 25.4 | 51.5 | 0.94 | 27.5 | 64.2 |
| 5 | Male | 139.2 | 13.7 | 33.9 | 56.7 | 1.04 | 27.5 | 59.4 |
| 6 | Female | 129.6 | 13.7 | 30.0 | 58.0 | 0.99 | 26.0 | 65.4 |
| 7 | Female | 139.8 | 14.4 | 28.4 | 60.5 | 0.96 | 25.5 | 72.6 |
| 8 | Female | 127.8 | 12.8 | 30.5 | 57.3 | 0.95 | 27.5 | 67.2 |
| 9 | Male | 133.1 | 14.2 | 32.2 | 56.5 | 0.98 | 27.5 | 78.6 |
| 10 | Male | 147.8 | 12.4 | 31.1 | 56.6 | 0.98 | 27.5 | 63.6 |
| 11 | Female | 139.9 | 12.9 | 31.0 | 55.9 | 0.94 | 27.5 | 70.8 |
| 12 | Female | 141.4 | 12.9 | 25.9 | 57.7 | 0.92 | 28.0 | 80.4 |
| 13 | Male | 136.5 | 13.6 | 33.4 | 58.3 | 0.99 | 27.5 | 81.6 |
| 14 | Male | 127.3 | 13.6 | 33.9 | 61.8 | 1.00 | 27.5 | 55.8 |
| 15 | Male | 131.7 | 12.1 | 30.9 | 59.6 | 0.96 | 27.5 | 70.8 |
| 16 | Male | 128.9 | 12.8 | 36.1 | 59.0 | 1.00 | 27.5 | 64.8 |
| 17 | Female | 117.6 | 12.5 | 28.1 | 56.7 | 0.94 | 27.5 | 65.4 |
| 18 | Female | 135.9 | 13.0 | 25.0 | 57.5 | 0.95 | 27.5 | 72.0 |
| 19 | Female | 129.9 | 13.0 | 28.3 | 59.9 | 0.95 | 27.5 | 73.2 |
| 20 | Male | 120.4 | 13.8 | 32.1 | 57.6 | 0.94 | 27.5 | 61.8 |
| | | | | | | | | |
| **Mean** | | **132.5** | **13.2** | **30.1** | **57.9** | **0.96** | **27.2** | **68.9** |
| **SD** | | **8.5** | **0.7** | **3.0** | **2.2** | **0.03** | **0.7** | **6.73** |

**TABLE D.126**
**$VO_2$ Percent Difference Relative to Treadmill**

| Sub | TR | SCC | %diff | BCC | %diff | SHK | %diff | BHK | %diff |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 62.1 | 60.8 | 97.8 | 59.1 | 95.1 | 63.4 | 102.0 | 58.1 | 93.6 |
| 2 | 60.0 | 53.3 | 88.8 | 61.5 | 102.6 | 56.9 | 94.8 | 61.3 | 102.1 |
| 3 | 62.4 | 56.8 | 91.0 | 59.6 | 95.5 | 55.0 | 88.1 | 57.6 | 92.3 |
| 4 | 61.3 | 53.6 | 87.5 | 50.2 | 82.0 | 53.6 | 87.5 | 51.5 | 84.1 |
| 5 | 60.5 | 58.0 | 95.9 | 61.1 | 100.9 | 60.7 | 100.3 | 56.7 | 93.7 |
| 6 | 56.5 | 56.3 | 99.8 | 54.6 | 96.7 | 59.8 | 105.8 | 58.0 | 102.7 |
| 7 | 59.3 | 55.2 | 93.1 | 62.3 | 105.1 | 54.8 | 92.5 | 60.5 | 102.1 |
| 8 | 59.1 | 55.1 | 93.3 | 55.4 | 93.7 | 58.1 | 98.2 | 57.3 | 96.9 |
| 9 | 57.8 | 60.1 | 103.9 | 64.3 | 111.2 | 58.1 | 100.6 | 56.5 | 97.8 |
| 10 | 58.3 | 62.8 | 107.7 | 62.0 | 106.4 | 59.1 | 101.4 | 56.6 | 97.1 |
| 11 | 61.6 | 60.7 | 98.6 | 58.8 | 95.5 | 58.9 | 95.5 | 55.9 | 90.7 |
| 12 | 59.0 | 59.4 | 100.6 | 60.3 | 102.2 | 58.5 | 99.2 | 57.7 | 97.8 |
| 13 | 62.5 | 60.2 | 96.4 | 57.2 | 91.6 | 58.4 | 93.5 | 58.3 | 93.4 |
| 14 | 60.1 | 60.7 | 101.0 | 56.1 | 93.3 | 61.9 | 103.0 | 61.8 | 102.8 |
| 15 | 58.6 | 55.2 | 94.2 | 64.9 | 110.9 | 58.3 | 99.6 | 59.6 | 101.7 |
| 16 | 60.6 | 59.4 | 98.0 | 59.7 | 98.4 | 57.8 | 95.3 | 59.0 | 97.3 |
| 17 | 57.7 | 59.7 | 103.6 | 63.6 | 110.4 | 50.6 | 87.8 | 56.7 | 98.2 |
| 18 | 57.9 | 55.3 | 95.4 | 59.5 | 102.7 | 56.1 | 96.8 | 57.5 | 99.2 |
| 19 | 57.3 | 55.7 | 97.1 | 60.2 | 105.0 | 58.2 | 101.5 | 59.9 | 104.4 |
| 20 | 58.2 | 55.5 | 95.3 | 58.2 | 100.0 | 59.3 | 101.9 | 57.6 | 98.9 |
| | | | | | | | | | |
| **Mean** | **59.5** | **57.7** | **97.0** | **59.4** | **99.9** | **57.9** | **97.3** | **57.9** | **97.3** |
| **SD** | **1.8** | **2.8** | **5.1** | **3.5** | **7.3** | **2.9** | **5.3** | **2.2** | **5.0** |

**TABLE D.127**
**HR Percent Difference Relative to Treadmill**

| Sub | TR | SCC | %diff | BCC | %diff | SHK | %diff | BHK | %diff |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 135.9 | 133.9 | 98.5 | 133.6 | 98.3 | 136.3 | 100.3 | 125.5 | 92.3 |
| 2 | 131.8 | 114.0 | 86.5 | 131.8 | 99.9 | 121.4 | 92.1 | 125.5 | 95.2 |
| 3 | 158.8 | 146.7 | 92.4 | 150.6 | 94.8 | 149.3 | 94.0 | 148.5 | 93.5 |
| 4 | 135.2 | 129.5 | 95.8 | 124.1 | 91.8 | 123.9 | 91.7 | 123.0 | 91.0 |
| 5 | 142.6 | 145.4 | 102.0 | 145.2 | 101.8 | 145.1 | 101.8 | 139.2 | 97.6 |
| 6 | 127.3 | 134.7 | 105.8 | 133.3 | 104.7 | 126.9 | 99.7 | 129.6 | 101.8 |
| 7 | 141.5 | 131.9 | 93.2 | 144.9 | 102.4 | 123.8 | 87.5 | 139.8 | 98.8 |
| 8 | 131.1 | 124.6 | 95.0 | 124.5 | 95.0 | 126.4 | 96.4 | 127.8 | 97.5 |
| 9 | 136.8 | 132.2 | 96.6 | 136.3 | 99.6 | 131.3 | 96.0 | 133.1 | 97.3 |
| 10 | 136.6 | 155.5 | 113.9 | 144.2 | 105.6 | 148.9 | 109.0 | 147.8 | 108.2 |
| 11 | 158.1 | 146.8 | 92.8 | 144.5 | 91.4 | 137.3 | 86.8 | 139.9 | 88.5 |
| 12 | 133.0 | 140.3 | 105.5 | 146.0 | 109.8 | 140.4 | 105.6 | 141.4 | 106.3 |
| 13 | 140.4 | 143.8 | 102.4 | 137.9 | 98.2 | 140.9 | 100.3 | 136.5 | 97.2 |
| 14 | 130.2 | 125.3 | 96.3 | 119.4 | 91.7 | 128.4 | 98.6 | 127.3 | 97.8 |
| 15 | 140.9 | 130.5 | 92.6 | 136.6 | 96.9 | 128.5 | 91.2 | 131.7 | 93.4 |
| 16 | 123.3 | 129.6 | 105.1 | 126.7 | 102.7 | 125.0 | 101.4 | 128.9 | 104.5 |
| 17 | 141.9 | 108.0 | 76.1 | 117.8 | 83.0 | 121.5 | 85.6 | 117.6 | 82.8 |
| 18 | 138.8 | 139.0 | 100.2 | 138.2 | 99.6 | 133.6 | 96.3 | 135.9 | 98.0 |
| 19 | 132.5 | 135.3 | 102.1 | 135.6 | 102.3 | 138.1 | 104.2 | 129.9 | 98.1 |
| 20 | 127.6 | 121.7 | 95.4 | 122.3 | 95.8 | 121.7 | 95.4 | 120.4 | 94.4 |
| | | | | | | | | | |
| **Mean** | **137.2** | **133.4** | **97.4** | **134.7** | **98.3** | **132.4** | **96.7** | **132.5** | **96.7** |
| **SD** | **9.0** | **11.5** | **8.0** | **9.7** | **6.0** | **9.1** | **6.3** | **8.5** | **5.9** |

**TABLE D.128**
**RPE Percent Difference Relative to Treadmill**

| Sub | TR | SCC | %diff | BCC | %diff | SHK | %diff | BHK | %diff |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 12.4 | 13.2 | 106.3 | 13.0 | 104.7 | 13.3 | 107.1 | 12.0 | 96.6 |
| 2 | 12.6 | 12.0 | 95.4 | 13.7 | 108.7 | 12.8 | 102.0 | 13.6 | 107.9 |
| 3 | 12.2 | 13.4 | 109.7 | 13.7 | 112.2 | 14.3 | 116.9 | 14.1 | 115.5 |
| 4 | 10.8 | 11.8 | 109.2 | 12.0 | 110.8 | 12.0 | 110.8 | 12.0 | 110.8 |
| 5 | 10.8 | 14.6 | 135.8 | 14.7 | 136.7 | 14.6 | 135.8 | 13.7 | 127.2 |
| 6 | 12.2 | 14.3 | 117.5 | 13.8 | 113.4 | 13.6 | 111.8 | 13.7 | 112.6 |
| 7 | 12.0 | 14.8 | 122.9 | 15.4 | 128.5 | 13.0 | 108.3 | 14.4 | 120.0 |
| 8 | 12.3 | 12.3 | 100.0 | 13.0 | 105.4 | 12.7 | 102.8 | 12.8 | 104.1 |
| 9 | 12.2 | 12.8 | 105.4 | 13.4 | 110.3 | 13.4 | 110.3 | 14.2 | 116.4 |
| 10 | 11.0 | 11.8 | 106.8 | 11.0 | 100.0 | 11.9 | 108.4 | 12.4 | 112.9 |
| 11 | 11.2 | 12.9 | 115.7 | 12.9 | 115.7 | 12.7 | 113.4 | 12.9 | 115.7 |
| 12 | 11.0 | 12.5 | 113.6 | 12.8 | 116.6 | 12.4 | 112.9 | 12.9 | 117.5 |
| 13 | 8.2 | 14.6 | 178.5 | 14.3 | 175.4 | 13.7 | 167.7 | 13.6 | 166.5 |
| 14 | 10.7 | 13.3 | 124.2 | 12.8 | 119.5 | 13.8 | 129.3 | 13.6 | 127.5 |
| 15 | 13.5 | 12.8 | 95.0 | 13.9 | 103.1 | 12.8 | 95.0 | 12.1 | 89.5 |
| 16 | 10.9 | 13.3 | 122.1 | 12.8 | 117.5 | 12.8 | 116.8 | 12.8 | 117.5 |
| 17 | 11.0 | 11.2 | 101.5 | 12.0 | 109.1 | 12.8 | 116.6 | 12.5 | 113.6 |
| 18 | 10.8 | 12.9 | 119.3 | 12.5 | 115.4 | 13.0 | 120.0 | 13.0 | 120.0 |
| 19 | 11.6 | 12.9 | 111.6 | 13.0 | 112.3 | 12.6 | 108.6 | 13.0 | 112.3 |
| 20 | 12.8 | 12.8 | 99.4 | 13.8 | 107.8 | 13.8 | 107.2 | 13.8 | 107.8 |
| | | | | | | | | | |
| **Mean** | **11.5** | **13.0** | **114.5** | **13.2** | **116.2** | **13.1** | **115.1** | **13.2** | **115.6** |
| **SD** | **1.1** | **1.0** | **18.4** | **1.0** | **16.3** | **0.7** | **15.4** | **0.7** | **15.0** |

**TABLE D.129**
**ANOVA Summary**

| | Significance | Power | Eta Squared | Mean Diff |
|---|---|---|---|---|
| **HR (beats/min)** | 0.042 | 0.693 | 0.444 | 5.29 |
| **RPE (Borg's 6-20)** | 0.001 | 0.980 | 0.656 | 1.77 |
| **$VO_2$ ($mlO_2 \cdot kg^{-1} \cdot min^{-1}$)** | 0.025 | 0.771 | 0.484 | 1.36 |

**TABLE D.130**
**Pairwise Mean Difference Summary**

| | TR/ SCC | TR/ BCC | TR/ SHK | TR/ BHK | SCC/ BCC | SCC/ SHK | SCC/ BHK | BCC/ SHK | BCC/ BHK | SHK/ BHK |
|---|---|---|---|---|---|---|---|---|---|---|
| **HR** | 3.3 | 2.8 | 5.1 | 5.3 | 0.5 | 1.80 | 2.0 | 2.3 | 2.5 | 0.2 |
| **RPE** | **1.50** | **1.7** | **1.5** | **1.6** | 0.2 | 0.0 | 0.1 | 0.2 | 0.1 | 0.1 |
| **$VO_2$** | 0.5 | 0.3 | 1.1 | 0.9 | 0.8 | 0.6 | 0.4 | 1.4 | 1.2 | 0.2 |

**bold=(<.004: largest mean - smallest mean)**

## APPENDIX E
## TABLE E.1
## Stride Rate: Knee Maximum Flexion to Maximum Flexion

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Subject** | **Hz** | **/min** | **Hz** | **/min** | **Hz** | **/min** | **Hz** | **/min** | **Hz** | **/min** |
| 1 | 1.25 | 75.0 | 0.78 | 46.8 | 0.81 | 48.6 | 1.13 | 67.8 | 1.14 | 68.4 |
| 2 | 1.43 | 85.8 | 0.84 | 50.4 | 0.93 | 55.8 | 1.01 | 60.6 | 1.18 | 70.8 |
| 3 | 1.36 | 81.6 | 0.95 | 57.0 | 0.95 | 57.0 | 1.14 | 68.4 | 1.21 | 72.6 |
| 4 | 1.27 | 76.2 | 0.82 | 49.2 | 0.94 | 56.4 | 1.00 | 60.0 | 1.07 | 64.2 |
| 5 | 1.29 | 77.4 | 0.69 | 41.4 | 0.74 | 44.4 | 0.98 | 58.8 | 1.02 | 61.2 |
| 6 | 1.41 | 84.6 | 0.88 | 52.8 | 0.81 | 48.6 | 1.09 | 65.4 | 1.09 | 65.4 |
| 7 | 1.29 | 77.4 | 0.96 | 57.6 | 0.90 | 54.0 | 1.08 | 64.8 | 1.19 | 71.4 |
| 8 | 1.42 | 85.2 | 0.82 | 49.2 | 0.88 | 52.8 | 1.06 | 63.6 | 1.13 | 67.8 |
| 9 | 1.35 | 81.0 | 0.72 | 43.2 | 0.86 | 51.6 | 1.21 | 72.6 | 1.31 | 78.6 |
| 10 | 1.43 | 85.8 | 0.72 | 43.2 | 0.77 | 46.2 | 1.05 | 63.0 | 1.06 | 63.6 |
| 11 | 1.29 | 77.4 | 0.82 | 49.2 | 0.86 | 51.6 | 1.13 | 67.8 | 1.18 | 70.8 |
| 12 | 1.47 | 88.2 | 0.96 | 57.6 | 0.99 | 59.4 | 1.27 | 76.2 | 1.33 | 79.8 |
| 13 | 1.36 | 81.6 | 0.96 | 57.6 | 0.84 | 50.4 | 1.29 | 77.4 | 1.36 | 81.6 |
| 14 | 1.34 | 80.4 | 0.82 | 49.2 | 0.90 | 54.0 | 0.86 | 51.6 | 0.93 | 55.8 |
| 15 | 1.32 | 79.2 | 0.94 | 56.4 | 1.02 | 61.2 | 1.01 | 60.6 | 1.18 | 70.8 |
| 16 | 1.32 | 79.2 | 1.00 | 60.0 | 0.99 | 59.4 | 1.11 | 66.6 | 1.08 | 64.8 |
| 17 | 1.44 | 86.4 | 0.89 | 53.4 | 1.01 | 60.6 | 0.99 | 59.4 | 1.09 | 65.4 |
| 18 | 1.34 | 80.4 | 0.83 | 49.8 | 0.90 | 54.0 | 1.06 | 63.6 | 1.20 | 72.0 |
| 19 | 1.34 | 80.4 | 0.91 | 54.6 | 0.98 | 58.8 | 1.12 | 67.2 | 1.23 | 73.8 |
| 20 | 1.15 | 69.0 | 0.78 | 46.8 | 0.86 | 51.6 | 1.01 | 60.6 | 1.03 | 61.8 |
| **Mean** | **1.25** | **75.0** | **0.78** | **46.8** | **0.81** | **48.6** | **1.13** | **67.8** | **1.14** | **68.4** |
| **SD** | **0.1** | **4.6** | **0.1** | **5.4** | **0.1** | **4.8** | **0.1** | **6.1** | **0.1** | **6.5** |

**TABLE E.2**
**Stride Rate Percent Difference Relative to Treadmill**

| Sub | TR | SCC | %diff | BCC | %diff | SHK | %diff | BHK | %diff |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.25 | 0.78 | 62.4 | 0.81 | 64.8 | 1.13 | 90.4 | 1.14 | 91.2 |
| 2 | 1.43 | 0.84 | 58.7 | 0.93 | 65.0 | 1.01 | 70.6 | 1.18 | 82.5 |
| 3 | 1.36 | 0.95 | 69.9 | 0.95 | 69.9 | 1.14 | 83.8 | 1.21 | 89.0 |
| 4 | 1.27 | 0.82 | 64.6 | 0.94 | 74.0 | 1.00 | 78.7 | 1.07 | 84.3 |
| 5 | 1.29 | 0.69 | 53.5 | 0.74 | 57.4 | 0.98 | 76.0 | 1.02 | 79.1 |
| 6 | 1.41 | 0.88 | 62.4 | 0.81 | 57.4 | 1.09 | 77.3 | 1.09 | 77.3 |
| 7 | 1.29 | 0.96 | 74.4 | 0.90 | 69.8 | 1.08 | 83.7 | 1.19 | 92.2 |
| 8 | 1.42 | 0.82 | 57.7 | 0.88 | 62.0 | 1.06 | 74.6 | 1.13 | 79.6 |
| 9 | 1.35 | 0.72 | 53.3 | 0.86 | 63.7 | 1.21 | 89.6 | 1.31 | 97.0 |
| 10 | 1.43 | 0.72 | 50.3 | 0.77 | 53.8 | 1.05 | 73.4 | 1.06 | 74.1 |
| 11 | 1.29 | 0.82 | 63.6 | 0.86 | 66.7 | 1.13 | 87.6 | 1.18 | 91.5 |
| 12 | 1.47 | 0.96 | 65.3 | 0.99 | 67.3 | 1.27 | 86.4 | 1.33 | 90.5 |
| 13 | 1.36 | 0.96 | 70.6 | 0.84 | 61.8 | 1.29 | 94.9 | 1.36 | 100.0 |
| 14 | 1.34 | 0.82 | 61.2 | 0.90 | 67.2 | 0.86 | 64.2 | 0.93 | 69.4 |
| 15 | 1.32 | 0.94 | 71.2 | 1.02 | 77.3 | 1.01 | 76.5 | 1.18 | 89.4 |
| 16 | 1.32 | 1.00 | 75.8 | 0.99 | 75.0 | 1.11 | 84.1 | 1.08 | 81.8 |
| 17 | 1.44 | 0.89 | 61.8 | 1.01 | 70.1 | 0.99 | 68.8 | 1.09 | 75.7 |
| 18 | 1.34 | 0.83 | 61.9 | 0.90 | 67.2 | 1.06 | 79.1 | 1.20 | 89.6 |
| 19 | 1.34 | 0.91 | 67.9 | 0.98 | 73.1 | 1.12 | 83.6 | 1.23 | 91.8 |
| 20 | 1.15 | 0.78 | 67.8 | 0.86 | 74.8 | 1.01 | 87.8 | 1.03 | 89.6 |
| **Mean** | **1.25** | **0.78** | **62.40** | **0.81** | **64.80** | **1.13** | **90.40** | **1.14** | **91.20** |
| **SD** | **0.08** | **0.09** | **6.91** | **0.08** | **6.37** | **0.10** | **7.97** | **0.11** | **8.05** |

# TABLE E.3
## Sub 1
## Knee XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.116 | -0.149 | 0.326 | -0.181 | 0.330 | -0.164 | 0.040 | 0.399 | 0.337 | -0.005 |
| 2 | 0.135 | -0.137 | 0.347 | -0.181 | 0.329 | -0.175 | 0.029 | 0.360 | 0.338 | 0.002 |
| 3 | 0.125 | -0.139 | 0.316 | -0.207 | 0.313 | -0.162 | -0.003 | 0.359 | 0.352 | 0.004 |
| 4 | 0.132 | -0.143 | 0.320 | -0.238 | 0.308 | -0.142 | 0.008 | 0.359 | 0.341 | -0.004 |
| 5 | 0.122 | -0.136 | 0.294 | -0.217 | 0.311 | -0.172 | 0.003 | 0.331 | 0.360 | 0.004 |
| 6 | 0.126 | -0.166 | 0.332 | -0.206 | 0.299 | -0.159 | 0.030 | 0.373 | 0.351 | -0.007 |
| 7 | 0.126 | -0.134 | 0.289 | -0.180 | 0.300 | -0.152 | 0.021 | 0.337 | 0.344 | 0.001 |
| 8 | 0.127 | -0.142 | 0.289 | -0.221 | 0.287 | -0.153 | -0.005 | 0.356 | 0.358 | -0.001 |
| 9 | 0.130 | -0.147 | 0.305 | -0.162 | 0.284 | -0.154 | -0.009 | 0.383 | 0.370 | 0.003 |
| 10 | 0.137 | -0.147 | 0.341 | -0.225 | 0.291 | -0.173 | 0.020 | 0.392 | 0.351 | -0.024 |
| **Mean** | **0.128** | **-0.144** | **0.316** | **-0.202** | **0.305** | **-0.161** | **0.013** | **0.365** | **0.350** | **-0.003** |
| **SD** | **0.006** | **0.009** | **0.021** | **0.025** | **0.016** | **0.011** | **0.017** | **0.022** | **0.011** | **0.008** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.341 | 0.380 | 0.267 | 0.524 | 0.268 | 0.488 | 0.212 | 0.524 | 0.266 | 0.519 |
| 2 | 0.348 | 0.378 | 0.275 | 0.519 | 0.260 | 0.494 | 0.216 | 0.519 | 0.273 | 0.510 |
| 3 | 0.350 | 0.397 | 0.298 | 0.521 | 0.286 | 0.486 | 0.233 | 0.523 | 0.251 | 0.512 |
| 4 | 0.345 | 0.381 | 0.305 | 0.526 | 0.302 | 0.487 | 0.216 | 0.520 | 0.232 | 0.518 |
| 5 | 0.345 | 0.408 | 0.321 | 0.517 | 0.305 | 0.494 | 0.209 | 0.528 | 0.202 | 0.513 |
| 6 | 0.348 | 0.388 | 0.283 | 0.529 | 0.291 | 0.494 | 0.223 | 0.508 | 0.233 | 0.525 |
| 7 | 0.345 | 0.391 | 0.297 | 0.523 | 0.327 | 0.497 | 0.223 | 0.513 | 0.223 | 0.512 |
| 8 | 0.354 | 0.376 | 0.288 | 0.520 | 0.331 | 0.492 | 0.201 | 0.522 | 0.228 | 0.520 |
| 9 | 0.338 | 0.384 | 0.275 | 0.523 | 0.293 | 0.501 | 0.198 | 0.528 | 0.240 | 0.522 |
| 10 | 0.339 | 0.378 | 0.458 | 0.524 | 0.271 | 0.497 | 0.188 | 0.529 | 0.205 | 0.510 |
| **Mean** | **0.345** | **0.386** | **0.307** | **0.523** | **0.293** | **0.493** | **0.212** | **0.521** | **0.235** | **0.516** |
| **SD** | **0.005** | **0.010** | **0.056** | **0.004** | **0.024** | **0.005** | **0.013** | **0.007** | **0.023** | **0.005** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.4
## Sub 2
## Knee XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.125 | -0.174 | 0.208 | -0.215 | 0.218 | -0.226 | 0.360 | 0.005 | 0.326 | -0.027 |
| **2** | 0.148 | -0.200 | 0.189 | -0.213 | 0.205 | -0.215 | 0.376 | 0.023 | 0.339 | -0.012 |
| **3** | 0.140 | -0.205 | 0.193 | -0.218 | 0.204 | -0.193 | 0.349 | 0.024 | 0.344 | -0.039 |
| **4** | 0.159 | -0.199 | 0.159 | -0.223 | 0.176 | -0.209 | 0.374 | 0.020 | 0.324 | -0.021 |
| **5** | 0.162 | -0.246 | 0.155 | -0.224 | 0.196 | -0.204 | 0.321 | 0.021 | 0.326 | -0.018 |
| **6** | 0.141 | -0.211 | 0.179 | -0.227 | 0.184 | -0.212 | 0.355 | 0.026 | 0.356 | 0.008 |
| **7** | 0.144 | -0.205 | 0.166 | -0.250 | 0.233 | -0.175 | 0.349 | 0.038 | 0.346 | -0.016 |
| **8** | 0.147 | -0.214 | 0.143 | -0.286 | 0.204 | -0.218 | 0.345 | 0.026 | 0.348 | -0.016 |
| **9** | 0.138 | -0.216 | 0.198 | -0.205 | 0.195 | -0.196 | 0.351 | 0.029 | 0.326 | 0.017 |
| **10** | 0.150 | -0.209 | 0.254 | -0.242 | 0.188 | 0.215 | 0.354 | 0.042 | 0.324 | -0.008 |
| **Mean** | **0.145** | **-0.208** | **0.184** | **-0.230** | **0.200** | **-0.206** | **0.353** | **0.025** | **0.336** | **-0.013** |
| **SD** | **0.011** | **0.018** | **0.032** | **0.024** | **0.017** | **0.015** | **0.015** | **0.010** | **0.012** | **0.016** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.335 | 0.407 | 0.373 | 0.481 | 0.388 | 0.474 | 0.229 | 0.481 | 0.282 | 0.464 |
| **2** | 0.346 | 0.390 | 0.389 | 0.471 | 0.388 | 0.485 | 0.226 | 0.451 | 0.272 | 0.482 |
| **3** | 0.346 | 0.394 | 0.389 | 0.466 | 0.400 | 0.468 | 0.448 | 0.469 | 0.244 | 0.483 |
| **4** | 0.347 | 0.381 | 0.404 | 0.479 | 0.399 | 0.471 | 0.191 | 0.481 | 0.271 | 0.477 |
| **5** | 0.334 | 0.381 | 0.401 | 0.479 | 0.393 | 0.472 | 0.245 | 0.471 | 0.294 | 0.494 |
| **6** | 0.330 | 0.401 | 0.402 | 0.466 | 0.400 | 0.474 | 0.226 | 0.483 | 0.238 | 0.490 |
| **7** | 0.338 | 0.401 | 0.389 | 0.477 | 0.351 | 0.475 | 0.232 | 0.471 | 0.248 | 0.485 |
| **8** | 0.336 | 0.389 | 0.403 | 0.473 | 0.367 | 0.476 | 0.242 | 0.470 | 0.243 | 0.477 |
| **9** | 0.336 | 0.384 | 0.432 | 0.474 | 0.382 | 0.466 | 0.227 | 0.471 | 0.276 | 0.488 |
| **10** | 0.329 | 0.405 | 0.404 | 0.463 | 0.381 | 0.475 | 0.218 | 0.478 | 0.282 | 0.482 |
| **Mean** | **0.338** | **0.393** | **0.399** | **0.473** | **0.385** | **0.474** | **0.248** | **0.473** | **0.265** | **0.482** |
| **SD** | **0.007** | **0.010** | **0.015** | **0.006** | **0.016** | **0.005** | **0.072** | **0.009** | **0.020** | **0.008** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.5
## Sub 3
## Knee XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.158 | -0.189 | 0.267 | -0.079 | 0.259 | -0.061 | 0.310 | 0.076 | 0.296 | 0.100 |
| **2** | 0.157 | -0.184 | 0.254 | -0.084 | 0.215 | -0.065 | 0.306 | 0.064 | 0.327 | 0.064 |
| **3** | 0.168 | -0.180 | 0.233 | -0.023 | 0.231 | -0.072 | 0.318 | 0.069 | 0.322 | 0.071 |
| **4** | 0.152 | -0.192 | 0.245 | -0.064 | 0.249 | -0.115 | 0.318 | 0.082 | 0.291 | 0.081 |
| **5** | 0.159 | -0.181 | 0.274 | -0.044 | 0.237 | -0.104 | 0.324 | 0.065 | 0.329 | 0.092 |
| **6** | 0.154 | -0.177 | 0.258 | -0.049 | 0.262 | -0.100 | 0.320 | 0.090 | 0.309 | 0.086 |
| **7** | 0.151 | -0.181 | 0.265 | -0.067 | 0.254 | -0.117 | 0.312 | 0.093 | 0.284 | 0.070 |
| **8** | 0.157 | -0.190 | 0.268 | -0.094 | 0.281 | -0.110 | 0.295 | 0.087 | 0.327 | 0.068 |
| **9** | 0.152 | -0.179 | 0.242 | -0.053 | 0.243 | -0.085 | 0.319 | 0.059 | 0.326 | 0.096 |
| **10** | 0.157 | -0.182 | 0.237 | -0.080 | 0.236 | -0.064 | 0.296 | 0.075 | 0.319 | 0.068 |
| **Mean** | **0.157** | **-0.184** | **0.254** | **-0.064** | **0.247** | **-0.089** | **0.312** | **0.076** | **0.313** | **0.080** |
| **SD** | **0.005** | **0.005** | **0.014** | **0.022** | **0.019** | **0.022** | **0.010** | **0.012** | **0.017** | **0.013** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.339 | 0.386 | 0.214 | 0.391 | 0.234 | 0.405 | 0.101 | 0.378 | 0.070 | 0.362 |
| **2** | 0.321 | 0.382 | 0.232 | 0.403 | 0.227 | 0.392 | 0.115 | 0.384 | 0.058 | 0.379 |
| **3** | 0.322 | 0.383 | 0.233 | 0.400 | 0.229 | 0.404 | 0.090 | 0.384 | 0.059 | 0.369 |
| **4** | 0.326 | 0.381 | 0.247 | 0.395 | 0.199 | 0.402 | 0.098 | 0.381 | 0.067 | 0.374 |
| **5** | 0.321 | 0.376 | 0.207 | 0.404 | 0.219 | 0.407 | 0.060 | 0.378 | 0.043 | 0.368 |
| **6** | 0.328 | 0.364 | 0.234 | 0.400 | 0.201 | 0.393 | 0.084 | 0.376 | 0.039 | 0.372 |
| **7** | 0.323 | 0.372 | 0.216 | 0.404 | 0.231 | 0.402 | 0.068 | 0.380 | 0.053 | 0.376 |
| **8** | 0.319 | 0.371 | 0.216 | 0.400 | 0.195 | 0.405 | 0.088 | 0.382 | 0.064 | 0.383 |
| **9** | 0.319 | 0.377 | 0.237 | 0.400 | 0.231 | 0.396 | 0.074 | 0.385 | 0.044 | 0.370 |
| **10** | 0.322 | 0.371 | 0.237 | 0.406 | 0.240 | 0.396 | 0.083 | 0.374 | 0.068 | 0.379 |
| **Mean** | **0.324** | **0.376** | **0.227** | **0.400** | **0.221** | **0.400** | **0.086** | **0.380** | **0.057** | **0.373** |
| **SD** | **0.006** | **0.007** | **0.013** | **0.004** | **0.016** | **0.005** | **0.016** | **0.004** | **0.011** | **0.006** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.6
## Sub 4
## Knee XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.157 | -0.178 | 0.265 | -0.183 | 0.226 | -0.123 | 0.297 | -0.110 | 0.248 | -0.190 |
| 2 | 0.158 | -0.177 | 0.292 | -0.207 | 0.217 | -0.171 | 0.310 | -0.142 | 0.239 | -0.183 |
| 3 | 0.148 | -0.175 | 0.298 | -0.259 | 0.212 | -0.194 | 0.316 | -0.131 | 0.246 | -0.184 |
| 4 | 0.153 | -0.170 | 0.324 | -0.229 | 0.191 | -0.185 | 0.324 | -0.130 | 0.209 | -0.182 |
| 5 | 0.150 | -0.163 | 0.357 | -0.180 | 0.226 | -0.194 | 0.305 | -0.148 | 0.217 | -0.225 |
| 6 | 0.146 | -0.169 | 0.361 | -0.156 | 0.285 | -0.161 | 0.306 | -0.136 | 0.256 | -0.203 |
| 7 | 0.142 | -0.184 | 0.312 | -0.161 | 0.229 | -0.153 | 0.301 | -0.115 | 0.287 | -0.144 |
| 8 | 0.151 | -0.181 | 0.322 | -0.179 | 0.228 | -0.115 | 0.293 | -0.114 | 0.314 | -0.131 |
| 9 | 0.142 | -0.184 | 0.292 | -0.211 | 0.223 | -0.118 | 0.301 | -0.150 | 0.347 | -0.126 |
| 10 | 0.131 | -0.180 | 0.268 | -0.213 | 0.251 | -0.132 | 0.309 | -0.129 | 0.324 | -0.133 |
| **Mean** | **0.148** | **-0.176** | **0.309** | **-0.198** | **0.229** | **-0.155** | **0.306** | **-0.131** | **0.269** | **-0.170** |
| **SD** | **0.008** | **0.007** | **0.033** | **0.032** | **0.025** | **0.031** | **0.009** | **0.014** | **0.047** | **0.034** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.300 | 0.361 | 0.337 | 0.475 | 0.359 | 0.483 | 0.262 | 0.459 | 0.359 | 0.425 |
| 2 | 0.292 | 0.356 | 0.319 | 0.485 | 0.360 | 0.484 | 0.268 | 0.481 | 0.370 | 0.473 |
| 3 | 0.302 | 0.356 | 0.331 | 0.475 | 0.375 | 0.489 | 0.262 | 0.473 | 0.344 | 0.475 |
| 4 | 0.295 | 0.358 | 0.293 | 0.479 | 0.396 | 0.488 | 0.254 | 0.475 | 0.388 | 0.473 |
| 5 | 0.301 | 0.368 | 0.230 | 0.488 | 0.350 | 0.481 | 0.272 | 0.473 | 0.371 | 0.473 |
| 6 | 0.310 | 0.355 | 0.283 | 0.490 | 0.326 | 0.481 | 0.273 | 0.473 | 0.331 | 0.465 |
| 7 | 0.309 | 0.365 | 0.302 | 0.480 | 0.356 | 0.486 | 0.261 | 0.476 | 0.300 | 0.464 |
| 8 | 0.298 | 0.358 | 0.281 | 0.490 | 0.373 | 0.478 | 0.259 | 0.469 | 0.293 | 0.474 |
| 9 | 0.311 | 0.361 | 0.331 | 0.490 | 0.371 | 0.483 | 0.291 | 0.464 | 0.249 | 0.478 |
| 10 | 0.313 | 0.367 | 0.336 | 0.473 | 0.344 | 0.478 | 0.283 | 0.473 | 0.269 | 0.473 |
| **Mean** | **0.303** | **0.361** | **0.304** | **0.483** | **0.361** | **0.483** | **0.269** | **0.472** | **0.327** | **0.467** |
| **SD** | **0.007** | **0.005** | **0.034** | **0.007** | **0.019** | **0.004** | **0.012** | **0.006** | **0.047** | **0.015** |
| **Smooth** | **fz** | **6** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.7
# Sub 5
# Knee XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.147 | -0.147 | 0.377 | 0.113 | 0.286 | -0.044 | 0.535 | 0.071 | 0.519 | 0.140 |
| 2 | 0.141 | -0.150 | 0.539 | 0.114 | 0.492 | -0.020 | 0.528 | 0.072 | 0.508 | 0.159 |
| 3 | 0.152 | -0.157 | 0.534 | 0.142 | 0.493 | 0.011 | 0.506 | 0.078 | 0.510 | 0.140 |
| 4 | 0.157 | -0.147 | 0.539 | 0.121 | 0.509 | -0.002 | 0.551 | 0.102 | 0.492 | 0.135 |
| 5 | 0.145 | -0.154 | 0.517 | 0.106 | 0.531 | -0.052 | 0.512 | 0.056 | 0.522 | 0.130 |
| 6 | 0.168 | -0.155 | 0.515 | 0.097 | 0.482 | -0.033 | 0.520 | 0.086 | 0.523 | 0.147 |
| 7 | 0.158 | -0.154 | 0.523 | 0.058 | 0.507 | -0.060 | 0.492 | 0.053 | 0.493 | 0.139 |
| 8 | 0.160 | -0.161 | 0.519 | 0.517 | 0.510 | -0.005 | 0.520 | 0.067 | 0.508 | 0.123 |
| 9 | 0.156 | -0.150 | 0.524 | 0.075 | 0.515 | 0.001 | 0.536 | 0.010 | 0.460 | 0.140 |
| 10 | 0.154 | -0.158 | 0.553 | 0.108 | 0.524 | 0.040 | 0.503 | 0.031 | 0.499 | 0.153 |
| **Mean** | **0.154** | **-0.153** | **0.529** | **0.145** | **0.485** | **-0.016** | **0.520** | **0.063** | **0.503** | **0.141** |
| **SD** | **0.008** | **0.005** | **0.013** | **0.133** | **0.071** | **0.031** | **0.018** | **0.027** | **0.019** | **0.010** |
| **Smooth** | **fz** | **5** | | **3** | | **3** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.343 | 0.388 | 0.092 | 0.575 | 0.489 | 0.612 | 0.056 | 0.604 | 0.059 | 0.591 |
| 2 | 0.344 | 0.394 | 0.145 | 0.563 | 0.195 | 0.606 | 0.099 | 0.588 | 0.094 | 0.575 |
| 3 | 0.349 | 0.390 | 0.118 | 0.555 | 0.171 | 0.597 | 0.076 | 0.592 | 0.080 | 0.597 |
| 4 | 0.342 | 0.399 | 0.167 | 0.573 | 0.180 | 0.614 | 0.052 | 0.594 | 0.073 | 0.578 |
| 5 | 0.342 | 0.387 | 0.193 | 0.591 | 0.166 | 0.615 | 0.062 | 0.586 | 0.069 | 0.579 |
| 6 | 0.347 | 0.372 | 0.195 | 0.602 | 0.240 | 0.610 | 0.107 | 0.595 | 0.082 | 0.573 |
| 7 | 0.335 | 0.373 | 0.147 | 0.588 | 0.221 | 0.602 | 0.080 | 0.594 | 0.051 | 0.580 |
| 8 | 0.322 | 0.384 | 0.162 | 0.579 | 0.212 | 0.615 | 0.111 | 0.589 | 0.118 | 0.584 |
| 9 | 0.341 | 0.381 | 0.577 | 0.577 | 0.154 | 0.594 | 0.106 | 0.598 | 0.059 | 0.568 |
| 10 | 0.329 | 0.382 | 0.119 | 0.581 | 0.160 | 0.593 | 0.055 | 0.609 | 0.050 | 0.577 |
| **Mean** | **0.339** | **0.385** | **0.192** | **0.578** | **0.219** | **0.606** | **0.080** | **0.595** | **0.074** | **0.580** |
| **SD** | **0.008** | **0.009** | **0.139** | **0.014** | **0.099** | **0.009** | **0.024** | **0.007** | **0.021** | **0.009** |
| **Smooth** | **fz** | **5** | | **3** | | **4** | | **4** | | **4** |
| **Combo** | **SD** | **0.014** | | **0.151** | | **0.142** | | **0.179** | | **0.174** |

# TABLE E.8
## Sub 6
## Knee XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.171 | -0.147 | 0.375 | -0.100 | 0.317 | -0.257 | 0.377 | 0.002 | 0.332 | -0.076 |
| 2 | 0.177 | -0.137 | 0.373 | -0.092 | 0.304 | -0.243 | 0.379 | -0.025 | 0.365 | -0.076 |
| 3 | 0.186 | -0.130 | 0.339 | -0.131 | 0.302 | -0.266 | 0.374 | -0.018 | 0.346 | -0.084 |
| 4 | 0.181 | -0.127 | 0.319 | -0.167 | 0.343 | -0.289 | 0.362 | -0.040 | 0.356 | -0.069 |
| 5 | 0.189 | -0.132 | 0.320 | -0.153 | 0.320 | -0.286 | 0.345 | -0.037 | 0.365 | -0.061 |
| 6 | 0.182 | -0.135 | 0.308 | -0.213 | 0.329 | -0.217 | 0.378 | -0.015 | 0.352 | -0.039 |
| 7 | 0.181 | -0.148 | 0.314 | -0.197 | 0.311 | -0.268 | 0.377 | -0.038 | 0.350 | -0.082 |
| 8 | 0.178 | -0.137 | 0.318 | -0.203 | 0.344 | -0.271 | 0.399 | -0.009 | 0.375 | -0.077 |
| 9 | 0.181 | -0.135 | 0.328 | -0.180 | 0.309 | -0.266 | 0.372 | -0.027 | 0.356 | -0.086 |
| 10 | 0.182 | -0.139 | 0.325 | -0.199 | 0.333 | -0.266 | 0.399 | -0.010 | 0.348 | -0.084 |
| **Mean** | **0.181** | **-0.137** | **0.332** | **-0.163** | **0.321** | **-0.263** | **0.376** | **-0.022** | **0.355** | **-0.073** |
| **SD** | **0.005** | **0.007** | **0.024** | **0.043** | **0.015** | **0.021** | **0.016** | **0.014** | **0.012** | **0.014** |
| **Smooth** | **fz** | **5** | | **3** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.258 | 0.337 | 0.158 | 0.491 | 0.273 | 0.491 | 0.141 | 0.478 | 0.188 | 0.468 |
| 2 | 0.264 | 0.337 | 0.154 | 0.498 | 0.304 | 0.485 | 0.133 | 0.475 | 0.199 | 0.469 |
| 3 | 0.255 | 0.336 | 0.232 | 0.481 | 0.294 | 0.482 | 0.134 | 0.486 | 0.180 | 0.482 |
| 4 | 0.254 | 0.337 | 0.243 | 0.478 | 0.262 | 0.488 | 0.128 | 0.485 | 0.167 | 0.467 |
| 5 | 0.246 | 0.338 | 0.239 | 0.482 | 0.288 | 0.480 | 0.151 | 0.483 | 0.142 | 0.467 |
| 6 | 0.261 | 0.332 | 0.228 | 0.481 | 0.280 | 0.474 | 0.114 | 0.474 | 0.176 | 0.477 |
| 7 | 0.260 | 0.345 | 0.247 | 0.478 | 0.250 | 0.469 | 0.121 | 0.480 | 0.169 | 0.474 |
| 8 | 0.261 | 0.331 | 0.246 | 0.486 | 0.275 | 0.481 | 0.127 | 0.486 | 0.172 | 0.476 |
| 9 | 0.255 | 0.336 | 0.243 | 0.483 | 0.269 | 0.483 | 0.139 | 0.483 | 0.167 | 0.481 |
| 10 | 0.268 | 0.332 | 0.243 | 0.449 | 0.291 | 0.463 | 0.118 | 0.479 | 0.180 | 0.469 |
| **Mean** | **0.258** | **0.336** | **0.223** | **0.481** | **0.279** | **0.480** | **0.131** | **0.481** | **0.174** | **0.473** |
| **SD** | **0.006** | **0.004** | **0.036** | **0.007** | **0.016** | **0.009** | **0.011** | **0.004** | **0.015** | **0.006** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.9
## Sub 7
## Knee XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.186 | -0.124 | 0.379 | -0.089 | 0.408 | -0.080 | 0.391 | 0.059 | 0.379 | -0.027 |
| 2 | 0.187 | -0.122 | 0.382 | -0.084 | 0.414 | -0.084 | 0.373 | 0.038 | 0.387 | -0.003 |
| 3 | 0.177 | -0.129 | 0.381 | -0.070 | 0.394 | -0.071 | 0.388 | 0.054 | 0.363 | -0.037 |
| 4 | 0.182 | -0.134 | 0.394 | -0.085 | 0.370 | -0.062 | 0.396 | 0.090 | 0.383 | -0.032 |
| 5 | 0.196 | -0.130 | 0.380 | -0.065 | 0.395 | -0.055 | 0.392 | 0.056 | 0.405 | -0.045 |
| 6 | 0.184 | -0.132 | 0.383 | -0.130 | 0.386 | -0.068 | 0.391 | 0.079 | 0.403 | -0.017 |
| 7 | 0.194 | -0.118 | 0.334 | -0.115 | 0.380 | -0.130 | 0.407 | 0.069 | 0.396 | -0.052 |
| 8 | 0.185 | -0.123 | 0.365 | -0.104 | 0.403 | -0.097 | 0.385 | 0.038 | 0.386 | -0.031 |
| 9 | 0.182 | -0.124 | 0.368 | -0.148 | 0.398 | -0.074 | 0.407 | 0.067 | 0.392 | -0.063 |
| 10 | 0.198 | -0.122 | 0.381 | -0.086 | 0.389 | -0.121 | 0.416 | 0.075 | 0.381 | -0.035 |
| **Mean** | **0.187** | **-0.126** | **0.375** | **-0.098** | **0.394** | **-0.084** | **0.395** | **0.063** | **0.388** | **-0.034** |
| **SD** | **0.007** | **0.005** | **0.016** | **0.026** | **0.013** | **0.025** | **0.012** | **0.017** | **0.012** | **0.017** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.299 | 0.363 | 0.160 | 0.446 | 0.070 | 0.449 | 0.179 | 0.451 | 0.201 | 0.462 |
| 2 | 0.298 | 0.359 | 0.162 | 0.455 | 0.055 | 0.450 | 0.208 | 0.465 | 0.183 | 0.476 |
| 3 | 0.311 | 0.368 | 0.158 | 0.443 | 0.085 | 0.446 | 0.181 | 0.461 | 0.199 | 0.469 |
| 4 | 0.299 | 0.364 | 0.153 | 0.450 | 0.132 | 0.452 | 0.134 | 0.445 | 0.187 | 0.447 |
| 5 | 0.296 | 0.365 | 0.178 | 0.454 | 0.108 | 0.447 | 0.158 | 0.452 | 0.173 | 0.458 |
| 6 | 0.299 | 0.362 | 0.178 | 0.453 | 0.127 | 0.441 | 0.168 | 0.462 | 0.172 | 0.464 |
| 7 | 0.292 | 0.360 | 0.221 | 0.452 | 0.134 | 0.446 | 0.154 | 0.451 | 0.151 | 0.464 |
| 8 | 0.306 | 0.370 | 0.193 | 0.450 | 0.109 | 0.455 | 0.215 | 0.446 | 0.194 | 0.462 |
| 9 | 0.298 | 0.364 | 0.175 | 0.456 | 0.127 | 0.458 | 0.125 | 0.461 | 0.196 | 0.470 |
| 10 | 0.287 | 0.365 | 0.155 | 0.451 | 0.076 | 0.453 | 0.101 | 0.453 | 0.179 | 0.474 |
| **Mean** | **0.299** | **0.364** | **0.173** | **0.451** | **0.102** | **0.450** | **0.162** | **0.455** | **0.184** | **0.465** |
| **SD** | **0.007** | **0.003** | **0.021** | **0.004** | **0.029** | **0.005** | **0.036** | **0.007** | **0.015** | **0.008** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

**TABLE E.10**
**Sub 8**
**Knee XY Displacement Difference Relative to Hip**

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.192 | -0.146 | 0.426 | -0.024 | 0.415 | -0.140 | 0.403 | 0.053 | 0.407 | 0.064 |
| **2** | 0.188 | -0.160 | 0.420 | -0.013 | 0.414 | -0.133 | 0.402 | 0.021 | 0.414 | 0.055 |
| **3** | 0.212 | -0.149 | 0.415 | -0.047 | 0.409 | -0.112 | 0.410 | 0.050 | 0.403 | 0.062 |
| **4** | 0.201 | -0.139 | 0.418 | -0.070 | 0.410 | -0.109 | 0.407 | 0.029 | 0.411 | 0.059 |
| **5** | 0.196 | -0.152 | 0.412 | -0.072 | 0.409 | -0.125 | 0.411 | 0.018 | 0.410 | 0.068 |
| **6** | 0.202 | -0.137 | 0.418 | -0.059 | 0.415 | -0.149 | 0.414 | 0.003 | 0.407 | 0.049 |
| **7** | 0.199 | -0.150 | 0.400 | -0.043 | 0.419 | -0.101 | 0.404 | 0.028 | 0.411 | 0.067 |
| **8** | 0.204 | -0.149 | 0.408 | -0.042 | 0.414 | -0.112 | 0.403 | 0.022 | 0.413 | 0.042 |
| **9** | 0.192 | -0.149 | 0.426 | -0.045 | 0.422 | -0.144 | 0.396 | 0.042 | 0.407 | 0.024 |
| **10** | 0.203 | -0.149 | 0.401 | -0.027 | 0.428 | -0.124 | 0.395 | 0.024 | 0.408 | 0.059 |
| **Mean** | **0.199** | **-0.148** | **0.414** | **-0.044** | **0.416** | **-0.125** | **0.405** | **0.029** | **0.409** | **0.055** |
| **SD** | **0.007** | **0.006** | **0.009** | **0.019** | **0.006** | **0.016** | **0.006** | **0.015** | **0.003** | **0.014** |
| **Smooth** | **fz** | **5** | | **3** | | **3** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.281 | 0.368 | 0.045 | 0.493 | 0.136 | 0.505 | 0.085 | 0.486 | 0.040 | 0.468 |
| **2** | 0.280 | 0.362 | 0.066 | 0.494 | 0.137 | 0.493 | 0.080 | 0.477 | 0.043 | 0.481 |
| **3** | 0.270 | 0.372 | 0.098 | 0.494 | 0.143 | 0.485 | 0.054 | 0.478 | 0.042 | 0.474 |
| **4** | 0.282 | 0.355 | 0.086 | 0.489 | 0.146 | 0.497 | 0.062 | 0.480 | 0.048 | 0.479 |
| **5** | 0.271 | 0.373 | 0.097 | 0.500 | 0.156 | 0.498 | 0.062 | 0.473 | 0.042 | 0.472 |
| **6** | 0.282 | 0.372 | 0.084 | 0.495 | 0.149 | 0.494 | 0.054 | 0.484 | 0.033 | 0.475 |
| **7** | 0.276 | 0.356 | 0.109 | 0.504 | 0.104 | 0.500 | 0.046 | 0.471 | 0.048 | 0.474 |
| **8** | 0.277 | 0.358 | 0.095 | 0.501 | 0.137 | 0.497 | 0.071 | 0.476 | 0.047 | 0.488 |
| **9** | 0.283 | 0.368 | 0.106 | 0.492 | 0.129 | 0.494 | 0.057 | 0.479 | 0.018 | 0.475 |
| **10** | 0.265 | 0.371 | 0.095 | 0.500 | 0.151 | 0.492 | 0.071 | 0.482 | 0.035 | 0.480 |
| **Mean** | **0.277** | **0.366** | **0.088** | **0.496** | **0.139** | **0.496** | **0.064** | **0.479** | **0.040** | **0.477** |
| **SD** | **0.006** | **0.007** | **0.019** | **0.005** | **0.015** | **0.005** | **0.012** | **0.005** | **0.009** | **0.006** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.11
## Sub 9
## Knee XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.196 | -0.163 | 0.406 | -0.133 | 0.381 | -0.090 | 0.401 | 0.039 | 0.386 | 0.019 |
| 2 | 0.193 | -0.174 | 0.388 | -0.119 | 0.412 | -0.109 | 0.396 | 0.024 | 0.401 | 0.055 |
| 3 | 0.189 | -0.159 | 0.397 | -0.119 | 0.396 | -0.120 | 0.410 | 0.013 | 0.386 | 0.042 |
| 4 | 0.185 | -0.162 | 0.379 | -0.095 | 0.388 | -0.089 | 0.385 | 0.032 | 0.352 | 0.028 |
| 5 | 0.199 | -0.167 | 0.382 | -0.136 | 0.382 | -0.081 | 0.378 | 0.042 | 0.370 | 0.014 |
| 6 | 0.182 | -0.170 | 0.362 | -0.129 | 0.391 | -0.074 | 0.394 | -0.005 | 0.373 | 0.016 |
| 7 | 0.188 | -0.167 | 0.382 | -0.084 | 0.397 | -0.046 | 0.414 | 0.008 | 0.391 | 0.018 |
| 8 | 0.191 | -0.160 | 0.404 | -0.097 | 0.377 | -0.090 | 0.402 | -0.011 | 0.389 | 0.053 |
| 9 | 0.190 | -0.163 | 0.416 | -0.100 | 0.377 | -0.107 | 0.383 | -0.003 | 0.398 | 0.038 |
| 10 | 0.198 | -0.164 | 0.402 | -0.102 | 0.405 | -0.079 | 0.386 | 0.021 | 0.393 | 0.019 |
| **Mean** | **0.191** | **-0.165** | **0.392** | **-0.111** | **0.391** | **-0.089** | **0.395** | **0.016** | **0.384** | **0.030** |
| **SD** | **0.006** | **0.005** | **0.016** | **0.018** | **0.012** | **0.021** | **0.012** | **0.019** | **0.015** | **0.016** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.298 | 0.377 | 0.244 | 0.502 | 0.241 | 0.503 | 0.222 | 0.484 | 0.188 | 0.501 |
| 2 | 0.305 | 0.372 | 0.265 | 0.518 | 0.216 | 0.508 | 0.199 | 0.503 | 0.177 | 0.490 |
| 3 | 0.294 | 0.389 | 0.233 | 0.516 | 0.223 | 0.510 | 0.193 | 0.496 | 0.175 | 0.483 |
| 4 | 0.301 | 0.379 | 0.268 | 0.512 | 0.245 | 0.502 | 0.190 | 0.489 | 0.241 | 0.475 |
| 5 | 0.291 | 0.374 | 0.248 | 0.509 | 0.251 | 0.505 | 0.224 | 0.481 | 0.246 | 0.488 |
| 6 | 0.306 | 0.369 | 0.277 | 0.502 | 0.247 | 0.516 | 0.204 | 0.505 | 0.218 | 0.481 |
| 7 | 0.302 | 0.376 | 0.256 | 0.502 | 0.263 | 0.501 | 0.184 | 0.507 | 0.201 | 0.484 |
| 8 | 0.298 | 0.377 | 0.253 | 0.507 | 0.271 | 0.514 | 0.184 | 0.493 | 0.165 | 0.466 |
| 9 | 0.288 | 0.371 | 0.222 | 0.516 | 0.264 | 0.508 | 0.199 | 0.498 | 0.145 | 0.480 |
| 10 | 0.297 | 0.385 | 0.236 | 0.520 | 0.238 | 0.510 | 0.215 | 0.497 | 0.187 | 0.481 |
| **Mean** | **0.298** | **0.377** | **0.250** | **0.510** | **0.246** | **0.508** | **0.201** | **0.495** | **0.194** | **0.483** |
| **SD** | **0.006** | **0.006** | **0.017** | **0.007** | **0.018** | **0.005** | **0.015** | **0.009** | **0.033** | **0.009** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.12
## Sub 10
## Knee XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.174 | -0.164 | 0.314 | -0.172 | 0.328 | -0.180 | 0.407 | -0.056 | 0.375 | -0.061 |
| **2** | 0.186 | -0.140 | 0.298 | -0.147 | 0.317 | -0.217 | 0.382 | -0.031 | 0.317 | -0.126 |
| **3** | 0.188 | -0.145 | 0.289 | -0.218 | 0.343 | -0.194 | 0.353 | -0.040 | 0.347 | -0.103 |
| **4** | 0.180 | -0.154 | 0.270 | -0.212 | 0.298 | -0.164 | 0.397 | -0.056 | 0.331 | -0.078 |
| **5** | 0.182 | -0.153 | 0.283 | -0.204 | 0.325 | -0.179 | 0.365 | -0.038 | 0.338 | -0.082 |
| **6** | 0.190 | -0.164 | 0.308 | -0.225 | 0.329 | -0.208 | 0.385 | -0.064 | 0.313 | -0.113 |
| **7** | 0.182 | -0.156 | 0.306 | -0.157 | 0.324 | -0.171 | 0.382 | -0.032 | 0.311 | -0.086 |
| **8** | 0.195 | -0.154 | 0.279 | -0.199 | 0.311 | -0.179 | 0.431 | -0.021 | 0.301 | -0.075 |
| **9** | 0.190 | -0.157 | 0.266 | -0.176 | 0.326 | -0.203 | 0.374 | -0.022 | 0.340 | -0.127 |
| **10** | 0.184 | -0.165 | 0.291 | -0.195 | 0.332 | -0.215 | 0.406 | -0.064 | 0.344 | -0.146 |
| **Mean** | **0.185** | **-0.155** | **0.290** | **-0.191** | **0.323** | **-0.191** | **0.388** | **-0.042** | **0.332** | **-0.100** |
| **SD** | **0.006** | **0.008** | **0.016** | **0.026** | **0.012** | **0.019** | **0.023** | **0.016** | **0.022** | **0.028** |
| **Smooth** | **fz** | **5** | | **3** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.327 | 0.388 | 0.328 | 0.505 | 0.303 | 0.486 | 0.192 | 0.478 | 0.192 | 0.489 |
| **2** | 0.312 | 0.384 | 0.336 | 0.502 | 0.306 | 0.483 | 0.150 | 0.479 | 0.290 | 0.486 |
| **3** | 0.310 | 0.373 | 0.349 | 0.498 | 0.276 | 0.490 | 0.171 | 0.481 | 0.225 | 0.485 |
| **4** | 0.309 | 0.379 | 0.356 | 0.504 | 0.296 | 0.493 | 0.182 | 0.483 | 0.239 | 0.519 |
| **5** | 0.309 | 0.388 | 0.365 | 0.491 | 0.292 | 0.491 | 0.162 | 0.487 | 0.219 | 0.494 |
| **6** | 0.313 | 0.391 | 0.343 | 0.496 | 0.296 | 0.495 | 0.149 | 0.485 | 0.294 | 0.497 |
| **7** | 0.317 | 0.390 | 0.327 | 0.488 | 0.294 | 0.487 | 0.205 | 0.470 | 0.308 | 0.492 |
| **8** | 0.298 | 0.389 | 0.339 | 0.505 | 0.325 | 0.498 | 0.152 | 0.477 | 0.316 | 0.508 |
| **9** | 0.311 | 0.386 | 0.362 | 0.495 | 0.294 | 0.487 | 0.154 | 0.469 | 0.212 | 0.501 |
| **10** | 0.314 | 0.390 | 0.325 | 0.494 | 0.297 | 0.490 | 0.181 | 0.485 | 0.222 | 0.494 |
| **Mean** | **0.312** | **0.386** | **0.343** | **0.498** | **0.298** | **0.490** | **0.170** | **0.479** | **0.252** | **0.497** |
| **SD** | **0.007** | **0.006** | **0.015** | **0.006** | **0.012** | **0.004** | **0.020** | **0.006** | **0.045** | **0.010** |
| **Smooth** | **fz** | **6** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.13
## Sub 11
## Knee XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.203 | -0.168 | 0.289 | -0.161 | 0.204 | -0.234 | 0.349 | 0.032 | 0.333 | 0.020 |
| **2** | 0.192 | -0.172 | 0.279 | -0.133 | 0.213 | -0.219 | 0.318 | 0.027 | 0.355 | 0.024 |
| **3** | 0.192 | -0.163 | 0.277 | -0.157 | 0.188 | -0.234 | 0.332 | 0.027 | 0.341 | 0.017 |
| **4** | 0.197 | -0.169 | 0.257 | -0.163 | 0.259 | -0.227 | 0.348 | 0.059 | 0.348 | 0.052 |
| **5** | 0.190 | -0.173 | 0.289 | -0.164 | 0.269 | -0.206 | 0.334 | 0.050 | 0.313 | -0.004 |
| **6** | 0.185 | -0.171 | 0.277 | -0.166 | 0.242 | -0.189 | 0.325 | 0.042 | 0.343 | 0.030 |
| **7** | 0.198 | -0.177 | 0.261 | -0.157 | 0.189 | -0.190 | 0.328 | 0.042 | 0.320 | 0.015 |
| **8** | 0.188 | -0.175 | 0.274 | -0.193 | 0.211 | -0.188 | 0.335 | 0.031 | 0.346 | 0.033 |
| **9** | 0.198 | -0.168 | 0.286 | -0.204 | 0.233 | -0.195 | 0.349 | 0.036 | 0.338 | 0.041 |
| **10** | 0.201 | -0.171 | 0.284 | -0.138 | 0.241 | -0.178 | 0.353 | 0.061 | 0.332 | 0.012 |
| **Mean** | **0.194** | **-0.171** | **0.277** | **-0.164** | **0.225** | **-0.206** | **0.337** | **0.041** | **0.337** | **0.024** |
| **SD** | **0.006** | **0.004** | **0.011** | **0.022** | **0.028** | **0.021** | **0.012** | **0.012** | **0.013** | **0.016** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.268 | 0.367 | 0.198 | 0.395 | 0.304 | 0.414 | 0.029 | 0.384 | 0.017 | 0.405 |
| **2** | 0.275 | 0.370 | 0.183 | 0.396 | 0.296 | 0.406 | 0.024 | 0.406 | 0.069 | 0.387 |
| **3** | 0.283 | 0.366 | 0.209 | 0.402 | 0.322 | 0.414 | -0.008 | 0.416 | 0.049 | 0.390 |
| **4** | 0.276 | 0.371 | 0.229 | 0.405 | 0.272 | 0.403 | 0.006 | 0.384 | 0.026 | 0.398 |
| **5** | 0.275 | 0.370 | 0.178 | 0.390 | 0.239 | 0.425 | -0.020 | 0.398 | 0.057 | 0.409 |
| **6** | 0.283 | 0.366 | 0.206 | 0.407 | 0.287 | 0.407 | 0.003 | 0.377 | 0.070 | 0.398 |
| **7** | 0.278 | 0.368 | 0.229 | 0.399 | 0.349 | 0.408 | 0.009 | 0.401 | 0.025 | 0.390 |
| **8** | 0.282 | 0.375 | 0.222 | 0.406 | 0.295 | 0.360 | -0.011 | 0.395 | 0.048 | 0.393 |
| **9** | 0.278 | 0.367 | 0.218 | 0.394 | 0.274 | 0.407 | -0.006 | 0.389 | 0.044 | 0.397 |
| **10** | 0.274 | 0.371 | 0.188 | 0.390 | 0.288 | 0.417 | 0.008 | 0.387 | 0.033 | 0.391 |
| **Mean** | **0.277** | **0.369** | **0.206** | **0.398** | **0.293** | **0.406** | **0.003** | **0.394** | **0.044** | **0.396** |
| **SD** | **0.005** | **0.003** | **0.019** | **0.006** | **0.030** | **0.017** | **0.015** | **0.012** | **0.018** | **0.007** |
| **Smooth** | **fz** | **6** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.14
## Sub 12
## Knee XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.128 | -0.141 | 0.248 | -0.088 | 0.238 | -0.137 | 0.326 | 0.058 | 0.319 | 0.042 |
| **2** | 0.128 | -0.152 | 0.265 | -0.096 | 0.255 | -0.136 | 0.337 | 0.053 | 0.322 | 0.058 |
| **3** | 0.134 | -0.146 | 0.255 | -0.074 | 0.234 | -0.128 | 0.334 | 0.064 | 0.325 | 0.061 |
| **4** | 0.122 | -0.163 | 0.266 | -0.088 | 0.229 | -0.127 | 0.334 | 0.066 | 0.326 | 0.067 |
| **5** | 0.110 | -0.156 | 0.267 | -0.098 | 0.235 | -0.147 | 0.345 | 0.059 | 0.329 | 0.062 |
| **6** | 0.116 | -0.162 | 0.271 | -0.084 | 0.245 | -0.126 | 0.343 | 0.061 | 0.324 | 0.078 |
| **7** | 0.120 | -0.158 | 0.278 | -0.078 | 0.246 | -0.139 | 0.329 | 0.078 | 0.327 | 0.081 |
| **8** | 0.122 | -0.165 | 0.266 | -0.082 | 0.230 | -0.129 | 0.341 | 0.067 | 0.347 | 0.062 |
| **9** | 0.124 | -0.155 | 0.266 | -0.052 | 0.237 | -0.125 | 0.333 | 0.060 | 0.345 | 0.061 |
| **10** | 0.120 | -0.149 | 0.272 | -0.077 | 0.239 | -0.124 | 0.337 | 0.059 | 0.349 | 0.058 |
| **Mean** | **0.122** | **-0.155** | **0.265** | **-0.082** | **0.239** | **-0.132** | **0.336** | **0.063** | **0.331** | **0.063** |
| **SD** | **0.007** | **0.008** | **0.008** | **0.013** | **0.008** | **0.008** | **0.006** | **0.007** | **0.011** | **0.011** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.320 | 0.365 | 0.248 | 0.401 | 0.260 | 0.384 | 0.122 | 0.399 | 0.114 | 0.390 |
| **2** | 0.324 | 0.367 | 0.241 | 0.396 | 0.250 | 0.391 | 0.101 | 0.397 | 0.109 | 0.390 |
| **3** | 0.319 | 0.368 | 0.251 | 0.395 | 0.269 | 0.402 | 0.108 | 0.393 | 0.113 | 0.387 |
| **4** | 0.320 | 0.366 | 0.240 | 0.399 | 0.288 | 0.392 | 0.086 | 0.392 | 0.093 | 0.388 |
| **5** | 0.324 | 0.363 | 0.232 | 0.398 | 0.260 | 0.400 | 0.090 | 0.392 | 0.108 | 0.394 |
| **6** | 0.325 | 0.358 | 0.228 | 0.393 | 0.261 | 0.397 | 0.087 | 0.393 | 0.124 | 0.393 |
| **7** | 0.323 | 0.353 | 0.227 | 0.393 | 0.254 | 0.394 | 0.096 | 0.386 | 0.110 | 0.395 |
| **8** | 0.322 | 0.360 | 0.228 | 0.393 | 0.262 | 0.394 | 0.091 | 0.382 | 0.068 | 0.399 |
| **9** | 0.315 | 0.367 | 0.242 | 0.390 | 0.274 | 0.397 | 0.094 | 0.395 | 0.085 | 0.401 |
| **10** | 0.316 | 0.369 | 0.231 | 0.400 | 0.263 | 0.392 | 0.091 | 0.391 | 0.077 | 0.399 |
| **Mean** | **0.321** | **0.364** | **0.237** | **0.396** | **0.264** | **0.394** | **0.097** | **0.392** | **0.100** | **0.394** |
| **SD** | **0.003** | **0.005** | **0.009** | **0.004** | **0.011** | **0.005** | **0.011** | **0.005** | **0.018** | **0.005** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.15
## Sub 13
## Knee XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.121 | -0.126 | 0.188 | -0.157 | 0.299 | -0.074 | 0.318 | 0.000 | 0.371 | 0.000 |
| **2** | 0.126 | -0.148 | 0.181 | -0.155 | 0.300 | -0.082 | 0.293 | 0.015 | 0.320 | 0.006 |
| **3** | 0.114 | -0.136 | 0.190 | -0.171 | 0.287 | -0.104 | 0.298 | 0.017 | 0.364 | 0.049 |
| **4** | 0.124 | -0.146 | 0.260 | -0.168 | 0.275 | -0.126 | 0.310 | 0.024 | 0.312 | 0.025 |
| **5** | 0.110 | -0.137 | 0.264 | -0.110 | 0.301 | -0.100 | 0.310 | 0.005 | 0.319 | 0.007 |
| **6** | 0.122 | -0.143 | 0.244 | -0.121 | 0.308 | -0.078 | 0.307 | 0.021 | 0.308 | 0.021 |
| **7** | 0.142 | -0.147 | 0.245 | -0.112 | 0.283 | -0.103 | 0.313 | -0.002 | 0.315 | 0.018 |
| **8** | 0.130 | -0.140 | 0.226 | -0.129 | 0.299 | -0.074 | 0.318 | 0.006 | 0.316 | 0.031 |
| **9** | 0.154 | -0.153 | 0.232 | -0.135 | 0.278 | -0.104 | 0.326 | -0.004 | 0.327 | 0.035 |
| **10** | 0.154 | -0.167 | 0.246 | -0.120 | 0.293 | -0.093 | 0.325 | 0.001 | 0.312 | 0.032 |
| **Mean** | **0.130** | **-0.144** | **0.228** | **-0.138** | **0.292** | **-0.094** | **0.312** | **0.008** | **0.326** | **0.025** |
| **SD** | **0.015** | **0.011** | **0.031** | **0.023** | **0.011** | **0.017** | **0.011** | **0.010** | **0.022** | **0.014** |
| **Smooth** | **fz** | **6** | | **4** | | **3** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.251 | 0.322 | 0.274 | 0.362 | 0.154 | 0.367 | 0.104 | 0.387 | 0.114 | 0.385 |
| **2** | 0.237 | 0.324 | 0.276 | 0.368 | 0.128 | 0.373 | 0.106 | 0.369 | 0.088 | 0.389 |
| **3** | 0.247 | 0.303 | 0.280 | 0.373 | 0.172 | 0.376 | 0.106 | 0.377 | 0.081 | 0.372 |
| **4** | 0.251 | 0.310 | 0.207 | 0.376 | 0.181 | 0.368 | 0.103 | 0.374 | 0.118 | 0.388 |
| **5** | 0.239 | 0.305 | 0.213 | 0.385 | 0.165 | 0.381 | 0.086 | 0.377 | 0.118 | 0.371 |
| **6** | 0.247 | 0.308 | 0.237 | 0.367 | 0.140 | 0.365 | 0.113 | 0.374 | 0.084 | 0.375 |
| **7** | 0.248 | 0.352 | 0.228 | 0.374 | 0.152 | 0.374 | 0.112 | 0.376 | 0.097 | 0.377 |
| **8** | 0.249 | 0.349 | 0.245 | 0.375 | 0.128 | 0.371 | 0.117 | 0.366 | 0.100 | 0.381 |
| **9** | 0.254 | 0.331 | 0.230 | 0.371 | 0.183 | 0.376 | 0.104 | 0.374 | 0.097 | 0.376 |
| **10** | 0.305 | 0.342 | 0.234 | 0.373 | 0.146 | 0.385 | 0.108 | 0.379 | 0.092 | 0.383 |
| **Mean** | **0.253** | **0.325** | **0.242** | **0.372** | **0.155** | **0.373** | **0.106** | **0.375** | **0.099** | **0.380** |
| **SD** | **0.019** | **0.018** | **0.026** | **0.006** | **0.020** | **0.006** | **0.008** | **0.006** | **0.014** | **0.006** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.16
## Sub 14
## Knee XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.181 | -0.157 | 0.475 | -0.191 | 0.394 | -0.197 | 0.510 | -0.053 | 0.448 | 0.018 |
| **2** | 0.189 | -0.158 | 0.431 | -0.150 | 0.439 | -0.175 | 0.489 | -0.020 | 0.450 | -0.015 |
| **3** | 0.184 | -0.154 | 0.449 | -0.153 | 0.435 | -0.193 | 0.483 | -0.067 | 0.447 | 0.027 |
| **4** | 0.190 | -0.142 | 0.450 | -0.156 | 0.403 | -0.180 | 0.510 | -0.065 | 0.429 | 0.025 |
| **5** | 0.189 | -0.155 | 0.438 | -0.144 | 0.408 | -0.227 | 0.470 | -0.037 | 0.437 | 0.006 |
| **6** | 0.179 | -0.167 | 0.466 | -0.193 | 0.405 | -0.218 | 0.480 | -0.051 | 0.408 | -0.003 |
| **7** | 0.192 | -0.149 | 0.464 | -0.131 | 0.408 | -0.197 | 0.477 | -0.046 | 0.423 | 0.004 |
| **8** | 0.187 | -0.156 | 0.460 | -0.138 | 0.392 | -0.176 | 0.486 | -0.069 | 0.432 | 0.044 |
| **9** | 0.188 | -0.154 | 0.452 | -0.137 | 0.420 | -0.192 | 0.506 | -0.018 | 0.408 | 0.011 |
| **10** | 0.190 | -0.161 | 0.445 | -0.069 | 0.405 | -0.190 | 0.516 | -0.023 | 0.417 | 0.006 |
| **Mean** | **0.187** | **-0.155** | **0.453** | **-0.146** | **0.411** | **-0.195** | **0.493** | **-0.045** | **0.430** | **0.012** |
| **SD** | **0.004** | **0.007** | **0.013** | **0.034** | **0.016** | **0.017** | **0.016** | **0.020** | **0.016** | **0.017** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.320 | 0.384 | 0.022 | 0.561 | 0.259 | 0.524 | -0.037 | 0.606 | -0.124 | 0.562 |
| **2** | 0.313 | 0.379 | 0.035 | 0.539 | 0.202 | 0.542 | -0.059 | 0.598 | -0.083 | 0.567 |
| **3** | 0.321 | 0.386 | 0.035 | 0.557 | 0.203 | 0.536 | -0.051 | 0.588 | -0.053 | 0.555 |
| **4** | 0.322 | 0.385 | 0.056 | 0.531 | 0.188 | 0.529 | -0.047 | 0.601 | -0.152 | 0.540 |
| **5** | 0.324 | 0.385 | 0.031 | 0.539 | 0.249 | 0.533 | -0.082 | 0.594 | -0.097 | 0.524 |
| **6** | 0.317 | 0.389 | 0.053 | 0.518 | 0.246 | 0.538 | -0.030 | 0.582 | -0.114 | 0.522 |
| **7** | 0.319 | 0.385 | 0.033 | 0.547 | 0.228 | 0.533 | -0.048 | 0.584 | -0.126 | 0.528 |
| **8** | 0.322 | 0.386 | 0.012 | 0.560 | 0.233 | 0.534 | -0.037 | 0.593 | -0.158 | 0.518 |
| **9** | 0.325 | 0.381 | 0.003 | 0.484 | 0.235 | 0.530 | -0.030 | 0.597 | -0.184 | 0.511 |
| **10** | 0.315 | 0.389 | -0.004 | 0.507 | 0.202 | 0.509 | -0.076 | 0.593 | -0.141 | 0.507 |
| **Mean** | **0.320** | **0.385** | **0.028** | **0.534** | **0.225** | **0.531** | **-0.050** | **0.594** | **-0.123** | **0.533** |
| **SD** | **0.004** | **0.003** | **0.020** | **0.025** | **0.024** | **0.009** | **0.018** | **0.007** | **0.039** | **0.021** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.17
## Sub 15
## Knee XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.182 | -0.164 | 0.384 | 0.047 | 0.312 | -0.115 | 0.426 | 0.059 | 0.351 | -0.024 |
| **2** | 0.182 | -0.143 | 0.359 | 0.020 | 0.312 | -0.050 | 0.428 | 0.073 | 0.370 | -0.039 |
| **3** | 0.169 | -0.161 | 0.367 | 0.015 | 0.333 | -0.084 | 0.435 | 0.088 | 0.329 | -0.047 |
| **4** | 0.174 | -0.166 | 0.371 | 0.046 | 0.313 | -0.083 | 0.430 | 0.056 | 0.336 | -0.055 |
| **5** | 0.180 | -0.144 | 0.396 | 0.054 | 0.328 | -0.095 | 0.412 | 0.042 | 0.325 | -0.039 |
| **6** | 0.156 | -0.171 | 0.386 | 0.048 | 0.321 | -0.083 | 0.414 | 0.059 | 0.346 | -0.035 |
| **7** | 0.181 | -0.158 | 0.380 | 0.079 | 0.301 | -0.095 | 0.407 | 0.080 | 0.325 | -0.055 |
| **8** | 0.185 | -0.149 | 0.350 | 0.000 | 0.326 | -0.118 | 0.419 | 0.075 | 0.314 | -0.043 |
| **9** | 0.172 | -0.162 | 0.380 | 0.028 | 0.345 | -0.085 | 0.440 | 0.069 | 0.351 | -0.062 |
| **10** | 0.181 | -0.161 | 0.382 | 0.014 | 0.368 | -0.088 | 0.433 | 0.062 | 0.348 | -0.016 |
| **Mean** | **0.176** | **-0.158** | **0.376** | **0.035** | **0.326** | **-0.090** | **0.424** | **0.066** | **0.340** | **-0.042** |
| **SD** | **0.009** | **0.009** | **0.014** | **0.024** | **0.019** | **0.019** | **0.011** | **0.013** | **0.017** | **0.014** |
| **Smooth** | **fz** | **6** | | **4** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.330 | 0.392 | 0.246 | 0.518 | 0.331 | 0.508 | 0.136 | 0.488 | 0.272 | 0.507 |
| **2** | 0.332 | 0.397 | 0.247 | 0.508 | 0.295 | 0.519 | 0.155 | 0.494 | 0.256 | 0.511 |
| **3** | 0.332 | 0.405 | 0.242 | 0.508 | 0.296 | 0.515 | 0.131 | 0.486 | 0.290 | 0.501 |
| **4** | 0.336 | 0.394 | 0.228 | 0.500 | 0.333 | 0.519 | 0.138 | 0.503 | 0.289 | 0.499 |
| **5** | 0.342 | 0.405 | 0.213 | 0.508 | 0.320 | 0.520 | 0.177 | 0.507 | 0.301 | 0.515 |
| **6** | 0.344 | 0.408 | 0.223 | 0.504 | 0.308 | 0.518 | 0.152 | 0.502 | 0.284 | 0.500 |
| **7** | 0.335 | 0.399 | 0.251 | 0.497 | 0.321 | 0.512 | 0.157 | 0.508 | 0.295 | 0.505 |
| **8** | 0.343 | 0.395 | 0.267 | 0.506 | 0.298 | 0.523 | 0.150 | 0.507 | 0.310 | 0.504 |
| **9** | 0.338 | 0.408 | 0.238 | 0.513 | 0.295 | 0.523 | 0.130 | 0.503 | 0.266 | 0.510 |
| **10** | 0.330 | 0.397 | 0.236 | 0.507 | 0.268 | 0.515 | 0.146 | 0.506 | 0.272 | 0.506 |
| **Mean** | **0.336** | **0.400** | **0.239** | **0.507** | **0.307** | **0.517** | **0.147** | **0.500** | **0.284** | **0.506** |
| **SD** | **0.005** | **0.006** | **0.015** | **0.006** | **0.020** | **0.005** | **0.014** | **0.008** | **0.017** | **0.005** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.18
## Sub 16
## Knee XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.211 | -0.113 | 0.326 | -0.117 | 0.275 | -0.144 | 0.422 | 0.119 | 0.409 | 0.049 |
| 2 | 0.198 | -0.175 | 0.305 | -0.087 | 0.264 | -0.153 | 0.394 | 0.112 | 0.415 | 0.056 |
| 3 | 0.217 | -0.195 | 0.309 | -0.118 | 0.263 | -0.146 | 0.403 | 0.040 | 0.395 | 0.049 |
| 4 | 0.216 | -0.168 | 0.320 | -0.079 | 0.264 | -0.151 | 0.406 | 0.086 | 0.408 | 0.064 |
| 5 | 0.217 | -0.168 | 0.284 | -0.080 | 0.266 | -0.110 | 0.408 | 0.109 | 0.395 | 0.027 |
| 6 | 0.233 | -0.165 | 0.314 | -0.084 | 0.301 | -0.179 | 0.408 | 0.123 | 0.388 | 0.092 |
| 7 | 0.246 | -0.163 | 0.287 | -0.133 | 0.229 | -0.148 | 0.420 | 0.123 | 0.390 | 0.060 |
| 8 | 0.226 | -0.160 | 0.309 | -0.126 | 0.294 | -0.202 | 0.426 | 0.119 | 0.404 | 0.041 |
| 9 | 0.226 | -0.159 | 0.323 | -0.087 | 0.304 | -0.164 | 0.403 | 0.095 | 0.409 | 0.022 |
| 10 | 0.215 | -0.171 | 0.303 | -0.118 | 0.267 | -0.104 | 0.419 | 0.107 | 0.399 | 0.053 |
| **Mean** | **0.221** | **-0.164** | **0.308** | **-0.103** | **0.273** | **-0.150** | **0.411** | **0.103** | **0.401** | **0.051** |
| **SD** | **0.013** | **0.021** | **0.014** | **0.021** | **0.022** | **0.029** | **0.010** | **0.025** | **0.009** | **0.020** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.301 | 0.394 | 0.333 | 0.514 | 0.373 | 0.513 | 0.054 | 0.463 | 0.187 | 0.464 |
| 2 | 0.295 | 0.383 | 0.323 | 0.502 | 0.378 | 0.501 | 0.102 | 0.470 | 0.157 | 0.458 |
| 3 | 0.293 | 0.396 | 0.351 | 0.498 | 0.360 | 0.504 | 0.120 | 0.476 | 0.141 | 0.455 |
| 4 | 0.287 | 0.384 | 0.326 | 0.481 | 0.383 | 0.495 | 0.118 | 0.484 | 0.162 | 0.480 |
| 5 | 0.286 | 0.404 | 0.344 | 0.490 | 0.383 | 0.512 | 0.079 | 0.459 | 0.156 | 0.469 |
| 6 | 0.292 | 0.412 | 0.330 | 0.500 | 0.340 | 0.500 | 0.079 | 0.454 | 0.115 | 0.457 |
| 7 | 0.288 | 0.405 | 0.316 | 0.502 | 0.403 | 0.524 | 0.070 | 0.452 | 0.147 | 0.445 |
| 8 | 0.274 | 0.406 | 0.327 | 0.493 | 0.346 | 0.500 | 0.069 | 0.462 | 0.184 | 0.477 |
| 9 | 0.283 | 0.417 | 0.308 | 0.487 | 0.342 | 0.493 | 0.082 | 0.466 | 0.137 | 0.470 |
| 10 | 0.292 | 0.406 | 0.328 | 0.487 | 0.351 | 0.478 | 0.115 | 0.469 | 0.124 | 0.461 |
| **Mean** | **0.289** | **0.401** | **0.329** | **0.495** | **0.366** | **0.502** | **0.093** | **0.466** | **0.151** | **0.464** |
| **SD** | **0.007** | **0.011** | **0.012** | **0.010** | **0.021** | **0.013** | **0.021** | **0.010** | **0.023** | **0.011** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.19
# Sub 17
# Knee XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.218 | -0.148 | 0.358 | -0.087 | 0.340 | -0.087 | 0.397 | -0.008 | 0.370 | -0.081 |
| 2 | 0.215 | -0.155 | 0.350 | -0.071 | 0.328 | -0.059 | 0.392 | -0.026 | 0.368 | -0.095 |
| 3 | 0.213 | -0.157 | 0.372 | -0.068 | 0.322 | -0.070 | 0.400 | -0.014 | 0.376 | -0.110 |
| 4 | 0.209 | -0.155 | 0.362 | -0.037 | 0.326 | -0.043 | 0.394 | 0.014 | 0.373 | -0.101 |
| 5 | 0.215 | -0.151 | 0.347 | -0.052 | 0.323 | -0.085 | 0.391 | 0.029 | 0.361 | -0.091 |
| 6 | 0.205 | -0.159 | 0.350 | -0.054 | 0.321 | -0.059 | 0.384 | -0.010 | 0.357 | -0.082 |
| 7 | 0.216 | -0.159 | 0.349 | -0.082 | 0.326 | -0.099 | 0.386 | 0.002 | 0.361 | -0.098 |
| 8 | 0.206 | -0.165 | 0.349 | -0.073 | 0.321 | -0.105 | 0.399 | 0.016 | 0.362 | -0.110 |
| 9 | 0.217 | -0.149 | 0.347 | -0.071 | 0.332 | -0.089 | 0.397 | 0.033 | 0.375 | -0.095 |
| 10 | 0.211 | -0.168 | 0.369 | -0.075 | 0.321 | -0.080 | 0.386 | 0.034 | 0.378 | -0.084 |
| **Mean** | **0.213** | **-0.157** | **0.355** | **-0.067** | **0.326** | **-0.078** | **0.393** | **0.007** | **0.368** | **-0.095** |
| **SD** | **0.005** | **0.007** | **0.009** | **0.015** | **0.006** | **0.020** | **0.006** | **0.021** | **0.007** | **0.011** |
| **Smooth** | **fz** | **5** | | **3** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.261 | 0.367 | 0.208 | 0.462 | 0.229 | 0.459 | 0.130 | 0.440 | 0.160 | 0.453 |
| 2 | 0.270 | 0.375 | 0.196 | 0.461 | 0.234 | 0.448 | 0.107 | 0.456 | 0.164 | 0.456 |
| 3 | 0.264 | 0.380 | 0.166 | 0.453 | 0.259 | 0.445 | 0.090 | 0.451 | 0.161 | 0.455 |
| 4 | 0.272 | 0.378 | 0.183 | 0.456 | 0.249 | 0.449 | 0.091 | 0.450 | 0.163 | 0.454 |
| 5 | 0.266 | 0.376 | 0.199 | 0.454 | 0.259 | 0.452 | 0.106 | 0.453 | 0.167 | 0.458 |
| 6 | 0.274 | 0.364 | 0.210 | 0.457 | 0.263 | 0.449 | 0.117 | 0.462 | 0.190 | 0.448 |
| 7 | 0.268 | 0.376 | 0.204 | 0.456 | 0.244 | 0.457 | 0.104 | 0.460 | 0.181 | 0.456 |
| 8 | 0.272 | 0.370 | 0.210 | 0.455 | 0.236 | 0.451 | 0.096 | 0.461 | 0.188 | 0.451 |
| 9 | 0.262 | 0.375 | 0.209 | 0.457 | 0.228 | 0.447 | 0.084 | 0.457 | 0.147 | 0.447 |
| 10 | 0.268 | 0.369 | 0.192 | 0.458 | 0.247 | 0.448 | 0.101 | 0.454 | 0.164 | 0.454 |
| **Mean** | **0.268** | **0.373** | **0.198** | **0.457** | **0.245** | **0.451** | **0.103** | **0.454** | **0.169** | **0.449** |
| **SD** | **0.004** | **0.005** | **0.014** | **0.003** | **0.013** | **0.004** | **0.014** | **0.007** | **0.014** | **0.004** |
| **Smooth** | **fz** | **6** | | **4** | | **4** | | **4** | | **4** |

## TABLE E.20
## Sub 18
## Knee XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.153 | -0.113 | 0.315 | -0.180 | 0.224 | -0.151 | 0.346 | -0.002 | 0.374 | 0.103 |
| **2** | 0.128 | -0.113 | 0.320 | -0.114 | 0.299 | -0.126 | 0.346 | -0.002 | 0.361 | 0.074 |
| **3** | 0.143 | -0.122 | 0.286 | -0.158 | 0.231 | -0.134 | 0.351 | -0.022 | 0.345 | 0.068 |
| **4** | 0.139 | -0.126 | 0.265 | -0.128 | 0.288 | -0.152 | 0.365 | 0.043 | 0.333 | 0.048 |
| **5** | 0.126 | -0.120 | 0.251 | -0.245 | 0.256 | -0.058 | 0.352 | 0.031 | 0.372 | 0.056 |
| **6** | 0.142 | -0.119 | 0.264 | -0.218 | 0.254 | -0.221 | 0.357 | 0.040 | 0.361 | 0.007 |
| **7** | 0.158 | -0.118 | 0.246 | -0.203 | 0.271 | -0.152 | 0.374 | 0.056 | 0.383 | 0.041 |
| **8** | 0.154 | -0.110 | 0.307 | -0.161 | 0.247 | -0.150 | 0.365 | 0.059 | 0.366 | 0.096 |
| **9** | 0.151 | -0.111 | 0.288 | -0.213 | 0.277 | -0.138 | 0.370 | 0.065 | 0.350 | 0.060 |
| **10** | 0.143 | -0.112 | 0.302 | -0.161 | 0.244 | -0.135 | 0.371 | 0.064 | 0.388 | 0.057 |
| **Mean** | **0.144** | **-0.116** | **0.284** | **-0.178** | **0.259** | **-0.142** | **0.360** | **0.033** | **0.363** | **0.061** |
| **SD** | **0.011** | **0.005** | **0.027** | **0.042** | **0.024** | **0.039** | **0.011** | **0.031** | **0.017** | **0.027** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.339 | 0.385 | 0.263 | 0.452 | 0.369 | 0.464 | 0.170 | 0.447 | 0.117 | 0.413 |
| **2** | 0.350 | 0.391 | 0.249 | 0.453 | 0.315 | 0.467 | 0.179 | 0.448 | 0.143 | 0.427 |
| **3** | 0.347 | 0.390 | 0.296 | 0.458 | 0.372 | 0.469 | 0.185 | 0.438 | 0.177 | 0.427 |
| **4** | 0.342 | 0.392 | 0.312 | 0.454 | 0.298 | 0.464 | 0.159 | 0.449 | 0.205 | 0.428 |
| **5** | 0.348 | 0.392 | 0.320 | 0.448 | 0.323 | 0.466 | 0.182 | 0.444 | 0.153 | 0.425 |
| **6** | 0.342 | 0.421 | 0.324 | 0.454 | 0.342 | 0.460 | 0.167 | 0.446 | 0.165 | 0.436 |
| **7** | 0.328 | 0.395 | 0.359 | 0.455 | 0.322 | 0.463 | 0.163 | 0.447 | 0.130 | 0.426 |
| **8** | 0.328 | 0.392 | 0.301 | 0.459 | 0.345 | 0.459 | 0.141 | 0.443 | 0.146 | 0.425 |
| **9** | 0.332 | 0.391 | 0.295 | 0.453 | 0.320 | 0.455 | 0.148 | 0.439 | 0.167 | 0.426 |
| **10** | 0.337 | 0.395 | 0.289 | 0.448 | 0.373 | 0.454 | 0.127 | 0.437 | 0.115 | 0.422 |
| **Mean** | **0.339** | **0.394** | **0.301** | **0.453** | **0.338** | **0.462** | **0.162** | **0.444** | **0.152** | **0.426** |
| **SD** | **0.008** | **0.010** | **0.031** | **0.004** | **0.027** | **0.005** | **0.019** | **0.004** | **0.028** | **0.006** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

**TABLE E.21**
**Sub 19**
**Knee XY Displacement Difference Relative to Hip**

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.107 | -0.115 | 0.312 | -0.015 | 0.147 | -0.205 | 0.353 | 0.089 | 0.351 | 0.071 |
| 2 | 0.108 | -0.123 | 0.297 | -0.069 | 0.196 | -0.172 | 0.359 | 0.054 | 0.345 | 0.086 |
| 3 | 0.104 | -0.099 | 0.320 | -0.040 | 0.179 | -0.192 | 0.365 | 0.099 | 0.351 | 0.080 |
| 4 | 0.121 | -0.085 | 0.278 | -0.022 | 0.193 | -0.161 | 0.366 | 0.082 | 0.331 | 0.062 |
| 5 | 0.097 | -0.121 | 0.281 | -0.036 | 0.156 | -0.183 | 0.357 | 0.036 | 0.348 | 0.052 |
| 6 | 0.122 | -0.106 | 0.267 | -0.061 | 0.190 | -0.179 | 0.349 | 0.082 | 0.334 | 0.070 |
| 7 | 0.099 | -0.089 | 0.304 | -0.082 | 0.172 | -0.161 | 0.366 | 0.056 | 0.347 | 0.068 |
| 8 | 0.106 | -0.096 | 0.279 | -0.056 | 0.160 | -0.172 | 0.352 | 0.047 | 0.352 | 0.085 |
| 9 | 0.092 | -0.110 | 0.271 | -0.074 | 0.199 | -0.155 | 0.364 | 0.053 | 0.357 | 0.091 |
| 10 | 0.091 | -0.104 | 0.256 | -0.073 | 0.251 | -0.175 | 0.361 | 0.033 | 0.340 | 0.091 |
| **Mean** | **0.105** | **-0.105** | **0.287** | **-0.053** | **0.184** | **-0.176** | **0.359** | **0.063** | **0.346** | **0.076** |
| **SD** | **0.011** | **0.013** | **0.021** | **0.023** | **0.030** | **0.015** | **0.006** | **0.023** | **0.008** | **0.013** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.214 | 0.250 | 0.193 | 0.415 | 0.336 | 0.419 | 0.012 | 0.409 | 0.121 | 0.409 |
| 2 | 0.200 | 0.279 | 0.219 | 0.412 | 0.323 | 0.421 | 0.002 | 0.415 | 0.108 | 0.409 |
| 3 | 0.234 | 0.268 | 0.187 | 0.414 | 0.328 | 0.410 | -0.020 | 0.406 | 0.122 | 0.413 |
| 4 | 0.207 | 0.276 | 0.210 | 0.421 | 0.327 | 0.406 | 0.019 | 0.410 | 0.141 | 0.410 |
| 5 | 0.203 | 0.262 | 0.246 | 0.410 | 0.336 | 0.411 | 0.029 | 0.417 | 0.125 | 0.406 |
| 6 | 0.228 | 0.310 | 0.259 | 0.408 | 0.324 | 0.416 | 0.023 | 0.419 | 0.136 | 0.406 |
| 7 | 0.237 | 0.252 | 0.216 | 0.416 | 0.349 | 0.411 | 0.055 | 0.414 | 0.109 | 0.403 |
| 8 | 0.203 | 0.284 | 0.205 | 0.413 | 0.337 | 0.405 | 0.060 | 0.426 | 0.101 | 0.401 |
| 9 | 0.238 | 0.269 | 0.234 | 0.411 | 0.316 | 0.411 | 0.067 | 0.412 | 0.087 | 0.398 |
| 10 | 0.212 | 0.240 | 0.274 | 0.411 | 0.282 | 0.419 | 0.067 | 0.424 | 0.062 | 0.404 |
| **Mean** | **0.218** | **0.269** | **0.224** | **0.413** | **0.326** | **0.413** | **0.031** | **0.415** | **0.111** | **0.406** |
| **SD** | **0.015** | **0.020** | **0.028** | **0.004** | **0.018** | **0.006** | **0.030** | **0.006** | **0.024** | **0.005** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.22
## Sub 20
## Knee XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stride | X Min | X Max | X Min | X Max | X Min | X Max | X Min | X Max | X Min | X Max |
| 1 | 0.200 | -0.193 | 0.263 | -0.145 | 0.311 | -0.049 | 0.347 | 0.000 | 0.269 | -0.128 |
| 2 | 0.208 | -0.199 | 0.312 | -0.135 | 0.312 | -0.036 | 0.337 | -0.032 | 0.235 | -0.127 |
| 3 | 0.199 | -0.188 | 0.278 | -0.146 | 0.324 | -0.063 | 0.318 | -0.028 | 0.270 | -0.099 |
| 4 | 0.220 | -0.199 | 0.258 | -0.138 | 0.300 | -0.034 | 0.324 | -0.028 | 0.270 | -0.100 |
| 5 | 0.204 | -0.200 | 0.252 | -0.166 | 0.306 | -0.049 | 0.326 | -0.030 | 0.276 | -0.092 |
| 6 | 0.201 | -0.205 | 0.268 | -0.174 | 0.298 | -0.066 | 0.329 | -0.042 | 0.273 | -0.104 |
| 7 | 0.209 | -0.202 | 0.267 | -0.152 | 0.329 | -0.081 | 0.320 | -0.028 | 0.278 | -0.075 |
| 8 | 0.195 | -0.205 | 0.271 | -0.163 | 0.302 | -0.029 | 0.313 | -0.043 | 0.274 | -0.088 |
| 9 | 0.206 | -0.197 | 0.258 | -0.152 | 0.300 | -0.023 | 0.336 | -0.049 | 0.264 | -0.106 |
| 10 | 0.212 | -0.204 | 0.273 | -0.172 | 0.296 | -0.050 | 0.313 | -0.054 | 0.267 | -0.093 |
| **Mean** | **0.205** | **-0.199** | **0.270** | **-0.154** | **0.308** | **-0.048** | **0.326** | **-0.033** | **0.268** | **-0.101** |
| **SD** | **0.007** | **0.005** | **0.017** | **0.014** | **0.011** | **0.018** | **0.011** | **0.015** | **0.012** | **0.016** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stride | Y Min | Y Max | Y Min | Y Max | Y Min | Y Max | Y Min | Y Max | Y Min | Y Max |
| 1 | 0.374 | 0.435 | 0.297 | 0.468 | 0.267 | 0.466 | 0.194 | 0.450 | 0.319 | 0.450 |
| 2 | 0.364 | 0.436 | 0.283 | 0.476 | 0.252 | 0.475 | 0.192 | 0.448 | 0.334 | 0.458 |
| 3 | 0.369 | 0.444 | 0.296 | 0.469 | 0.243 | 0.474 | 0.226 | 0.456 | 0.306 | 0.458 |
| 4 | 0.350 | 0.437 | 0.314 | 0.472 | 0.279 | 0.472 | 0.223 | 0.455 | 0.296 | 0.460 |
| 5 | 0.370 | 0.441 | 0.314 | 0.473 | 0.265 | 0.479 | 0.214 | 0.453 | 0.280 | 0.458 |
| 6 | 0.363 | 0.447 | 0.304 | 0.472 | 0.275 | 0.475 | 0.206 | 0.450 | 0.282 | 0.458 |
| 7 | 0.366 | 0.436 | 0.299 | 0.471 | 0.225 | 0.473 | 0.216 | 0.453 | 0.274 | 0.466 |
| 8 | 0.366 | 0.439 | 0.294 | 0.478 | 0.242 | 0.476 | 0.236 | 0.450 | 0.300 | 0.465 |
| 9 | 0.362 | 0.438 | 0.311 | 0.479 | 0.252 | 0.475 | 0.206 | 0.454 | 0.302 | 0.464 |
| 10 | 0.354 | 0.447 | 0.302 | 0.466 | 0.260 | 0.477 | 0.231 | 0.450 | 0.301 | 0.463 |
| **Mean** | **0.364** | **0.440** | **0.301** | **0.472** | **0.256** | **0.474** | **0.214** | **0.452** | **0.299** | **0.460** |
| **SD** | **0.007** | **0.005** | **0.010** | **0.004** | **0.017** | **0.003** | **0.015** | **0.003** | **0.018** | **0.005** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.23
## Sub 1
## Ankle XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | -0.126 | 0.413 | -0.179 | 0.603 | -0.192 | 0.517 | -0.040 | 0.172 | -0.090 | 0.207 |
| **2** | -0.148 | 0.405 | -0.096 | 0.607 | -0.266 | 0.547 | -0.084 | 0.162 | -0.066 | 0.220 |
| **3** | -0.163 | 0.399 | -0.123 | 0.629 | -0.267 | 0.522 | -0.015 | 0.194 | -0.063 | 0.218 |
| **4** | -0.159 | 0.401 | -0.075 | 0.659 | -0.235 | 0.490 | 0.005 | 0.195 | -0.071 | 0.180 |
| **5** | -0.151 | 0.399 | -0.172 | 0.655 | -0.173 | 0.532 | -0.006 | 0.191 | -0.038 | 0.157 |
| **6** | -0.158 | 0.430 | -0.078 | 0.660 | -0.209 | 0.501 | -0.055 | 0.141 | -0.070 | 0.176 |
| **7** | -0.141 | 0.404 | -0.186 | 0.629 | -0.212 | 0.493 | -0.018 | 0.181 | -0.087 | 0.189 |
| **8** | -0.148 | 0.419 | -0.111 | 0.655 | -0.214 | 0.509 | -0.013 | 0.178 | -0.063 | 0.152 |
| **9** | -0.138 | 0.411 | -0.176 | 0.605 | -0.182 | 0.501 | 0.017 | 0.230 | -0.089 | 0.173 |
| **10** | -0.148 | 0.412 | -0.136 | 0.672 | -0.205 | 0.549 | -0.067 | 0.142 | -0.038 | 0.182 |
| **Mean** | **-0.148** | **0.409** | **-0.133** | **0.637** | **-0.216** | **0.516** | **-0.028** | **0.179** | **-0.068** | **0.185** |
| **SD** | **0.011** | **0.010** | **0.043** | **0.026** | **0.032** | **0.021** | **0.03** | **0.03** | **0.02** | **0.02** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.529 | 0.740 | 0.202 | 1.030 | 0.417 | 0.944 | 0.378 | 1.034 | 0.405 | 1.025 |
| **2** | 0.511 | 0.765 | 0.219 | 1.049 | 0.381 | 0.952 | 0.337 | 1.039 | 0.415 | 1.014 |
| **3** | 0.520 | 0.774 | 0.262 | 1.031 | 0.426 | 0.944 | 0.366 | 1.031 | 0.381 | 1.002 |
| **4** | 0.523 | 0.777 | 0.271 | 1.051 | 0.434 | 0.965 | 0.376 | 1.032 | 0.407 | 1.010 |
| **5** | 0.515 | 0.743 | 0.251 | 1.033 | 0.427 | 0.940 | 0.382 | 1.023 | 0.396 | 0.999 |
| **6** | 0.523 | 0.753 | 0.273 | 1.041 | 0.410 | 0.947 | 0.403 | 1.035 | 0.399 | 1.003 |
| **7** | 0.519 | 0.787 | 0.282 | 1.053 | 0.441 | 0.955 | 0.392 | 1.034 | 0.410 | 1.012 |
| **8** | 0.699 | 0.773 | 0.293 | 1.038 | 0.393 | 0.957 | 0.334 | 1.043 | 0.413 | 1.007 |
| **9** | 0.508 | 0.775 | 0.219 | 1.050 | 0.317 | 0.963 | 0.390 | 1.046 | 0.416 | 1.025 |
| **10** | 0.512 | 0.750 | 0.234 | 1.040 | 0.399 | 0.920 | 0.370 | 1.031 | 0.385 | 1.016 |
| **Mean** | **0.536** | **0.764** | **0.251** | **1.042** | **0.405** | **0.949** | **0.373** | **1.035** | **0.403** | **1.011** |
| **SD** | **0.058** | **0.016** | **0.031** | **0.009** | **0.036** | **0.013** | **0.022** | **0.007** | **0.012** | **0.009** |
| **Smooth** | **fz** | **4** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.24
## Sub 2
## Ankle XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | -0.175 | 0.476 | 0.065 | 0.585 | 0.018 | 0.601 | -0.074 | 0.215 | -0.019 | 0.238 |
| **2** | -0.189 | 0.495 | 0.164 | 0.583 | -0.006 | 0.580 | -0.124 | 0.248 | -0.088 | 0.235 |
| **3** | -0.187 | 0.491 | 0.195 | 0.612 | 0.043 | 0.562 | -0.106 | 0.251 | -0.050 | 0.240 |
| **4** | -0.196 | 0.473 | 0.187 | 0.516 | 0.033 | 0.601 | -0.090 | 0.246 | -0.056 | 0.246 |
| **5** | -0.181 | 0.490 | 0.226 | 0.588 | 0.086 | 0.600 | -0.139 | 0.237 | -0.052 | 0.248 |
| **6** | -0.172 | 0.491 | 0.268 | 0.510 | 0.081 | 0.611 | -0.166 | 0.240 | 0.028 | 0.204 |
| **7** | -0.166 | 0.481 | 0.246 | 0.646 | 0.060 | 0.527 | -0.141 | 0.273 | -0.058 | 0.220 |
| **8** | -0.150 | 0.484 | 0.257 | 0.709 | -0.012 | 0.616 | -0.109 | 0.257 | 0.023 | 0.222 |
| **9** | -0.166 | 0.498 | 0.220 | 0.620 | 0.065 | 0.574 | -0.105 | 0.290 | -0.058 | 0.214 |
| **10** | -0.176 | 0.477 | 0.261 | 0.650 | 0.091 | 0.617 | -0.113 | 0.240 | -0.080 | 0.239 |
| **Mean** | **-0.176** | **0.486** | **0.209** | **0.602** | **0.046** | **0.589** | **-0.117** | **0.250** | **-0.041** | **0.231** |
| **SD** | **0.013** | **0.009** | **0.061** | **0.060** | **0.037** | **0.028** | **0.027** | **0.021** | **0.040** | **0.015** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **5** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.507 | 0.762 | 0.265 | 0.968 | 0.377 | 0.930 | 0.304 | 0.972 | 0.405 | 0.964 |
| **2** | 0.490 | 0.762 | 0.253 | 0.954 | 0.389 | 0.946 | 0.306 | 0.955 | 0.400 | 0.948 |
| **3** | 0.504 | 0.757 | 0.211 | 0.933 | 0.362 | 0.933 | 0.303 | 0.937 | 0.338 | 0.950 |
| **4** | 0.494 | 0.749 | 0.242 | 0.941 | 0.359 | 0.940 | 0.294 | 0.950 | 0.375 | 0.945 |
| **5** | 0.484 | 0.735 | 0.232 | 0.934 | 0.372 | 0.940 | 0.370 | 0.936 | 0.391 | 0.950 |
| **6** | 0.499 | 0.771 | 0.245 | 0.921 | 0.373 | 0.944 | 0.352 | 0.944 | 0.369 | 0.965 |
| **7** | 0.485 | 0.745 | 0.215 | 0.937 | 0.370 | 0.934 | 0.328 | 0.948 | 0.374 | 0.968 |
| **8** | 0.496 | 0.739 | 0.236 | 0.945 | 0.366 | 0.934 | 0.352 | 0.944 | 0.377 | 0.966 |
| **9** | 0.473 | 0.736 | 0.277 | 0.938 | 0.391 | 0.934 | 0.324 | 0.961 | 0.422 | 0.957 |
| **10** | 0.487 | 0.759 | 0.296 | 0.915 | 0.356 | 0.947 | 0.310 | 0.944 | 0.408 | 0.961 |
| **Mean** | **0.492** | **0.752** | **0.247** | **0.939** | **0.372** | **0.938** | **0.324** | **0.949** | **0.386** | **0.957** |
| **SD** | **0.010** | **0.012** | **0.027** | **0.015** | **0.012** | **0.006** | **0.026** | **0.011** | **0.024** | **0.009** |
| **Smooth** | **fz** | **4** | | **4** | | **4** | | **4** | | **5** |

# TABLE E.25
## Sub 3
## Ankle XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -0.235 | 0.458 | -0.052 | 0.366 | -0.186 | 0.241 | -0.071 | 0.092 | -0.061 | 0.049 |
| 2 | -0.202 | 0.456 | -0.079 | 0.351 | -0.088 | 0.275 | -0.082 | 0.146 | -0.092 | 0.040 |
| 3 | -0.220 | 0.452 | -0.009 | 0.292 | -0.144 | 0.291 | -0.098 | 0.120 | -0.098 | 0.051 |
| 4 | -0.214 | 0.468 | -0.013 | 0.349 | -0.113 | 0.348 | -0.070 | 0.081 | -0.107 | 0.060 |
| 5 | -0.212 | 0.462 | 0.040 | 0.316 | -0.206 | 0.364 | -0.122 | 0.127 | -0.155 | 0.034 |
| 6 | -0.219 | 0.460 | -0.068 | 0.307 | -0.199 | 0.282 | -0.135 | 0.097 | -0.101 | 0.008 |
| 7 | -0.211 | 0.454 | -0.013 | 0.356 | -0.205 | 0.349 | -0.078 | 0.080 | -0.085 | 0.035 |
| 8 | -0.216 | 0.453 | -0.042 | 0.369 | -0.160 | 0.358 | -0.031 | 0.060 | -0.152 | 0.081 |
| 9 | -0.222 | 0.449 | -0.070 | 0.334 | -0.220 | 0.309 | -0.026 | 0.148 | -0.071 | 0.009 |
| 10 | -0.222 | 0.452 | -0.007 | 0.361 | -0.196 | 0.298 | -0.098 | 0.128 | -0.085 | 0.092 |
| **Mean** | **-0.217** | **0.456** | **-0.031** | **0.340** | **-0.172** | **0.312** | **-0.081** | **0.108** | **-0.101** | **0.046** |
| **SD** | **0.009** | **0.006** | **0.037** | **0.027** | **0.044** | **0.041** | **0.035** | **0.030** | **0.031** | **0.027** |
| **Smooth** | **fz** | **6** | | **4** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.486 | 0.727 | 0.215 | 0.802 | 0.286 | 0.813 | 0.310 | 0.773 | 0.277 | 0.763 |
| 2 | 0.466 | 0.735 | 0.228 | 0.819 | 0.256 | 0.825 | 0.298 | 0.770 | 0.279 | 0.779 |
| 3 | 0.469 | 0.729 | 0.208 | 0.817 | 0.269 | 0.815 | 0.290 | 0.795 | 0.265 | 0.768 |
| 4 | 0.454 | 0.727 | 0.192 | 0.813 | 0.257 | 0.819 | 0.312 | 0.788 | 0.280 | 0.780 |
| 5 | 0.470 | 0.722 | 0.222 | 0.816 | 0.246 | 0.809 | 0.300 | 0.766 | 0.273 | 0.784 |
| 6 | 0.461 | 0.719 | 0.211 | 0.811 | 0.279 | 0.807 | 0.294 | 0.792 | 0.272 | 0.779 |
| 7 | 0.450 | 0.715 | 0.222 | 0.822 | 0.262 | 0.819 | 0.295 | 0.792 | 0.263 | 0.776 |
| 8 | 0.449 | 0.729 | 0.205 | 0.832 | 0.253 | 0.811 | 0.292 | 0.782 | 0.268 | 0.767 |
| 9 | 0.459 | 0.728 | 0.203 | 0.822 | 0.259 | 0.810 | 0.304 | 0.792 | 0.265 | 0.780 |
| 10 | 0.461 | 0.718 | 0.229 | 0.820 | 0.239 | 0.809 | 0.304 | 0.778 | 0.264 | 0.786 |
| **Mean** | **0.463** | **0.725** | **0.214** | **0.817** | **0.261** | **0.814** | **0.300** | **0.783** | **0.271** | **0.776** |
| **SD** | **0.011** | **0.006** | **0.012** | **0.008** | **0.014** | **0.006** | **0.007** | **0.011** | **0.006** | **0.008** |
| **Smooth** | **fz** | **4** | | **4** | | **5** | | **4** | | **4** |

# TABLE E.26
## Sub 4
## Ankle XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | -0.370 | 0.465 | 0.281 | 0.529 | 0.194 | 0.454 | 0.103 | 0.415 | 0.179 | 0.488 |
| **2** | -0.136 | 0.457 | 0.173 | 0.545 | 0.195 | 0.481 | 0.110 | 0.436 | 0.193 | 0.389 |
| **3** | -0.142 | 0.456 | 0.119 | 0.653 | 0.219 | 0.548 | 0.099 | 0.445 | 0.183 | 0.430 |
| **4** | -0.140 | 0.465 | 0.103 | 0.588 | 0.237 | 0.555 | 0.086 | 0.400 | 0.220 | 0.433 |
| **5** | -0.128 | 0.454 | 0.036 | 0.516 | 0.194 | 0.559 | 0.111 | 0.421 | 0.194 | 0.510 |
| **6** | -0.132 | 0.457 | 0.001 | 0.429 | 0.069 | 0.497 | 0.111 | 0.434 | 0.165 | 0.487 |
| **7** | -0.130 | 0.481 | 0.025 | 0.445 | 0.160 | 0.507 | 0.108 | 0.410 | 0.136 | 0.343 |
| **8** | -0.158 | 0.469 | 0.116 | 0.489 | 0.131 | 0.463 | 0.125 | 0.389 | 0.108 | 0.331 |
| **9** | -0.134 | 0.476 | 0.088 | 0.573 | 0.152 | 0.456 | 0.119 | 0.445 | 0.056 | 0.351 |
| **10** | -0.120 | 0.470 | 0.145 | 0.584 | 0.172 | 0.422 | 0.120 | 0.426 | 0.090 | 0.319 |
| **Mean** | **-0.159** | **0.465** | **0.109** | **0.535** | **0.172** | **0.494** | **0.109** | **0.422** | **0.152** | **0.408** |
| **SD** | **0.075** | **0.009** | **0.081** | **0.069** | **0.048** | **0.048** | **0.011** | **0.019** | **0.053** | **0.071** |
| **Smooth** | **fz** | **5** | | **4** | | **5** | | **4** | | **5** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.308 | 0.694 | 0.258 | 0.936 | 0.352 | 0.966 | 0.302 | 0.918 | 0.332 | 0.888 |
| **2** | 0.332 | 0.694 | 0.281 | 0.955 | 0.347 | 0.957 | 0.289 | 0.938 | 0.333 | 0.909 |
| **3** | 0.334 | 0.688 | 0.282 | 0.931 | 0.336 | 0.955 | 0.305 | 0.916 | 0.334 | 0.891 |
| **4** | 0.338 | 0.704 | 0.322 | 0.952 | 0.312 | 0.948 | 0.321 | 0.923 | 0.335 | 0.895 |
| **5** | 0.316 | 0.692 | 0.339 | 0.973 | 0.294 | 0.929 | 0.310 | 0.915 | 0.339 | 0.866 |
| **6** | 0.346 | 0.703 | 0.399 | 0.952 | 0.328 | 0.955 | 0.304 | 0.902 | 0.349 | 0.908 |
| **7** | 0.319 | 0.700 | 0.297 | 0.942 | 0.331 | 0.979 | 0.320 | 0.924 | 0.334 | 0.918 |
| **8** | 0.332 | 0.696 | 0.281 | 0.970 | 0.334 | 0.951 | 0.298 | 0.926 | 0.351 | 0.930 |
| **9** | 0.311 | 0.690 | 0.269 | 0.955 | 0.350 | 0.967 | 0.326 | 0.894 | 0.369 | 0.927 |
| **10** | 0.331 | 0.703 | 0.256 | 0.922 | 0.317 | 0.962 | 0.312 | 0.907 | 0.375 | 0.927 |
| **Mean** | **0.327** | **0.696** | **0.298** | **0.949** | **0.330** | **0.957** | **0.309** | **0.916** | **0.345** | **0.906** |
| **SD** | **0.012** | **0.006** | **0.044** | **0.016** | **0.018** | **0.013** | **0.011** | **0.013** | **0.016** | **0.021** |
| **Smooth** | **fz** | **4** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.27
## Sub 5
## Ankle XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -0.179 | 0.472 | -0.745 | 0.233 | -0.489 | 0.426 | -0.042 | 0.188 | -0.153 | 0.138 |
| 2 | -0.169 | 0.478 | -0.784 | 0.220 | -0.647 | 0.400 | -0.063 | 0.200 | -0.146 | 0.131 |
| 3 | -0.173 | 0.486 | -0.799 | 0.223 | -0.582 | 0.421 | -0.040 | 0.179 | -0.182 | 0.102 |
| 4 | -0.175 | 0.457 | -0.796 | 0.229 | -0.631 | 0.467 | -0.041 | 0.145 | -0.109 | 0.170 |
| 5 | -0.170 | 0.481 | -0.811 | 0.236 | -0.569 | 0.519 | -0.044 | 0.233 | -0.104 | 0.159 |
| 6 | -0.184 | 0.464 | -0.812 | 0.188 | -0.594 | 0.470 | -0.027 | 0.159 | -0.121 | 0.135 |
| 7 | -0.190 | 0.462 | -0.749 | 0.362 | -0.649 | 0.475 | -0.024 | 0.225 | -0.132 | 0.163 |
| 8 | -0.181 | 0.479 | -0.778 | 0.210 | -0.550 | 0.460 | -0.018 | 0.249 | -0.124 | 0.173 |
| 9 | -0.183 | 0.464 | -0.855 | 0.219 | -0.679 | 0.438 | -0.028 | 0.275 | -0.233 | 0.093 |
| 10 | -0.170 | 0.480 | -0.815 | 0.243 | -0.572 | 0.468 | -0.085 | 0.237 | -0.139 | 0.148 |
| **Mean** | **-0.177** | **0.472** | **-0.794** | **0.236** | **-0.596** | **0.454** | **-0.041** | **0.209** | **-0.144** | **0.141** |
| **SD** | **0.007** | **0.010** | **0.033** | **0.047** | **0.056** | **0.034** | **0.020** | **0.042** | **0.039** | **0.027** |
| **Smooth** | **fz** | **5** | | **3** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.399 | 0.750 | 0.592 | 1.121 | 0.664 | 1.177 | 0.282 | 1.166 | 0.339 | 1.162 |
| 2 | 0.391 | 0.759 | 0.668 | 1.100 | 0.658 | 1.157 | 0.330 | 1.172 | 0.328 | 1.143 |
| 3 | 0.384 | 0.764 | 0.638 | 1.084 | 0.647 | 1.152 | 0.303 | 1.176 | 0.339 | 1.167 |
| 4 | 0.404 | 0.764 | 0.633 | 1.116 | 0.583 | 1.179 | 0.286 | 1.199 | 0.330 | 1.147 |
| 5 | 0.401 | 0.759 | 0.710 | 1.116 | 0.640 | 1.168 | 0.290 | 1.155 | 0.303 | 1.146 |
| 6 | 0.394 | 0.757 | 0.640 | 1.150 | 0.620 | 1.164 | 0.320 | 1.174 | 0.341 | 1.138 |
| 7 | 0.386 | 0.765 | 0.697 | 1.124 | 0.655 | 1.151 | 0.313 | 1.168 | 0.324 | 1.148 |
| 8 | 0.389 | 0.752 | 0.588 | 1.114 | 0.598 | 1.173 | 0.285 | 1.167 | 0.323 | 1.150 |
| 9 | 0.386 | 0.758 | 0.660 | 1.141 | 0.672 | 1.153 | 0.296 | 1.188 | 0.355 | 1.141 |
| 10 | 0.372 | 0.768 | 0.650 | 1.142 | 0.551 | 1.164 | 0.300 | 1.205 | 0.321 | 1.130 |
| **Mean** | **0.391** | **0.760** | **0.648** | **1.121** | **0.629** | **1.164** | **0.301** | **1.177** | **0.330** | **1.147** |
| **SD** | **0.009** | **0.006** | **0.039** | **0.020** | **0.040** | **0.010** | **0.016** | **0.016** | **0.014** | **0.011** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.28
## Sub 6
## Ankle XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -0.174 | 0.417 | -0.315 | 0.362 | -0.204 | 0.593 | -0.020 | 0.216 | -0.020 | 0.312 |
| 2 | -0.198 | 0.406 | -0.342 | 0.367 | -0.131 | 0.549 | -0.039 | 0.191 | 0.044 | 0.332 |
| 3 | -0.196 | 0.403 | -0.347 | 0.434 | -0.087 | 0.578 | -0.085 | 0.209 | -0.027 | 0.325 |
| 4 | -0.222 | 0.394 | -0.171 | 0.469 | -0.080 | 0.626 | -0.077 | 0.239 | -0.025 | 0.285 |
| 5 | -0.198 | 0.402 | -0.197 | 0.441 | -0.140 | 0.266 | -0.061 | 0.246 | -0.074 | 0.280 |
| 6 | -0.201 | 0.415 | -0.183 | 0.526 | -0.077 | 0.541 | -0.086 | 0.219 | -0.023 | 0.242 |
| 7 | -0.205 | 0.411 | -0.149 | 0.500 | -0.120 | 0.595 | -0.073 | 0.205 | -0.015 | 0.302 |
| 8 | -0.208 | 0.405 | -0.170 | 0.518 | -0.129 | 0.597 | -0.104 | 0.223 | 0.011 | 0.287 |
| 9 | -0.201 | 0.413 | -0.204 | 0.495 | -0.113 | 0.585 | -0.039 | 0.249 | -0.010 | 0.308 |
| 10 | -0.208 | 0.404 | -0.153 | 0.512 | -0.058 | 0.572 | -0.123 | 0.224 | 0.014 | 0.302 |
| **Mean** | **-0.201** | **0.407** | **-0.223** | **0.462** | **-0.114** | **0.550** | **-0.071** | **0.222** | **-0.013** | **0.298** |
| **SD** | **0.012** | **0.007** | **0.079** | **0.060** | **0.042** | **0.103** | **0.032** | **0.018** | **0.031** | **0.026** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **5** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.337 | 0.650 | 0.374 | 0.933 | 0.348 | 0.922 | 0.274 | 0.936 | 0.299 | 0.925 |
| 2 | 0.355 | 0.663 | 0.343 | 0.941 | 0.318 | 0.917 | 0.289 | 0.951 | 0.314 | 0.927 |
| 3 | 0.359 | 0.650 | 0.304 | 0.946 | 0.376 | 0.939 | 0.269 | 0.950 | 0.291 | 0.936 |
| 4 | 0.365 | 0.655 | 0.332 | 0.944 | 0.351 | 0.932 | 0.269 | 0.951 | 0.310 | 0.927 |
| 5 | 0.359 | 0.657 | 0.357 | 0.933 | 0.387 | 0.933 | 0.253 | 0.941 | 0.294 | 0.923 |
| 6 | 0.354 | 0.647 | 0.358 | 0.934 | 0.419 | 0.930 | 0.274 | 0.960 | 0.302 | 0.931 |
| 7 | 0.360 | 0.642 | 0.329 | 0.942 | 0.550 | 0.924 | 0.269 | 0.951 | 0.317 | 0.931 |
| 8 | 0.356 | 0.640 | 0.335 | 0.955 | 0.483 | 0.942 | 0.278 | 0.970 | 0.319 | 0.926 |
| 9 | 0.361 | 0.653 | 0.316 | 0.943 | 0.414 | 0.933 | 0.280 | 0.959 | 0.316 | 0.933 |
| 10 | 0.359 | 0.651 | 0.338 | 0.945 | 0.383 | 0.913 | 0.267 | 0.955 | 0.313 | 0.912 |
| **Mean** | **0.357** | **0.651** | **0.339** | **0.942** | **0.403** | **0.929** | **0.272** | **0.952** | **0.308** | **0.927** |
| **SD** | **0.008** | **0.007** | **0.021** | **0.007** | **0.069** | **0.009** | **0.009** | **0.010** | **0.010** | **0.007** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **5** |

# TABLE E.29
## Sub 7
## Ankle XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | -0.184 | 0.430 | -0.051 | 0.415 | -0.246 | 0.431 | -0.031 | 0.184 | 0.046 | 0.324 |
| **2** | -0.180 | 0.418 | -0.030 | 0.405 | -0.250 | 0.408 | -0.024 | 0.199 | 0.022 | 0.226 |
| **3** | -0.169 | 0.452 | -0.109 | 0.360 | -0.167 | 0.420 | -0.075 | 0.023 | 0.062 | 0.268 |
| **4** | -0.160 | 0.457 | -0.023 | 0.380 | -0.101 | 0.405 | -0.164 | 0.133 | 0.026 | 0.294 |
| **5** | -0.180 | 0.445 | -0.102 | 0.353 | -0.151 | 0.351 | -0.043 | 0.100 | 0.009 | 0.340 |
| **6** | -0.186 | 0.442 | 0.003 | 0.439 | -0.113 | 0.349 | -0.118 | 0.100 | -0.001 | 0.267 |
| **7** | -0.174 | 0.434 | -0.006 | 0.433 | -0.083 | 0.489 | -0.078 | 0.155 | -0.012 | 0.307 |
| **8** | -0.190 | 0.445 | 0.069 | 0.420 | -0.159 | 0.418 | -0.069 | 0.012 | 0.025 | 0.264 |
| **9** | -0.187 | 0.443 | 0.040 | 0.476 | -0.086 | 0.387 | -0.022 | 0.127 | 0.030 | 0.343 |
| **10** | -0.175 | 0.437 | -0.020 | 0.413 | -0.137 | 0.471 | -0.089 | 0.073 | 0.026 | 0.297 |
| **Mean** | **-0.179** | **0.440** | **-0.023** | **0.409** | **-0.149** | **0.413** | **-0.071** | **0.111** | **0.023** | **0.293** |
| **SD** | **0.009** | **0.011** | **0.056** | **0.037** | **0.060** | **0.045** | **0.045** | **0.062** | **0.021** | **0.037** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.395 | 0.726 | 0.305 | 0.924 | 0.351 | 0.956 | 0.351 | 0.979 | 0.353 | 0.951 |
| **2** | 0.390 | 0.726 | 0.326 | 0.931 | 0.384 | 0.926 | 0.334 | 0.980 | 0.403 | 0.969 |
| **3** | 0.379 | 0.733 | 0.318 | 0.917 | 0.340 | 0.972 | 0.358 | 0.974 | 0.368 | 0.979 |
| **4** | 0.372 | 0.741 | 0.373 | 0.940 | 0.388 | 0.979 | 0.367 | 0.960 | 0.373 | 0.970 |
| **5** | 0.381 | 0.730 | 0.335 | 0.928 | 0.396 | 0.968 | 0.349 | 0.981 | 0.364 | 0.941 |
| **6** | 0.372 | 0.737 | 0.354 | 0.913 | 0.400 | 0.947 | 0.379 | 0.978 | 0.373 | 0.958 |
| **7** | 0.379 | 0.738 | 0.364 | 0.933 | 0.382 | 0.969 | 0.363 | 0.982 | 0.370 | 0.948 |
| **8** | 0.385 | 0.737 | 0.315 | 0.921 | 0.399 | 0.976 | 0.417 | 0.981 | 0.380 | 0.966 |
| **9** | 0.386 | 0.732 | 0.325 | 0.912 | 0.393 | 0.967 | 0.351 | 0.985 | 0.391 | 0.933 |
| **10** | 0.390 | 0.735 | 0.303 | 0.959 | 0.368 | 0.967 | 0.359 | 0.978 | 0.359 | 0.994 |
| **Mean** | **0.383** | **0.734** | **0.332** | **0.928** | **0.380** | **0.963** | **0.363** | **0.978** | **0.373** | **0.961** |
| **SD** | **0.008** | **0.005** | **0.024** | **0.014** | **0.021** | **0.016** | **0.022** | **0.007** | **0.015** | **0.018** |
| **Smooth** | **fz** | **4** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.30
## Sub 8
## Ankle XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -0.177 | 0.413 | -0.374 | 0.285 | -0.279 | 0.455 | -0.019 | 0.210 | -0.117 | 0.140 |
| 2 | -0.212 | 0.417 | -0.444 | 0.272 | -0.209 | 0.466 | -0.089 | 0.244 | -0.119 | 0.162 |
| 3 | -0.220 | 0.413 | -0.295 | 0.312 | -0.263 | 0.437 | -0.086 | 0.210 | -0.131 | 0.153 |
| 4 | -0.232 | 0.413 | -0.326 | 0.456 | -0.222 | 0.404 | -0.083 | 0.210 | -0.114 | 0.159 |
| 5 | -0.226 | 0.397 | -0.224 | 0.342 | -0.216 | 0.449 | -0.103 | 0.240 | -0.107 | 0.114 |
| 6 | -0.228 | 0.405 | -0.315 | 0.335 | -0.241 | 0.457 | -0.111 | 0.221 | -0.123 | 0.187 |
| 7 | -0.227 | 0.420 | -0.301 | 0.336 | -0.276 | 0.388 | -0.094 | 0.192 | -0.122 | 0.139 |
| 8 | -0.235 | 0.422 | -0.333 | 0.326 | -0.234 | 0.423 | -0.061 | 0.230 | -0.112 | 0.182 |
| 9 | -0.219 | 0.416 | -0.347 | 0.328 | -0.219 | 0.465 | -0.113 | 0.210 | -0.138 | 0.196 |
| 10 | -0.285 | 0.412 | -0.354 | 0.305 | -0.277 | 0.436 | -0.057 | 0.210 | -0.118 | 0.150 |
| **Mean** | **-0.226** | **0.413** | **-0.331** | **0.330** | **-0.244** | **0.438** | **-0.082** | **0.218** | **-0.120** | **0.158** |
| **SD** | **0.026** | **0.007** | **0.057** | **0.050** | **0.028** | **0.026** | **0.029** | **0.016** | **0.009** | **0.025** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **5** | | **5** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.423 | 0.662 | 0.328 | 0.984 | 0.470 | 1.012 | 0.289 | 0.952 | 0.331 | 0.956 |
| 2 | 0.399 | 0.695 | 0.349 | 0.986 | 0.466 | 1.011 | 0.297 | 0.967 | 0.332 | 0.968 |
| 3 | 0.392 | 0.691 | 0.356 | 0.993 | 0.491 | 1.005 | 0.317 | 0.964 | 0.327 | 0.965 |
| 4 | 0.404 | 0.685 | 0.332 | 0.984 | 0.482 | 1.012 | 0.308 | 0.980 | 0.322 | 0.972 |
| 5 | 0.406 | 0.684 | 0.375 | 0.998 | 0.460 | 0.998 | 0.288 | 0.971 | 0.322 | 0.959 |
| 6 | 0.403 | 0.689 | 0.341 | 0.999 | 0.501 | 0.994 | 0.292 | 0.972 | 0.312 | 0.958 |
| 7 | 0.389 | 0.677 | 0.366 | 0.991 | 0.473 | 0.997 | 0.298 | 0.954 | 0.333 | 0.969 |
| 8 | 0.393 | 0.680 | 0.325 | 0.994 | 0.441 | 1.015 | 0.303 | 0.958 | 0.332 | 0.960 |
| 9 | 0.395 | 0.697 | 0.328 | 0.985 | 0.461 | 0.996 | 0.302 | 0.967 | 0.334 | 0.960 |
| 10 | 0.388 | 0.696 | 0.360 | 0.992 | 0.479 | 1.002 | 0.306 | 0.967 | 0.322 | 0.977 |
| **Mean** | **0.399** | **0.686** | **0.346** | **0.991** | **0.472** | **1.004** | **0.300** | **0.965** | **0.327** | **0.964** |
| **SD** | **0.010** | **0.011** | **0.018** | **0.006** | **0.017** | **0.008** | **0.009** | **0.009** | **0.007** | **0.007** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.31
## Sub 9
## Ankle XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -0.210 | 0.509 | -0.377 | 0.548 | -0.349 | 0.467 | 0.039 | 0.147 | -0.047 | 0.179 |
| 2 | -0.205 | 0.519 | -0.370 | 0.534 | -0.425 | 0.430 | -0.025 | 0.127 | -0.074 | 0.111 |
| 3 | -0.216 | 0.493 | -0.354 | 0.561 | -0.478 | 0.483 | -0.030 | 0.195 | -0.059 | 0.114 |
| 4 | -0.216 | 0.488 | -0.333 | 0.545 | -0.470 | 0.443 | -0.011 | 0.174 | 0.087 | 0.162 |
| 5 | -0.209 | 0.503 | -0.321 | 0.550 | -0.425 | 0.455 | 0.003 | 0.172 | 0.004 | 0.178 |
| 6 | -0.224 | 0.504 | -0.284 | 0.560 | -0.460 | 0.484 | 0.022 | 0.173 | -0.021 | 0.222 |
| 7 | -0.196 | 0.510 | -0.311 | 0.507 | -0.436 | 0.451 | -0.002 | 0.148 | -0.054 | 0.157 |
| 8 | -0.221 | 0.494 | -0.337 | 0.503 | -0.451 | 0.492 | -0.009 | 0.245 | -0.074 | 0.132 |
| 9 | -0.209 | 0.499 | -0.365 | 0.491 | -0.389 | 0.503 | 0.007 | 0.179 | -0.077 | 0.124 |
| 10 | -0.207 | 0.513 | -0.426 | 0.525 | -0.398 | 0.460 | -0.011 | 0.180 | -0.074 | 0.164 |
| **Mean** | **-0.211** | **0.503** | **-0.348** | **0.532** | **-0.428** | **0.467** | **-0.002** | **0.174** | **-0.039** | **0.154** |
| **SD** | **0.008** | **0.010** | **0.040** | **0.025** | **0.040** | **0.023** | **0.021** | **0.032** | **0.051** | **0.035** |
| **Smooth** | **fz** | **6** | | **3** | | **4** | | **4** | | **5** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.352 | 0.790 | 0.553 | 1.051 | 0.643 | 1.047 | 0.499 | 1.007 | 0.521 | 1.002 |
| 2 | 0.328 | 0.788 | 0.490 | 1.060 | 0.633 | 1.049 | 0.504 | 1.043 | 0.528 | 1.011 |
| 3 | 0.346 | 0.773 | 0.492 | 1.061 | 0.651 | 1.051 | 0.453 | 1.019 | 0.540 | 1.003 |
| 4 | 0.363 | 0.783 | 0.480 | 1.061 | 0.677 | 1.040 | 0.472 | 1.026 | 0.562 | 0.986 |
| 5 | 0.353 | 0.782 | 0.436 | 1.060 | 0.698 | 1.041 | 0.498 | 0.990 | 0.567 | 0.996 |
| 6 | 0.364 | 0.771 | 0.507 | 1.053 | 0.683 | 1.040 | 0.497 | 1.037 | 0.558 | 0.982 |
| 7 | 0.350 | 0.794 | 0.474 | 1.067 | 0.690 | 1.034 | 0.475 | 1.040 | 0.557 | 0.990 |
| 8 | 0.348 | 0.770 | 0.473 | 1.063 | 0.636 | 1.052 | 0.441 | 1.010 | 0.518 | 0.968 |
| 9 | 0.351 | 0.776 | 0.533 | 1.059 | 0.586 | 1.043 | 0.472 | 1.041 | 0.490 | 0.982 |
| 10 | 0.339 | 0.776 | 0.547 | 1.076 | 0.631 | 1.064 | 0.529 | 1.044 | 0.511 | 0.995 |
| **Mean** | **0.349** | **0.780** | **0.499** | **1.061** | **0.653** | **1.046** | **0.484** | **1.026** | **0.535** | **0.992** |
| **SD** | **0.011** | **0.008** | **0.037** | **0.007** | **0.034** | **0.008** | **0.026** | **0.019** | **0.026** | **0.013** |
| **Smooth** | **fz** | **4** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.32
## Sub 10
## Ankle XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -0.232 | 0.454 | -0.026 | 0.495 | -0.138 | 0.521 | 0.004 | 0.263 | 0.052 | 0.311 |
| 2 | -0.262 | 0.420 | -0.024 | 0.532 | -0.157 | 0.542 | 0.099 | 0.215 | 0.089 | 0.285 |
| 3 | -0.262 | 0.440 | 0.014 | 0.558 | -0.201 | 0.532 | 0.045 | 0.280 | 0.012 | 0.231 |
| 4 | -0.263 | 0.454 | 0.086 | 0.552 | -0.196 | 0.493 | 0.016 | 0.269 | 0.041 | 0.197 |
| 5 | -0.246 | 0.453 | 0.091 | 0.548 | -0.131 | 0.541 | 0.013 | 0.236 | 0.016 | 0.292 |
| 6 | -0.239 | 0.457 | 0.033 | 0.596 | -0.179 | 0.551 | 0.076 | 0.234 | 0.056 | 0.217 |
| 7 | -0.254 | 0.456 | -0.068 | 0.523 | -0.128 | 0.530 | 0.034 | 0.252 | 0.088 | 0.170 |
| 8 | -0.273 | 0.446 | -0.027 | 0.544 | -0.143 | 0.542 | 0.021 | 0.288 | 0.065 | 0.226 |
| 9 | -0.256 | 0.456 | 0.026 | 0.535 | -0.095 | 0.529 | 0.006 | 0.238 | 0.009 | 0.346 |
| 10 | -0.247 | 0.481 | -0.063 | 0.520 | -0.205 | 0.537 | 0.022 | 0.254 | 0.013 | 0.343 |
| **Mean** | **-0.253** | **0.452** | **0.004** | **0.540** | **-0.157** | **0.532** | **0.034** | **0.253** | **0.044** | **0.262** |
| **SD** | **0.012** | **0.015** | **0.056** | **0.027** | **0.037** | **0.016** | **0.031** | **0.023** | **0.031** | **0.062** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **5** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.450 | 0.745 | 0.191 | 0.975 | 0.275 | 0.933 | 0.260 | 0.907 | 0.420 | 0.957 |
| 2 | 0.475 | 0.765 | 0.131 | 0.987 | 0.277 | 0.944 | 0.256 | 0.909 | 0.345 | 0.935 |
| 3 | 0.475 | 0.737 | 0.127 | 0.975 | 0.260 | 0.942 | 0.260 | 0.908 | 0.378 | 0.942 |
| 4 | 0.459 | 0.746 | 0.163 | 0.967 | 0.314 | 0.949 | 0.256 | 0.890 | 0.358 | 0.977 |
| 5 | 0.457 | 0.753 | 0.124 | 0.975 | 0.236 | 0.939 | 0.280 | 0.898 | 0.396 | 0.965 |
| 6 | 0.459 | 0.749 | 0.166 | 0.971 | 0.242 | 0.940 | 0.267 | 0.938 | 0.354 | 0.957 |
| 7 | 0.452 | 0.765 | 0.184 | 0.953 | 0.264 | 0.951 | 0.285 | 0.909 | 0.351 | 0.953 |
| 8 | 0.458 | 0.750 | 0.149 | 0.970 | 0.236 | 0.953 | 0.267 | 0.882 | 0.379 | 0.958 |
| 9 | 0.434 | 0.758 | 0.134 | 0.971 | 0.277 | 0.966 | 0.270 | 0.915 | 0.398 | 0.978 |
| 10 | 0.431 | 0.757 | 0.122 | 0.969 | 0.243 | 0.945 | 0.277 | 0.900 | 0.391 | 0.948 |
| **Mean** | **0.455** | **0.753** | **0.149** | **0.971** | **0.262** | **0.946** | **0.268** | **0.906** | **0.377** | **0.957** |
| **SD** | **0.015** | **0.009** | **0.026** | **0.008** | **0.025** | **0.009** | **0.010** | **0.015** | **0.025** | **0.014** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.33
## Sub 11
## Ankle XY Displacement Difference Relative to Hip

| Stride | TR X Min | TR X Max | SCC X Min | SCC X Max | BCC X Min | BCC X Max | SHK X Min | SHK X Max | BHK X Min | BHK X Max |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | -0.204 | 0.460 | -0.225 | 0.423 | -0.099 | 0.555 | -0.096 | 0.040 | -0.077 | 0.131 |
| 2 | -0.230 | 0.464 | -0.285 | 0.406 | -0.053 | 0.538 | -0.118 | 0.065 | -0.063 | 0.109 |
| 3 | -0.216 | 0.447 | -0.261 | 0.452 | -0.090 | 0.577 | -0.114 | 0.071 | -0.157 | 0.143 |
| 4 | -0.240 | 0.451 | -0.228 | 0.462 | -0.019 | 0.541 | -0.112 | 0.063 | -0.100 | 0.049 |
| 5 | -0.221 | 0.463 | -0.192 | 0.453 | -0.149 | 0.516 | -0.119 | 0.041 | -0.012 | 0.122 |
| 6 | -0.210 | 0.455 | -0.256 | 0.452 | -0.143 | 0.511 | -0.148 | 0.041 | -0.113 | 0.081 |
| 7 | -0.203 | 0.467 | -0.261 | 0.468 | -0.161 | 0.504 | -0.115 | 0.080 | -0.099 | 0.107 |
| 8 | -0.219 | 0.461 | -0.222 | 0.505 | -0.017 | 0.464 | -0.110 | 0.065 | -0.104 | 0.079 |
| 9 | -0.219 | 0.453 | -0.229 | 0.502 | -0.045 | 0.505 | -0.118 | 0.045 | -0.092 | 0.098 |
| 10 | -0.224 | 0.449 | -0.218 | 0.441 | -0.033 | 0.490 | -0.113 | 0.063 | -0.061 | 0.082 |
| **Mean** | **-0.219** | **0.457** | **-0.238** | **0.456** | **-0.081** | **0.520** | **-0.116** | **0.057** | **-0.088** | **0.100** |
| **SD** | **0.011** | **0.007** | **0.027** | **0.031** | **0.055** | **0.033** | **0.013** | **0.014** | **0.038** | **0.028** |
| **Smooth** | **fz** | **6** | | **4** | | **4** | | **4** | | **5** |

| Stride | TR Y Min | TR Y Max | SCC Y Min | SCC Y Max | BCC Y Min | BCC Y Max | SHK Y Min | SHK Y Max | BHK Y Min | BHK Y Max |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.327 | 0.694 | 0.318 | 0.752 | 0.242 | 0.779 | 0.219 | 0.755 | 0.231 | 0.764 |
| 2 | 0.319 | 0.674 | 0.295 | 0.744 | 0.357 | 0.772 | 0.213 | 0.745 | 0.243 | 0.765 |
| 3 | 0.450 | 0.686 | 0.300 | 0.756 | 0.231 | 0.785 | 0.193 | 0.739 | 0.237 | 0.758 |
| 4 | 0.317 | 0.670 | 0.296 | 0.749 | 0.218 | 0.791 | 0.197 | 0.738 | 0.251 | 0.759 |
| 5 | 0.314 | 0.688 | 0.279 | 0.770 | 0.264 | 0.796 | 0.195 | 0.712 | 0.280 | 0.774 |
| 6 | 0.333 | 0.682 | 0.263 | 0.747 | 0.247 | 0.777 | 0.201 | 0.755 | 0.248 | 0.772 |
| 7 | 0.305 | 0.684 | 0.307 | 0.743 | 0.362 | 0.786 | 0.212 | 0.735 | 0.241 | 0.764 |
| 8 | 0.309 | 0.687 | 0.304 | 0.752 | 0.245 | 0.782 | 0.191 | 0.752 | 0.264 | 0.761 |
| 9 | 0.342 | 0.673 | 0.285 | 0.743 | 0.214 | 0.779 | 0.194 | 0.732 | 0.245 | 0.768 |
| 10 | 0.329 | 0.679 | 0.242 | 0.713 | 0.267 | 0.784 | 0.201 | 0.733 | 0.253 | 0.774 |
| **Mean** | **0.335** | **0.682** | **0.289** | **0.747** | **0.265** | **0.783** | **0.202** | **0.740** | **0.249** | **0.766** |
| **SD** | **0.042** | **0.008** | **0.023** | **0.014** | **0.053** | **0.007** | **0.010** | **0.013** | **0.014** | **0.006** |
| **Smooth** | **fz** | **4** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.34
## Sub 12
## Ankle XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -0.139 | 0.393 | -0.090 | 0.362 | -0.057 | 0.431 | -0.175 | -0.001 | -0.186 | 0.051 |
| 2 | -0.127 | 0.410 | -0.115 | 0.364 | -0.126 | 0.438 | -0.169 | 0.018 | -0.179 | 0.038 |
| 3 | -0.147 | 0.399 | -0.124 | 0.341 | -0.170 | 0.425 | -0.207 | -0.021 | -0.221 | 0.045 |
| 4 | -0.146 | 0.416 | -0.120 | 0.353 | -0.161 | 0.433 | -0.192 | -0.017 | -0.192 | 0.048 |
| 5 | -0.136 | 0.404 | -0.140 | 0.374 | -0.078 | 0.460 | -0.179 | -0.005 | -0.228 | 0.043 |
| 6 | -0.121 | 0.421 | -0.184 | 0.356 | -0.108 | 0.446 | -0.180 | 0.013 | -0.233 | 0.046 |
| 7 | -0.125 | 0.407 | -0.153 | 0.343 | -0.081 | 0.449 | -0.248 | -0.031 | -0.181 | 0.034 |
| 8 | -0.130 | 0.407 | -0.179 | 0.357 | -0.099 | 0.432 | -0.203 | 0.010 | -0.168 | 0.012 |
| 9 | -0.126 | 0.414 | -0.159 | 0.325 | -0.129 | 0.418 | -0.178 | -0.025 | -0.179 | 0.032 |
| 10 | -0.133 | 0.398 | -0.139 | 0.356 | -0.157 | 0.410 | -0.177 | 0.034 | -0.105 | 0.011 |
| **Mean** | **-0.133** | **0.407** | **-0.140** | **0.353** | **-0.117** | **0.434** | **-0.191** | **-0.003** | **-0.187** | **0.036** |
| **SD** | **0.009** | **0.009** | **0.029** | **0.014** | **0.039** | **0.015** | **0.024** | **0.021** | **0.037** | **0.014** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **5** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.455 | 0.710 | 0.338 | 0.783 | 0.295 | 0.769 | 0.364 | 0.775 | 0.342 | 0.754 |
| 2 | 0.434 | 0.709 | 0.348 | 0.785 | 0.307 | 0.767 | 0.363 | 0.781 | 0.321 | 0.753 |
| 3 | 0.444 | 0.704 | 0.358 | 0.783 | 0.328 | 0.783 | 0.366 | 0.765 | 0.320 | 0.764 |
| 4 | 0.438 | 0.716 | 0.346 | 0.785 | 0.335 | 0.776 | 0.350 | 0.768 | 0.316 | 0.771 |
| 5 | 0.435 | 0.706 | 0.337 | 0.781 | 0.287 | 0.786 | 0.353 | 0.772 | 0.327 | 0.756 |
| 6 | 0.443 | 0.708 | 0.345 | 0.780 | 0.319 | 0.776 | 0.350 | 0.775 | 0.367 | 0.757 |
| 7 | 0.443 | 0.712 | 0.342 | 0.774 | 0.314 | 0.772 | 0.358 | 0.763 | 0.329 | 0.768 |
| 8 | 0.436 | 0.710 | 0.334 | 0.787 | 0.317 | 0.784 | 0.343 | 0.749 | 0.310 | 0.780 |
| 9 | 0.434 | 0.703 | 0.345 | 0.778 | 0.328 | 0.786 | 0.338 | 0.771 | 0.317 | 0.778 |
| 10 | 0.433 | 0.703 | 0.344 | 0.783 | 0.356 | 0.772 | 0.347 | 0.771 | 0.308 | 0.766 |
| **Mean** | **0.440** | **0.708** | **0.344** | **0.782** | **0.319** | **0.777** | **0.353** | **0.769** | **0.326** | **0.765** |
| **SD** | **0.007** | **0.004** | **0.007** | **0.004** | **0.020** | **0.007** | **0.009** | **0.009** | **0.018** | **0.010** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **5** |

## TABLE E.35
## Sub 13
## Ankle XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -0.115 | 0.393 | 0.034 | 0.474 | -0.276 | 0.327 | 0.013 | 0.177 | -0.002 | 0.163 |
| 2 | -0.127 | 0.427 | 0.042 | 0.469 | -0.289 | 0.331 | 0.002 | 0.146 | -0.036 | 0.167 |
| 3 | -0.134 | 0.425 | 0.043 | 0.504 | -0.327 | 0.404 | 0.008 | 0.131 | -0.018 | 0.076 |
| 4 | -0.149 | 0.436 | 0.012 | 0.457 | -0.264 | 0.427 | 0.001 | 0.123 | -0.011 | 0.128 |
| 5 | -0.159 | 0.430 | -0.174 | 0.388 | -0.179 | 0.371 | 0.014 | 0.131 | 0.002 | 0.139 |
| 6 | -0.143 | 0.429 | -0.232 | 0.438 | -0.276 | 0.348 | 0.021 | 0.130 | -0.003 | 0.124 |
| 7 | -0.154 | 0.423 | -0.153 | 0.398 | -0.256 | 0.369 | 0.021 | 0.152 | -0.012 | 0.107 |
| 8 | -0.172 | 0.432 | -0.176 | 0.431 | -0.272 | 0.348 | 0.014 | 0.126 | -0.009 | 0.110 |
| 9 | -0.148 | 0.426 | -0.082 | 0.438 | -0.272 | 0.407 | 0.060 | 0.177 | -0.017 | 0.115 |
| 10 | -0.168 | 0.455 | -0.102 | 0.411 | -0.231 | 0.373 | -0.002 | 0.182 | -0.005 | 0.103 |
| **Mean** | **-0.147** | **0.428** | **-0.079** | **0.441** | **-0.264** | **0.370** | **0.015** | **0.148** | **-0.011** | **0.123** |
| **SD** | **0.018** | **0.015** | **0.105** | **0.036** | **0.039** | **0.034** | **0.018** | **0.023** | **0.011** | **0.028** |
| **Smooth** | **fz** | **6** | | **4** | | **4** | | **4** | | **5** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.253 | 0.629 | 0.223 | 0.731 | 0.361 | 0.758 | 0.236 | 0.740 | 0.274 | 0.710 |
| 2 | 0.223 | 0.613 | 0.230 | 0.737 | 0.395 | 0.747 | 0.243 | 0.729 | 0.230 | 0.764 |
| 3 | 0.243 | 0.612 | 0.196 | 0.737 | 0.311 | 0.759 | 0.232 | 0.737 | 0.266 | 0.766 |
| 4 | 0.249 | 0.602 | 0.277 | 0.745 | 0.291 | 0.751 | 0.238 | 0.743 | 0.283 | 0.778 |
| 5 | 0.241 | 0.629 | 0.330 | 0.734 | 0.295 | 0.750 | 0.233 | 0.732 | 0.265 | 0.755 |
| 6 | 0.261 | 0.614 | 0.321 | 0.735 | 0.291 | 0.742 | 0.235 | 0.741 | 0.247 | 0.765 |
| 7 | 0.249 | 0.637 | 0.299 | 0.736 | 0.298 | 0.764 | 0.241 | 0.738 | 0.260 | 0.768 |
| 8 | 0.275 | 0.647 | 0.302 | 0.728 | 0.271 | 0.751 | 0.240 | 0.735 | 0.254 | 0.772 |
| 9 | 0.281 | 0.662 | 0.285 | 0.730 | 0.328 | 0.743 | 0.223 | 0.742 | 0.249 | 0.769 |
| 10 | 0.298 | 0.657 | 0.251 | 0.734 | 0.293 | 0.743 | 0.236 | 0.741 | 0.236 | 0.771 |
| **Mean** | **0.257** | **0.630** | **0.271** | **0.735** | **0.313** | **0.751** | **0.236** | **0.738** | **0.256** | **0.762** |
| **SD** | **0.022** | **0.020** | **0.045** | **0.005** | **0.038** | **0.008** | **0.006** | **0.005** | **0.017** | **0.019** |
| **Smooth** | **fz** | **4** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.36
## Sub 14
## Ankle XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -0.176 | 0.460 | -0.254 | 0.466 | -0.199 | 0.568 | -0.236 | 0.295 | -0.281 | 0.125 |
| 2 | -0.199 | 0.464 | -0.214 | 0.426 | -0.254 | 0.470 | -0.226 | 0.244 | -0.259 | 0.186 |
| 3 | -0.204 | 0.479 | -0.265 | 0.429 | -0.286 | 0.553 | -0.223 | 0.284 | -0.280 | 0.169 |
| 4 | -0.199 | 0.452 | -0.186 | 0.446 | -0.292 | 0.536 | -0.242 | 0.267 | -0.237 | 0.252 |
| 5 | -0.210 | 0.461 | -0.187 | 0.487 | -0.223 | 0.602 | -0.221 | 0.222 | -0.206 | 0.210 |
| 6 | -0.195 | 0.471 | -0.182 | 0.531 | -0.216 | 0.594 | -0.275 | 0.291 | -0.218 | 0.228 |
| 7 | -0.201 | 0.459 | -0.227 | 0.416 | -0.213 | 0.574 | -0.199 | 0.280 | -0.213 | 0.189 |
| 8 | -0.210 | 0.459 | -0.235 | 0.414 | -0.315 | 0.539 | -0.219 | 0.256 | -0.173 | 0.119 |
| 9 | -0.208 | 0.461 | -0.285 | 0.420 | -0.276 | 0.561 | -0.230 | 0.243 | -0.255 | 0.184 |
| 10 | -0.207 | 0.469 | -0.232 | 0.326 | -0.246 | 0.561 | -0.231 | 0.273 | -0.254 | 0.205 |
| **Mean** | **-0.201** | **0.464** | **-0.227** | **0.436** | **-0.252** | **0.556** | **-0.230** | **0.266** | **-0.238** | **0.187** |
| **SD** | **0.010** | **0.008** | **0.035** | **0.054** | **0.039** | **0.037** | **0.020** | **0.024** | **0.035** | **0.042** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.405 | 0.735 | 0.380 | 1.056 | 0.476 | 1.081 | 0.322 | 1.112 | 0.342 | 1.115 |
| 2 | 0.394 | 0.752 | 0.403 | 1.087 | 0.442 | 1.103 | 0.310 | 1.118 | 0.347 | 1.119 |
| 3 | 0.362 | 0.756 | 0.422 | 1.070 | 0.462 | 1.088 | 0.318 | 1.096 | 0.400 | 1.078 |
| 4 | 0.400 | 0.751 | 0.439 | 1.077 | 0.394 | 1.086 | 0.292 | 1.109 | 0.303 | 1.020 |
| 5 | 0.381 | 0.760 | 0.414 | 1.046 | 0.454 | 1.089 | 0.272 | 1.119 | 0.342 | 1.063 |
| 6 | 0.403 | 0.756 | 0.407 | 1.054 | 0.398 | 1.097 | 0.294 | 1.104 | 0.322 | 1.053 |
| 7 | 0.411 | 0.740 | 0.431 | 1.027 | 0.439 | 1.076 | 0.259 | 1.090 | 0.321 | 1.047 |
| 8 | 0.399 | 0.750 | 0.375 | 1.071 | 0.442 | 1.087 | 0.293 | 1.131 | 0.311 | 1.047 |
| 9 | 0.402 | 0.760 | 0.390 | 1.075 | 0.444 | 1.080 | 0.308 | 1.134 | 0.283 | 1.042 |
| 10 | 0.398 | 0.752 | 0.402 | 0.999 | 0.423 | 1.061 | 0.267 | 1.105 | 0.315 | 1.047 |
| **Mean** | **0.396** | **0.751** | **0.406** | **1.056** | **0.437** | **1.085** | **0.294** | **1.112** | **0.329** | **1.063** |
| **SD** | **0.014** | **0.008** | **0.021** | **0.027** | **0.026** | **0.012** | **0.022** | **0.014** | **0.032** | **0.032** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.37
## Sub 15
## Ankle XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -0.182 | 0.470 | -0.169 | 0.198 | 0.060 | 0.432 | -0.029 | 0.156 | 0.037 | 0.210 |
| 2 | -0.196 | 0.433 | -0.152 | 0.267 | -0.054 | 0.365 | -0.092 | 0.169 | 0.050 | 0.221 |
| 3 | -0.202 | 0.461 | -0.167 | 0.251 | -0.042 | 0.367 | -0.152 | 0.091 | 0.115 | 0.257 |
| 4 | -0.195 | 0.468 | -0.195 | 0.229 | -0.015 | 0.367 | -0.071 | 0.123 | 0.112 | 0.305 |
| 5 | -0.205 | 0.439 | -0.238 | 0.216 | 0.002 | 0.383 | -0.082 | 0.167 | -0.005 | 0.234 |
| 6 | -0.181 | 0.497 | -0.256 | 0.214 | 0.024 | 0.359 | -0.136 | 0.112 | -0.012 | 0.197 |
| 7 | -0.174 | 0.452 | -0.248 | 0.222 | 0.013 | 0.429 | -0.194 | 0.134 | 0.069 | 0.256 |
| 8 | -0.200 | 0.452 | -0.118 | 0.293 | 0.029 | 0.451 | -0.199 | 0.045 | 0.052 | 0.281 |
| 9 | -0.198 | 0.475 | -0.175 | 0.267 | 0.016 | 0.405 | -0.044 | 0.087 | 0.054 | 0.243 |
| 10 | -0.204 | 0.459 | -0.151 | 0.272 | 0.049 | 0.401 | -0.069 | 0.125 | 0.084 | 0.270 |
| **Mean** | **-0.194** | **0.461** | **-0.187** | **0.243** | **0.008** | **0.396** | **-0.107** | **0.121** | **0.056** | **0.247** |
| **SD** | **0.011** | **0.018** | **0.046** | **0.031** | **0.037** | **0.033** | **0.060** | **0.039** | **0.043** | **0.033** |
| **Smooth** | **fz** | **5** | | **4** | | **5** | | **4** | | **5** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.414 | 0.758 | 0.248 | 1.037 | 0.282 | 1.035 | 0.275 | 1.005 | 0.346 | 0.998 |
| 2 | 0.441 | 0.792 | 0.228 | 1.012 | 0.280 | 1.038 | 0.302 | 1.008 | 0.339 | 1.001 |
| 3 | 0.421 | 0.796 | 0.229 | 1.022 | 0.310 | 1.040 | 0.290 | 0.997 | 0.355 | 0.985 |
| 4 | 0.412 | 0.788 | 0.245 | 1.019 | 0.300 | 1.034 | 0.307 | 1.024 | 0.319 | 0.983 |
| 5 | 0.443 | 0.802 | 0.244 | 1.024 | 0.268 | 1.039 | 0.289 | 1.043 | 0.372 | 1.007 |
| 6 | 0.403 | 0.805 | 0.238 | 1.035 | 0.304 | 1.043 | 0.296 | 1.025 | 0.339 | 0.994 |
| 7 | 0.436 | 0.801 | 0.267 | 1.025 | 0.276 | 1.042 | 0.283 | 1.039 | 0.342 | 1.002 |
| 8 | 0.419 | 0.788 | 0.271 | 1.052 | 0.295 | 1.043 | 0.308 | 1.007 | 0.317 | 1.002 |
| 9 | 0.421 | 0.796 | 0.243 | 1.050 | 0.324 | 1.053 | 0.311 | 1.029 | 0.344 | 1.001 |
| 10 | 0.426 | 0.792 | 0.263 | 1.031 | 0.330 | 1.053 | 0.309 | 1.030 | 0.330 | 0.995 |
| **Mean** | **0.424** | **0.792** | **0.248** | **1.031** | **0.297** | **1.042** | **0.297** | **1.021** | **0.340** | **0.997** |
| **SD** | **0.013** | **0.013** | **0.015** | **0.013** | **0.021** | **0.007** | **0.012** | **0.016** | **0.016** | **0.008** |
| **Smooth** | **fz** | **5** | | **5** | | **5** | | **4** | | **5** |

# TABLE E.38
## Sub 16
## Ankle XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -0.198 | 0.516 | -0.028 | 0.494 | -0.110 | 0.486 | -0.055 | 0.146 | -0.037 | 0.232 |
| 2 | -0.190 | 0.492 | -0.067 | 0.485 | -0.171 | 0.530 | -0.097 | 0.116 | -0.089 | 0.209 |
| 3 | -0.192 | 0.506 | 0.007 | 0.519 | -0.119 | 0.515 | -0.049 | 0.204 | -0.088 | 0.221 |
| 4 | -0.188 | 0.472 | -0.029 | 0.468 | -0.124 | 0.544 | -0.154 | 0.103 | -0.097 | 0.161 |
| 5 | -0.200 | 0.498 | -0.057 | 0.491 | -0.144 | 0.494 | -0.126 | 0.199 | -0.093 | 0.266 |
| 6 | -0.173 | 0.486 | 0.004 | 0.514 | -0.125 | 0.541 | -0.129 | 0.107 | -0.109 | 0.219 |
| 7 | -0.195 | 0.492 | 0.029 | 0.533 | -0.187 | 0.524 | -0.150 | 0.162 | -0.105 | 0.152 |
| 8 | -0.182 | 0.456 | 0.041 | 0.533 | -0.073 | 0.592 | -0.133 | 0.112 | -0.035 | 0.215 |
| 9 | -0.206 | 0.490 | 0.017 | 0.524 | -0.073 | 0.528 | -0.090 | 0.151 | -0.036 | 0.266 |
| 10 | -0.197 | 0.496 | -0.030 | 0.543 | -0.137 | 0.489 | -0.137 | 0.114 | -0.051 | 0.155 |
| **Mean** | **-0.192** | **0.490** | **-0.011** | **0.510** | **-0.126** | **0.524** | **-0.112** | **0.141** | **-0.074** | **0.210** |
| **SD** | **0.009** | **0.017** | **0.036** | **0.025** | **0.037** | **0.032** | **0.038** | **0.038** | **0.030** | **0.042** |
| **Smooth** | **fz** | **6** | | **4** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.362 | 0.750 | 0.420 | 1.001 | 0.509 | 0.981 | 0.265 | 0.937 | 0.309 | 0.960 |
| 2 | 0.395 | 0.740 | 0.388 | 1.007 | 0.470 | 0.992 | 0.276 | 0.951 | 0.290 | 0.947 |
| 3 | 0.356 | 0.745 | 0.397 | 0.989 | 0.491 | 0.988 | 0.285 | 0.973 | 0.262 | 0.951 |
| 4 | 0.377 | 0.754 | 0.399 | 0.998 | 0.474 | 0.991 | 0.296 | 0.978 | 0.295 | 0.973 |
| 5 | 0.396 | 0.721 | 0.389 | 0.994 | 0.513 | 0.987 | 0.272 | 0.954 | 0.245 | 0.957 |
| 6 | 0.392 | 0.757 | 0.347 | 1.008 | 0.463 | 0.994 | 0.307 | 0.949 | 0.256 | 0.954 |
| 7 | 0.384 | 0.753 | 0.377 | 0.992 | 0.481 | 0.996 | 0.256 | 0.937 | 0.285 | 0.940 |
| 8 | 0.387 | 0.755 | 0.396 | 0.999 | 0.457 | 1.003 | 0.261 | 0.947 | 0.295 | 0.971 |
| 9 | 0.382 | 0.769 | 0.368 | 0.998 | 0.455 | 0.986 | 0.252 | 0.944 | 0.279 | 0.962 |
| 10 | 0.401 | 0.761 | 0.376 | 0.994 | 0.472 | 0.978 | 0.309 | 0.953 | 0.274 | 0.955 |
| **Mean** | **0.383** | **0.751** | **0.386** | **0.998** | **0.479** | **0.990** | **0.278** | **0.952** | **0.279** | **0.957** |
| **SD** | **0.015** | **0.013** | **0.020** | **0.006** | **0.020** | **0.007** | **0.021** | **0.014** | **0.020** | **0.010** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **5** |

# TABLE E.39
## Sub 17
## Ankle XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -0.177 | 0.414 | -0.239 | 0.340 | -0.193 | 0.362 | -0.051 | 0.149 | -0.005 | 0.287 |
| 2 | -0.220 | 0.414 | -0.276 | 0.330 | -0.174 | 0.328 | -0.049 | 0.156 | -0.003 | 0.312 |
| 3 | -0.216 | 0.430 | -0.268 | 0.333 | -0.176 | 0.353 | -0.060 | 0.173 | 0.002 | 0.316 |
| 4 | -0.212 | 0.422 | -0.321 | 0.307 | -0.146 | 0.317 | -0.068 | 0.125 | -0.006 | 0.309 |
| 5 | -0.228 | 0.414 | -0.251 | 0.303 | -0.232 | 0.350 | -0.038 | 0.087 | 0.009 | 0.289 |
| 6 | -0.211 | 0.428 | -0.256 | 0.291 | -0.143 | 0.343 | -0.049 | 0.165 | 0.010 | 0.291 |
| 7 | -0.210 | 0.427 | -0.204 | 0.318 | -0.172 | 0.369 | -0.064 | 0.134 | 0.001 | 0.290 |
| 8 | -0.205 | 0.428 | -0.216 | 0.307 | -0.198 | 0.382 | -0.069 | 0.121 | 0.002 | 0.320 |
| 9 | -0.210 | 0.420 | -0.228 | 0.330 | -0.188 | 0.388 | -0.074 | 0.078 | -0.010 | 0.303 |
| 10 | -0.197 | 0.433 | -0.214 | 0.335 | -0.178 | 0.354 | -0.050 | 0.115 | -0.005 | 0.291 |
| **Mean** | **-0.209** | **0.423** | **-0.247** | **0.319** | **-0.180** | **0.355** | **-0.057** | **0.130** | **-0.001** | **0.301** |
| **SD** | **0.014** | **0.007** | **0.035** | **0.017** | **0.026** | **0.022** | **0.011** | **0.032** | **0.006** | **0.013** |
| **Smooth** | **fz** | **6** | | **4** | | **4** | | **4** | | **5** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.356 | 0.680 | 0.381 | 0.900 | 0.487 | 0.868 | 0.240 | 0.879 | 0.227 | 0.861 |
| 2 | 0.357 | 0.675 | 0.410 | 0.878 | 0.396 | 0.852 | 0.224 | 0.883 | 0.239 | 0.866 |
| 3 | 0.361 | 0.687 | 0.388 | 0.890 | 0.448 | 0.860 | 0.209 | 0.877 | 0.237 | 0.869 |
| 4 | 0.359 | 0.670 | 0.416 | 0.878 | 0.439 | 0.846 | 0.225 | 0.878 | 0.218 | 0.862 |
| 5 | 0.355 | 0.680 | 0.403 | 0.882 | 0.503 | 0.864 | 0.225 | 0.879 | 0.230 | 0.874 |
| 6 | 0.348 | 0.686 | 0.431 | 0.891 | 0.442 | 0.855 | 0.246 | 0.890 | 0.238 | 0.857 |
| 7 | 0.355 | 0.692 | 0.393 | 0.880 | 0.453 | 0.869 | 0.231 | 0.890 | 0.221 | 0.868 |
| 8 | 0.342 | 0.690 | 0.385 | 0.879 | 0.468 | 0.859 | 0.225 | 0.885 | 0.233 | 0.859 |
| 9 | 0.356 | 0.693 | 0.378 | 0.885 | 0.440 | 0.850 | 0.238 | 0.887 | 0.216 | 0.860 |
| 10 | 0.344 | 0.687 | 0.408 | 0.886 | 0.466 | 0.860 | 0.213 | 0.881 | 0.241 | 0.812 |
| **Mean** | **0.353** | **0.684** | **0.399** | **0.885** | **0.454** | **0.858** | **0.228** | **0.883** | **0.230** | **0.859** |
| **SD** | **0.006** | **0.008** | **0.017** | **0.007** | **0.029** | **0.008** | **0.012** | **0.005** | **0.009** | **0.017** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.40
## Sub 18
## Ankle XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -0.157 | 0.373 | -0.268 | 0.491 | -0.196 | 0.424 | -0.053 | 0.123 | -0.155 | -0.005 |
| 2 | -0.163 | 0.377 | -0.343 | 0.382 | -0.153 | 0.355 | -0.101 | 0.191 | -0.155 | 0.074 |
| 3 | -0.161 | 0.373 | -0.279 | 0.478 | -0.189 | 0.439 | -0.103 | 0.243 | -0.154 | -0.136 |
| 4 | -0.166 | 0.379 | -0.264 | 0.394 | -0.139 | 0.447 | -0.156 | 0.152 | -0.093 | -0.145 |
| 5 | -0.177 | 0.374 | -0.222 | 0.602 | -0.130 | 0.376 | -0.116 | 0.160 | -0.122 | 0.114 |
| 6 | -0.144 | 0.386 | -0.219 | 0.575 | -0.103 | 0.561 | -0.096 | 0.161 | -0.159 | 0.171 |
| 7 | -0.167 | 0.370 | -0.216 | 0.512 | -0.119 | 0.472 | -0.207 | 0.203 | -0.111 | 0.123 |
| 8 | -0.178 | 0.364 | -0.217 | 0.497 | -0.130 | 0.452 | -0.229 | 0.140 | -0.212 | 0.056 |
| 9 | -0.179 | 0.366 | -0.307 | 0.579 | -0.135 | 0.416 | -0.236 | 0.130 | -0.129 | 0.080 |
| 10 | -0.171 | 0.361 | -0.263 | 0.488 | -0.138 | 0.449 | -0.174 | 0.174 | -0.112 | 0.085 |
| **Mean** | **-0.166** | **0.372** | **-0.260** | **0.500** | **-0.143** | **0.439** | **-0.147** | **0.168** | **-0.140** | **0.042** |
| **SD** | **0.011** | **0.007** | **0.043** | **0.073** | **0.029** | **0.056** | **0.063** | **0.037** | **0.034** | **0.106** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.503 | 0.726 | 0.460 | 0.908 | 0.389 | 0.906 | 0.396 | 0.876 | 0.342 | 0.810 |
| 2 | 0.516 | 0.753 | 0.393 | 0.904 | 0.513 | 0.898 | 0.428 | 0.887 | 0.386 | 0.845 |
| 3 | 0.520 | 0.750 | 0.484 | 0.970 | 0.508 | 0.908 | 0.427 | 0.868 | 0.392 | 0.847 |
| 4 | 0.511 | 0.754 | 0.474 | 0.896 | 0.443 | 0.896 | 0.405 | 0.889 | 0.375 | 0.855 |
| 5 | 0.499 | 0.741 | 0.474 | 0.906 | 0.404 | 0.903 | 0.418 | 0.874 | 0.410 | 0.841 |
| 6 | 0.487 | 0.756 | 0.414 | 0.898 | 0.372 | 0.896 | 0.418 | 0.875 | 0.390 | 0.868 |
| 7 | 0.500 | 0.749 | 0.413 | 0.900 | 0.380 | 0.893 | 0.418 | 0.871 | 0.410 | 0.854 |
| 8 | 0.489 | 0.743 | 0.394 | 0.891 | 0.424 | 0.885 | 0.448 | 0.877 | 0.385 | 0.842 |
| 9 | 0.480 | 0.750 | 0.393 | 0.893 | 0.484 | 0.888 | 0.406 | 0.878 | 0.387 | 0.846 |
| 10 | 0.508 | 0.748 | 0.449 | 0.901 | 0.454 | 0.891 | 0.407 | 0.869 | 0.408 | 0.851 |
| **Mean** | **0.501** | **0.747** | **0.435** | **0.907** | **0.437** | **0.896** | **0.417** | **0.876** | **0.389** | **0.846** |
| **SD** | **0.013** | **0.009** | **0.037** | **0.023** | **0.052** | **0.008** | **0.015** | **0.007** | **0.020** | **0.015** |
| **Smooth** | **fz** | **4** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.41
## Sub 19
## Ankle XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -0.109 | 0.356 | -0.160 | 0.211 | -0.035 | 0.493 | -0.142 | -0.042 | -0.107 | 0.005 |
| 2 | -0.104 | 0.369 | -0.298 | 0.329 | -0.026 | 0.462 | -0.194 | 0.009 | -0.209 | -0.001 |
| 3 | -0.123 | 0.346 | -0.227 | 0.257 | -0.123 | 0.468 | -0.251 | -0.035 | -0.205 | -0.045 |
| 4 | -0.125 | 0.345 | -0.191 | 0.276 | -0.113 | 0.419 | -0.212 | -0.010 | -0.195 | 0.028 |
| 5 | -0.119 | 0.372 | -0.162 | 0.250 | -0.087 | 0.448 | -0.175 | 0.056 | -0.196 | 0.059 |
| 6 | -0.102 | 0.362 | -0.231 | 0.330 | -0.057 | 0.459 | -0.225 | 0.003 | -0.199 | 0.015 |
| 7 | -0.118 | 0.357 | -0.135 | 0.317 | -0.125 | 0.434 | -0.193 | 0.030 | -0.170 | 0.023 |
| 8 | -0.108 | 0.352 | -0.215 | 0.288 | -0.123 | 0.439 | -0.232 | 0.104 | -0.193 | 0.012 |
| 9 | -0.126 | 0.366 | -0.219 | 0.282 | -0.095 | 0.433 | -0.207 | 0.056 | -0.230 | -0.012 |
| 10 | -0.116 | 0.365 | -0.209 | 0.301 | -0.116 | 0.457 | -0.176 | 0.124 | -0.234 | -0.029 |
| **Mean** | **-0.115** | **0.359** | **-0.205** | **0.284** | **-0.090** | **0.451** | **-0.201** | **0.030** | **-0.194** | **0.006** |
| **SD** | **0.009** | **0.009** | **0.046** | **0.038** | **0.038** | **0.021** | **0.032** | **0.056** | **0.036** | **0.030** |
| **Smooth** | **fz** | **5** | | **4** | | **4** | | **4** | | **4** |
| **Combo** | **SD** | **0.157** | | **0.173** | | **0.182** | | **0.086** | | **0.079** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 0.299 | 0.609 | 0.405 | 0.800 | 0.314 | 0.785 | 0.234 | 0.801 | 0.414 | 0.783 |
| 2 | 0.335 | 0.611 | 0.474 | 0.800 | 0.333 | 0.798 | 0.327 | 0.811 | 0.410 | 0.792 |
| 3 | 0.331 | 0.601 | 0.459 | 0.805 | 0.352 | 0.787 | 0.299 | 0.793 | 0.417 | 0.792 |
| 4 | 0.291 | 0.608 | 0.414 | 0.806 | 0.340 | 0.788 | 0.334 | 0.804 | 0.430 | 0.802 |
| 5 | 0.286 | 0.610 | 0.481 | 0.800 | 0.322 | 0.783 | 0.329 | 0.810 | 0.419 | 0.797 |
| 6 | 0.344 | 0.591 | 0.410 | 0.813 | 0.336 | 0.788 | 0.317 | 0.804 | 0.427 | 0.796 |
| 7 | 0.322 | 0.625 | 0.434 | 0.798 | 0.382 | 0.787 | 0.310 | 0.807 | 0.403 | 0.784 |
| 8 | 0.319 | 0.588 | 0.405 | 0.801 | 0.382 | 0.785 | 0.354 | 0.825 | 0.396 | 0.789 |
| 9 | 0.287 | 0.609 | 0.427 | 0.792 | 0.373 | 0.783 | 0.347 | 0.809 | 0.395 | 0.778 |
| 10 | 0.287 | 0.618 | 0.391 | 0.796 | 0.358 | 0.781 | 0.342 | 0.821 | 0.384 | 0.777 |
| **Mean** | **0.310** | **0.607** | **0.430** | **0.801** | **0.349** | **0.787** | **0.319** | **0.809** | **0.410** | **0.789** |
| **SD** | **0.023** | **0.011** | **0.031** | **0.006** | **0.024** | **0.005** | **0.034** | **0.009** | **0.015** | **0.008** |
| **Smooth** | **fz** | **4** | | **4** | | **4** | | **4** | | **4** |

# TABLE E.42
## Sub 20
## Ankle XY Displacement Difference Relative to Hip

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | -0.182 | 0.575 | 0.033 | 0.485 | -0.233 | 0.266 | 0.055 | 0.209 | 0.145 | 0.350 |
| 2 | -0.202 | 0.572 | -0.027 | 0.422 | -0.201 | 0.249 | 0.064 | 0.232 | 0.126 | 0.354 |
| 3 | -0.200 | 0.568 | -0.046 | 0.439 | -0.212 | 0.299 | 0.089 | 0.219 | 0.142 | 0.290 |
| 4 | -0.198 | 0.582 | -0.048 | 0.466 | -0.233 | 0.263 | 0.088 | 0.247 | 0.138 | 0.286 |
| 5 | -0.205 | 0.575 | 0.040 | 0.497 | -0.236 | 0.280 | 0.086 | 0.255 | 0.129 | 0.285 |
| 6 | -0.200 | 0.568 | 0.050 | 0.480 | -0.157 | 0.319 | 0.081 | 0.253 | 0.145 | 0.297 |
| 7 | -0.208 | 0.559 | -0.006 | 0.482 | -0.157 | 0.310 | 0.090 | 0.254 | 0.129 | 0.264 |
| 8 | -0.198 | 0.581 | 0.001 | 0.449 | -0.260 | 0.214 | 0.075 | 0.265 | 0.129 | 0.261 |
| 9 | -0.183 | 0.568 | -0.038 | 0.437 | -0.203 | 0.222 | 0.073 | 0.281 | 0.142 | 0.330 |
| 10 | -0.200 | 0.571 | -0.016 | 0.470 | -0.107 | 0.264 | 0.094 | 0.237 | 0.144 | 0.275 |
| **Mean** | **-0.198** | **0.572** | **-0.006** | **0.463** | **-0.200** | **0.269** | **0.080** | **0.245** | **0.137** | **0.299** |
| **SD** | **0.009** | **0.007** | **0.036** | **0.025** | **0.047** | **0.035** | **0.013** | **0.021** | **0.008** | **0.034** |
| **Smooth** | **fz** | **6** | | **4** | | **4** | | **4** | | **5** |

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | 0.364 | 0.874 | 0.384 | 0.950 | 0.416 | 0.930 | 0.247 | 0.860 | 0.314 | 0.908 |
| 2 | 0.366 | 0.865 | 0.380 | 0.952 | 0.408 | 0.938 | 0.243 | 0.859 | 0.310 | 0.913 |
| 3 | 0.331 | 0.857 | 0.390 | 0.947 | 0.426 | 0.931 | 0.262 | 0.880 | 0.293 | 0.906 |
| 4 | 0.349 | 0.870 | 0.362 | 0.946 | 0.426 | 0.937 | 0.229 | 0.891 | 0.300 | 0.902 |
| 5 | 0.356 | 0.854 | 0.372 | 0.947 | 0.448 | 0.947 | 0.258 | 0.896 | 0.286 | 0.899 |
| 6 | 0.366 | 0.858 | 0.374 | 0.946 | 0.385 | 0.940 | 0.255 | 0.872 | 0.300 | 0.917 |
| 7 | 0.383 | 0.857 | 0.357 | 0.948 | 0.387 | 0.938 | 0.238 | 0.883 | 0.304 | 0.905 |
| 8 | 0.366 | 0.864 | 0.413 | 0.948 | 0.420 | 0.942 | 0.267 | 0.870 | 0.307 | 0.912 |
| 9 | 0.368 | 0.867 | 0.372 | 0.956 | 0.430 | 0.935 | 0.266 | 0.883 | 0.283 | 0.911 |
| 10 | 0.369 | 0.863 | 0.380 | 0.949 | 0.396 | 0.934 | 0.244 | 0.866 | 0.287 | 0.908 |
| **Mean** | **0.362** | **0.863** | **0.378** | **0.949** | **0.414** | **0.937** | **0.251** | **0.876** | **0.298** | **0.908** |
| **SD** | **0.014** | **0.006** | **0.016** | **0.003** | **0.020** | **0.005** | **0.013** | **0.013** | **0.011** | **0.005** |
| **Smooth** | **fz** | **4** | | **4** | | **4** | | **4** | | **5** |

# TABLE E.43
## Knee X Difference Relative to Hip Summary

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| **Sub** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.128 | -0.144 | 0.316 | -0.202 | 0.305 | -0.161 | 0.365 | 0.013 | 0.350 | -0.003 |
| **2** | 0.145 | -0.208 | 0.184 | -0.230 | 0.200 | -0.206 | 0.353 | 0.025 | 0.336 | 0.013 |
| **3** | 0.157 | -0.184 | 0.254 | -0.064 | 0.247 | -0.089 | 0.312 | 0.076 | 0.313 | 0.080 |
| **4** | 0.148 | -0.176 | 0.309 | -0.198 | 0.229 | -0.155 | 0.306 | -0.131 | 0.269 | -0.170 |
| **5** | 0.154 | -0.153 | 0.529 | 0.145 | 0.485 | -0.016 | 0.520 | 0.063 | 0.503 | 0.141 |
| **6** | 0.181 | -0.137 | 0.332 | -0.163 | 0.321 | -0.263 | 0.376 | -0.022 | 0.355 | -0.073 |
| **7** | 0.187 | -0.126 | 0.375 | -0.098 | 0.394 | -0.084 | 0.395 | 0.063 | 0.388 | -0.034 |
| **8** | 0.199 | -0.148 | 0.414 | -0.044 | 0.416 | -0.125 | 0.405 | 0.029 | 0.409 | 0.055 |
| **9** | 0.191 | -0.165 | 0.392 | -0.111 | 0.391 | -0.089 | 0.395 | 0.016 | 0.384 | 0.030 |
| **10** | 0.185 | -0.155 | 0.290 | -0.191 | 0.323 | -0.191 | 0.388 | -0.042 | 0.332 | -0.100 |
| **11** | 0.194 | -0.171 | 0.277 | -0.164 | 0.225 | -0.206 | 0.337 | 0.041 | 0.337 | 0.024 |
| **12** | 0.122 | -0.155 | 0.265 | -0.082 | 0.239 | -0.132 | 0.336 | 0.063 | 0.331 | 0.063 |
| **13** | 0.130 | -0.144 | 0.228 | -0.138 | 0.292 | -0.094 | 0.312 | 0.008 | 0.326 | 0.025 |
| **14** | 0.187 | -0.155 | 0.453 | -0.146 | 0.411 | -0.195 | 0.493 | -0.045 | 0.430 | 0.012 |
| **15** | 0.176 | -0.158 | 0.376 | 0.035 | 0.326 | -0.090 | 0.424 | 0.066 | 0.340 | -0.042 |
| **16** | 0.221 | -0.164 | 0.308 | -0.103 | 0.273 | -0.150 | 0.411 | 0.103 | 0.401 | 0.051 |
| **17** | 0.213 | -0.157 | 0.355 | -0.067 | 0.326 | -0.078 | 0.393 | 0.007 | 0.368 | -0.095 |
| **18** | 0.144 | -0.116 | 0.284 | -0.178 | 0.259 | -0.142 | 0.360 | 0.033 | 0.363 | 0.061 |
| **19** | 0.105 | -0.105 | 0.287 | -0.053 | 0.184 | -0.176 | 0.359 | 0.063 | 0.346 | 0.076 |
| **20** | 0.205 | -0.199 | 0.270 | -0.154 | 0.308 | -0.048 | 0.326 | -0.033 | 0.268 | -0.101 |
| **Mean** | **0.169** | **-0.156** | **0.325** | **-0.110** | **0.308** | **-0.135** | **0.378** | **0.020** | **0.357** | **0.001** |
| **SD** | **0.03** | **0.03** | **0.08** | **0.09** | **0.08** | **0.06** | **0.06** | **0.05** | **0.05** | **0.08** |

# TABLE E.44
## Knee Y Difference Relative to Hip Summary

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Sub** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.345 | 0.386 | 0.307 | 0.523 | 0.293 | 0.493 | 0.212 | 0.521 | 0.235 | 0.516 |
| **2** | 0.338 | 0.393 | 0.399 | 0.473 | 0.385 | 0.474 | 0.248 | 0.473 | 0.265 | 0.482 |
| **3** | 0.324 | 0.376 | 0.227 | 0.400 | 0.221 | 0.400 | 0.086 | 0.380 | 0.057 | 0.373 |
| **4** | 0.303 | 0.361 | 0.304 | 0.483 | 0.361 | 0.483 | 0.269 | 0.472 | 0.327 | 0.467 |
| **5** | 0.339 | 0.385 | 0.192 | 0.578 | 0.219 | 0.606 | 0.080 | 0.595 | 0.074 | 0.580 |
| **6** | 0.258 | 0.336 | 0.223 | 0.481 | 0.279 | 0.480 | 0.131 | 0.481 | 0.174 | 0.473 |
| **7** | 0.299 | 0.364 | 0.173 | 0.451 | 0.102 | 0.450 | 0.162 | 0.455 | 0.184 | 0.465 |
| **8** | 0.277 | 0.366 | 0.088 | 0.496 | 0.139 | 0.496 | 0.064 | 0.479 | 0.040 | 0.477 |
| **9** | 0.298 | 0.377 | 0.250 | 0.510 | 0.246 | 0.508 | 0.201 | 0.495 | 0.194 | 0.483 |
| **10** | 0.312 | 0.386 | 0.343 | 0.498 | 0.298 | 0.490 | 0.170 | 0.479 | 0.252 | 0.497 |
| **11** | 0.277 | 0.369 | 0.206 | 0.398 | 0.293 | 0.406 | 0.003 | 0.394 | 0.044 | 0.396 |
| **12** | 0.321 | 0.364 | 0.396 | 0.237 | 0.364 | 0.394 | 0.097 | 0.392 | 0.100 | 0.394 |
| **13** | 0.253 | 0.325 | 0.242 | 0.372 | 0.155 | 0.373 | 0.106 | 0.375 | 0.099 | 0.380 |
| **14** | 0.320 | 0.385 | 0.028 | 0.534 | 0.225 | 0.531 | -0.050 | 0.594 | -0.123 | 0.533 |
| **15** | 0.336 | 0.400 | 0.239 | 0.507 | 0.307 | 0.517 | 0.147 | 0.500 | 0.284 | 0.506 |
| **16** | 0.289 | 0.401 | 0.329 | 0.495 | 0.366 | 0.502 | 0.093 | 0.466 | 0.151 | 0.464 |
| **17** | 0.268 | 0.373 | 0.198 | 0.457 | 0.245 | 0.451 | 0.103 | 0.454 | 0.169 | 0.449 |
| **18** | 0.339 | 0.394 | 0.301 | 0.453 | 0.338 | 0.462 | 0.162 | 0.444 | 0.152 | 0.426 |
| **19** | 0.218 | 0.269 | 0.224 | 0.413 | 0.326 | 0.413 | 0.031 | 0.415 | 0.111 | 0.406 |
| **20** | 0.364 | 0.440 | 0.301 | 0.472 | 0.256 | 0.474 | 0.214 | 0.452 | 0.299 | 0.460 |
| **Mean** | **0.304** | **0.373** | **0.249** | **0.462** | **0.271** | **0.470** | **0.126** | **0.466** | **0.154** | **0.461** |
| **SD** | **0.04** | **0.03** | **0.09** | **0.07** | **0.08** | **0.05** | **0.08** | **0.06** | **0.11** | **0.05** |

# TABLE E.45
## Ankle X Difference Relative to Hip Summary

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | X | X |
| **Sub** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | -0.148 | 0.409 | -0.133 | 0.637 | -0.216 | 0.516 | -0.028 | 0.179 | -0.068 | 0.185 |
| **2** | -0.176 | 0.486 | 0.209 | 0.602 | 0.046 | 0.589 | -0.117 | 0.250 | -0.041 | 0.231 |
| **3** | -0.217 | 0.456 | -0.031 | 0.340 | -0.172 | 0.312 | -0.081 | 0.108 | -0.101 | 0.046 |
| **4** | -0.159 | 0.465 | 0.109 | 0.535 | 0.172 | 0.494 | 0.109 | 0.422 | 0.452 | 0.408 |
| **5** | -0.177 | 0.472 | -0.794 | 0.236 | -0.596 | 0.454 | -0.041 | 0.209 | -0.144 | 0.141 |
| **6** | -0.201 | 0.407 | -0.223 | 0.462 | -0.114 | 0.550 | -0.071 | 0.222 | -0.013 | 0.298 |
| **7** | -0.179 | 0.440 | -0.023 | 0.409 | -0.149 | 0.413 | -0.071 | 0.111 | 0.023 | 0.293 |
| **8** | -0.226 | 0.413 | -0.331 | 0.330 | -0.244 | 0.438 | -0.082 | 0.218 | -0.120 | 0.158 |
| **9** | -0.211 | 0.503 | -0.348 | 0.532 | -0.428 | 0.467 | -0.002 | 0.174 | -0.039 | 0.154 |
| **10** | -0.253 | 0.452 | 0.004 | 0.540 | -0.157 | 0.532 | 0.034 | 0.253 | 0.044 | 0.262 |
| **11** | -0.219 | 0.457 | -0.238 | 0.456 | -0.081 | 0.520 | -0.116 | 0.057 | -0.088 | 0.100 |
| **12** | -0.133 | 0.407 | -0.140 | 0.353 | -0.117 | 0.434 | -0.191 | -0.003 | -0.187 | 0.036 |
| **13** | -0.147 | 0.428 | -0.079 | 0.441 | -0.264 | 0.370 | 0.015 | 0.148 | -0.011 | 0.123 |
| **14** | -0.201 | 0.464 | -0.227 | 0.436 | -0.252 | 0.556 | -0.230 | 0.266 | -0.238 | 0.187 |
| **15** | -0.194 | 0.461 | -0.187 | 0.243 | 0.008 | 0.396 | -0.107 | 0.121 | 0.056 | 0.247 |
| **16** | -0.192 | 0.490 | -0.011 | 0.510 | -0.126 | 0.524 | -0.112 | 0.141 | -0.074 | 0.210 |
| **17** | -0.209 | 0.423 | -0.247 | 0.319 | -0.180 | 0.355 | -0.057 | 0.130 | -0.001 | 0.301 |
| **18** | -0.166 | 0.372 | -0.260 | 0.500 | -0.143 | 0.439 | -0.147 | 0.168 | -0.140 | 0.042 |
| **19** | -0.115 | 0.359 | -0.205 | 0.284 | -0.090 | 0.451 | -0.201 | 0.030 | -0.194 | 0.006 |
| **20** | -0.198 | 0.572 | -0.006 | 0.463 | -0.200 | 0.269 | 0.080 | 0.245 | 0.137 | 0.299 |
| **Mean** | **-0.186** | **0.447** | **-0.158** | **0.431** | **-0.165** | **0.454** | **-0.071** | **0.172** | **-0.037** | **0.186** |
| **SD** | **0.03** | **0.05** | **0.21** | **0.11** | **0.16** | **0.08** | **0.09** | **0.10** | **0.15** | **0.11** |

## TABLE E.46
## Ankle Y Difference Relative to Hip Summary

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| **Sub** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 0.536 | 0.764 | 0.251 | 1.041 | 0.405 | 0.949 | 0.373 | 1.035 | 0.403 | 1.011 |
| **2** | 0.492 | 0.752 | 0.247 | 0.939 | 0.372 | 0.938 | 0.324 | 0.949 | 0.386 | 0.957 |
| **3** | 0.463 | 0.725 | 0.214 | 0.817 | 0.261 | 0.814 | 0.300 | 0.783 | 0.271 | 0.776 |
| **4** | 0.327 | 0.696 | 0.298 | 0.949 | 0.330 | 0.957 | 0.309 | 0.916 | 0.345 | 0.906 |
| **5** | 0.760 | 0.391 | 0.648 | 1.121 | 0.629 | 1.164 | 0.301 | 1.177 | 0.330 | 1.147 |
| **6** | 0.357 | 0.651 | 0.339 | 0.942 | 0.403 | 0.929 | 0.272 | 0.952 | 0.308 | 0.927 |
| **7** | 0.383 | 0.734 | 0.332 | 0.928 | 0.380 | 0.963 | 0.363 | 0.978 | 0.373 | 0.961 |
| **8** | 0.399 | 0.686 | 0.346 | 0.991 | 0.472 | 1.004 | 0.300 | 0.965 | 0.327 | 0.964 |
| **9** | 0.349 | 0.780 | 0.499 | 1.061 | 0.653 | 1.046 | 0.484 | 1.026 | 0.535 | 0.992 |
| **10** | 0.455 | 0.753 | 0.149 | 0.971 | 0.262 | 0.946 | 0.268 | 0.906 | 0.377 | 0.957 |
| **11** | 0.335 | 0.682 | 0.289 | 0.747 | 0.265 | 0.783 | 0.202 | 0.740 | 0.249 | 0.766 |
| **12** | 0.440 | 0.708 | 0.344 | 0.782 | 0.319 | 0.777 | 0.353 | 0.769 | 0.326 | 0.765 |
| **13** | 0.257 | 0.630 | 0.271 | 0.735 | 0.313 | 0.751 | 0.236 | 0.738 | 0.256 | 0.762 |
| **14** | 0.396 | 0.751 | 0.406 | 1.056 | 0.437 | 1.085 | 0.294 | 1.112 | 0.329 | 1.063 |
| **15** | 0.424 | 0.792 | 0.248 | 1.031 | 0.297 | 1.042 | 0.297 | 1.021 | 0.340 | 0.997 |
| **16** | 0.383 | 0.751 | 0.386 | 0.998 | 0.479 | 0.990 | 0.278 | 0.952 | 0.279 | 0.957 |
| **17** | 0.353 | 0.684 | 0.399 | 0.885 | 0.454 | 0.858 | 0.228 | 0.883 | 0.230 | 0.859 |
| **18** | 0.501 | 0.747 | 0.435 | 0.907 | 0.437 | 0.896 | 0.417 | 0.876 | 0.389 | 0.846 |
| **19** | 0.310 | 0.607 | 0.430 | 0.801 | 0.349 | 0.787 | 0.319 | 0.809 | 0.410 | 0.789 |
| **20** | 0.362 | 0.863 | 0.378 | 0.949 | 0.414 | 0.937 | 0.251 | 0.876 | 0.298 | 0.908 |
| **Mean** | **0.414** | **0.707** | **0.345** | **0.933** | **0.397** | **0.931** | **0.308** | **0.923** | **0.338** | **0.916** |
| **SD** | **0.11** | **0.09** | **0.11** | **0.11** | **0.11** | **0.11** | **0.07** | **0.12** | **0.07** | **0.11** |

Figure E.1
XY Filtered Scaled Coordinates Displacements of Subject 1 in each Running Style

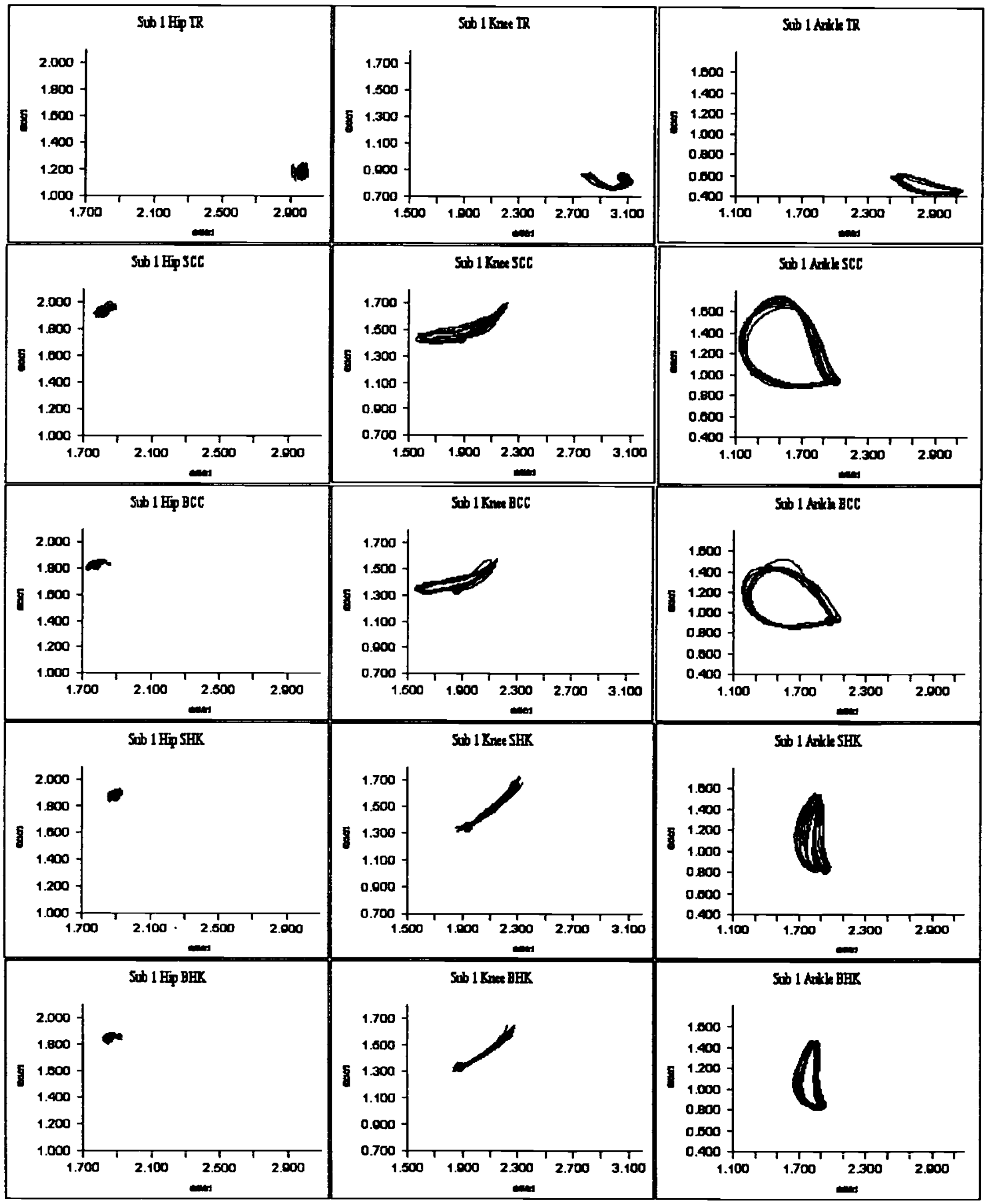


**Figure E.2**
**XY Filtered Scaled Coordinates Displacements of Subject 2 in each Running Style**

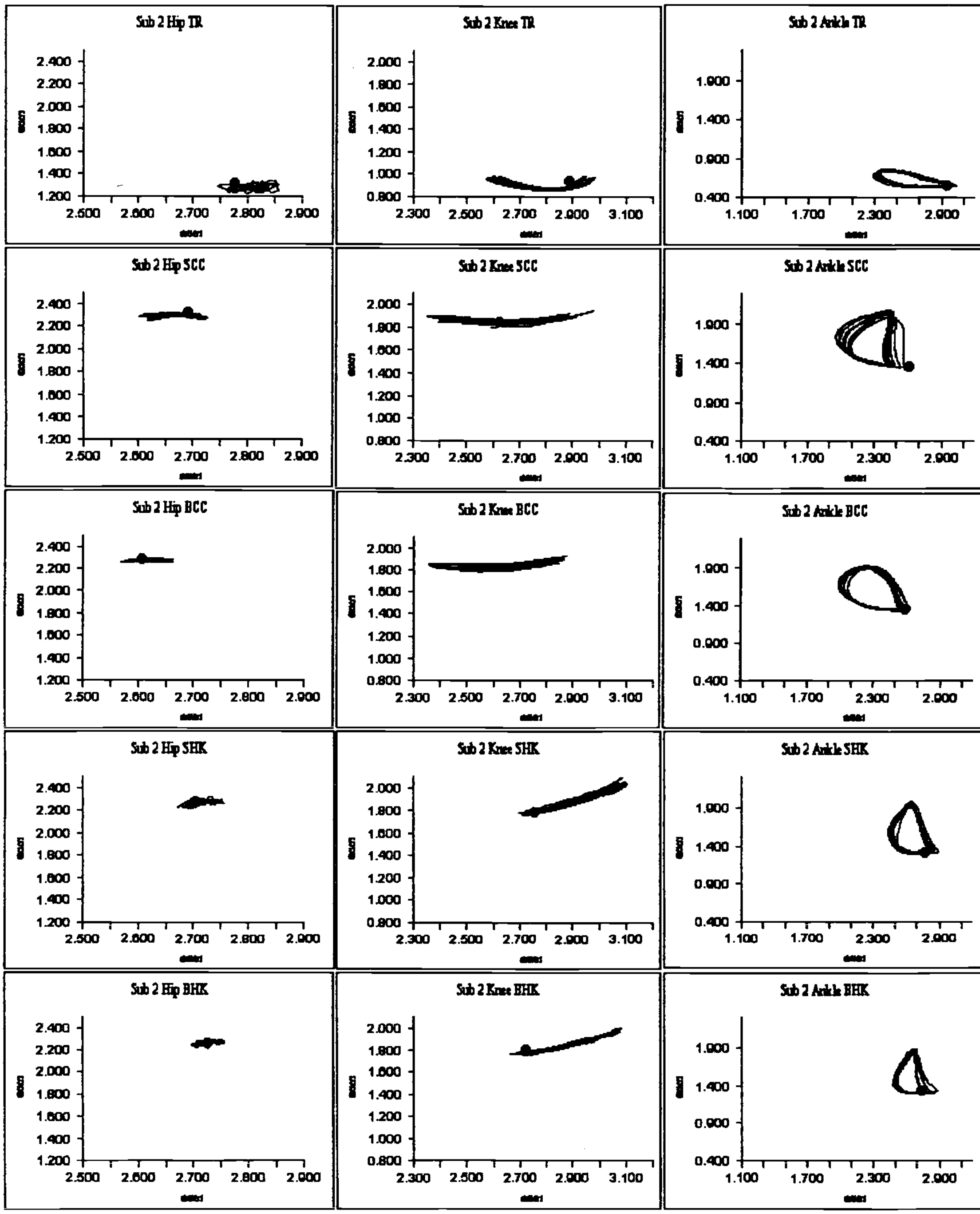


Figure E.3
XY Filtered Scaled Coordinates Displacements of Subject 3 in each Running Style

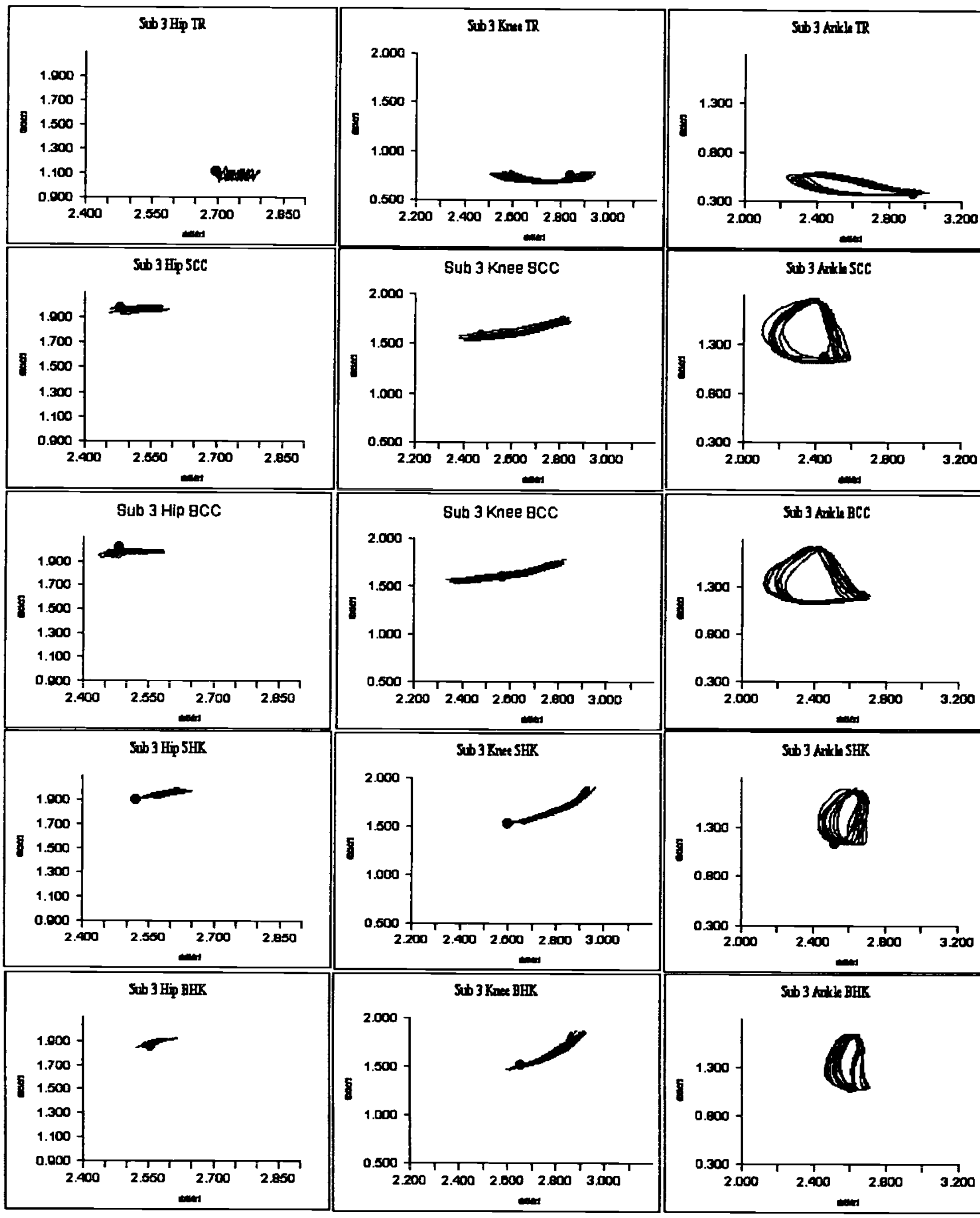


**Figure E.4**
**XY Filtered Scaled Coordinates Displacements of Subject 4 in each Running Style**

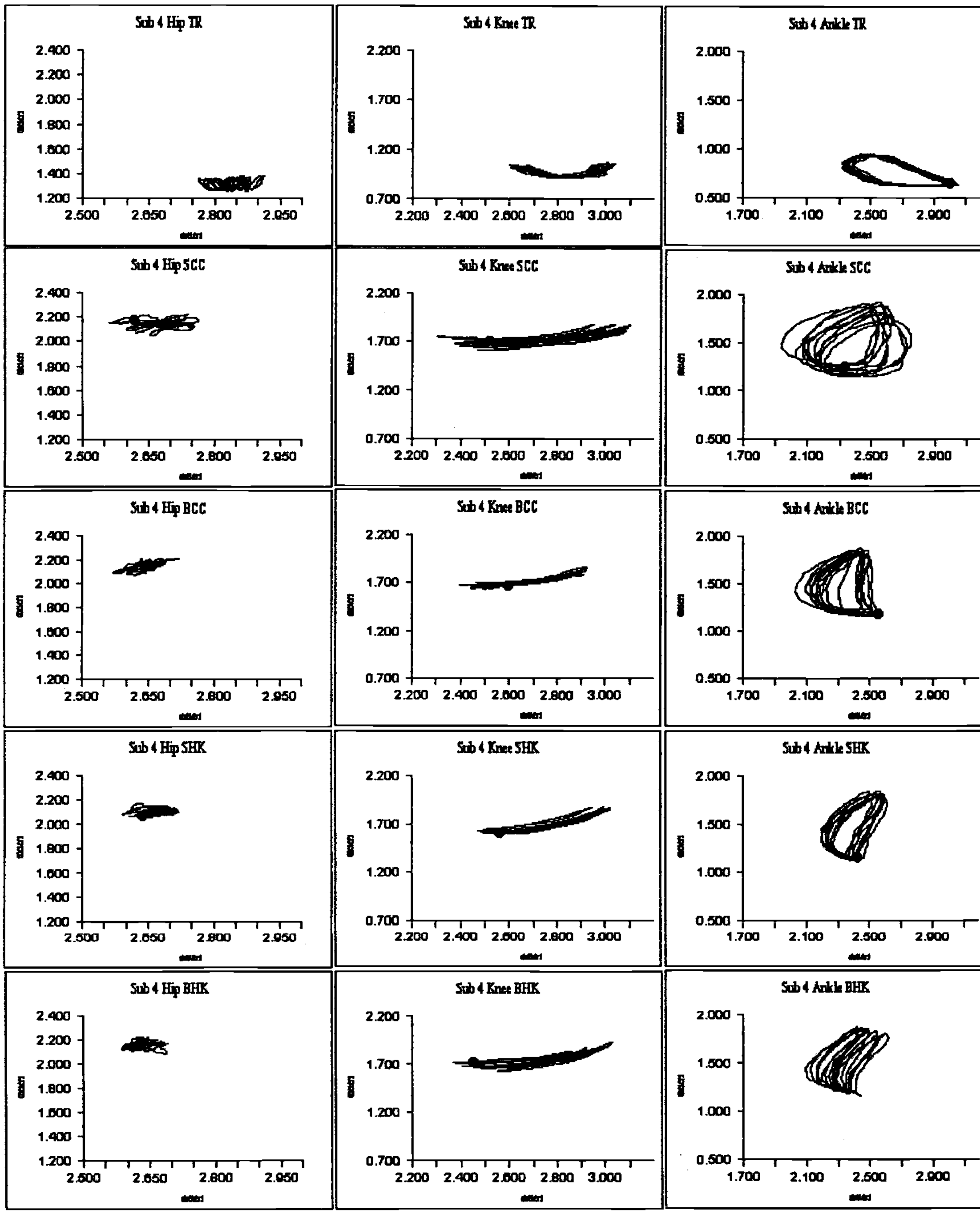


**Figure E.5**
**XY Filtered Scaled Coordinates Displacements of Subject 5 in each Running Style**

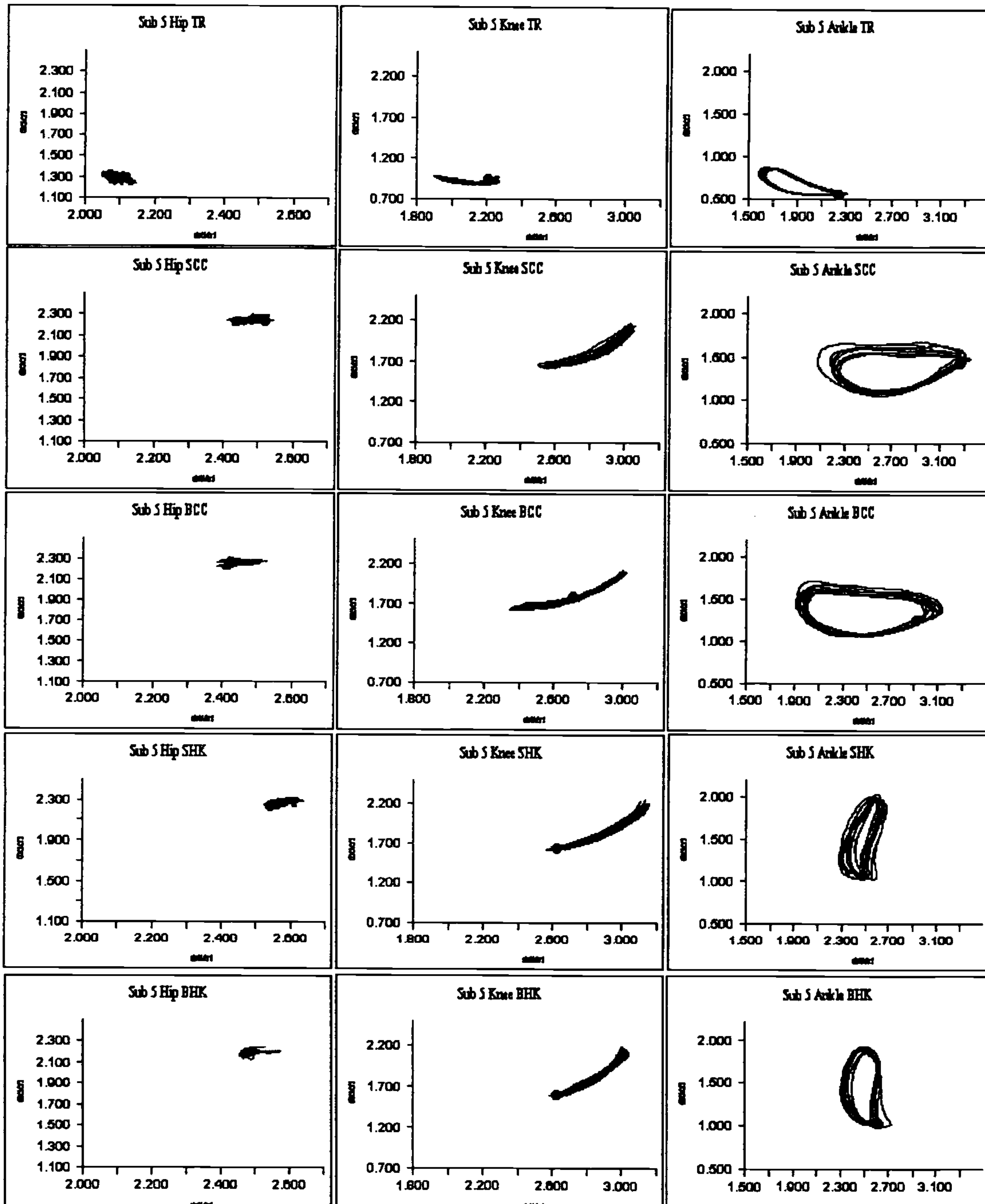


**Figure E.6**
**XY Filtered Scaled Coordinates Displacements of Subject 6 in each Running Style**

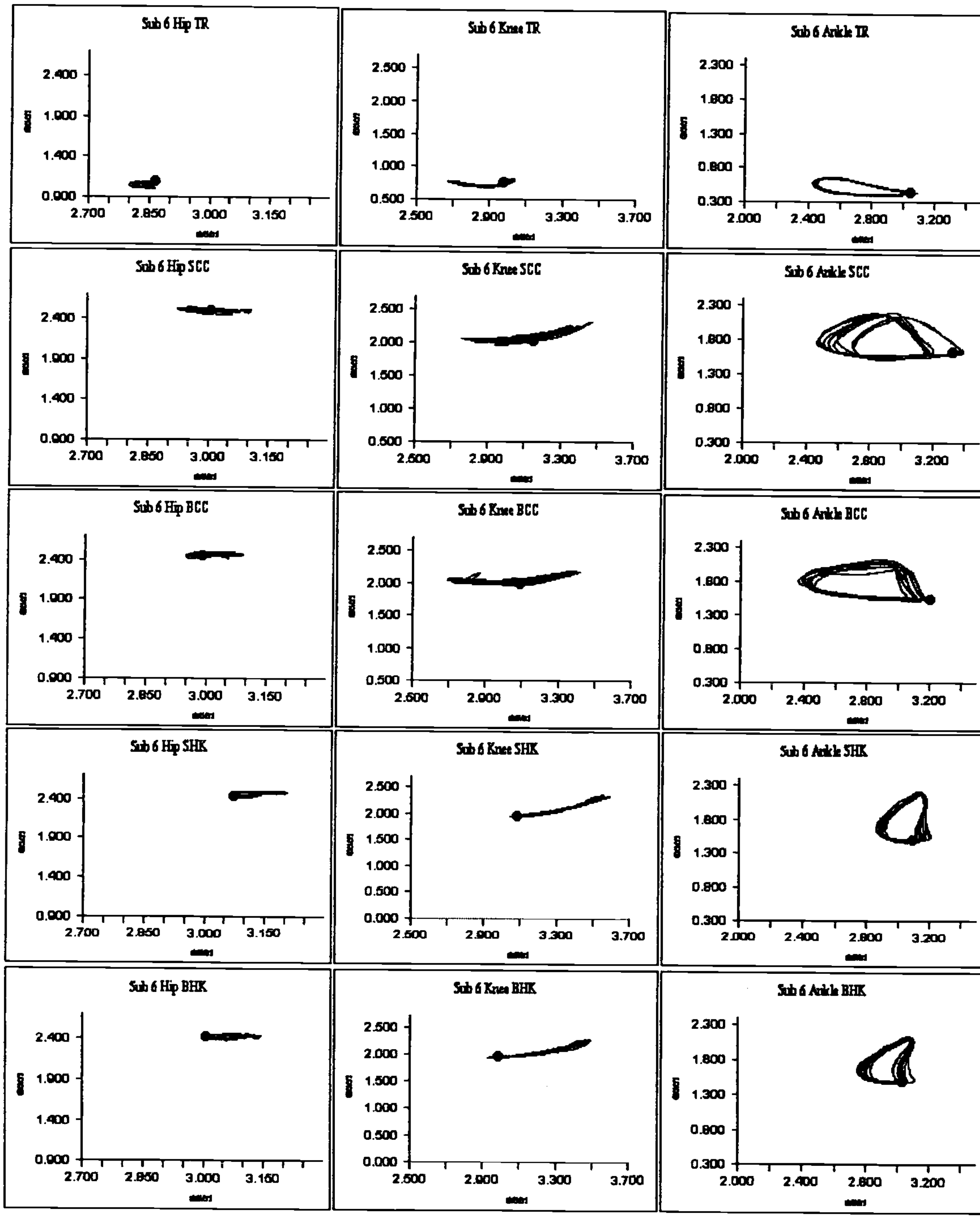


**Figure E.7**
**XY Filtered Scaled Coordinates Displacements of Subject 7 in each Running Style**

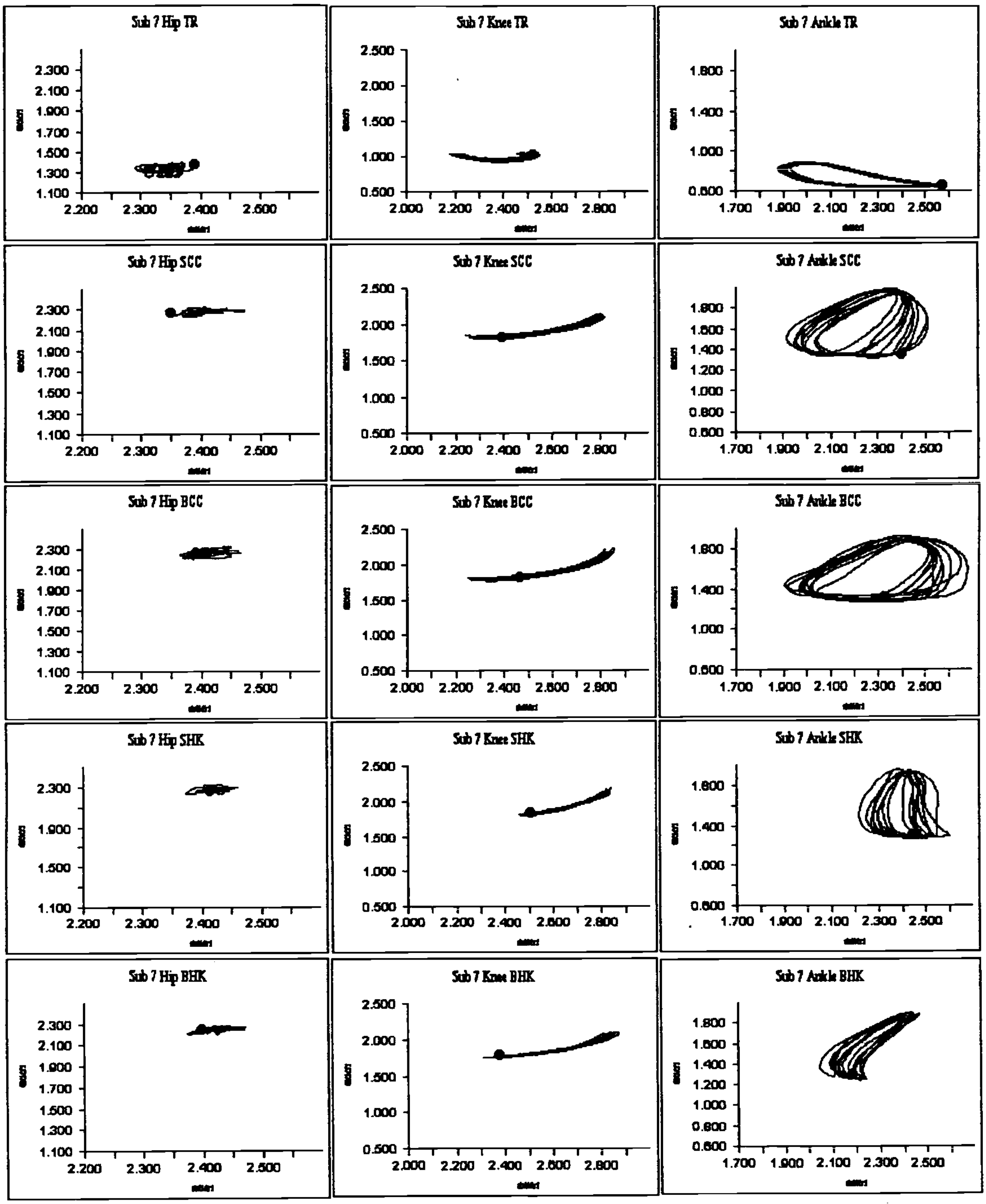


Figure E.8
XY Filtered Scaled Coordinates Displacements of Subject 8 in each Running Style

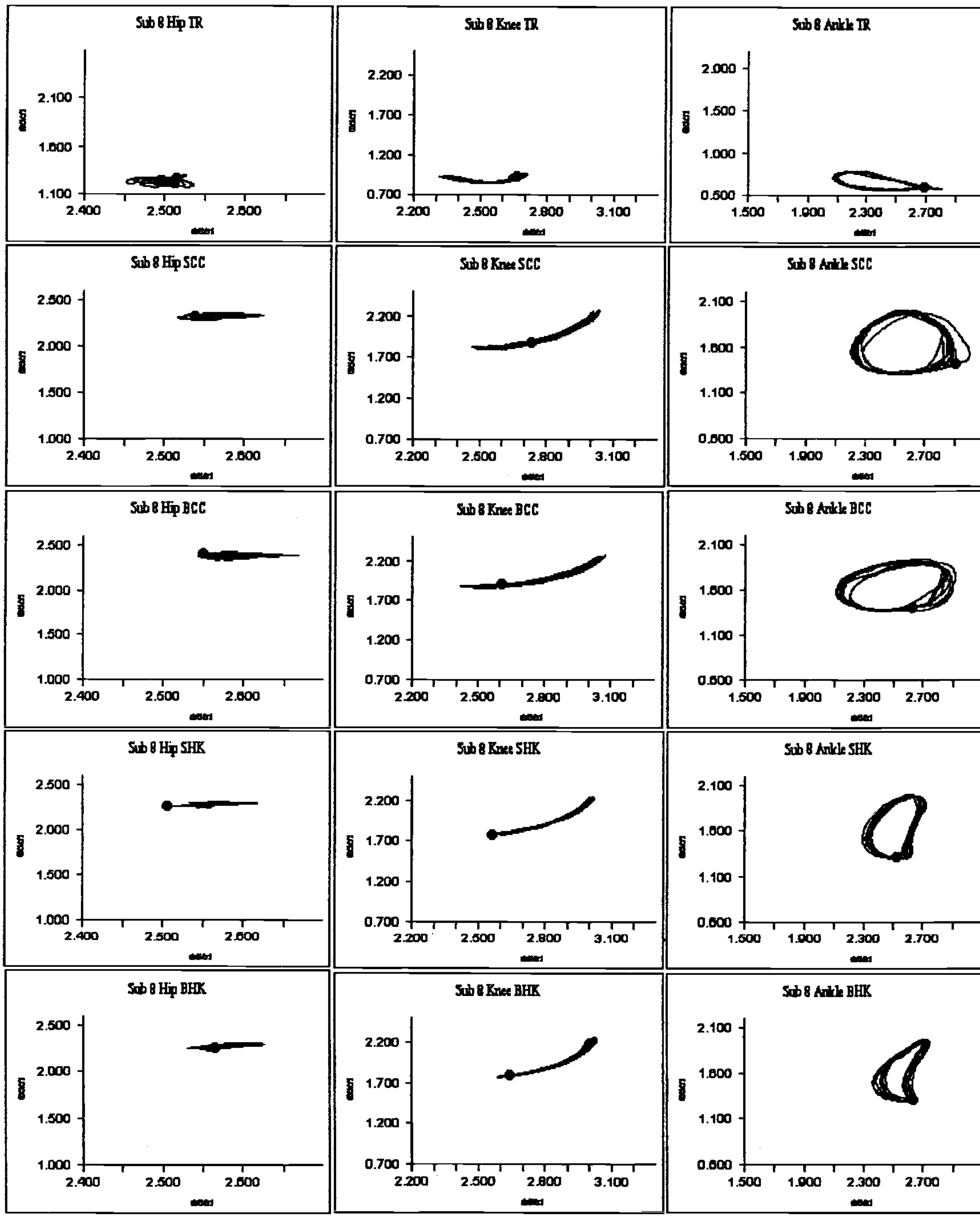


**Figure E9**
**XY Filtered Scaled Coordinates Displacements of Subject 9 in each Running Style**

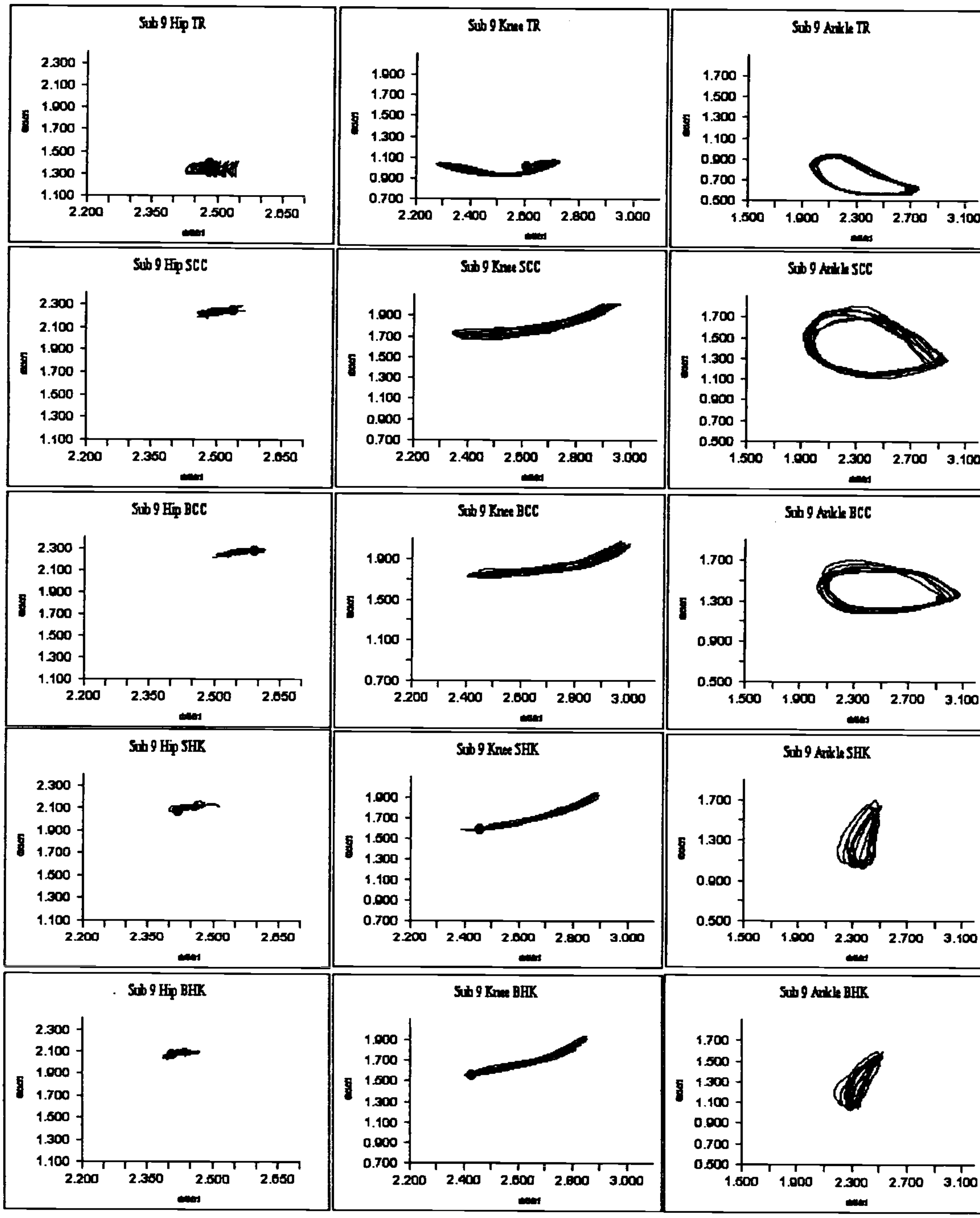


**Figure E.18**
**XY Filtered Scaled Coordinates Displacements of Subject 10 in each Running Style**

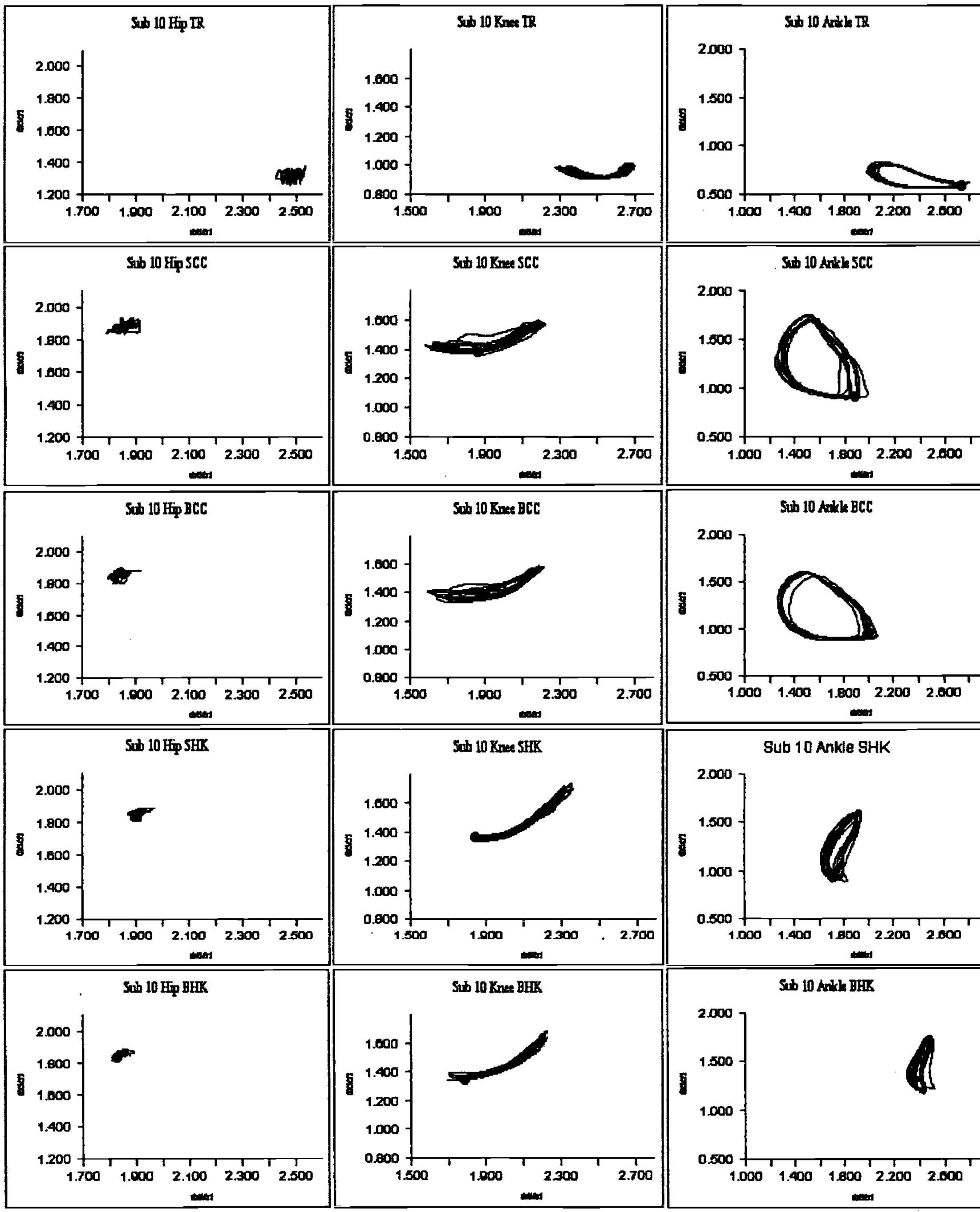


**Figure E11**
**XY Filtered Scaled Coordinates Displacements of Subject 11 in each Running Style**

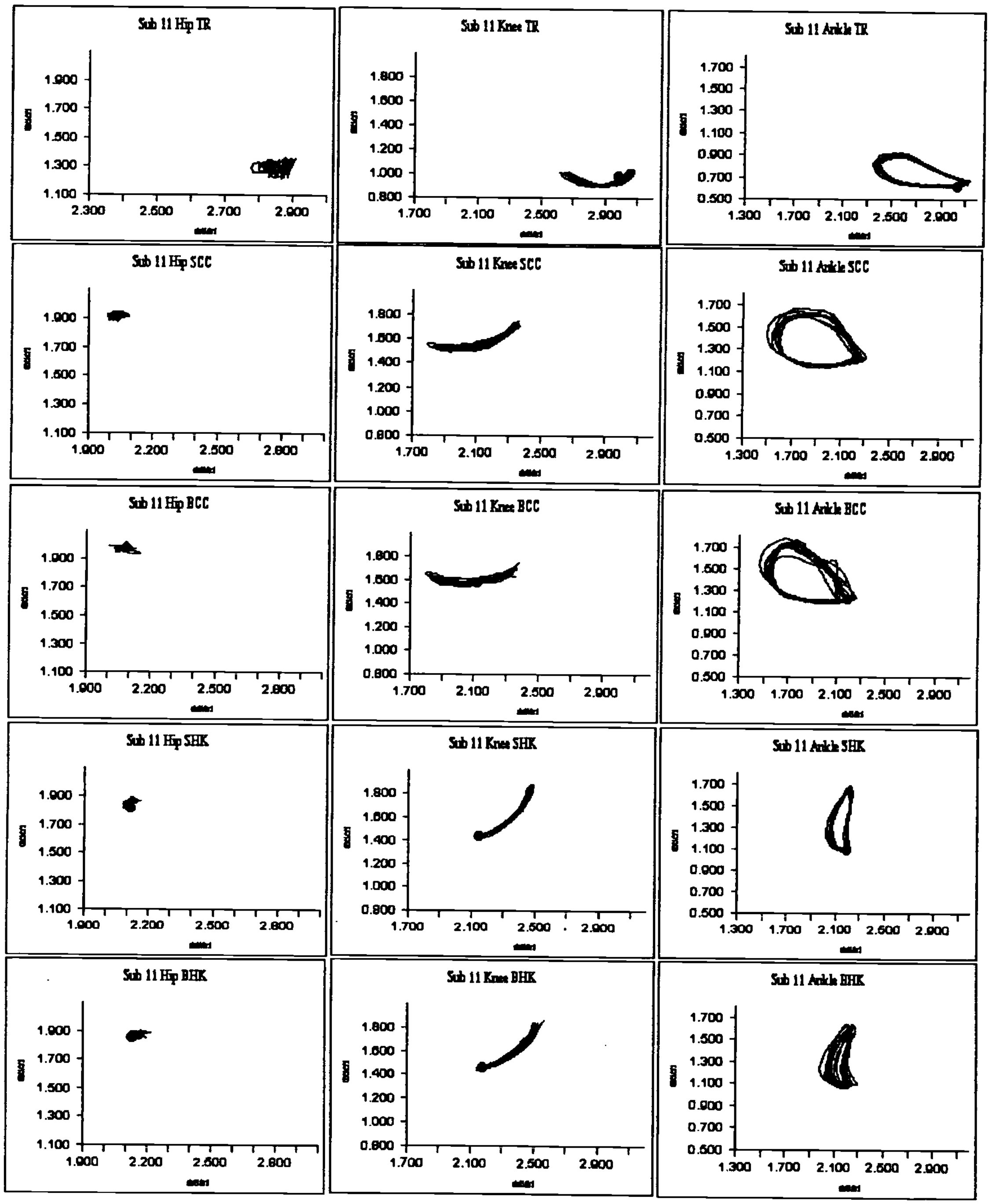


**Figure E.12**
**XY Filtered Scaled Coordinates Displacements of Subject 12 in each Running Style**

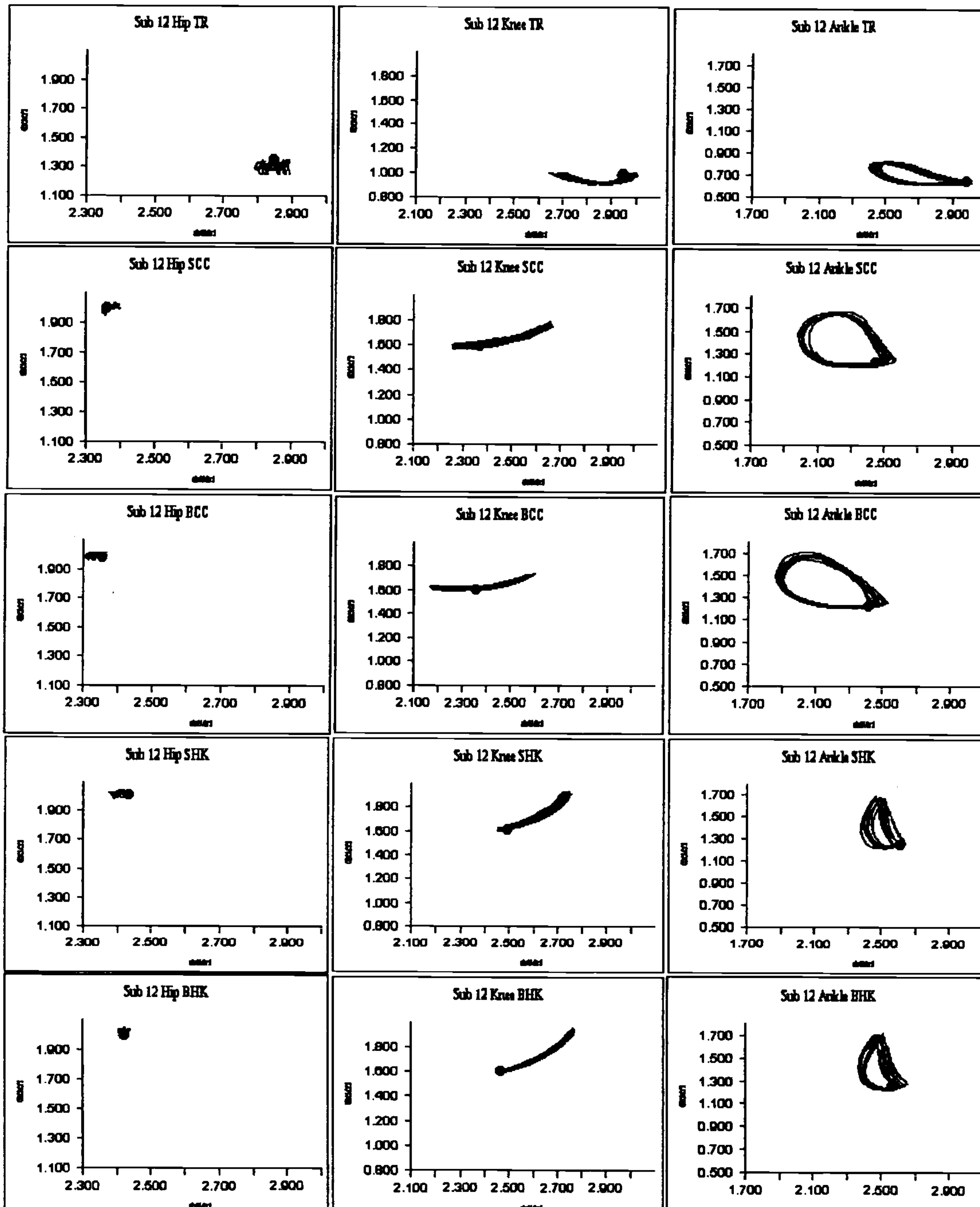


**Figure E.13**
**XY Filtered Scaled Coordinates Displacements of Subject 13 in each Running Style**

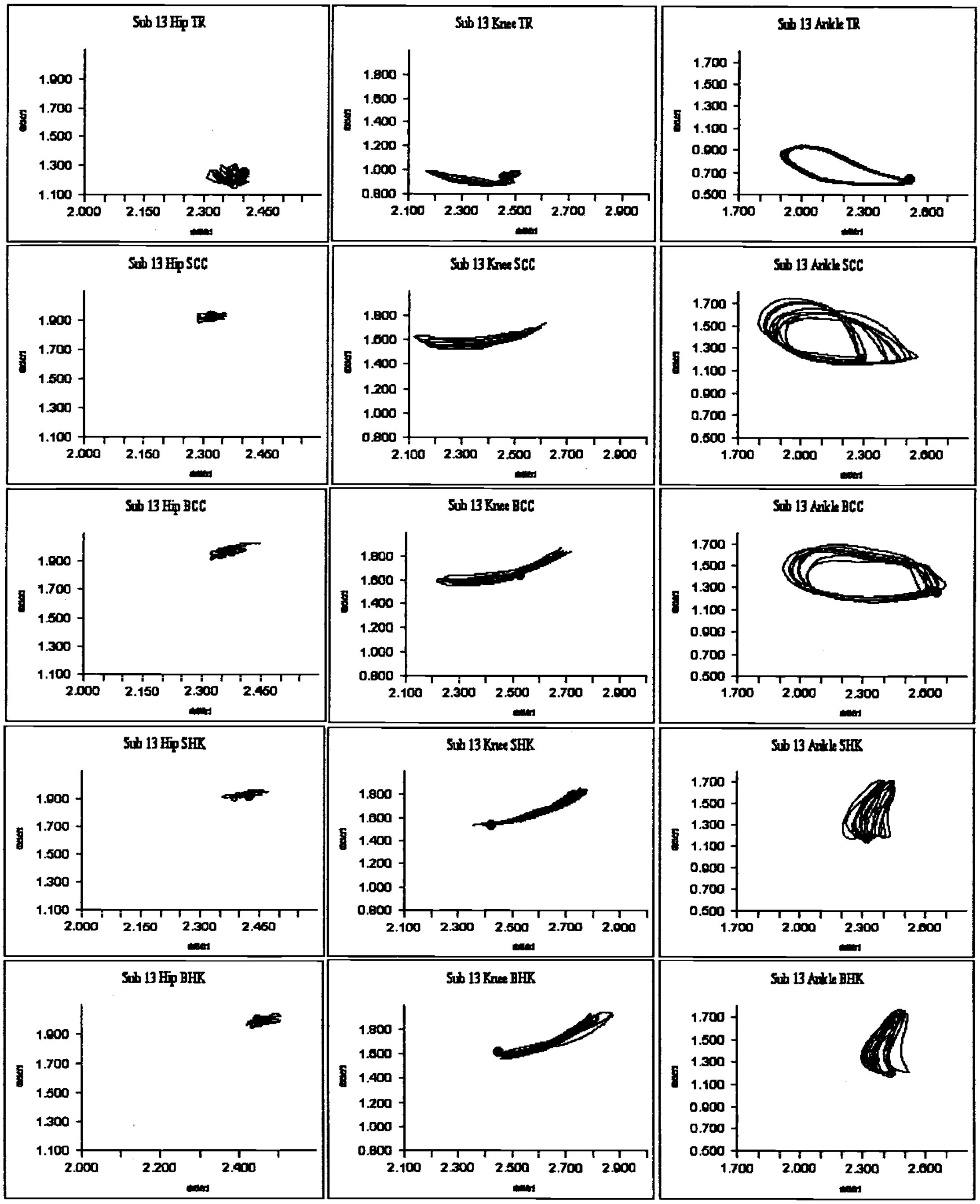


**Figure E 14**
**XY Filtered Scaled Coordinates Displacements of Subject 14 in each Running Style**

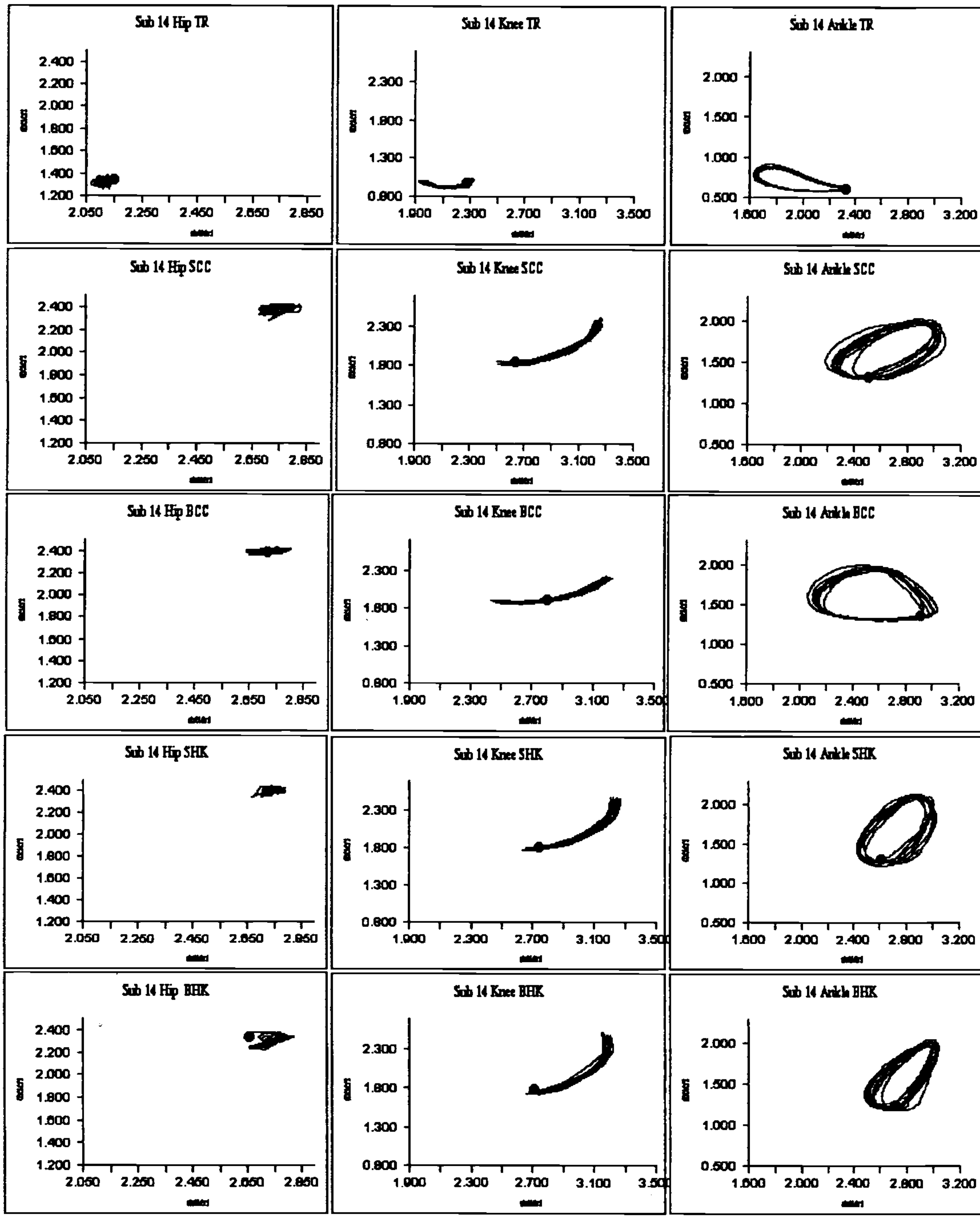


**Figure E.15**
**XY Filtered Scaled Coordinates Displacements of Subject 15 in each Running Style**

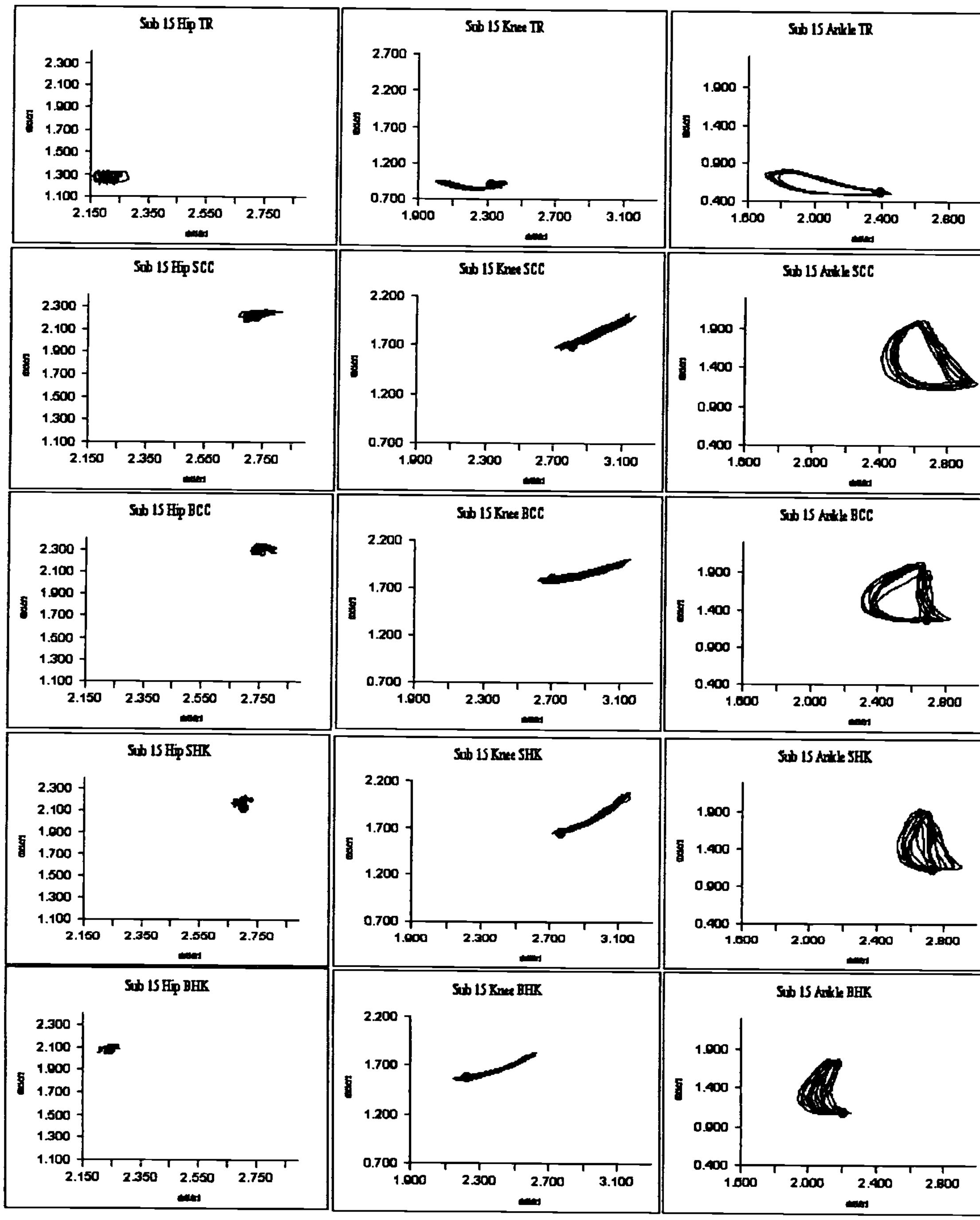


**Figure E.16**
**XY Filtered Scaled Coordinates Displacements of Subject 16 in each Running Style**

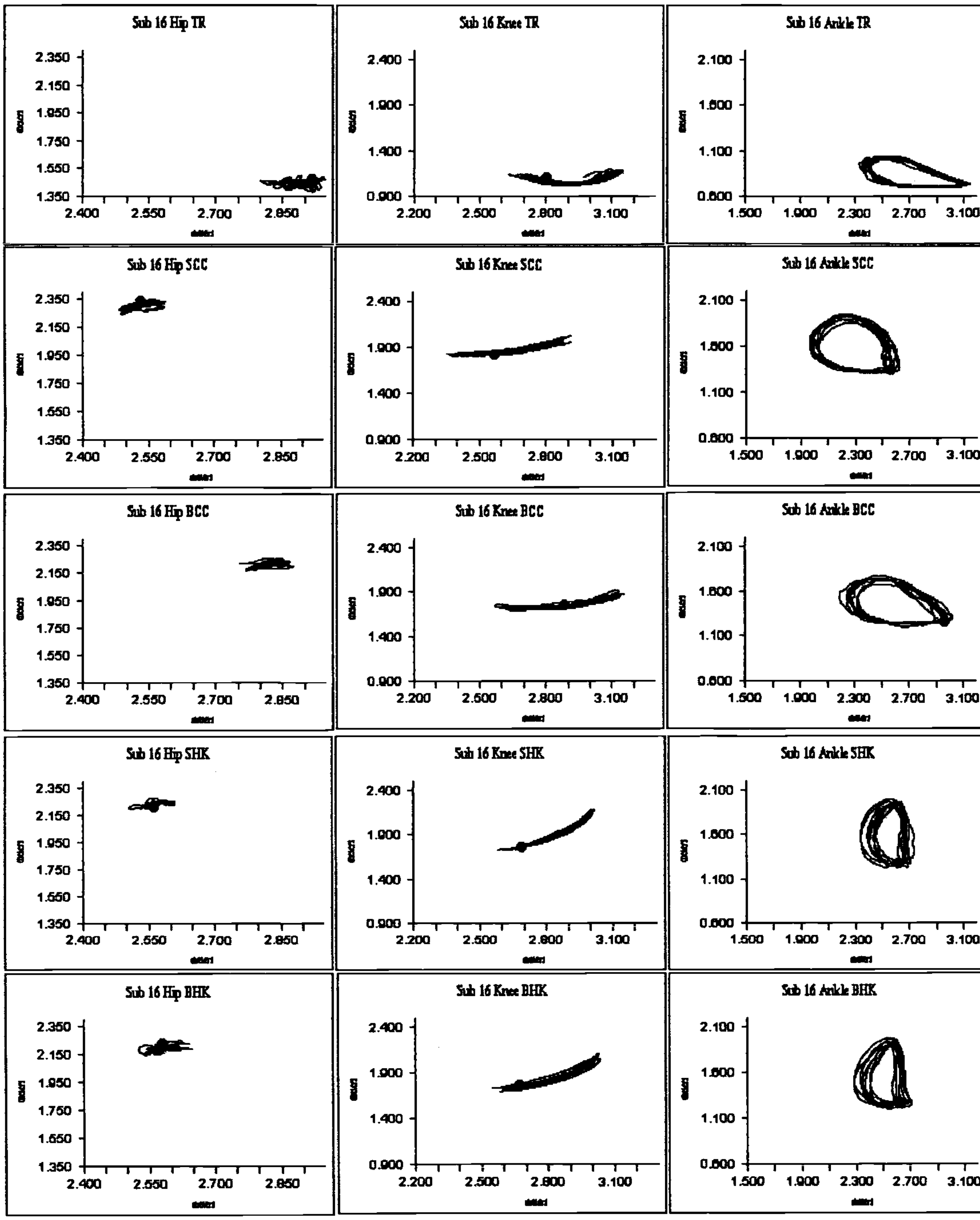


**Figure E17**
**XY Filtered Scaled Coordinates Displacements of Subject 17 in each Running Style**

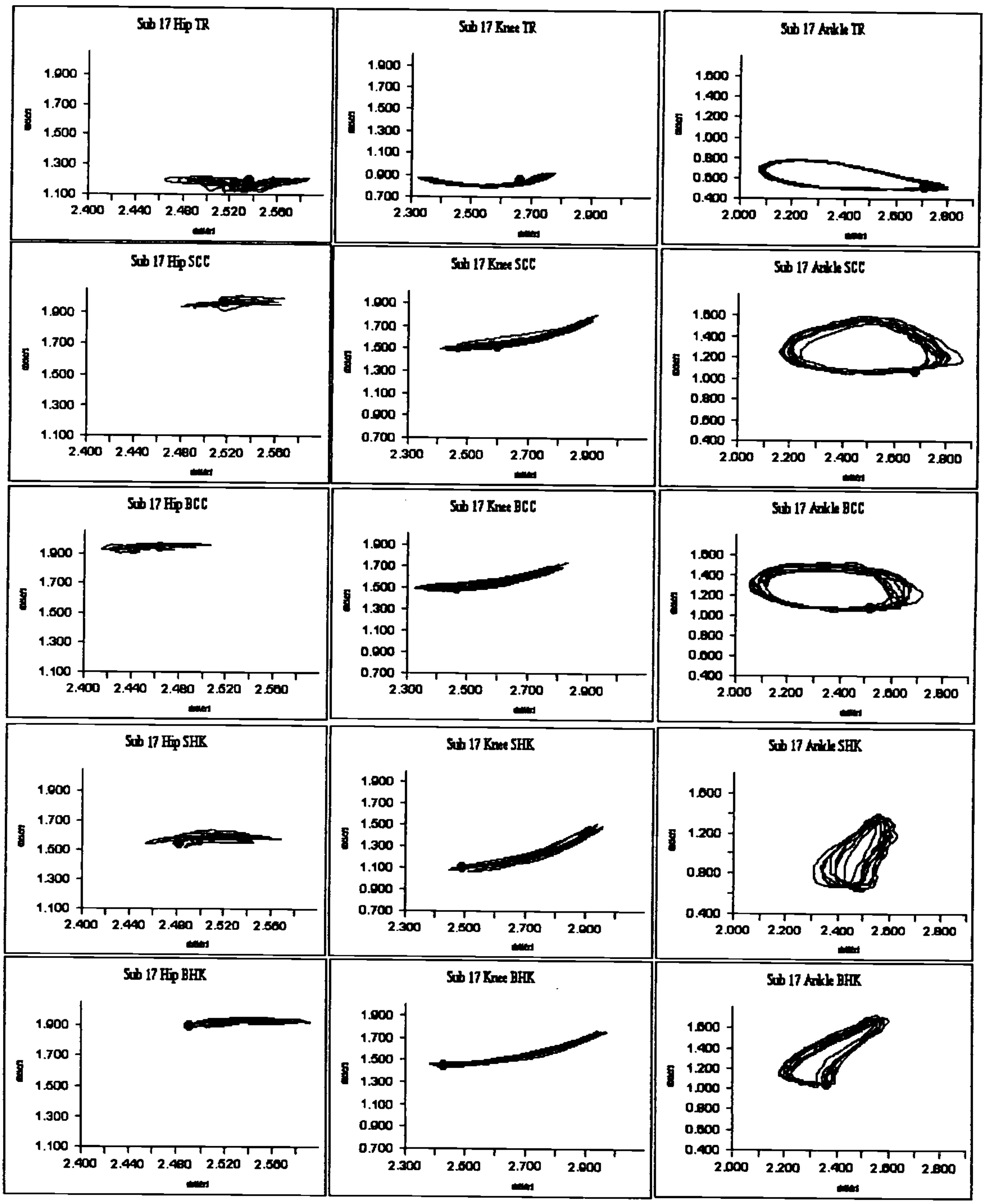


**Figure E.18**
**XY Filtered Scaled Coordinates Displacements of Subject 18 in each Running Style**

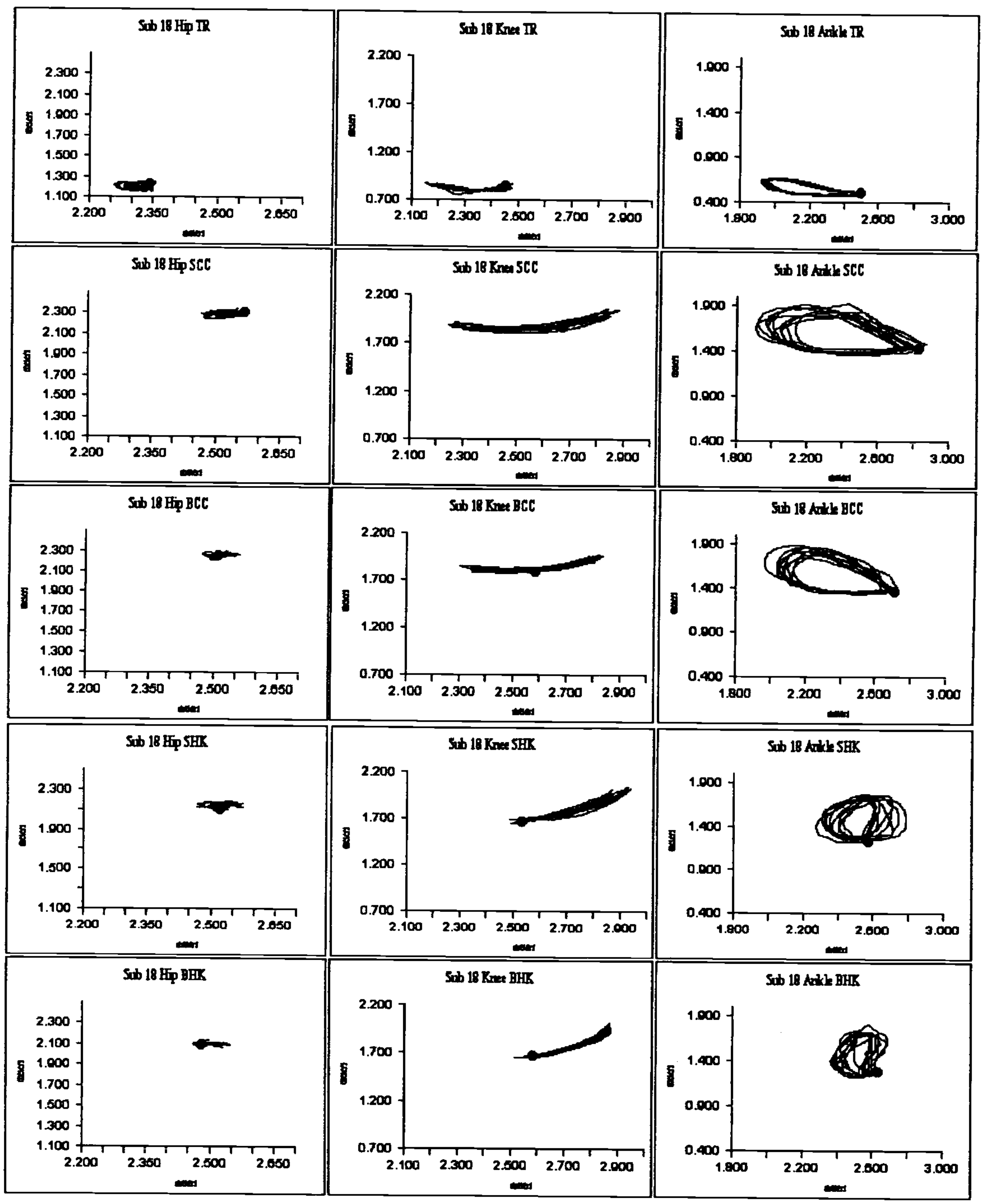


**Figure E.19**
**XY Filtered Scaled Coordinates Displacements of Subject 19 in each Running Style**

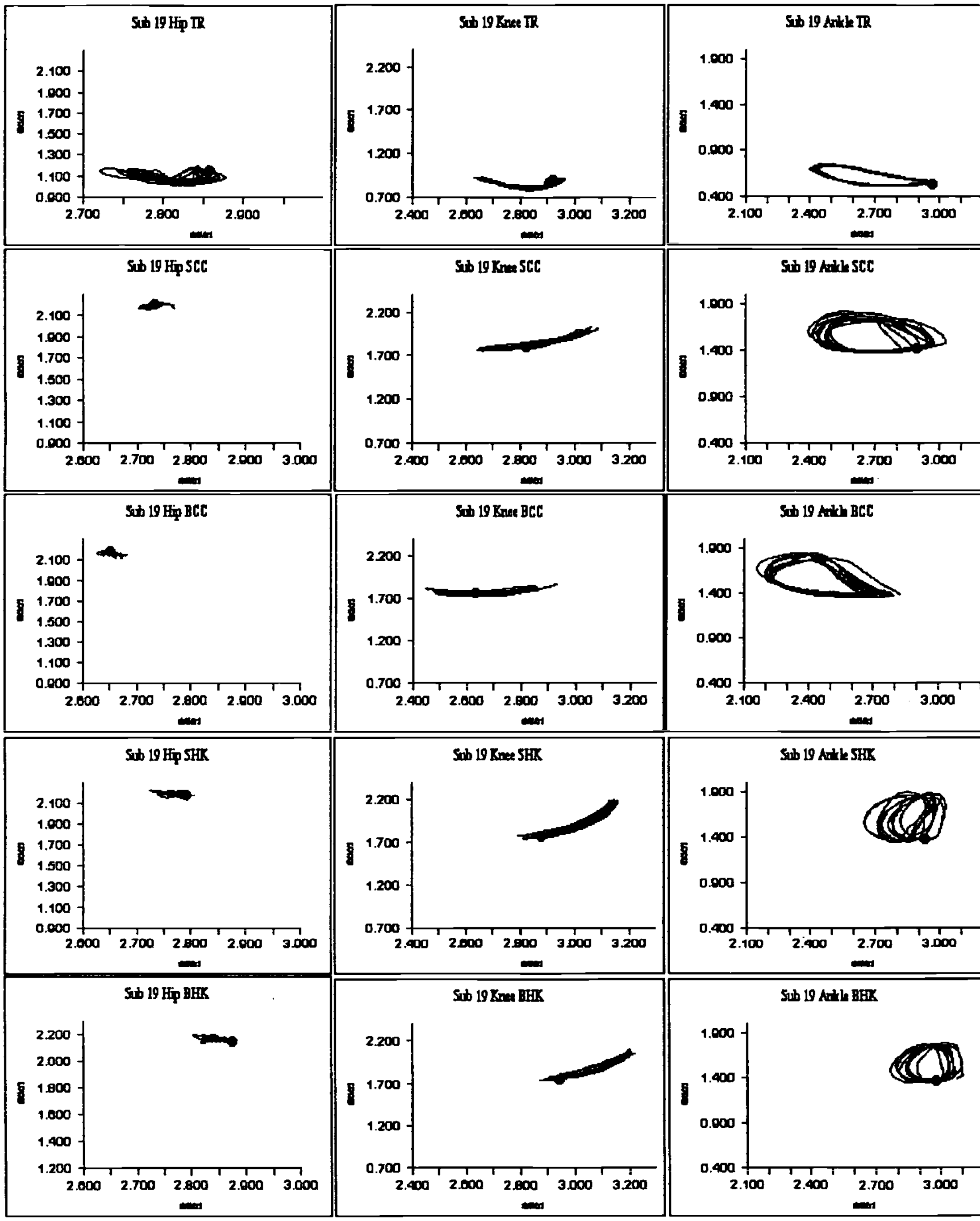
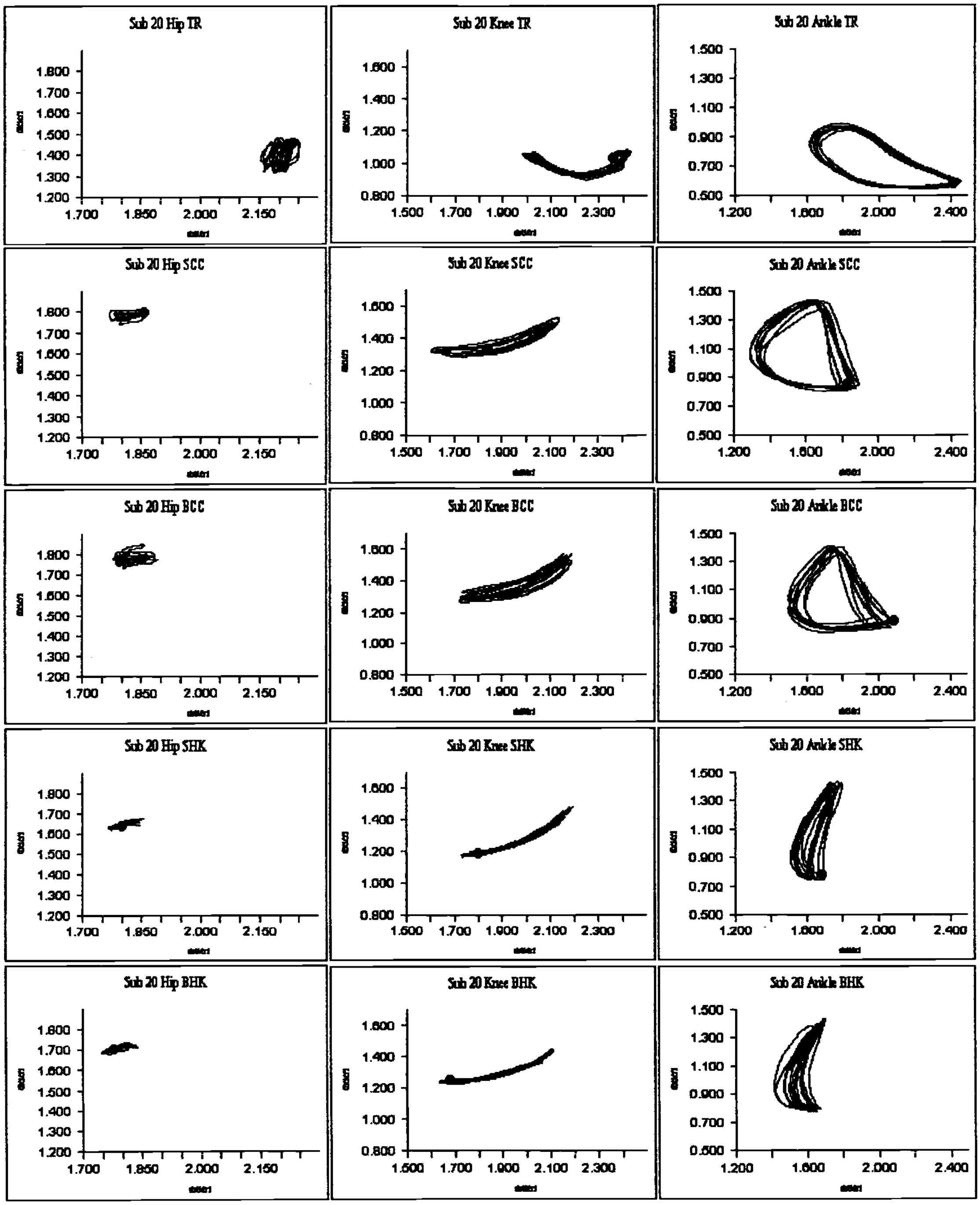


**Figure E.20**
**XY Filtered Scaled Coordinates Displacements of Subject 20 in each Running Style**



# TABLE E.47
## Knee XY Data Smoothing Frequency Summary

F1: XY KNEE

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Sub** | **X** | **Y** | **X** | **Y** | **X** | **Y** | **X** | **Y** | **X** | **Y** |
| **1** | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **2** | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **3** | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **4** | 6 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **5** | 5 | 5 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 |
| **6** | 5 | 5 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **7** | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **8** | 5 | 5 | 3 | 4 | 3 | 4 | 4 | 4 | 4 | 4 |
| **9** | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **10** | 5 | 6 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **11** | 5 | 6 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **12** | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **13** | 6 | 5 | 4 | 4 | 3 | 4 | 4 | 4 | 4 | 4 |
| **14** | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **15** | 6 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **16** | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **17** | 5 | 6 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **18** | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **19** | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **20** | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **Mean** | **5.2** | **5.2** | **3.8** | **4.0** | **3.9** | **4.0** | **4.0** | **4.0** | **4.0** | **4.0** |
| **SD** | **0.4** | **0.4** | **0.4** | **0.2** | **0.4** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |

# TABLE E.48
## Ankle XY Data Smoothing Frequency Summary

| | XY ANKLE | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | TR | | SCC | | BCC | | SHK | | BHK | |
| **Sub** | **X** | **Y** | **X** | **Y** | **X** | **Y** | **X** | **Y** | **X** | **Y** |
| **1** | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **2** | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 5 |
| **3** | 6 | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 |
| **4** | 5 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 5 | 4 |
| **5** | 5 | 5 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **6** | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 5 |
| **7** | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **8** | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 4 | 5 |
| **9** | 6 | 4 | 3 | 4 | 4 | 4 | 4 | 4 | 5 | 4 |
| **10** | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 4 |
| **11** | 6 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 4 |
| **12** | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 5 |
| **13** | 6 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 4 |
| **14** | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **15** | 5 | 5 | 4 | 5 | 5 | 5 | 4 | 4 | 5 | 5 |
| **16** | 6 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 |
| **17** | 6 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 4 |
| **18** | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **19** | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| **20** | 6 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 5 |
| **Mean** | **5.4** | **4.4** | **3.9** | **4.1** | **4.1** | **4.1** | **4.0** | **4.1** | **4.6** | **4.4** |
| **SD** | **0.5** | **0.5** | **0.3** | **0.2** | **0.3** | **0.3** | **0.0** | **0.2** | **0.5** | **0.5** |

**TABLE E.49**
**ANOVA Table**

| | Significance | Power | Eta Squared | Mean Diff |
|---|---|---|---|---|
| **SR (Strides/sec or Hz)** | 0.000 | 1.000 | 0.966 | 0.48 |
| **KXMN (meters)** | 0.000 | 1.000 | 0.952 | 0.2097 |
| **KXMX (meters)** | 0.000 | 1.000 | 0.927 | 0.176 |
| **KYMN (meters)** | 0.000 | 1.000 | 0.921 | 0.1495 |
| **KYMX (meters)** | 0.000 | 1.000 | 0.846 | 0.0977 |
| **AXMN (meters)** | 0.003 | 0.955 | 0.616 | -0.1337 |
| **AXMX (meters)** | 0.000 | 1.000 | 0.930 | 0.2815 |
| **AYMN (meters)** | 0.000 | 0.998 | 0.729 | 0.1057 |
| **AYMX (meters)** | 0.000 | 1.000 | 0.797 | 0.2252 |

**TABLE E.50**
**Pairwise Mean Differences**

| | TR/ SCC | TR/ BCC | TR/ SHK | TR/ BHK | SCC/ BCC | SCC/ SHK | SCC/ BHK | BCC/ SHK | BCC/ BHK | SHK/ BHK |
|---|---|---|---|---|---|---|---|---|---|---|
| **SR** (Hz) | **0.47** | **0.44** | **0.26** | **0.19** | 0.03 | **0.35** | **0.36** | **0.32** | **0.33** | **0.01** |
| **KXMN** (meters) | **0.156** | **0.139** | **0.210** | **0.189** | 0.017 | **0.053** | 0.033 | **0.071** | **0.049** | **0.021** |
| **KXMX** (meters) | -0.046 | -0.022 | **-0.176** | **-0.155** | -0.025 | **-0.130** | **-0.110** | **-0.154** | **-0.134** | 0.019 |
| **KYMN** (meters) | **0.055** | 0.033 | **0.178** | **0.150** | 0.022 | **0.123** | **0.095** | **0.145** | **0.117** | 0.028 |
| **KYMX** (meters) | **0.089** | **0.097** | **0.093** | **0.088** | 0.008 | 0.004 | 0.001 | 0.004 | 0.009 | 0.005 |
| **AXMN** (meters) | 0.028 | 0.021 | **0.115** | 0.149 | 0.007 | -0.087 | -0.121 | -0.094 | **-0.128** | -0.034 |
| **AXMX** (meters) | 0.016 | 0.007 | **0.275** | **0.261** | 0.023 | **0.259** | **0.245** | **0.282** | **0.268** | 0.014 |
| **AYMN** (meters) | 0.069 | 0.017 | **0.106** | 0.076 | **0.052** | 0.037 | 0.007 | **0.089** | 0.059 | **0.030** |
| **AYMX** (meters) | **0.226** | **0.224** | **0.216** | **0.208** | 0.002 | 0.010 | 0.017 | 0.008 | 0.015 | 0.007 |

**bold=(<.004: largest mean - smallest mean)**

## TABLE E.51

| | RELIABILITY COEFFICIENTS | | | | |
|---|---|---|---|---|---|
| | **TR** | **SCC** | **BCC** | **SHK** | **BHK** |
| **SR (hz)** | 0.9692 | 0.9895 | 0.9748 | 0.9880 | 0.9865 |
| **Knee $Hor_{disp}$ ($X_{min}$)** | 0.9936 | 0.9919 | 0.9581 | 0.9950 | 0.8930 |
| **Knee $Hor_{disp}$ ($X_{max}$)** | 0.9865 | 0.9803 | 0.9869 | 0.9883 | 0.9947 |
| **Knee $Vert_{disp}$ ($Y_{min}$)** | 0.9953 | 0.9822 | 0.9850 | 0.9915 | 0.9953 |
| **Knee $Vert_{disp}$ ($Y_{max}$)** | 0.9931 | 0.9585 | 0.9982 | 0.9986 | 0.9972 |
| **Ankle $Hor_{disp}$ ($X_{min}$)** | 0.9627 | 0.9903 | 0.9931 | 0.9881 | 0.9901 |
| **Ankle $Hor_{disp}$ ($X_{max}$)** | 0.9952 | 0.9865 | 0.9777 | 0.9884 | 0.9848 |
| **Ankle $Vert_{disp}$ ($Y_{min}$)** | 0.9676 | 0.9939 | 0.9907 | 0.9930 | 0.9935 |
| **Ankle $Vert_{disp}$ ($Y_{max}$)** | 0.9971 | 0.9986 | 0.9993 | 0.9991 | 0.9983 |
| **Hip Joint $Angle_{min}$** | 0.9858 | 0.9809 | 0.989 | 0.9830 | 0.9959 |
| **Hip Joint $Angle_{max}$** | 0.9885 | 0.9928 | 0.9902 | 0.9932 | 0.9947 |
| **Knee Joint $Angle_{min}$** | 0.9597 | 0.9791 | 0.9806 | 0.9687 | 0.9824 |
| **Knee Joint $Angle_{max}$** | 0.9958 | 0.9905 | 0.9850 | 0.9938 | 0.9930 |
| **Ankle Joint $Angle_{min}$** | 0.9553 | 0.9883 | 0.9510 | 0.9851 | 0.9884 |
| **Ankle Joint $Angle_{max}$** | 0.9862 | 0.9786 | 0.9762 | 0.9794 | 0.9846 |

TABLE K9: JOINT ANGLES - SUB 1

| HIP | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -17.09 | 11.91 | 12.36 | 73.82 | 0.47 | 61.45 | 13.63 | 58.45 | 8.53 | 56.27 |
| 2 | -16.78 | 12.06 | 14.04 | 78.47 | 2.84 | 59.52 | 14.75 | 55.94 | 10.89 | 54.35 |
| 3 | -15.52 | 12.98 | 7.12 | 70.57 | 4.71 | 62.42 | 9.88 | 53.44 | 9.09 | 57.32 |
| 4 | -17.57 | 14.48 | 1.95 | 66.69 | 9.02 | 59.78 | 11.38 | 58.40 | 7.61 | 54.22 |
| 5 | -12.58 | 13.76 | 6.19 | 65.13 | 5.15 | 60.45 | 8.25 | 49.40 | 8.03 | 60.22 |
| 6 | -22.48 | 12.28 | 6.98 | 74.24 | 4.51 | 61.13 | 9.31 | 51.66 | 8.46 | 51.31 |
| 7 | -12.67 | 12.39 | 8.88 | 67.55 | 6.08 | 59.58 | 10.37 | 48.34 | 12.15 | 55.93 |
| 8 | -17.53 | 12.34 | 5.59 | 70.55 | 6.14 | 55.35 | 8.01 | 58.23 | 7.02 | 53.86 |
| 9 | -18.83 | 14.10 | 14.95 | 78.55 | 6.31 | 59.30 | 7.99 | 56.95 | 11.05 | 56.86 |
| 10 | -19.23 | 13.99 | 5.31 | 71.67 | 2.36 | 63.34 | 8.88 | 60.60 | 4.28 | 59.81 |
| **Mean** | **-17.03** | **13.03** | **8.34** | **71.72** | **4.76** | **60.23** | **10.24** | **55.14** | **8.71** | **56.02** |
| **SD** | **2.97** | **0.96** | **4.19** | **4.62** | **2.41** | **2.18** | **2.36** | **4.20** | **2.27** | **2.73** |
| **Smooth** | **4** | | **4** | | **4** | | **4** | | **4** | |
| **KNEE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | 6.85 | 70.22 | -13.83 | 139.25 | -10.00 | 114.54 | 4.32 | 132.40 | -2.46 | 123.55 |
| 2 | 5.83 | 77.23 | -12.88 | 137.13 | -13.39 | 115.99 | -1.46 | 133.53 | -3.39 | 122.35 |
| 3 | 6.68 | 74.61 | -12.74 | 132.41 | -11.23 | 108.72 | 0.41 | 130.01 | -3.26 | 126.72 |
| 4 | 7.60 | 76.22 | -11.22 | 130.02 | -12.44 | 110.39 | 4.93 | 127.53 | -3.55 | 121.94 |
| 5 | 5.61 | 74.56 | -12.40 | 133.99 | -11.91 | 112.45 | 2.89 | 125.62 | -1.93 | 125.46 |
| 6 | 3.72 | 73.11 | -13.91 | 135.56 | -11.61 | 115.23 | 2.92 | 126.99 | -6.62 | 124.29 |
| 7 | 7.42 | 72.60 | -13.43 | 134.04 | -12.68 | 106.74 | 2.70 | 125.87 | -5.35 | 122.35 |
| 8 | 8.65 | 74.91 | -13.70 | 127.53 | -13.03 | 110.50 | -1.00 | 132.87 | -3.83 | 122.09 |
| 9 | 8.46 | 76.51 | -13.00 | 137.92 | -11.37 | 125.30 | 0.96 | 128.08 | -6.03 | 124.29 |
| 10 | 8.88 | 76.01 | -13.56 | 138.62 | -9.97 | 110.85 | -1.46 | 130.95 | -6.80 | 125.11 |
| **Mean** | **6.97** | **74.60** | **-13.07** | **134.65** | **-11.76** | **113.07** | **1.52** | **129.39** | **-4.32** | **123.81** |
| **SD** | **1.60** | **2.12** | **0.82** | **3.84** | **1.17** | **5.19** | **2.37** | **2.96** | **1.75** | **1.64** |
| **Smooth** | **6** | | **4** | | **4** | | **5** | | **4** | |
| **ANKLE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | -9.90 | -56.81 | -30.90 | -79.05 | -48.61 | -80.32 | -29.05 | -46.83 | -21.64 | -53.37 |
| 2 | -11.82 | -58.75 | -29.86 | -75.73 | -40.05 | -74.51 | -19.56 | -56.54 | -23.93 | -57.55 |
| 3 | -8.48 | -57.46 | -31.83 | -62.54 | -16.86 | -65.82 | -22.51 | -64.98 | -24.61 | -65.12 |
| 4 | -17.38 | -55.19 | -31.70 | -58.62 | -9.31 | -63.16 | -23.10 | -58.14 | -23.62 | -54.62 |
| 5 | -16.74 | -59.78 | -27.74 | -56.32 | -45.14 | -80.01 | -18.84 | -69.35 | -21.97 | -50.41 |
| 6 | -16.37 | -52.82 | -32.64 | -57.44 | -58.75 | -82.78 | -21.97 | -55.91 | -21.58 | -63.21 |
| 7 | -16.02 | -60.82 | -28.32 | -62.70 | -58.95 | -73.38 | -21.65 | -65.80 | -21.96 | -64.00 |
| 8 | -19.27 | -65.06 | -31.87 | -56.47 | -0.12 | -75.08 | -18.05 | -54.60 | -27.11 | -50.86 |
| 9 | -15.81 | -62.93 | -27.33 | -65.10 | -43.22 | -70.15 | -11.53 | -56.97 | -25.55 | -59.27 |
| 10 | -14.85 | -55.79 | -36.09 | -56.91 | -11.00 | -68.77 | -7.23 | -50.96 | -26.65 | -54.62 |
| **Mean** | **-14.66** | **-58.54** | **-30.83** | **-63.09** | **-33.20** | **-73.40** | **-19.35** | **-58.01** | **-23.86** | **-57.30** |
| **SD** | **3.47** | **3.72** | **2.64** | **8.16** | **21.78** | **6.48** | **6.15** | **6.93** | **2.09** | **5.41** |
| **Smooth** | **3** | | **2** | | **2** | | **3** | | **2** | |

TABLE K9: JOINT ANGLES - SUB 2

| HIP | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -20.83 | 16.28 | 4.50 | 47.46 | 3.34 | 54.44 | 8.68 | 57.51 | 14.69 | 58.25 |
| 2 | -23.37 | 13.44 | 4.12 | 43.72 | 5.86 | 46.46 | 9.60 | 62.46 | 17.08 | 64.24 |
| 3 | -28.03 | 15.18 | 4.09 | 47.64 | 8.15 | 50.58 | 5.95 | 56.74 | 13.35 | 67.47 |
| 4 | -20.94 | 22.17 | 2.57 | 39.49 | 5.40 | 43.51 | 5.66 | 65.94 | 12.52 | 61.24 |
| 5 | -24.97 | 16.86 | 2.86 | 41.45 | 6.54 | 46.30 | 9.18 | 58.42 | 17.90 | 56.21 |
| 6 | -25.08 | 17.69 | 0.84 | 43.02 | 3.32 | 45.38 | 13.92 | 61.68 | 19.13 | 66.76 |
| 7 | -25.72 | 17.85 | 2.57 | 45.97 | 9.58 | 58.71 | 13.92 | 63.50 | 10.83 | 62.38 |
| 8 | -26.83 | 16.17 | -3.76 | 39.55 | 6.17 | 53.32 | 13.34 | 62.74 | 14.51 | 65.67 |
| 9 | -24.10 | 17.49 | 4.01 | 51.63 | 8.70 | 48.41 | 9.51 | 58.35 | 17.36 | 58.69 |
| 10 | -24.29 | 15.35 | 3.04 | 53.29 | 7.39 | 51.805 | 13.98 | 59.32 | 17.00 | 58.66 |
| **Mean** | **-24.42** | **16.85** | **2.48** | **45.32** | **6.44** | **49.89** | **10.37** | **60.67** | **15.44** | **61.96** |
| **SD** | **2.30** | **2.31** | **2.45** | **4.76** | **2.10** | **4.74** | **3.24** | **3.02** | **2.67** | **3.96** |
| **Smooth** | **5** | | **4** | | **4** | | **5** | | **5** | |
| **KNEE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | 6.06 | 73.38 | -10.00 | 130.05 | -14.50 | 109.33 | 4.29 | 137.71 | -3.17 | 120.85 |
| 2 | 3.45 | 74.02 | -7.63 | 131.09 | -13.00 | 109.09 | 0.74 | 138.23 | -1.86 | 123.43 |
| 3 | 3.02 | 71.96 | -7.88 | 135.81 | -16.08 | 109.75 | -0.45 | 137.36 | -3.43 | 130.62 |
| 4 | 4.67 | 77.41 | -11.12 | 130.88 | -13.85 | 110.72 | -2.55 | 139.64 | -3.36 | 124.96 |
| 5 | 2.96 | 76.45 | -10.23 | 131.50 | -14.07 | 109.09 | 4.10 | 126.85 | -2.88 | 125.16 |
| 6 | 2.26 | 75.66 | -8.92 | 132.48 | -15.05 | 106.18 | -3.16 | 130.27 | -6.61 | 128.31 |
| 7 | 0.68 | 77.12 | -9.70 | 132.19 | -12.72 | 110.88 | 2.29 | 133.76 | -4.53 | 126.63 |
| 8 | 2.67 | 72.16 | -10.23 | 124.45 | -16.24 | 109.16 | 3.72 | 130.62 | -6.62 | 125.41 |
| 9 | -0.28 | 79.20 | -7.95 | 130.25 | -13.87 | 107.87 | 4.04 | 134.29 | -5.53 | 118.85 |
| 10 | 6.23 | 77.75 | -7.57 | 128.94 | -12.43 | 106.14 | 4.85 | 135.08 | -2.00 | 123.00 |
| **Mean** | **3.17** | **75.51** | **-9.12** | **130.76** | **-14.18** | **108.82** | **1.79** | **134.38** | **-4.00** | **124.72** |
| **SD** | **2.09** | **2.50** | **1.30** | **2.89** | **1.31** | **1.64** | **2.97** | **4.10** | **1.75** | **3.43** |
| **Smooth** | **7** | | **4** | | **4** | | **5** | | **5** | |
| **ANKLE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | -17.75 | -54.33 | -11.09 | -68.92 | -54.11 | -73.56 | -16.21 | -57.87 | -22.80 | -50.31 |
| 2 | -19.72 | -49.83 | -14.70 | -56.79 | -52.16 | -77.18 | -19.65 | -50.19 | -20.89 | -55.51 |
| 3 | -29.89 | -55.26 | -17.54 | -52.65 | -50.09 | -76.99 | -20.25 | -50.26 | -18.28 | -48.43 |
| 4 | -21.23 | -58.27 | -24.28 | -58.42 | -45.28 | -65.71 | -10.15 | -49.52 | -21.67 | -46.23 |
| 5 | -22.86 | -56.44 | -11.69 | -58.67 | -50.38 | -74.98 | -16.48 | -48.00 | -17.43 | -46.31 |
| 6 | -20.60 | -56.46 | -15.43 | -57.76 | -50.32 | -76.14 | -11.68 | -45.20 | -14.79 | -49.61 |
| 7 | -24.44 | -54.85 | -19.57 | -57.97 | -53.75 | -72.68 | -9.74 | -41.11 | -18.37 | -45.06 |
| 8 | -25.40 | -57.74 | -35.27 | -54.87 | -49.94 | -73.20 | -11.45 | -47.80 | -16.84 | -43.27 |
| 9 | -31.15 | -57.87 | -22.46 | -58.84 | -49.06 | -80.98 | -4.36 | -44.10 | -25.97 | -50.98 |
| 10 | -24.84 | -60.21 | -39.57 | -77.42 | -46.79 | -74.16 | -13.99 | -48.24 | -21.00 | -40.04 |
| **Mean** | **-23.79** | **-56.13** | **-21.16** | **-60.23** | **-50.19** | **-74.56** | **-13.40** | **-48.23** | **-19.80** | **-47.57** |
| **SD** | **4.30** | **2.84** | **9.61** | **7.36** | **2.77** | **3.97** | **4.90** | **4.47** | **3.28** | **4.37** |
| **Smooth** | **2** | | **3** | | **2** | | **2** | | **4** | |

**TABLE K9: JOINT ANGLES - SUB 3**

| HIP | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -18.66 | 24.77 | 21.07 | 70.38 | 21.26 | 62.36 | 27.50 | 76.50 | 21.30 | 66.68 |
| 2 | -21.36 | 23.05 | 16.06 | 59.31 | 23.65 | 60.88 | 25.08 | 74.12 | 12.96 | 75.44 |
| 3 | -16.52 | 25.95 | 29.60 | 64.24 | 20.97 | 61.95 | 28.04 | 76.98 | 15.87 | 71.66 |
| 4 | -18.15 | 25.45 | 21.07 | 60.91 | 16.32 | 68.76 | 26.80 | 73.69 | 13.88 | 62.65 |
| 5 | -20.37 | 23.46 | 21.04 | 69.50 | 18.75 | 62.43 | 25.51 | 83.79 | 14.16 | 74.05 |
| 6 | -19.60 | 23.92 | 21.15 | 56.79 | 16.23 | 70.11 | 29.69 | 78.84 | 11.40 | 74.70 |
| 7 | -19.00 | 22.15 | 16.32 | 61.31 | 14.65 | 63.80 | 28.04 | 75.96 | 10.40 | 70.97 |
| 8 | -24.12 | 24.12 | 13.70 | 63.87 | 15.62 | 73.69 | 25.27 | 74.13 | 11.43 | 71.17 |
| 9 | -19.99 | 24.28 | 20.58 | 56.76 | 15.40 | 62.97 | 25.73 | 81.72 | 15.83 | 72.80 |
| 10 | -20.23 | 24.94 | 16.15 | 61.99 | 20.28 | 61.70 | 26.33 | 79.28 | 11.95 | 71.96 |
| **Mean** | **-19.80** | **24.21** | **19.67** | **62.51** | **18.31** | **64.86** | **26.80** | **77.50** | **13.92** | **71.21** |
| **SD** | **2.03** | **1.14** | **4.47** | **4.67** | **3.09** | **4.37** | **1.50** | **3.39** | **3.19** | **3.88** |
| **Smooth** | **5** | | **4** | | **5** | | **4** | | **4** | |
| **KNEE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | 8.38 | 83.50 | -4.85 | 138.30 | -8.04 | 129.29 | 22.16 | 129.14 | 22.79 | 129.13 |
| 2 | 10.74 | 85.55 | -10.05 | 135.88 | -11.07 | 127.93 | 24.66 | 130.67 | 9.19 | 130.46 |
| 3 | 8.53 | 85.60 | -9.33 | 134.12 | -12.31 | 128.10 | 12.82 | 132.78 | 12.27 | 134.29 |
| 4 | 5.69 | 80.29 | -9.13 | 140.05 | -12.50 | 126.30 | 15.06 | 129.18 | 12.90 | 131.00 |
| 5 | 7.02 | 80.91 | -6.54 | 136.59 | -9.34 | 129.44 | 18.54 | 130.67 | 13.86 | 133.25 |
| 6 | 7.14 | 83.47 | -0.88 | 138.82 | -13.62 | 129.28 | 12.57 | 131.22 | 6.30 | 130.47 |
| 7 | 4.24 | 84.06 | -7.34 | 139.00 | -10.58 | 129.72 | 13.90 | 129.71 | 5.88 | 130.57 |
| 8 | 3.40 | 85.17 | -10.68 | 139.38 | -15.15 | 132.50 | 15.56 | 128.40 | 12.28 | 134.31 |
| 9 | 1.28 | 84.62 | -8.92 | 138.92 | -12.87 | 130.80 | 16.16 | 129.60 | 9.01 | 134.37 |
| 10 | 2.25 | 86.69 | -8.73 | 133.95 | -14.15 | 132.66 | 20.75 | 127.67 | 11.28 | 133.95 |
| **Mean** | **5.87** | **83.98** | **-7.65** | **137.50** | **-11.96** | **129.60** | **17.22** | **129.90** | **11.58** | **132.18** |
| **SD** | **3.04** | **2.05** | **2.94** | **2.22** | **2.21** | **1.98** | **4.14** | **1.48** | **4.79** | **2.03** |
| **Smooth** | **6** | | **4** | | **4** | | **5** | | **5** | |
| **ANKLE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | -21.42 | -57.46 | -20.13 | -62.18 | -27.79 | -66.89 | -18.29 | -61.60 | -36.00 | -70.96 |
| 2 | -20.63 | -59.72 | -20.70 | -60.71 | -21.11 | -70.51 | -20.54 | -59.96 | -29.08 | -71.25 |
| 3 | -22.45 | -55.00 | -25.14 | -58.04 | -16.49 | -67.14 | -18.84 | -57.55 | -31.88 | -67.07 |
| 4 | -20.37 | -56.53 | -27.28 | -66.99 | -17.98 | -72.30 | -16.69 | -61.81 | -34.55 | -66.68 |
| 5 | -20.41 | -54.17 | -23.30 | -66.69 | -22.56 | -66.88 | -22.34 | -63.55 | -32.43 | -62.70 |
| 6 | -21.04 | -53.49 | -26.83 | -66.41 | -30.05 | -72.88 | -18.07 | -59.96 | -29.50 | -66.04 |
| 7 | -18.75 | -53.77 | -20.51 | -62.80 | -26.07 | -72.19 | -16.35 | -60.41 | -34.08 | -65.70 |
| 8 | -20.40 | -58.67 | -18.63 | -65.27 | -15.18 | -71.36 | -17.09 | -62.69 | -35.92 | -58.36 |
| 9 | -20.48 | -56.68 | -19.02 | -62.48 | -14.74 | -74.04 | -24.73 | -62.60 | -36.37 | -65.30 |
| 10 | -18.82 | -58.13 | -21.64 | -62.38 | -25.62 | -65.77 | -26.58 | -60.69 | -28.80 | -68.54 |
| **Mean** | **-20.48** | **-56.36** | **-22.32** | **-63.40** | **-21.76** | **-70.00** | **-19.95** | **-61.08** | **-32.86** | **-66.26** |
| **SD** | **1.10** | **2.18** | **3.15** | **2.91** | **5.52** | **3.02** | **3.53** | **1.74** | **2.96** | **3.79** |
| **Smooth** | **2** | | **2** | | **2** | | **2** | | **3** | |

**TABLE K9: JOINT ANGLES - SUB 4**

| HIP | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -12.56 | 20.57 | 19.60 | 56.97 | 23.58 | 61.68 | 16.28 | 64.89 | 17.31 | 65.91 |
| 2 | -13.43 | 22.48 | 14.63 | 66.50 | 15.76 | 60.97 | 17.19 | 68.12 | 17.44 | 65.81 |
| 3 | -11.99 | 22.96 | 11.01 | 64.61 | 12.82 | 59.40 | 13.99 | 72.78 | 15.07 | 67.28 |
| 4 | -12.09 | 21.16 | 8.17 | 69.96 | 6.18 | 55.38 | 16.02 | 77.06 | 19.33 | 64.13 |
| 5 | -9.18 | 22.37 | 10.81 | 71.91 | 13.22 | 58.22 | 12.40 | 72.86 | 11.76 | 66.53 |
| 6 | -12.97 | 20.57 | 16.16 | 72.27 | 17.90 | 72.78 | 15.89 | 70.05 | 15.67 | 75.87 |
| 7 | -16.03 | 20.09 | 16.30 | 65.24 | 14.76 | 59.33 | 24.46 | 72.26 | 20.74 | 71.13 |
| 8 | -14.95 | 21.91 | 10.70 | 62.18 | 20.48 | 55.12 | 22.85 | 72.97 | 20.04 | 76.25 |
| 9 | -13.82 | 24.21 | 10.02 | 61.71 | 21.46 | 60.02 | 14.22 | 69.45 | 23.17 | 85.96 |
| 10 | -12.78 | 21.71 | 10.89 | 62.46 | 23.19 | 68.93 | 18.02 | 75.07 | 15.60 | 81.58 |
| **Mean** | **-12.98** | **21.80** | **12.83** | **65.38** | **16.94** | **61.18** | **17.13** | **71.55** | **17.61** | **72.04** |
| **SD** | **1.84** | **1.26** | **3.61** | **4.90** | **5.47** | **5.60** | **3.82** | **3.52** | **3.30** | **7.53** |
| **Smooth** | **5** | | **4** | | **5** | | **5** | | **4** | |
| **KNEE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | 3.75 | 104.24 | 0.50 | 135.69 | -5.47 | 122.72 | 6.80 | 131.87 | -3.38 | 127.98 |
| 2 | 5.12 | 101.09 | -3.30 | 133.59 | -6.63 | 122.29 | -4.31 | 135.79 | -5.37 | 128.07 |
| 3 | 5.39 | 100.62 | 2.13 | 134.62 | -8.01 | 124.86 | 4.41 | 133.58 | -2.41 | 126.79 |
| 4 | 3.29 | 99.98 | 8.10 | 132.78 | -4.64 | 127.10 | -0.39 | 131.40 | -3.60 | 125.75 |
| 5 | 5.64 | 102.55 | 5.42 | 130.73 | -5.41 | 128.99 | -1.94 | 132.00 | -2.80 | 124.55 |
| 6 | 6.14 | 96.02 | 3.86 | 125.73 | -8.92 | 127.83 | 7.10 | 131.80 | -6.91 | 124.56 |
| 7 | 6.64 | 98.11 | 8.20 | 137.00 | -8.20 | 123.46 | 1.91 | 130.90 | -3.98 | 129.53 |
| 8 | 3.53 | 99.96 | 0.61 | 137.35 | -6.42 | 124.98 | 2.05 | 133.82 | -2.15 | 128.89 |
| 9 | 5.43 | 99.79 | 5.99 | 137.56 | -7.33 | 122.29 | 0.43 | 130.57 | 0.01 | 128.26 |
| 10 | 4.05 | 98.61 | 6.47 | 138.56 | -7.49 | 128.73 | 2.69 | 132.15 | -0.69 | 126.19 |
| **Mean** | **4.90** | **100.10** | **3.80** | **134.36** | **-6.85** | **125.32** | **1.87** | **132.39** | **-3.13** | **127.06** |
| **SD** | **1.17** | **2.30** | **3.75** | **3.89** | **1.38** | **2.66** | **3.63** | **1.58** | **2.05** | **1.76** |
| **Smooth** | **7** | | **4** | | **4** | | **4** | | **4** | |
| **ANKLE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | -13.65 | -60.29 | -9.76 | -58.61 | -15.15 | -53.01 | -22.62 | -72.25 | -22.80 | -63.37 |
| 2 | -20.54 | -63.33 | -12.53 | -55.61 | -0.20 | -57.41 | -15.66 | -58.22 | -23.00 | -61.86 |
| 3 | -15.92 | -65.61 | -16.95 | -54.92 | -6.55 | -55.80 | -15.22 | -70.06 | -22.37 | -66.90 |
| 4 | -21.00 | -62.11 | -8.61 | -62.45 | -9.82 | -50.96 | -18.36 | -64.68 | -23.38 | -65.12 |
| 5 | -20.93 | -61.50 | -11.33 | -59.25 | -10.40 | -55.25 | -19.68 | -68.69 | -29.28 | -64.43 |
| 6 | -18.79 | -60.70 | -8.17 | -54.38 | -16.55 | -53.44 | -17.13 | -65.73 | -23.52 | -60.15 |
| 7 | -18.97 | -62.00 | -7.38 | -53.98 | -18.81 | -54.02 | -19.04 | -57.49 | -25.46 | -58.83 |
| 8 | -15.55 | -62.22 | -3.37 | -54.16 | -12.61 | -59.58 | -17.55 | -65.37 | -28.52 | -61.72 |
| 9 | -16.23 | -60.76 | -2.17 | -61.68 | -15.28 | -53.84 | -23.76 | -71.68 | -22.88 | -57.53 |
| 10 | -19.27 | -62.18 | -9.30 | -55.67 | -11.46 | -56.04 | -22.91 | -62.81 | -26.45 | -60.60 |
| **Mean** | **-18.09** | **-62.07** | **-8.96** | **-57.07** | **-11.68** | **-54.93** | **-19.19** | **-65.70** | **-24.77** | **-62.05** |
| **SD** | **2.57** | **1.54** | **4.26** | **3.18** | **5.41** | **2.44** | **3.03** | **5.16** | **2.53** | **2.93** |
| **Smooth** | **3** | | **3** | | **3** | | **2** | | **2** | |

TABLE K9: JOINT ANGLES - SUB 5

| HIP | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -10.58 | 22.35 | 32.02 | 96.40 | 25.41 | 89.12 | 22.85 | 94.54 | 24.21 | 90.89 |
| 2 | -9.28 | 25.91 | 31.90 | 93.46 | 28.30 | 94.30 | 22.11 | 91.54 | 30.37 | 92.02 |
| 3 | -7.88 | 27.69 | 37.01 | 96.60 | 30.34 | 91.49 | 23.18 | 91.32 | 29.51 | 90.42 |
| 4 | -6.99 | 26.86 | 34.19 | 88.89 | 29.41 | 98.09 | 24.94 | 96.18 | 28.91 | 96.52 |
| 5 | -7.81 | 27.34 | 31.33 | 88.73 | 25.58 | 79.34 | 21.15 | 94.47 | 29.95 | 96.65 |
| 6 | -7.20 | 26.59 | 31.47 | 89.04 | 27.72 | 84.76 | 22.98 | 90.65 | 30.94 | 93.34 |
| 7 | -7.43 | 30.55 | 28.26 | 91.77 | 21.50 | 88.93 | 21.14 | 89.89 | 29.32 | 92.07 |
| 8 | -8.86 | 29.70 | 24.94 | 84.47 | 29.64 | 96.70 | 21.54 | 89.12 | 25.56 | 85.82 |
| 9 | -7.84 | 33.99 | 29.12 | 96.48 | 27.64 | 96.93 | 17.93 | 91.57 | 28.32 | 91.78 |
| 10 | -7.57 | 28.83 | 29.91 | 91.89 | 33.49 | 84.51 | 18.86 | 96.64 | 29.96 | 95.86 |
| **Mean** | **-8.14** | **27.98** | **31.01** | **91.77** | **27.90** | **90.42** | **21.67** | **92.59** | **28.70** | **92.54** |
| **SD** | **1.11** | **3.09** | **3.29** | **4.06** | **3.25** | **6.24** | **2.07** | **2.66** | **2.17** | **3.30** |
| **Smooth** | 7 | | 4 | | 4 | | 4 | | 4 | |
| **KNEE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | 10.09 | 88.86 | -7.18 | 105.14 | -7.09 | 100.88 | 22.39 | 150.63 | 14.50 | 143.68 |
| 2 | 9.26 | 89.01 | 7.72 | 100.79 | -6.86 | 100.51 | 19.77 | 145.54 | 23.31 | 145.58 |
| 3 | 13.56 | 91.90 | 1.72 | 103.85 | -1.81 | 97.74 | 21.53 | 147.36 | 11.17 | 144.68 |
| 4 | 12.93 | 92.12 | 1.44 | 102.24 | 2.11 | 106.77 | 18.80 | 150.99 | 22.15 | 143.78 |
| 5 | 9.23 | 89.64 | -7.04 | 110.43 | -0.24 | 98.29 | 24.42 | 148.89 | 19.59 | 146.49 |
| 6 | 13.94 | 94.13 | -8.99 | 97.72 | -3.97 | 102.67 | 21.91 | 147.02 | 18.43 | 141.24 |
| 7 | 9.19 | 91.75 | -3.22 | 110.29 | -9.07 | 100.26 | 18.37 | 145.67 | 18.60 | 144.04 |
| 8 | 11.74 | 95.59 | -2.93 | 102.22 | -4.40 | 100.06 | 24.60 | 149.59 | 18.03 | 142.93 |
| 9 | 12.45 | 90.92 | -9.28 | 105.26 | -3.00 | 113.06 | 16.18 | 149.22 | 8.24 | 141.37 |
| 10 | 11.62 | 90.64 | -4.02 | 107.03 | -0.41 | 109.97 | 14.04 | 147.15 | 22.95 | 144.28 |
| **Mean** | **11.40** | **91.46** | **-3.18** | **104.50** | **-3.47** | **103.02** | **20.20** | **148.20** | **17.70** | **143.81** |
| **SD** | **1.84** | **2.16** | **5.44** | **4.03** | **3.51** | **5.17** | **3.44** | **1.94** | **5.01** | **1.66** |
| **Smooth** | 7 | | 4 | | 4 | | 4 | | 5 | |
| **ANKLE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | -11.72 | -41.16 | -30.20 | -77.41 | -29.58 | -69.56 | -15.65 | -59.63 | -17.92 | -35.63 |
| 2 | -12.97 | -41.92 | -28.56 | -82.01 | -17.54 | -60.65 | -13.32 | -45.53 | -15.76 | -44.37 |
| 3 | -16.45 | -40.43 | -25.53 | -78.06 | -31.96 | -81.75 | -11.55 | -60.66 | -14.92 | -45.99 |
| 4 | -12.70 | -43.70 | -21.32 | -80.51 | -35.58 | -80.85 | -13.17 | -54.49 | -16.93 | -42.71 |
| 5 | -11.62 | -43.85 | -32.28 | -79.59 | -12.52 | -78.81 | -10.90 | -53.75 | -12.93 | -44.66 |
| 6 | -14.31 | -45.22 | -31.46 | -83.57 | -32.22 | -71.42 | -15.32 | -61.29 | -15.07 | -46.25 |
| 7 | -16.03 | -44.32 | -33.20 | -82.80 | -39.36 | -83.27 | -16.99 | -58.37 | -18.67 | -44.71 |
| 8 | -11.92 | -45.56 | -32.89 | -86.73 | -38.49 | -72.37 | -14.14 | -44.31 | -14.99 | -48.57 |
| 9 | -14.74 | -42.02 | -27.36 | -81.98 | -37.58 | -72.85 | -17.38 | -56.21 | -19.10 | -52.09 |
| 10 | -10.11 | -42.89 | -34.36 | -83.18 | -15.00 | -71.66 | -20.93 | -55.39 | -18.59 | -40.86 |
| **Mean** | **-13.25** | **-43.11** | **-29.72** | **-81.58** | **-28.98** | **-74.32** | **-14.93** | **-54.96** | **-16.49** | **-44.58** |
| **SD** | **2.06** | **1.71** | **4.06** | **2.78** | **10.18** | **6.90** | **3.00** | **5.89** | **2.06** | **4.40** |
| **Smooth** | **2** | | **2** | | **2** | | **2** | | **2** | |

TABLE K9: JOINT ANGLES - SUB 6

| HIP | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -11.34 | 17.60 | 23.90 | 101.43 | 7.66 | 78.97 | 29.19 | 88.17 | 25.81 | 76.88 |
| 2 | -10.96 | 20.58 | 29.32 | 98.76 | 8.28 | 72.60 | 23.47 | 92.35 | 23.88 | 82.59 |
| 3 | -8.22 | 21.47 | 27.35 | 95.49 | 1.97 | 73.91 | 28.04 | 92.76 | 20.83 | 82.42 |
| 4 | -8.39 | 20.63 | 21.55 | 90.43 | -1.07 | 81.38 | 24.26 | 88.51 | 21.81 | 87.72 |
| 5 | -9.79 | 24.05 | 25.13 | 91.16 | 1.27 | 76.50 | 26.59 | 87.20 | 21.36 | 87.35 |
| 6 | -9.68 | 21.79 | 17.38 | 93.94 | 9.78 | 76.90 | 25.37 | 94.05 | 25.08 | 85.56 |
| 7 | -11.52 | 21.43 | 17.28 | 90.41 | 3.48 | 78.39 | 21.77 | 93.77 | 20.26 | 86.95 |
| 8 | -9.35 | 23.04 | 18.56 | 92.21 | 3.25 | 81.31 | 28.08 | 91.56 | 19.77 | 90.87 |
| 9 | -9.82 | 23.78 | 22.49 | 93.31 | 5.82 | 79.73 | 27.67 | 91.87 | 21.36 | 86.03 |
| 10 | -9.78 | 23.51 | 18.90 | 91.04 | 4.37 | 79.71 | 29.17 | 95.52 | 20.05 | 85.64 |
| **Mean** | **-9.88** | **21.79** | **22.19** | **93.82** | **4.48** | **77.94** | **26.36** | **91.58** | **22.02** | **85.20** |
| **SD** | **1.12** | **1.95** | **4.23** | **3.74** | **3.41** | **2.96** | **2.54** | **2.76** | **2.15** | **3.81** |
| **Smooth** | **2** | | **4** | | **4** | | **5** | | **4** | |
| **KNEE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | 8.29 | 99.67 | -15.06 | 125.47 | -20.11 | 127.29 | -0.05 | 142.53 | -8.84 | 135.13 |
| 2 | 4.78 | 96.68 | -14.12 | 130.77 | -15.50 | 130.54 | -1.66 | 139.47 | -6.85 | 134.81 |
| 3 | 8.09 | 96.72 | -13.13 | 133.17 | -14.75 | 122.85 | -6.92 | 143.47 | -11.57 | 136.95 |
| 4 | 5.94 | 95.18 | -13.59 | 128.87 | -15.06 | 127.57 | -8.07 | 142.03 | -10.61 | 134.24 |
| 5 | 8.66 | 97.63 | -12.57 | 126.23 | -17.99 | 122.03 | -6.08 | 143.04 | -11.14 | 137.90 |
| 6 | 7.72 | 96.71 | -12.35 | 123.42 | -18.18 | 116.64 | -2.95 | 140.98 | -6.43 | 135.97 |
| 7 | 4.99 | 93.91 | -13.95 | 128.56 | -15.98 | 108.99 | -6.35 | 142.92 | -8.52 | 133.05 |
| 8 | 8.97 | 99.95 | -12.65 | 128.11 | -16.33 | 121.39 | -3.40 | 144.25 | -6.42 | 134.84 |
| 9 | 10.09 | 96.07 | -9.51 | 130.57 | -17.33 | 123.56 | -3.21 | 140.15 | -9.38 | 134.09 |
| 10 | 7.24 | 96.60 | -13.69 | 127.94 | -18.50 | 126.45 | -5.52 | 145.91 | -8.22 | 131.28 |
| **Mean** | **7.48** | **96.91** | **-13.06** | **128.31** | **-16.97** | **122.73** | **-4.42** | **142.47** | **-8.80** | **134.82** |
| **SD** | **1.75** | **1.83** | **1.49** | **2.82** | **1.73** | **6.22** | **2.55** | **1.93** | **1.89** | **1.88** |
| **Smooth** | **7** | | **4** | | **4** | | **5** | | **4** | |
| **ANKLE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | -13.83 | -48.59 | -16.40 | -77.60 | -34.98 | -60.28 | -22.75 | -70.61 | -35.23 | -72.41 |
| 2 | -22.76 | -48.02 | -14.17 | -56.75 | -19.28 | -65.85 | -25.18 | -66.44 | -32.72 | -67.34 |
| 3 | -21.46 | -48.42 | -11.92 | -53.08 | -24.03 | -69.39 | -18.37 | -61.02 | -33.69 | -67.51 |
| 4 | -20.39 | -46.42 | -10.61 | -49.77 | -31.81 | -69.82 | -24.70 | -67.95 | -38.96 | -69.86 |
| 5 | -22.39 | -48.37 | -11.29 | -53.00 | -24.21 | -71.26 | -25.50 | -59.30 | -34.53 | -67.74 |
| 6 | -21.47 | -45.12 | -8.60 | -52.58 | -39.94 | -74.12 | -18.21 | -61.93 | -27.42 | -64.18 |
| 7 | -25.26 | -47.67 | -13.78 | -58.60 | -37.49 | -77.34 | -23.88 | -60.99 | -35.85 | -63.69 |
| 8 | -20.25 | -45.74 | -11.78 | -56.93 | -37.83 | -60.02 | -21.43 | -60.84 | -23.13 | -70.96 |
| 9 | -29.96 | -46.18 | -14.42 | -51.18 | -30.20 | -66.00 | -21.54 | -58.01 | -35.24 | -73.48 |
| 10 | -10.11 | -51.39 | -14.07 | -50.87 | -35.23 | -64.47 | -16.23 | -57.69 | -25.94 | -73.10 |
| **Mean** | **-20.79** | **-47.59** | **-12.70** | **-56.04** | **-31.50** | **-67.85** | **-21.78** | **-62.48** | **-32.27** | **-69.03** |
| **SD** | **5.52** | **1.82** | **2.27** | **8.11** | **6.94** | **5.63** | **3.24** | **4.37** | **5.05** | **3.51** |
| **Smooth** | **2** | | **3** | | **2** | | **2** | | **3** | |

TABLE K9: JOINT ANGLES - SUB 7

| HIP | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -9.05 | 23.16 | 13.57 | 79.98 | 12.90 | 96.23 | 13.43 | 69.31 | 10.81 | 66.67 |
| 2 | -8.46 | 28.91 | 14.16 | 79.98 | 17.79 | 97.26 | 11.34 | 63.11 | 14.14 | 68.37 |
| 3 | -8.81 | 30.39 | 13.16 | 80.48 | 16.67 | 91.16 | 13.64 | 66.49 | 11.39 | 64.62 |
| 4 | -12.23 | 29.04 | 11.04 | 78.64 | 20.36 | 81.26 | 15.38 | 73.04 | 10.19 | 73.87 |
| 5 | -11.98 | 30.07 | 16.77 | 75.17 | 16.99 | 93.82 | 10.08 | 70.00 | 11.43 | 75.39 |
| 6 | -10.37 | 32.64 | 9.26 | 77.03 | 22.97 | 90.65 | 17.23 | 68.77 | 13.60 | 72.16 |
| 7 | -8.81 | 30.92 | 11.52 | 67.98 | 12.79 | 90.97 | 13.83 | 72.74 | 7.85 | 76.41 |
| 8 | -6.69 | 32.10 | 13.71 | 76.42 | 15.06 | 99.04 | 7.44 | 63.92 | 11.66 | 70.29 |
| 9 | -11.16 | 29.15 | 6.49 | 76.73 | 17.87 | 90.91 | 10.37 | 71.88 | 9.47 | 72.10 |
| 10 | -8.43 | 29.03 | 17.65 | 82.90 | 10.45 | 91.58 | 12.90 | 78.56 | 10.65 | 70.98 |
| Mean | -9.60 | 29.54 | 12.73 | 77.53 | 16.39 | 92.29 | 12.56 | 69.78 | 11.12 | 71.09 |
| SD | 1.77 | 2.60 | 3.33 | 4.08 | 3.74 | 4.92 | 2.83 | 4.62 | 1.84 | 3.74 |
| Smooth | 6 | | 4 | | 4 | | 5 | | 5 | |
| KNEE | TR | | SCC | | BCC | | SHK | | BHK | |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 12.69 | 98.52 | 2.66 | 137.86 | 13.58 | 131.28 | 14.81 | 133.09 | 18.75 | 132.60 |
| 2 | 10.50 | 98.84 | 2.68 | 134.58 | 17.34 | 129.93 | 11.03 | 134.15 | 17.31 | 126.37 |
| 3 | 9.70 | 98.10 | 7.36 | 135.91 | 8.34 | 133.93 | 8.43 | 131.38 | 11.48 | 129.60 |
| 4 | 10.72 | 100.14 | 5.78 | 129.62 | 7.76 | 126.04 | 6.45 | 129.80 | 17.60 | 130.00 |
| 5 | 9.86 | 100.21 | 7.81 | 134.16 | 7.38 | 126.53 | 11.81 | 132.54 | 18.35 | 132.43 |
| 6 | 10.36 | 100.34 | 9.93 | 131.91 | 6.12 | 125.53 | 8.65 | 128.96 | 18.71 | 130.88 |
| 7 | 10.33 | 100.76 | 4.93 | 126.98 | 5.20 | 127.77 | 10.43 | 130.42 | 14.30 | 129.91 |
| 8 | 7.49 | 100.44 | 5.77 | 135.56 | 7.58 | 126.90 | 6.79 | 123.86 | 16.73 | 128.89 |
| 9 | 9.58 | 97.17 | 6.89 | 133.67 | 6.48 | 128.49 | 7.03 | 132.15 | 15.72 | 129.60 |
| 10 | 9.98 | 93.59 | 6.85 | 134.85 | 9.78 | 130.13 | 8.14 | 132.06 | 10.08 | 131.83 |
| Mean | 9.84 | 98.81 | 6.07 | 133.51 | 8.96 | 128.65 | 9.36 | 130.84 | 15.90 | 130.21 |
| SD | 0.96 | 2.19 | 2.25 | 3.21 | 3.75 | 2.66 | 2.65 | 2.90 | 3.05 | 1.86 |
| Smooth | 6 | | 4 | | 4 | | 4 | | 5 | |
| ANKLE | TR | | SCC | | BCC | | SHK | | BHK | |
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -12.65 | -43.97 | -25.78 | -63.08 | -13.99 | -75.74 | -16.37 | -54.36 | -16.06 | -55.02 |
| 2 | -8.78 | -46.48 | -24.94 | -60.19 | -9.40 | -63.76 | -17.02 | -59.52 | -13.66 | -59.51 |
| 3 | -12.72 | -42.78 | -18.22 | -65.75 | -11.22 | -63.24 | -21.86 | -59.83 | -15.99 | -57.61 |
| 4 | -9.42 | -39.68 | -21.72 | -63.06 | -10.83 | -74.38 | -15.33 | -49.14 | -18.97 | -63.01 |
| 5 | -11.47 | -40.97 | -20.86 | -58.45 | -12.45 | -64.14 | -13.47 | -51.87 | -18.23 | -58.50 |
| 6 | -12.61 | -43.74 | -18.67 | -61.88 | -4.80 | -57.91 | -12.90 | -53.88 | -16.86 | -61.37 |
| 7 | -7.75 | -39.14 | -19.83 | -55.50 | -9.08 | -69.53 | -25.33 | -70.38 | -16.99 | -57.98 |
| 8 | -11.15 | -41.03 | -14.40 | -49.39 | -5.89 | -56.62 | -17.49 | -55.98 | -19.32 | -57.52 |
| 9 | -11.42 | -40.73 | -14.81 | -57.85 | -7.43 | -52.41 | -16.34 | -56.10 | -15.88 | -62.66 |
| 10 | -9.85 | -41.36 | -20.72 | -59.94 | -4.77 | -57.03 | -21.29 | -50.73 | -17.67 | -53.16 |
| Mean | -10.78 | -41.99 | -20.00 | -59.51 | -8.99 | -63.48 | -17.74 | -56.18 | -16.96 | -58.63 |
| SD | 1.75 | 2.24 | 3.73 | 4.63 | 3.21 | 7.81 | 3.93 | 6.08 | 1.68 | 3.15 |
| Smooth | 2 | | 3 | | 3 | | 2 | | 2 | |

TABLE K9: JOINT ANGLES - SUB 8

| HIP | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | -14.48 | 29.73 | 22.02 | 92.84 | 14.78 | 92.27 | 26.86 | 82.73 | 23.79 | 88.72 |
| 2 | -15.41 | 31.63 | 19.79 | 88.76 | 13.89 | 91.44 | 22.17 | 82.99 | 23.33 | 84.92 |
| 3 | -12.41 | 33.18 | 19.79 | 82.96 | 17.11 | 86.16 | 23.01 | 82.89 | 25.65 | 86.29 |
| 4 | -11.79 | 31.33 | 16.52 | 84.15 | 15.84 | 87.17 | 22.81 | 80.26 | 22.72 | 82.97 |
| 5 | -14.32 | 33.12 | 16.18 | 86.94 | 14.84 | 83.01 | 23.24 | 87.00 | 22.84 | 83.93 |
| 6 | -10.12 | 30.35 | 17.04 | 87.82 | 9.63 | 86.86 | 21.98 | 87.17 | 20.63 | 81.80 |
| 7 | -16.18 | 33.19 | 18.46 | 82.71 | 13.88 | 90.46 | 22.70 | 85.57 | 23.93 | 81.30 |
| 8 | -16.50 | 32.30 | 19.84 | 82.39 | 12.61 | 87.06 | 23.30 | 76.56 | 20.10 | 81.57 |
| 9 | -15.07 | 28.89 | 17.32 | 78.50 | 10.78 | 90.29 | 25.17 | 81.98 | 17.46 | 81.06 |
| 10 | -12.15 | 31.86 | 19.73 | 83.45 | 16.69 | 85.47 | 22.92 | 84.63 | 21.88 | 82.13 |
| **Mean** | **-13.84** | **31.56** | **18.67** | **85.05** | **14.01** | **88.02** | **23.41** | **83.18** | **22.23** | **83.47** |
| **SD** | **2.11** | **1.50** | **1.87** | **4.07** | **2.43** | **2.96** | **1.49** | **3.21** | **2.33** | **2.51** |
| **Smooth** | **6** | | **3** | | **4** | | **4** | | **4** | |
| **KNEE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | 11.01 | 91.79 | -3.54 | 134.12 | -3.23 | 117.25 | 11.61 | 139.49 | 10.61 | 130.14 |
| 2 | 9.87 | 93.75 | -6.27 | 131.38 | 1.53 | 115.48 | 8.82 | 138.03 | 7.68 | 131.49 |
| 3 | 11.95 | 97.64 | -5.37 | 130.87 | -2.22 | 112.23 | 11.57 | 134.16 | 8.65 | 132.39 |
| 4 | 13.16 | 92.76 | -2.88 | 134.09 | -4.29 | 113.46 | 5.31 | 136.44 | 6.52 | 131.49 |
| 5 | 10.66 | 90.49 | -2.67 | 129.12 | 1.01 | 116.20 | 6.06 | 139.79 | 9.46 | 132.77 |
| 6 | 11.07 | 91.78 | -3.04 | 132.87 | -2.02 | 111.69 | 5.47 | 138.75 | 9.32 | 134.16 |
| 7 | 6.92 | 95.37 | -4.18 | 130.05 | -1.26 | 115.46 | 9.19 | 137.93 | 6.78 | 131.71 |
| 8 | 11.22 | 91.92 | -4.99 | 135.10 | -1.76 | 118.82 | 11.24 | 137.33 | 5.86 | 129.12 |
| 9 | 7.48 | 90.60 | -7.38 | 134.62 | -4.72 | 116.90 | 10.20 | 136.57 | 4.48 | 128.99 |
| 10 | 10.84 | 93.41 | -4.18 | 130.04 | -1.06 | 114.98 | 4.01 | 136.13 | 8.68 | 131.74 |
| **Mean** | **10.42** | **92.95** | **-4.45** | **132.23** | **-1.80** | **115.25** | **8.35** | **137.46** | **7.80** | **131.40** |
| **SD** | **1.90** | **2.21** | **1.55** | **2.19** | **2.02** | **2.25** | **2.89** | **1.71** | **1.89** | **1.61** |
| **Smooth** | **6** | | **4** | | **4** | | **5** | | **5** | |
| **ANKLE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | -8.84 | -42.39 | -27.89 | -48.83 | -14.76 | -47.22 | -23.24 | -61.97 | -19.63 | -67.14 |
| 2 | -13.78 | -51.76 | -25.66 | -58.71 | -16.15 | -45.59 | -25.95 | -58.66 | -21.39 | -59.55 |
| 3 | -11.65 | -46.02 | -26.24 | -47.98 | -14.97 | -38.96 | -19.86 | -54.82 | -15.19 | -50.22 |
| 4 | -22.42 | -48.46 | -21.56 | -47.64 | -18.47 | -46.54 | -21.71 | -53.13 | -17.71 | -56.35 |
| 5 | -19.86 | -54.69 | -24.48 | -43.69 | -19.10 | -39.01 | -16.76 | -50.03 | -20.63 | -61.12 |
| 6 | -16.78 | -52.01 | -23.83 | -51.85 | -11.11 | -53.70 | -19.48 | -51.21 | -16.18 | -58.78 |
| 7 | -14.60 | -51.39 | -27.16 | -51.17 | -11.95 | -48.91 | -28.56 | -51.21 | -16.35 | -55.08 |
| 8 | -16.11 | -51.98 | -27.33 | -46.10 | -13.25 | -43.43 | -19.06 | -46.64 | -19.63 | -63.30 |
| 9 | -13.56 | -48.15 | -26.86 | -52.80 | -11.56 | -41.85 | -28.24 | -50.98 | -18.46 | -60.86 |
| 10 | -17.28 | -51.12 | -23.43 | -49.94 | -14.02 | -46.88 | -24.17 | -50.18 | -19.42 | -71.51 |
| **Mean** | **-15.49** | **-49.79** | **-25.44** | **-49.87** | **-14.53** | **-45.21** | **-22.70** | **-52.88** | **-18.46** | **-60.39** |
| **SD** | **3.93** | **3.58** | **2.05** | **4.14** | **2.76** | **4.55** | **4.03** | **4.51** | **2.05** | **6.05** |
| **Smooth** | **3** | | **3** | | **2** | | **2** | | **2** | |

## TABLE K9: JOINT ANGLES - SUB 9

| HIP | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | -15.55 | 24.43 | 11.37 | 78.83 | 13.41 | 69.88 | 6.17 | 57.15 | 11.26 | 63.76 |
| **2** | -17.80 | 23.00 | 14.59 | 72.67 | 12.96 | 78.00 | 4.54 | 57.01 | 12.89 | 66.07 |
| **3** | -18.56 | 23.72 | 13.64 | 70.44 | 13.09 | 76.11 | 3.64 | 62.87 | 8.87 | 61.98 |
| **4** | -19.00 | 20.80 | 15.41 | 68.86 | 15.56 | 71.25 | 4.69 | 55.48 | 10.06 | 56.25 |
| **5** | -19.29 | 25.54 | 10.75 | 73.77 | 18.40 | 70.26 | 6.08 | 53.49 | 9.26 | 56.80 |
| **6** | -20.32 | 20.94 | 8.76 | 72.19 | 18.17 | 73.14 | 1.84 | 59.20 | 8.17 | 58.24 |
| **7** | -17.34 | 22.75 | 15.28 | 74.31 | 21.35 | 72.34 | 1.96 | 62.26 | 3.64 | 62.09 |
| **8** | -17.24 | 23.99 | 13.61 | 77.26 | 17.94 | 64.57 | 1.38 | 63.68 | 12.61 | 64.92 |
| **9** | -16.45 | 23.88 | 13.69 | 78.01 | 12.63 | 67.44 | 0.47 | 59.77 | 10.92 | 68.83 |
| **10** | -16.83 | 23.65 | 11.14 | 77.35 | 14.87 | 71.96 | 3.81 | 56.69 | 7.48 | 63.88 |
| **Mean** | **-17.84** | **23.27** | **12.82** | **74.37** | **15.84** | **71.50** | **3.46** | **58.76** | **9.52** | **62.28** |
| **SD** | **1.45** | **1.48** | **2.20** | **3.40** | **2.98** | **3.88** | **1.98** | **3.38** | **2.73** | **4.32** |
| **Smooth** | **5** | | **4** | | **4** | | **5** | | **4** | |
| **KNEE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 6.68 | 99.09 | -6.61 | 110.00 | -3.79 | 98.83 | 13.00 | 116.72 | 17.27 | 110.89 |
| **2** | 6.49 | 102.83 | -9.39 | 113.77 | -4.75 | 95.83 | 10.13 | 115.37 | 17.39 | 109.60 |
| **3** | 5.88 | 100.67 | -11.02 | 115.50 | -7.94 | 94.55 | 12.32 | 122.36 | 15.01 | 108.06 |
| **4** | 5.65 | 99.64 | -5.71 | 112.72 | -7.82 | 89.83 | 15.35 | 117.43 | 16.37 | 104.02 |
| **5** | 7.70 | 99.63 | -7.82 | 121.56 | -5.39 | 87.18 | 21.53 | 115.51 | 14.98 | 103.68 |
| **6** | 9.82 | 98.00 | -7.92 | 109.91 | -6.70 | 88.84 | 9.93 | 116.33 | 18.23 | 104.80 |
| **7** | 7.59 | 98.70 | -7.54 | 110.44 | -4.45 | 93.78 | 11.98 | 120.16 | 15.34 | 105.69 |
| **8** | 2.87 | 99.65 | -7.36 | 116.28 | -7.19 | 99.47 | 14.55 | 124.72 | 21.47 | 109.24 |
| **9** | 7.07 | 100.90 | -11.57 | 112.77 | -6.09 | 96.53 | 8.45 | 118.27 | 15.40 | 113.67 |
| **10** | 9.58 | 103.13 | -8.66 | 109.26 | -5.26 | 85.43 | 11.88 | 110.64 | 13.24 | 112.97 |
| **Mean** | **6.93** | **100.22** | **-8.36** | **113.22** | **-5.94** | **93.03** | **12.91** | **117.75** | **16.47** | **108.26** |
| **SD** | **2.00** | **1.68** | **1.85** | **3.80** | **1.44** | **4.92** | **3.68** | **3.95** | **2.28** | **3.63** |
| **Smooth** | **6** | | **4** | | **4** | | **4** | | **5** | |
| **ANKLE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | -19.40 | -63.75 | -47.99 | -80.56 | -31.03 | -71.95 | -36.87 | -61.92 | -54.38 | -71.30 |
| **2** | -22.96 | -61.20 | -48.99 | -80.04 | -42.70 | -70.40 | -39.74 | -64.27 | -43.76 | -71.04 |
| **3** | -27.19 | -62.34 | -45.08 | -77.04 | -59.90 | -88.00 | -33.87 | -57.37 | -40.72 | -70.62 |
| **4** | -20.83 | -61.72 | -47.32 | -76.63 | -28.97 | -79.34 | -27.54 | -54.75 | -42.25 | -73.19 |
| **5** | -19.01 | -62.23 | -43.67 | -73.37 | -50.30 | -80.07 | -33.63 | -57.12 | -47.40 | -75.19 |
| **6** | -20.38 | -61.06 | -41.34 | -79.35 | -67.58 | -85.42 | -36.03 | -64.45 | -50.46 | -74.66 |
| **7** | -18.61 | -60.67 | -48.69 | -82.28 | -59.79 | -78.29 | -32.01 | -65.22 | -49.09 | -70.03 |
| **8** | -29.99 | -61.39 | -47.01 | -78.94 | -48.45 | -74.41 | -33.99 | -61.27 | -44.85 | -71.52 |
| **9** | -25.88 | -66.13 | -47.66 | -77.12 | -44.32 | -71.92 | -34.67 | -63.60 | -46.71 | -76.23 |
| **10** | -25.44 | -64.07 | -41.85 | -77.99 | -51.32 | -84.35 | -33.69 | -67.50 | -44.43 | -70.13 |
| **Mean** | **-22.97** | **-62.45** | **-45.96** | **-78.33** | **-48.43** | **-78.42** | **-34.20** | **-61.75** | **-46.40** | **-72.39** |
| **SD** | **3.95** | **1.71** | **2.81** | **2.49** | **12.34** | **6.18** | **3.19** | **4.11** | **4.10** | **2.26** |
| **Smooth** | **2** | | **2** | | **2** | | **2** | | **2** | |

## TABLE K9: JOINT ANGLES - SUB 10

| HIP | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -18.10 | 19.26 | 1.34 | 61.45 | 1.77 | 67.38 | 9.03 | 76.30 | 11.68 | 76.03 |
| 2 | -13.65 | 23.65 | 10.59 | 62.56 | -1.94 | 68.33 | 12.42 | 77.09 | 6.50 | 63.83 |
| 3 | -16.07 | 25.66 | 0.48 | 60.53 | -2.67 | 66.80 | 12.83 | 72.03 | 8.52 | 73.59 |
| 4 | -16.67 | 23.13 | 0.99 | 54.23 | -0.16 | 57.71 | 9.17 | 74.07 | 12.24 | 68.56 |
| 5 | -17.99 | 23.76 | 3.64 | 58.96 | 4.02 | 67.26 | 9.68 | 74.44 | 9.00 | 71.65 |
| 6 | -18.16 | 29.28 | -1.99 | 59.10 | -2.87 | 68.87 | 7.63 | 74.99 | 9.95 | 63.47 |
| 7 | -13.90 | 24.90 | 3.22 | 58.76 | 2.39 | 62.79 | 12.14 | 74.09 | 7.19 | 56.34 |
| 8 | -16.88 | 26.82 | -1.10 | 59.04 | 2.42 | 62.38 | 12.31 | 81.11 | 12.45 | 61.04 |
| 9 | -15.18 | 26.29 | 6.82 | 55.58 | 0.41 | 63.02 | 12.97 | 75.15 | 7.87 | 77.87 |
| 10 | -17.50 | 24.87 | 4.73 | 56.76 | -7.17 | 63.56 | 4.49 | 77.95 | 7.86 | 75.23 |
| **Mean** | **-16.41** | **24.76** | **2.87** | **58.70** | **-0.38** | **64.81** | **10.27** | **75.72** | **9.32** | **68.76** |
| **SD** | **1.68** | **2.65** | **3.81** | **2.57** | **3.33** | **3.51** | **2.78** | **2.53** | **2.15** | **7.27** |
| **Smooth** | **5** | | **4** | | **4** | | **4** | | **4** | |
| **KNEE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | -1.79 | 88.06 | -11.57 | 123.71 | -11.71 | 122.22 | 10.05 | 144.82 | -2.11 | 118.61 |
| 2 | 1.66 | 85.68 | -9.03 | 130.63 | -12.44 | 126.12 | 7.77 | 143.60 | 2.50 | 129.98 |
| 3 | 4.14 | 85.82 | -12.29 | 132.86 | -13.87 | 123.13 | 16.04 | 142.24 | -5.36 | 123.38 |
| 4 | 3.99 | 87.48 | -9.01 | 131.35 | -12.62 | 121.95 | 11.62 | 145.57 | -6.70 | 126.50 |
| 5 | 1.81 | 87.10 | -13.68 | 134.43 | -13.50 | 123.84 | 9.46 | 139.25 | -10.60 | 120.03 |
| 6 | 3.57 | 86.77 | -13.01 | 133.87 | -13.96 | 123.67 | -4.36 | 143.25 | -6.57 | 127.84 |
| 7 | 0.80 | 87.51 | -14.42 | 130.96 | -12.90 | 123.27 | 14.76 | 141.99 | -3.87 | 129.55 |
| 8 | 5.68 | 88.66 | -13.87 | 134.84 | -14.63 | 125.74 | 21.22 | 146.05 | -7.50 | 124.55 |
| 9 | 7.14 | 90.25 | -14.59 | 134.13 | -10.38 | 123.29 | 11.98 | 140.68 | -5.00 | 120.35 |
| 10 | 3.99 | 91.44 | -9.07 | 135.69 | -14.75 | 123.84 | 5.12 | 143.94 | -7.77 | 120.47 |
| **Mean** | **3.10** | **87.88** | **-12.05** | **132.25** | **-13.08** | **123.71** | **10.36** | **143.14** | **-5.30** | **124.12** |
| **SD** | **2.56** | **1.83** | **2.27** | **3.46** | **1.36** | **1.33** | **6.88** | **2.14** | **3.59** | **4.20** |
| **Smooth** | **7** | | **3** | | **4** | | **5** | | **4** | |
| **ANKLE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | -13.11 | -45.97 | -11.60 | -83.09 | -23.39 | -73.06 | 2.34 | -50.21 | -13.74 | -54.37 |
| 2 | -18.63 | -43.28 | -11.57 | -75.47 | -27.64 | -68.98 | -6.57 | -48.50 | -18.25 | -49.01 |
| 3 | -16.18 | -47.00 | -11.32 | -74.73 | -27.04 | -54.77 | -6.22 | -47.33 | -10.04 | -56.45 |
| 4 | -21.20 | -44.74 | -9.99 | -75.62 | -26.71 | -58.74 | -4.52 | -48.84 | -14.10 | -48.52 |
| 5 | -15.59 | -44.66 | -8.73 | -75.87 | -20.78 | -72.05 | 0.67 | -47.28 | -18.55 | -55.28 |
| 6 | -16.79 | -45.45 | -14.36 | -76.15 | -33.02 | -66.78 | -2.72 | -45.86 | -20.20 | -51.09 |
| 7 | -16.02 | -42.90 | -5.27 | -75.27 | -29.10 | -73.86 | 0.30 | -37.12 | -10.99 | -54.39 |
| 8 | -16.89 | -45.69 | 0.35 | -72.34 | -16.47 | -65.17 | -4.21 | -40.25 | -13.16 | -53.26 |
| 9 | -15.32 | -41.85 | -2.56 | -76.22 | -31.01 | -74.19 | -2.04 | -44.86 | -17.37 | -50.10 |
| 10 | -14.27 | -43.79 | -4.65 | -74.21 | -21.71 | -63.69 | -2.67 | -43.51 | -13.96 | -49.22 |
| **Mean** | **-16.40** | **-44.53** | **-7.97** | **-75.90** | **-25.69** | **-67.13** | **-2.56** | **-45.37** | **-15.04** | **-52.17** |
| **SD** | **2.26** | **1.58** | **4.71** | **2.78** | **5.06** | **6.64** | **2.96** | **4.10** | **3.39** | **2.91** |
| **Smooth** | **2** | | **2** | | **2** | | **2** | | **2** | |

TABLE K9: JOINT ANGLES - SUB 11

| HIP | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -15.18 | 32.57 | 16.76 | 83.13 | 8.52 | 62.55 | 14.75 | 88.60 | 17.06 | 92.84 |
| 2 | -18.60 | 30.08 | 17.18 | 84.14 | 10.52 | 67.46 | 13.96 | 86.23 | 15.79 | 83.06 |
| 3 | -15.60 | 30.10 | 15.20 | 84.99 | 10.54 | 66.56 | 13.61 | 94.72 | 15.38 | 86.54 |
| 4 | -19.13 | 29.59 | 13.19 | 78.64 | 9.00 | 80.36 | 16.56 | 93.24 | 18.31 | 92.96 |
| 5 | -17.09 | 33.63 | 14.68 | 91.25 | 13.93 | 84.57 | 14.76 | 91.24 | 10.93 | 83.02 |
| 6 | -16.50 | 28.56 | 15.81 | 84.34 | 14.26 | 73.72 | 17.58 | 89.99 | 20.53 | 85.56 |
| 7 | -17.04 | 31.80 | 15.09 | 78.78 | 14.55 | 68.79 | 15.81 | 90.40 | 17.15 | 88.33 |
| 8 | -18.82 | 28.18 | 6.99 | 80.77 | 15.34 | 72.36 | 12.50 | 93.21 | 18.62 | 85.36 |
| 9 | -17.38 | 30.88 | 7.08 | 84.31 | 13.60 | 74.36 | 13.76 | 96.20 | 16.17 | 84.23 |
| 10 | -16.13 | 36.33 | 18.64 | 89.31 | 15.95 | 82.97 | 17.88 | 93.53 | 9.97 | 81.58 |
| **Mean** | **-17.15** | **31.17** | **14.06** | **83.97** | **12.62** | **73.37** | **15.12** | **91.74** | **15.99** | **86.35** |
| **SD** | **1.36** | **2.49** | **3.99** | **4.07** | **2.71** | **7.36** | **1.79** | **3.01** | **3.29** | **3.95** |
| **Smooth** | **5** | | **4** | | **4** | | **4** | | **4** | |
| **KNEE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | 13.39 | 107.34 | -14.74 | 120.56 | -8.29 | 114.88 | -2.80 | 141.56 | 3.39 | 138.23 |
| 2 | 13.31 | 107.56 | -9.73 | 124.61 | -14.98 | 114.95 | 0.30 | 138.15 | 1.81 | 138.45 |
| 3 | 11.96 | 101.41 | -12.39 | 124.33 | -11.98 | 118.01 | -3.87 | 141.32 | 3.83 | 138.91 |
| 4 | 8.60 | 104.84 | -13.41 | 113.04 | -11.38 | 105.54 | 4.93 | 144.64 | -6.62 | 134.09 |
| 5 | 11.26 | 107.20 | -16.64 | 127.42 | -7.64 | 111.45 | 1.79 | 142.59 | -4.00 | 132.37 |
| 6 | 9.33 | 103.47 | -15.18 | 131.03 | -10.08 | 99.28 | -8.23 | 143.74 | -6.16 | 132.01 |
| 7 | 10.54 | 107.98 | -15.37 | 112.63 | -12.18 | 117.45 | 2.15 | 142.37 | -2.31 | 140.40 |
| 8 | 10.21 | 107.22 | -16.93 | 121.98 | -11.72 | 119.18 | 2.57 | 144.70 | -3.88 | 131.10 |
| 9 | 10.28 | 102.92 | -13.97 | 124.59 | -7.65 | 114.20 | 0.03 | 143.73 | 1.08 | 134.80 |
| 10 | 11.11 | 107.49 | -16.26 | 129.93 | -6.15 | 115.55 | 7.96 | 142.99 | -7.00 | 135.34 |
| **Mean** | **11.00** | **105.74** | **-14.46** | **123.01** | **-10.20** | **113.05** | **0.48** | **142.58** | **-1.98** | **135.57** |
| **SD** | **1.56** | **2.38** | **2.33** | **6.26** | **2.72** | **6.19** | **4.60** | **1.94** | **4.19** | **3.26** |
| **Smooth** | **6** | | **4** | | **4** | | **4** | | **4** | |
| **ANKLE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | -7.77 | -54.98 | -39.53 | -75.30 | -26.13 | -62.31 | -25.95 | -69.69 | -37.93 | -69.86 |
| 2 | -13.77 | -53.92 | -41.62 | -68.57 | -15.72 | -64.87 | -35.27 | -66.65 | -27.50 | -77.82 |
| 3 | -8.71 | -57.83 | -36.37 | -72.91 | -47.29 | -65.83 | -37.63 | -65.66 | -22.16 | -71.16 |
| 4 | -10.84 | -55.49 | -34.24 | -79.90 | -46.00 | -65.00 | -42.61 | -62.13 | -28.00 | -75.50 |
| 5 | -9.88 | -52.32 | -41.80 | -63.76 | -23.26 | -79.43 | -40.17 | -72.25 | -45.35 | -81.67 |
| 6 | -12.50 | -53.91 | -38.88 | -67.99 | -7.32 | -64.96 | -38.45 | -77.78 | -51.19 | -76.75 |
| 7 | -7.20 | -51.09 | -41.73 | -72.66 | -11.45 | -64.42 | -43.63 | -72.25 | -40.47 | -69.77 |
| 8 | -15.74 | -53.68 | -46.34 | -65.59 | -45.47 | -78.25 | -36.45 | -65.73 | -37.31 | -78.61 |
| 9 | -13.95 | -57.48 | -32.02 | -66.51 | -14.65 | -63.65 | -39.92 | -77.71 | -36.91 | -78.00 |
| 10 | -11.01 | -56.75 | -30.74 | -66.56 | -4.38 | -68.35 | -45.32 | -72.43 | -32.28 | -75.30 |
| **Mean** | **-11.14** | **-54.75** | **-38.33** | **-69.98** | **-24.17** | **-67.71** | **-38.54** | **-70.23** | **-35.91** | **-75.44** |
| **SD** | **2.83** | **2.20** | **4.92** | **5.06** | **16.56** | **6.44** | **5.45** | **5.23** | **8.73** | **4.01** |
| **Smooth** | **2** | | **2** | | **2** | | **2** | | **2** | |

**TABLE K9: JOINT ANGLES - SUB 12**

| HIP | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | -13.91 | 14.14 | -1.53 | 50.14 | -10.09 | 43.37 | 10.27 | 65.85 | 8.89 | 76.48 |
| **2** | -13.12 | 19.38 | -5.61 | 46.97 | -10.38 | 48.34 | 8.90 | 73.16 | 13.40 | 74.68 |
| **3** | -15.30 | 18.92 | -1.86 | 47.15 | -7.05 | 44.32 | 10.43 | 70.93 | 14.76 | 77.92 |
| **4** | -16.83 | 18.33 | -3.71 | 47.07 | -6.61 | 42.71 | 11.36 | 73.97 | 14.95 | 79.38 |
| **5** | -15.69 | 16.29 | -5.97 | 48.61 | -11.67 | 44.20 | 11.31 | 76.52 | 12.88 | 76.40 |
| **6** | -17.87 | 16.58 | -3.05 | 50.69 | -10.77 | 45.45 | 11.97 | 73.99 | 15.10 | 78.12 |
| **7** | -16.76 | 16.78 | -1.97 | 50.42 | -10.42 | 47.99 | 11.01 | 69.24 | 20.00 | 74.96 |
| **8** | -15.49 | 15.71 | -3.05 | 46.51 | -10.13 | 41.41 | 11.67 | 75.46 | 13.63 | 85.72 |
| **9** | -14.09 | 16.72 | 2.02 | 47.17 | -10.30 | 42.17 | 10.56 | 73.23 | 16.16 | 81.59 |
| **10** | -17.14 | 16.61 | -1.50 | 50.98 | -10.19 | 47.54 | 12.71 | 74.06 | 13.24 | 80.43 |
| **Mean** | **-15.62** | **16.95** | **-2.62** | **48.57** | **-9.76** | **44.75** | **11.02** | **72.64** | **14.30** | **78.57** |
| **SD** | **1.56** | **1.56** | **2.28** | **1.80** | **1.62** | **2.49** | **1.05** | **3.16** | **2.81** | **3.37** |
| **Smooth** | **5** | | **5** | | **5** | | **5** | | **6** | |
| **KNEE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 10.45 | 78.80 | -11.09 | 117.04 | -8.47 | 116.24 | -9.35 | 115.71 | -9.52 | 120.85 |
| **2** | 9.67 | 80.91 | -8.88 | 115.74 | -7.22 | 116.00 | -6.42 | 117.58 | -8.71 | 123.69 |
| **3** | 9.22 | 79.53 | -6.16 | 113.55 | -6.85 | 113.00 | -7.42 | 114.87 | -5.64 | 124.19 |
| **4** | 7.83 | 78.05 | -8.63 | 116.63 | -6.12 | 111.16 | -5.54 | 117.65 | -7.69 | 124.52 |
| **5** | 8.93 | 84.73 | -8.67 | 114.58 | -8.36 | 114.71 | -6.26 | 119.89 | -7.20 | 123.53 |
| **6** | 9.71 | 77.89 | -8.62 | 115.99 | -7.87 | 116.82 | -3.91 | 118.90 | -6.86 | 115.78 |
| **7** | 7.54 | 79.31 | -8.45 | 117.21 | -6.87 | 117.47 | -7.07 | 115.47 | -7.56 | 120.70 |
| **8** | 4.81 | 81.37 | -6.61 | 118.17 | -7.19 | 113.14 | -7.99 | 120.45 | -6.29 | 124.58 |
| **9** | 11.60 | 78.47 | -6.15 | 116.11 | -6.82 | 109.75 | -6.24 | 120.96 | -2.57 | 124.25 |
| **10** | 6.99 | 83.24 | -8.85 | 118.21 | -8.08 | 103.77 | -3.23 | 119.74 | -6.72 | 125.17 |
| **Mean** | **8.67** | **80.23** | **-8.21** | **116.32** | **-7.39** | **113.21** | **-6.34** | **118.12** | **-6.88** | **122.73** |
| **SD** | **1.94** | **2.30** | **1.52** | **1.48** | **0.77** | **4.16** | **1.82** | **2.21** | **1.89** | **2.88** |
| **Smooth** | **7** | | **5** | | **5** | | **4** | | **4** | |
| **ANKLE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | -16.22 | -45.01 | -41.61 | -79.14 | -20.22 | -66.80 | -22.67 | -59.25 | -42.28 | -69.83 |
| **2** | -14.62 | -47.23 | -44.83 | -80.78 | -23.58 | -65.86 | -31.06 | -53.44 | -45.98 | -64.53 |
| **3** | -16.58 | -48.85 | -44.19 | -80.31 | -42.67 | -73.42 | -27.54 | -68.35 | -53.73 | -65.45 |
| **4** | -14.03 | -49.30 | -45.97 | -80.70 | -29.23 | -66.30 | -31.06 | -57.08 | -54.59 | -66.20 |
| **5** | -18.22 | -50.90 | -45.35 | -71.32 | -39.12 | -60.14 | -20.15 | -65.74 | -53.00 | -68.24 |
| **6** | -14.69 | -51.38 | -35.63 | -76.99 | -30.07 | -75.27 | -25.04 | -54.33 | -57.42 | -78.21 |
| **7** | -14.88 | -50.30 | -38.61 | -83.18 | -48.06 | -75.63 | -24.36 | -64.02 | -55.05 | -71.79 |
| **8** | -18.95 | -49.64 | -42.03 | -84.87 | -50.50 | -69.38 | -26.39 | -65.55 | -44.44 | -71.54 |
| **9** | -15.67 | -49.67 | -45.48 | -84.44 | -12.51 | -71.80 | -28.78 | -63.68 | -37.70 | -67.25 |
| **10** | -12.03 | -50.15 | -43.91 | -82.57 | -47.77 | -71.61 | -28.70 | -64.49 | -44.16 | -67.32 |
| **Mean** | **-15.59** | **-49.24** | **-42.76** | **-80.43** | **-34.37** | **-69.62** | **-26.58** | **-61.59** | **-48.83** | **-69.04** |
| **SD** | **2.03** | **1.88** | **3.37** | **4.01** | **13.16** | **4.88** | **3.56** | **5.19** | **6.69** | **4.04** |
| **Smooth** | **2** | | **2** | | **2** | | **3** | | **2** | |

TABLE K9: JOINT ANGLES - SUB 13

| HIP | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | -10.43 | 17.91 | 1.15 | 52.85 | 16.08 | 83.34 | 10.78 | 80.37 | 24.59 | 91.08 |
| 2 | -20.19 | 20.23 | 4.42 | 51.39 | 14.48 | 87.25 | 12.50 | 74.82 | 24.28 | 88.71 |
| 3 | -14.43 | 20.49 | 2.25 | 51.99 | 14.50 | 80.65 | 14.42 | 75.58 | 24.20 | 89.16 |
| 4 | -18.13 | 18.19 | 1.70 | 64.43 | 8.00 | 73.35 | 12.68 | 74.25 | 21.48 | 84.84 |
| 5 | -15.32 | 17.65 | 12.75 | 65.02 | 12.95 | 81.33 | 9.12 | 74.90 | 20.44 | 83.98 |
| 6 | -15.28 | 19.69 | 10.17 | 62.09 | 17.41 | 87.86 | 14.53 | 73.06 | 20.69 | 85.37 |
| 7 | -19.91 | 22.01 | 9.43 | 62.57 | 13.33 | 79.61 | 9.02 | 73.79 | 19.44 | 83.07 |
| 8 | -16.53 | 20.20 | 6.08 | 59.47 | 16.32 | 87.73 | 10.98 | 76.77 | 23.31 | 84.00 |
| 9 | -19.94 | 24.48 | 7.04 | 60.67 | 15.09 | 75.74 | 13.82 | 79.71 | 22.96 | 84.48 |
| 10 | -17.84 | 25.90 | 9.36 | 61.83 | 15.14 | 82.21 | 13.40 | 75.06 | 22.19 | 81.27 |
| **Mean** | **-16.80** | **20.67** | **6.43** | **59.23** | **14.33** | **81.91** | **12.13** | **75.83** | **22.36** | **85.60** |
| **SD** | **3.07** | **2.75** | **4.00** | **5.20** | **2.60** | **4.93** | **2.05** | **2.44** | **1.80** | **3.07** |
| **Smooth** | **4** | | **4** | | **4** | | **5** | | **5** | |
| **KNEE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | 0.39 | 104.92 | -5.59 | 119.62 | -3.99 | 106.19 | 16.32 | 142.65 | 16.39 | 141.12 |
| 2 | 3.81 | 105.92 | -8.85 | 118.92 | -5.65 | 101.59 | 13.89 | 137.60 | 8.65 | 138.15 |
| 3 | 2.20 | 104.75 | -8.60 | 121.66 | -5.12 | 109.70 | 12.99 | 139.04 | 8.52 | 141.46 |
| 4 | 3.93 | 101.54 | -8.02 | 120.67 | -7.10 | 115.23 | 11.93 | 139.35 | 13.29 | 130.95 |
| 5 | 4.58 | 104.87 | -7.99 | 113.15 | -6.88 | 113.09 | 11.31 | 139.55 | 10.14 | 136.75 |
| 6 | 5.41 | 104.47 | -6.59 | 112.05 | -5.60 | 119.76 | 13.38 | 139.41 | 7.00 | 137.02 |
| 7 | 2.69 | 102.74 | -9.56 | 117.98 | -7.97 | 113.18 | 14.15 | 139.74 | 6.80 | 136.54 |
| 8 | 5.31 | 102.57 | -8.53 | 113.40 | -3.57 | 125.48 | 9.53 | 140.66 | 7.80 | 138.58 |
| 9 | -0.59 | 105.25 | -7.24 | 118.24 | -5.10 | 108.20 | 14.76 | 143.59 | 6.71 | 138.22 |
| 10 | 2.45 | 103.39 | -9.09 | 122.83 | -9.26 | 115.29 | 14.39 | 142.05 | 7.51 | 136.47 |
| **Mean** | **3.31** | **104.04** | **-8.01** | **117.85** | **-6.02** | **112.77** | **13.27** | **140.36** | **9.28** | **137.53** |
| **SD** | **1.88** | **1.40** | **1.22** | **3.76** | **1.77** | **6.84** | **1.93** | **1.86** | **3.19** | **2.92** |
| **Smooth** | **7** | | **4** | | **4** | | **5** | | **5** | |
| **ANKLE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | -6.07 | -52.27 | -46.75 | -80.62 | -40.85 | -66.67 | -23.18 | -56.23 | -33.97 | -68.66 |
| 2 | -10.45 | -57.67 | -44.74 | -72.83 | -42.24 | -78.35 | -24.44 | -61.12 | -38.76 | -68.90 |
| 3 | -11.66 | -52.66 | -49.96 | -74.49 | -15.73 | -72.73 | -22.26 | -60.97 | -37.04 | -71.66 |
| 4 | -14.24 | -57.47 | -55.71 | -75.70 | -47.73 | -80.98 | -23.95 | -62.08 | -37.21 | -68.63 |
| 5 | -11.08 | -53.63 | -42.46 | -70.10 | -36.81 | -66.99 | -28.79 | -61.91 | -35.80 | -69.90 |
| 6 | -12.27 | -55.38 | -33.49 | -74.24 | -48.26 | -75.74 | -24.40 | -65.79 | -42.90 | -65.73 |
| 7 | -10.62 | -54.08 | -45.98 | -76.66 | -45.41 | -73.96 | -28.78 | -61.03 | -40.28 | -65.84 |
| 8 | -10.69 | -54.60 | -39.79 | -78.22 | -47.38 | -82.42 | -29.42 | -64.53 | -33.22 | -71.03 |
| 9 | -12.62 | -55.80 | -47.62 | -77.20 | -48.40 | -77.26 | -31.05 | -58.53 | -37.52 | -69.32 |
| 10 | -17.46 | -53.13 | -41.27 | -79.36 | -48.29 | -67.78 | -28.60 | -55.93 | -47.17 | -65.03 |
| **Mean** | **-11.72** | **-54.67** | **-44.78** | **-75.94** | **-42.11** | **-74.29** | **-26.49** | **-60.81** | **-38.39** | **-68.47** |
| **SD** | **2.92** | **1.89** | **6.05** | **3.16** | **10.06** | **5.72** | **3.13** | **3.19** | **4.19** | **2.26** |
| **Smooth** | **3** | | **2** | | **2** | | **2** | | **2** | |

TABLE K9: JOINT ANGLES - SUB 14

| HIP | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -11.43 | 26.93 | 12.30 | 109.34 | 7.17 | 75.73 | 10.01 | 102.35 | 12.39 | 106.20 |
| 2 | -8.20 | 29.83 | 17.42 | 101.66 | 11.88 | 89.37 | 13.85 | 105.17 | 6.61 | 94.59 |
| 3 | -7.12 | 30.69 | 16.27 | 104.93 | 8.90 | 83.89 | 11.34 | 104.18 | 9.38 | 90.06 |
| 4 | -5.87 | 29.23 | 17.17 | 105.27 | 8.67 | 83.32 | 8.61 | 105.23 | 10.95 | 106.30 |
| 5 | -8.38 | 29.77 | 14.61 | 104.35 | 5.24 | 79.45 | 15.26 | 110.05 | 9.50 | 96.82 |
| 6 | -12.23 | 29.75 | 9.59 | 102.09 | 5.69 | 81.61 | 12.76 | 104.75 | 9.34 | 95.66 |
| 7 | -6.90 | 28.62 | 14.03 | 103.72 | 7.37 | 82.54 | 13.45 | 104.42 | 6.82 | 94.76 |
| 8 | -8.56 | 33.02 | 15.52 | 106.92 | 11.28 | 79.03 | 10.73 | 104.77 | 10.99 | 101.66 |
| 9 | -8.38 | 30.43 | 15.77 | 108.64 | 5.87 | 82.81 | 14.24 | 102.67 | 9.33 | 109.25 |
| 10 | -13.35 | 29.26 | 18.49 | 105.95 | 7.27 | 78.08 | 15.04 | 109.91 | 8.04 | 100.17 |
| **Mean** | **-9.04** | **29.75** | **15.12** | **105.29** | **7.93** | **81.58** | **12.53** | **105.35** | **9.34** | **99.55** |
| **SD** | **2.46** | **1.56** | **2.64** | **2.53** | **2.26** | **3.79** | **2.25** | **2.63** | **1.83** | **6.23** |
| **Smooth** | **5** | | **4** | | **4** | | **4** | | **4** | |
| **KNEE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | 11.54 | 94.28 | -2.11 | 131.84 | -7.41 | 120.65 | 11.79 | 139.85 | 4.35 | 128.23 |
| 2 | 6.45 | 97.66 | -0.51 | 129.81 | -4.31 | 127.16 | 7.52 | 136.31 | 2.27 | 128.99 |
| 3 | 7.97 | 98.59 | -3.00 | 126.01 | -7.14 | 124.06 | 7.75 | 138.58 | 12.09 | 121.05 |
| 4 | 9.47 | 95.90 | -0.97 | 125.61 | -7.59 | 129.13 | 4.32 | 141.86 | 22.43 | 132.21 |
| 5 | 9.28 | 97.19 | 7.56 | 125.95 | -6.03 | 124.53 | 3.66 | 140.38 | 0.99 | 131.98 |
| 6 | 10.14 | 93.92 | 3.64 | 131.39 | -5.07 | 127.41 | 6.29 | 142.17 | -4.57 | 134.61 |
| 7 | 7.02 | 91.56 | 3.82 | 125.51 | -5.46 | 123.12 | 4.23 | 145.99 | 6.18 | 133.34 |
| 8 | 10.69 | 95.43 | -0.96 | 132.83 | -4.70 | 124.59 | -0.23 | 142.85 | 4.85 | 132.77 |
| 9 | 10.24 | 94.40 | 6.38 | 127.41 | -5.09 | 126.00 | 4.53 | 141.39 | 6.24 | 134.89 |
| 10 | 10.61 | 97.84 | 6.13 | 125.31 | -4.61 | 124.30 | 9.88 | 146.51 | 7.65 | 134.78 |
| **Mean** | **9.34** | **95.68** | **2.00** | **128.17** | **-5.74** | **125.10** | **5.97** | **141.59** | **6.25** | **131.29** |
| **SD** | **1.68** | **2.19** | **3.93** | **2.99** | **1.23** | **2.42** | **3.44** | **3.11** | **7.18** | **4.26** |
| **Smooth** | **6** | | **4** | | **4** | | **4** | | **4** | |
| **ANKLE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | -12.87 | -43.80 | -41.35 | -72.13 | -50.09 | -80.45 | -12.28 | -53.87 | -21.15 | -66.74 |
| 2 | -16.34 | -41.93 | -40.64 | -76.35 | -46.69 | -77.29 | -23.30 | -52.65 | -25.40 | -70.81 |
| 3 | -18.72 | -39.37 | -40.74 | -77.02 | -48.25 | -72.63 | -26.42 | -56.83 | -21.12 | -71.73 |
| 4 | -14.50 | -43.03 | -33.84 | -73.61 | -42.70 | -78.59 | -29.91 | -52.01 | -24.90 | -74.56 |
| 5 | -17.29 | -43.25 | -36.73 | -77.97 | -43.51 | -83.69 | -26.03 | -56.04 | -19.38 | -74.78 |
| 6 | -15.12 | -46.75 | -34.27 | -77.87 | -42.85 | -79.90 | -25.80 | -59.41 | -20.50 | -75.70 |
| 7 | -14.66 | -45.04 | -39.20 | -77.69 | -45.55 | -81.99 | -21.95 | -57.85 | -22.82 | -69.79 |
| 8 | -10.85 | -48.34 | -37.75 | -74.80 | -47.05 | -72.35 | -27.31 | -55.66 | -18.01 | -72.89 |
| 9 | -14.17 | -45.15 | -44.53 | -80.75 | -34.18 | -71.65 | -27.17 | -58.79 | -17.56 | -68.01 |
| 10 | -14.63 | -42.71 | -41.44 | -79.64 | -35.92 | -79.54 | -23.47 | -56.90 | -16.83 | -72.74 |
| **Mean** | **-15.14** | **-43.94** | **-39.05** | **-76.78** | **-43.68** | **-77.81** | **-24.36** | **-56.00** | **-20.77** | **-71.78** |
| **SD** | **2.21** | **2.53** | **3.39** | **2.65** | **5.14** | **4.24** | **4.83** | **2.50** | **2.95** | **2.96** |
| **Smooth** | **2** | | **2** | | **2** | | **2** | | **2** | |

TABLE K9: JOINT ANGLES - SUB 15

| HIP | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | -9.46 | 30.68 | 19.98 | 65.68 | 15.33 | 64.06 | 13.36 | 76.49 | 9.91 | 59.54 |
| **2** | -6.22 | 29.44 | 18.15 | 63.11 | 20.08 | 66.57 | 16.73 | 71.91 | 5.94 | 62.55 |
| **3** | -10.80 | 27.28 | 15.19 | 64.13 | 19.04 | 68.85 | 14.29 | 71.66 | 6.01 | 52.49 |
| **4** | -11.14 | 26.53 | 19.93 | 64.86 | 20.44 | 68.02 | 9.95 | 70.61 | 6.58 | 53.70 |
| **5** | -6.37 | 27.87 | 18.51 | 68.33 | 21.55 | 68.18 | 9.85 | 65.19 | 5.37 | 51.45 |
| **6** | -10.30 | 24.31 | 18.48 | 67.13 | 18.50 | 71.57 | 12.58 | 67.93 | 5.48 | 53.86 |
| **7** | -9.21 | 28.73 | 22.67 | 63.12 | 18.02 | 64.67 | 13.55 | 68.77 | 6.11 | 51.16 |
| **8** | -6.78 | 30.46 | 11.51 | 55.60 | 13.06 | 68.71 | 10.02 | 70.17 | 6.54 | 50.46 |
| **9** | -6.93 | 27.79 | 11.87 | 63.76 | 19.60 | 73.04 | 12.73 | 73.54 | 5.65 | 60.73 |
| **10** | -9.07 | 29.71 | 12.22 | 66.05 | 17.11 | 76.89 | 13.63 | 73.01 | 8.01 | 56.49 |
| **Mean** | **-8.63** | **28.28** | **16.85** | **64.17** | **18.27** | **69.06** | **12.67** | **70.93** | **6.56** | **55.24** |
| **SD** | **1.89** | **1.95** | **3.91** | **3.47** | **2.55** | **3.89** | **2.20** | **3.18** | **1.40** | **4.34** |
| **Smooth** | **5** | | **4** | | **4** | | **4** | | **5** | |
| **KNEE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | 4.12 | 92.31 | -2.01 | 145.34 | -6.09 | 138.13 | 10.09 | 145.86 | 0.03 | 132.60 |
| **2** | 2.04 | 91.96 | -3.52 | 146.24 | -10.01 | 138.08 | 12.24 | 142.49 | -1.45 | 133.94 |
| **3** | 2.81 | 90.62 | -6.41 | 146.69 | -8.10 | 137.22 | 7.08 | 144.37 | 4.10 | 130.01 |
| **4** | 1.99 | 91.66 | 1.24 | 146.24 | -10.91 | 136.52 | 6.58 | 141.83 | 3.91 | 135.29 |
| **5** | 2.13 | 88.97 | -3.86 | 146.01 | -10.98 | 140.58 | 4.29 | 143.96 | -8.22 | 128.67 |
| **6** | 0.01 | 91.50 | -4.03 | 145.67 | -7.62 | 136.84 | 0.86 | 142.94 | -8.05 | 134.08 |
| **7** | 2.80 | 91.56 | -0.43 | 143.59 | -9.90 | 137.31 | 2.32 | 144.40 | -2.54 | 132.11 |
| **8** | 4.29 | 94.14 | -5.91 | 139.33 | -5.22 | 137.01 | -2.31 | 142.07 | -2.42 | 134.21 |
| **9** | 2.69 | 90.07 | -3.61 | 145.27 | -0.67 | 135.63 | 10.70 | 141.95 | -7.38 | 132.91 |
| **10** | 4.06 | 94.17 | -3.47 | 141.99 | 2.34 | 136.52 | 8.87 | 142.35 | 8.34 | 134.61 |
| **Mean** | **2.69** | **91.70** | **-3.20** | **144.64** | **-6.72** | **137.38** | **6.07** | **143.22** | **-1.37** | **132.84** |
| **SD** | **1.29** | **1.62** | **2.31** | **2.34** | **4.48** | **1.35** | **4.71** | **1.35** | **5.62** | **2.10** |
| **Smooth** | **6** | | **4** | | **5** | | **5** | | **5** | |
| **ANKLE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **1** | -11.88 | -48.10 | -12.06 | -55.62 | -15.86 | -51.94 | -13.97 | -47.79 | -13.63 | -52.26 |
| **2** | -17.78 | -49.66 | -12.54 | -56.49 | -13.52 | -48.44 | -17.12 | -49.20 | -17.39 | -47.85 |
| **3** | -15.41 | -47.74 | -5.55 | -55.70 | -14.09 | -47.70 | -11.54 | -50.89 | -12.57 | -43.86 |
| **4** | -15.35 | -51.32 | -12.61 | -52.39 | -10.76 | -42.06 | -14.17 | -51.14 | -9.35 | -45.88 |
| **5** | -15.92 | -60.59 | -13.41 | -50.80 | -9.71 | -46.15 | -5.57 | -52.44 | -8.39 | -48.33 |
| **6** | -21.61 | -53.04 | -14.50 | -54.08 | -18.25 | -41.10 | -7.79 | -51.00 | -10.52 | -46.13 |
| **7** | -17.07 | -62.62 | -14.06 | -53.38 | -12.39 | -48.88 | -9.01 | -52.53 | -7.69 | -49.57 |
| **8** | -16.15 | -55.87 | -15.87 | -48.57 | -8.86 | -47.94 | -16.11 | -50.91 | -8.50 | -46.80 |
| **9** | -15.15 | -58.71 | -14.60 | -47.00 | -20.51 | -45.90 | -8.11 | -49.56 | -11.55 | -50.43 |
| **10** | -17.16 | -53.15 | -11.50 | -49.35 | -18.42 | -47.83 | -11.18 | -55.02 | -10.80 | -39.89 |
| **Mean** | **-16.35** | **-54.08** | **-12.67** | **-52.34** | **-14.24** | **-46.79** | **-11.46** | **-51.05** | **-11.04** | **-47.10** |
| **SD** | **2.46** | **5.22** | **2.83** | **3.29** | **3.96** | **3.21** | **3.84** | **2.01** | **2.93** | **3.51** |
| **Smooth** | **2** | | **3** | | **2** | | **3** | | **4** | |

TABLE K9: JOINT ANGLES - SUB 16

| HIP | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -13.00 | 28.27 | 18.79 | 64.16 | 4.08 | 50.72 | 18.57 | 81.29 | 21.13 | 71.44 |
| 2 | -22.84 | 26.30 | 20.10 | 65.20 | 4.82 | 46.36 | 20.40 | 72.86 | 19.92 | 76.92 |
| 3 | -25.21 | 28.84 | 20.38 | 67.59 | 6.40 | 43.47 | 12.29 | 74.66 | 19.77 | 75.16 |
| 4 | -21.24 | 32.17 | 20.91 | 69.83 | 5.79 | 45.07 | 20.67 | 76.82 | 22.64 | 77.34 |
| 5 | -19.57 | 33.19 | 23.53 | 64.59 | 9.25 | 48.23 | 21.34 | 81.14 | 19.83 | 71.32 |
| 6 | -20.68 | 35.54 | 20.18 | 68.84 | 3.39 | 52.61 | 19.92 | 80.27 | 24.73 | 81.12 |
| 7 | -20.66 | 35.45 | 16.91 | 66.46 | 7.69 | 38.67 | 24.67 | 83.82 | 16.96 | 73.87 |
| 8 | -18.90 | 33.26 | 14.57 | 67.53 | -2.65 | 51.51 | 23.51 | 82.88 | 20.22 | 70.80 |
| 9 | -21.61 | 34.25 | 21.43 | 69.38 | 2.11 | 56.09 | 17.67 | 78.95 | 17.21 | 75.74 |
| 10 | -19.25 | 31.51 | 18.01 | 63.31 | 10.52 | 51.93 | 21.08 | 75.39 | 19.49 | 76.04 |
| **Mean** | **-21.11** | **31.88** | **19.48** | **66.69** | **5.14** | **48.47** | **20.01** | **78.81** | **20.19** | **74.98** |
| **SD** | **1.97** | **3.14** | **2.52** | **2.30** | **3.78** | **5.15** | **3.41** | **3.71** | **2.30** | **3.22** |
| **Smooth** | **5** | | **4** | | **4** | | **5** | | **5** | |
| **KNEE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | 11.73 | 102.55 | 2.58 | 119.10 | -5.29 | 101.82 | 24.39 | 145.48 | 17.69 | 138.60 |
| 2 | 6.94 | 100.05 | -1.66 | 119.17 | -9.84 | 102.27 | 21.45 | 143.36 | 11.60 | 141.28 |
| 3 | 10.79 | 103.75 | 0.98 | 119.10 | -3.84 | 102.33 | 10.63 | 143.08 | 8.01 | 144.51 |
| 4 | 8.13 | 101.77 | 4.28 | 120.61 | -9.27 | 101.21 | 5.47 | 140.21 | 10.30 | 140.61 |
| 5 | 12.21 | 101.26 | -0.40 | 118.42 | -8.32 | 102.72 | 20.97 | 144.15 | 3.52 | 145.49 |
| 6 | 10.27 | 104.03 | -5.35 | 123.90 | -7.82 | 102.47 | 18.37 | 139.03 | 17.19 | 144.69 |
| 7 | 13.71 | 104.93 | -2.85 | 120.25 | -8.12 | 100.31 | 21.97 | 146.97 | 8.77 | 141.72 |
| 8 | 12.47 | 106.12 | -4.32 | 117.77 | -8.69 | 106.43 | 14.88 | 144.85 | 9.88 | 141.02 |
| 9 | 9.16 | 103.10 | -0.74 | 122.06 | -4.06 | 104.48 | 17.54 | 146.77 | 13.96 | 142.66 |
| 10 | 5.16 | 102.53 | -4.14 | 119.93 | -6.40 | 103.24 | 13.38 | 138.98 | 12.03 | 142.51 |
| **Mean** | **10.06** | **103.01** | **-1.16** | **120.03** | **-7.17** | **102.73** | **16.91** | **143.29** | **11.30** | **142.31** |
| **SD** | **2.70** | **1.79** | **3.14** | **1.81** | **2.14** | **1.71** | **5.85** | **2.98** | **4.27** | **2.12** |
| **Smooth** | **6** | | **4** | | **4** | | **5** | | **4** | |
| **ANKLE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | -10.53 | -47.49 | -43.23 | -79.70 | -7.00 | -67.62 | -1.64 | -43.10 | -7.90 | -50.28 |
| 2 | -14.00 | -52.41 | -32.70 | -80.03 | -51.04 | -79.17 | 3.03 | -33.15 | -20.81 | -47.21 |
| 3 | -12.29 | -56.36 | -44.41 | -74.34 | -44.95 | -73.12 | -4.20 | -39.81 | -10.31 | -53.21 |
| 4 | -9.82 | -52.84 | -36.79 | -80.66 | -30.32 | -84.20 | -3.74 | -39.69 | -13.91 | -44.39 |
| 5 | -12.07 | -47.45 | -43.88 | -80.48 | -38.73 | -73.90 | -5.78 | -35.67 | -14.07 | -51.51 |
| 6 | -8.55 | -53.49 | -48.94 | -71.69 | -51.61 | -68.54 | -1.02 | -38.39 | -11.87 | -43.98 |
| 7 | -8.85 | -48.83 | -42.43 | -80.47 | -63.01 | -86.12 | -3.43 | -36.80 | -11.33 | -38.37 |
| 8 | -12.57 | -51.85 | -46.54 | -77.35 | -53.18 | -80.17 | -2.87 | -43.73 | -17.04 | -57.36 |
| 9 | -16.01 | -58.08 | -42.99 | -79.83 | -60.36 | -82.75 | -2.90 | -39.54 | -20.06 | -67.66 |
| 10 | -22.55 | -56.84 | -44.03 | -81.80 | -24.02 | -73.65 | -4.16 | -29.24 | -11.48 | -60.84 |
| **Mean** | **-12.72** | **-53.13** | **-42.59** | **-78.63** | **-42.42** | **-76.92** | **-2.67** | **-37.91** | **-13.88** | **-51.48** |
| **SD** | **4.15** | **3.57** | **4.66** | **3.23** | **17.57** | **6.48** | **2.41** | **4.40** | **4.23** | **8.72** |
| **Smooth** | **3** | | **3** | | **2** | | **3** | | **3** | |

TABLE K9: JOINT ANGLES - SUB 17

| HIP | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | -10.95 | 34.01 | 14.03 | 73.50 | 15.28 | 73.42 | 10.13 | 65.86 | 6.14 | 68.23 |
| 2 | -11.49 | 32.50 | 17.67 | 76.87 | 18.51 | 69.98 | 10.31 | 71.28 | 5.48 | 69.87 |
| 3 | -11.11 | 32.93 | 17.81 | 79.89 | 21.27 | 69.45 | 11.38 | 74.10 | 3.18 | 64.03 |
| 4 | -11.37 | 31.91 | 23.58 | 77.96 | 21.65 | 67.94 | 17.50 | 71.26 | 4.74 | 64.91 |
| 5 | -11.06 | 33.38 | 20.83 | 76.18 | 15.81 | 65.06 | 14.67 | 68.25 | 4.31 | 64.11 |
| 6 | -10.47 | 32.88 | 16.98 | 78.99 | 18.70 | 66.53 | 12.13 | 63.87 | 5.44 | 61.46 |
| 7 | -10.58 | 33.57 | 16.42 | 71.61 | 13.38 | 64.40 | 9.60 | 63.08 | 2.64 | 62.67 |
| 8 | -13.88 | 33.24 | 18.05 | 72.68 | 12.55 | 67.04 | 14.24 | 67.96 | 1.09 | 67.72 |
| 9 | -11.04 | 34.24 | 17.09 | 76.02 | 15.02 | 62.49 | 9.48 | 68.57 | 3.68 | 68.05 |
| 10 | -13.75 | 32.58 | 17.57 | 80.94 | 14.37 | 69.33 | 13.94 | 65.80 | 3.22 | 63.72 |
| **Mean** | **-11.64** | **33.12** | **18.00** | **76.46** | **16.65** | **67.56** | **12.34** | **68.00** | **3.99** | **65.48** |
| **SD** | **1.28** | **0.71** | **2.57** | **3.12** | **3.20** | **3.17** | **2.66** | **3.49** | **1.53** | **2.79** |
| **Smooth** | **6** | | **4** | | **4** | | **4** | | **5** | |
| **KNEE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | 8.71 | 104.12 | -2.54 | 123.20 | -7.60 | 103.35 | 3.56 | 145.80 | 0.71 | 147.02 |
| 2 | 9.28 | 104.07 | -4.95 | 117.20 | -4.51 | 118.88 | 1.05 | 147.07 | 1.43 | 145.09 |
| 3 | 9.86 | 104.94 | -4.25 | 121.27 | -2.88 | 110.32 | 7.03 | 149.97 | -2.51 | 145.78 |
| 4 | 8.14 | 104.52 | -4.00 | 117.76 | -3.70 | 110.52 | 9.31 | 146.88 | 1.75 | 148.90 |
| 5 | 10.50 | 106.59 | -4.39 | 120.04 | -4.46 | 99.36 | 6.39 | 146.53 | 0.54 | 146.48 |
| 6 | 10.22 | 103.80 | -4.61 | 115.39 | -2.51 | 108.29 | 5.78 | 143.63 | 3.95 | 144.73 |
| 7 | 11.84 | 104.08 | -3.90 | 121.55 | -4.40 | 107.40 | 6.64 | 145.64 | -0.20 | 148.24 |
| 8 | 10.89 | 106.58 | -3.46 | 120.52 | -3.79 | 105.06 | 4.66 | 147.73 | 0.29 | 146.65 |
| 9 | 12.13 | 102.52 | -3.37 | 123.32 | -5.40 | 108.75 | 7.82 | 145.23 | 0.40 | 148.39 |
| 10 | 10.58 | 103.31 | -3.35 | 118.05 | -4.78 | 105.10 | 7.52 | 148.50 | 0.67 | 145.61 |
| **Mean** | **10.21** | **104.45** | **-3.88** | **119.83** | **-4.40** | **107.70** | **5.98** | **146.70** | **0.70** | **146.69** |
| **SD** | **1.27** | **1.30** | **0.72** | **2.65** | **1.42** | **5.20** | **2.37** | **1.79** | **1.62** | **1.44** |
| **Smooth** | **7** | | **4** | | **4** | | **4** | | **5** | |
| **ANKLE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | -22.67 | -53.81 | -42.16 | -67.87 | -53.42 | -82.96 | -26.10 | -60.27 | -32.75 | -63.79 |
| 2 | -23.24 | -57.18 | -45.23 | -68.05 | -54.73 | -79.06 | -26.11 | -64.40 | -38.15 | -69.51 |
| 3 | -25.09 | -55.96 | -41.37 | -74.30 | -41.94 | -83.15 | -25.70 | -64.26 | -36.83 | -64.47 |
| 4 | -21.11 | -55.63 | -38.07 | -68.11 | -53.82 | -86.40 | -21.73 | -62.48 | -32.91 | -67.25 |
| 5 | -26.09 | -55.08 | -45.97 | -71.17 | -53.75 | -81.01 | -30.07 | -65.25 | -34.93 | -66.75 |
| 6 | -24.05 | -55.03 | -46.60 | -72.77 | -28.90 | -81.89 | -25.57 | -60.02 | -36.52 | -62.94 |
| 7 | -22.48 | -57.05 | -41.22 | -61.10 | -51.72 | -64.40 | -26.58 | -64.46 | -39.34 | -61.51 |
| 8 | -18.44 | -54.93 | -46.27 | -68.37 | -14.35 | -83.54 | -26.96 | -65.55 | -37.88 | -63.10 |
| 9 | -22.64 | -55.78 | -41.89 | -63.66 | -55.34 | -71.96 | -28.22 | -63.59 | -37.27 | -63.06 |
| 10 | -18.41 | -53.27 | -44.17 | -60.06 | -48.81 | -86.49 | -27.83 | -65.69 | -35.98 | -65.87 |
| **Mean** | **-22.42** | **-55.54** | **-43.30** | **-67.55** | **-45.68** | **-80.09** | **-26.49** | **-63.60** | **-36.26** | **-64.83** |
| **SD** | **2.53** | **1.18** | **2.79** | **4.71** | **13.70** | **6.89** | **2.17** | **2.05** | **2.17** | **2.46** |
| **Smooth** | **2** | | **2** | | **2** | | **2** | | **2** | |

TABLE K9: JOINT ANGLES - SUB 18

| HIP | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | 1.75 | 24.41 | 19.37 | 79.49 | 14.29 | 59.50 | 17.88 | 79.22 | 32.17 | 83.49 |
| 2 | 0.08 | 27.69 | 24.56 | 84.94 | 22.15 | 76.18 | 22.51 | 77.43 | 25.35 | 81.23 |
| 3 | -1.92 | 19.62 | 22.78 | 73.77 | 17.37 | 60.41 | 11.99 | 79.06 | 21.98 | 68.91 |
| 4 | 0.26 | 27.38 | 28.42 | 79.09 | 15.13 | 71.09 | 25.18 | 83.17 | 20.07 | 72.92 |
| 5 | -0.70 | 28.48 | 8.17 | 70.98 | 29.20 | 67.19 | 27.52 | 72.00 | 23.47 | 80.13 |
| 6 | -3.66 | 23.12 | 15.24 | 73.89 | 9.18 | 65.62 | 26.37 | 82.05 | 15.29 | 80.12 |
| 7 | 1.26 | 27.45 | 18.35 | 67.07 | 15.73 | 68.48 | 29.03 | 81.97 | 23.84 | 82.23 |
| 8 | 1.70 | 31.77 | 22.43 | 85.33 | 16.23 | 64.60 | 28.63 | 79.12 | 26.29 | 78.34 |
| 9 | -0.12 | 28.74 | 12.01 | 71.94 | 17.69 | 74.91 | 20.76 | 76.10 | 25.56 | 78.82 |
| 10 | 1.54 | 26.63 | 19.60 | 77.16 | 17.40 | 61.76 | 30.75 | 85.56 | 23.39 | 90.59 |
| **Mean** | **0.02** | **26.53** | **19.09** | **76.36** | **17.44** | **66.97** | **24.06** | **79.57** | **23.74** | **79.68** |
| **SD** | **1.75** | **3.38** | **6.03** | **5.96** | **5.25** | **5.78** | **5.83** | **3.88** | **4.37** | **5.84** |
| **Smooth** | **6** | | **5** | | **5** | | **4** | | **4** | |
| **KNEE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | 10.24 | 77.26 | -7.52 | 110.40 | 3.68 | 105.79 | -4.71 | 117.69 | 6.61 | 125.62 |
| 2 | 6.29 | 69.30 | -8.59 | 117.87 | -8.21 | 95.06 | 0.22 | 113.25 | 8.84 | 118.78 |
| 3 | 2.00 | 69.81 | -10.15 | 105.95 | -8.21 | 88.27 | 6.14 | 111.30 | 16.02 | 118.14 |
| 4 | 2.80 | 71.84 | -6.89 | 103.66 | -7.61 | 106.83 | 7.10 | 117.45 | 12.61 | 121.03 |
| 5 | 5.04 | 70.68 | -7.00 | 101.69 | -11.95 | 109.43 | 7.91 | 114.98 | 10.28 | 114.70 |
| 6 | 3.16 | 78.74 | -10.26 | 100.56 | -10.83 | 104.50 | 14.98 | 115.59 | 4.64 | 121.22 |
| 7 | 3.96 | 77.61 | -8.81 | 103.76 | -9.64 | 110.02 | 9.24 | 117.93 | 7.65 | 118.28 |
| 8 | 4.63 | 76.20 | -7.09 | 107.67 | -9.95 | 102.05 | 10.09 | 108.94 | 17.66 | 119.31 |
| 9 | 4.82 | 78.49 | -5.35 | 110.57 | -9.41 | 95.68 | 11.85 | 117.83 | 2.39 | 119.57 |
| 10 | 4.87 | 73.91 | -9.18 | 108.18 | -10.22 | 99.01 | 18.07 | 115.68 | 14.25 | 111.16 |
| **Mean** | **4.78** | **74.38** | **-7.96** | **107.03** | **-8.24** | **101.66** | **8.09** | **115.06** | **10.10** | **118.78** |
| **SD** | **2.29** | **3.73** | **1.62** | **5.13** | **4.39** | **7.05** | **6.64** | **3.06** | **5.00** | **3.86** |
| **Smooth** | **6** | | **5** | | **4** | | **4** | | **5** | |
| **ANKLE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | -16.88 | -47.96 | -26.27 | -64.28 | -35.38 | -80.62 | -24.39 | -34.14 | -29.37 | -46.17 |
| 2 | -15.47 | -48.25 | -42.59 | -46.87 | -45.18 | -84.63 | -25.07 | -36.15 | -23.58 | -33.13 |
| 3 | -14.62 | -48.39 | -41.34 | -52.57 | -47.98 | -85.82 | -31.08 | -37.22 | -13.78 | -33.82 |
| 4 | -16.09 | -50.57 | -43.78 | -80.97 | -50.80 | -84.37 | -26.53 | -39.17 | -16.32 | -26.62 |
| 5 | -19.29 | -52.08 | -42.72 | -76.25 | -47.23 | -81.10 | -29.26 | -41.07 | -24.53 | -37.12 |
| 6 | -19.37 | -49.90 | -46.32 | -80.02 | -53.18 | -86.12 | -32.53 | -44.96 | -25.52 | -31.03 |
| 7 | -17.31 | -57.42 | -46.15 | -81.18 | -49.96 | -78.47 | -30.84 | -62.24 | -18.88 | -28.88 |
| 8 | -17.76 | -54.95 | -45.77 | -83.24 | -45.78 | -84.76 | -29.36 | -39.01 | -12.53 | -29.60 |
| 9 | -14.05 | -54.14 | -43.82 | -73.89 | -51.13 | -77.22 | -24.25 | -43.70 | -25.00 | -49.85 |
| 10 | -17.30 | -50.15 | -43.39 | -85.58 | -44.28 | -83.66 | -22.51 | -34.78 | -21.47 | -67.28 |
| **Mean** | **-16.81** | **-51.38** | **-42.21** | **-72.49** | **-47.09** | **-82.68** | **-27.58** | **-41.24** | **-21.10** | **-38.35** |
| **SD** | **1.79** | **3.20** | **5.84** | **13.45** | **5.02** | **3.13** | **3.15** | **8.19** | **5.54** | **12.64** |
| **Smooth** | **2** | | **2** | | **2** | | **2** | | **3** | |

TABLE K9: JOINT ANGLES - SUB 19

| HIP | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | -14.45 | 19.05 | 21.33 | 70.62 | -2.31 | 42.63 | 14.24 | 82.36 | 7.89 | 69.36 |
| 2 | -13.08 | 19.00 | 13.79 | 64.44 | 1.33 | 51.60 | 14.33 | 86.30 | 12.48 | 65.16 |
| 3 | -9.23 | 19.84 | 16.87 | 70.32 | 0.64 | 46.78 | 12.90 | 87.95 | 9.75 | 59.94 |
| 4 | -5.34 | 21.83 | 16.25 | 59.99 | 1.65 | 49.17 | 14.92 | 80.78 | 6.98 | 60.10 |
| 5 | -11.40 | 16.33 | 13.88 | 57.98 | -1.82 | 41.85 | 8.93 | 82.90 | 10.99 | 65.13 |
| 6 | -9.61 | 20.85 | 14.51 | 61.12 | -2.92 | 45.28 | 12.94 | 79.32 | 6.97 | 66.85 |
| 7 | -6.69 | 17.30 | 9.54 | 66.96 | 0.67 | 40.88 | 14.11 | 77.98 | 9.70 | 71.61 |
| 8 | -5.96 | 15.55 | 14.63 | 69.30 | -1.70 | 40.71 | 15.93 | 80.01 | 14.24 | 73.05 |
| 9 | -10.38 | 13.51 | 13.44 | 63.53 | -1.74 | 48.69 | 11.44 | 79.08 | 16.46 | 73.12 |
| 10 | -8.75 | 18.99 | 13.77 | 58.10 | -2.87 | 54.93 | 10.39 | 79.72 | 12.98 | 72.72 |
| **Mean** | **-9.49** | **18.23** | **14.08** | **64.23** | **-0.91** | **46.25** | **13.01** | **81.64** | **10.84** | **67.70** |
| **SD** | **2.98** | **2.54** | **2.07** | **4.90** | **1.78** | **4.85** | **2.18** | **3.27** | **3.19** | **5.09** |
| **Smooth** | **4** | | **5** | | **4** | | **4** | | **5** | |

| KNEE | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | 6.43 | 86.15 | -5.44 | 111.28 | -10.52 | 110.37 | 4.50 | 119.91 | 4.42 | 107.52 |
| 2 | -1.05 | 86.50 | -7.00 | 99.80 | -8.61 | 111.16 | 1.77 | 116.80 | 5.26 | 106.38 |
| 3 | 0.85 | 88.55 | -6.85 | 104.09 | -8.04 | 107.08 | 4.71 | 122.93 | 0.48 | 106.88 |
| 4 | 6.87 | 89.27 | -4.82 | 108.46 | -5.69 | 111.52 | 11.74 | 118.30 | 5.75 | 104.91 |
| 5 | 1.59 | 84.80 | -10.33 | 98.74 | -5.33 | 114.46 | 2.90 | 121.22 | 0.59 | 107.40 |
| 6 | 0.74 | 89.58 | -9.14 | 106.36 | -7.89 | 113.52 | 3.21 | 122.66 | 3.83 | 104.71 |
| 7 | 2.51 | 85.63 | -4.88 | 104.91 | -6.62 | 105.13 | 12.03 | 128.13 | 4.04 | 109.02 |
| 8 | 3.76 | 85.08 | -6.80 | 108.96 | -7.50 | 102.41 | 3.44 | 119.68 | 7.27 | 110.92 |
| 9 | -2.97 | 80.76 | -3.43 | 106.28 | -6.23 | 107.92 | 5.42 | 121.27 | 2.44 | 108.56 |
| 10 | 0.76 | 88.02 | -7.82 | 111.29 | -4.73 | 115.38 | 6.35 | 123.85 | 5.02 | 107.71 |
| **Mean** | **1.95** | **86.43** | **-6.65** | **106.02** | **-7.12** | **109.90** | **5.61** | **121.48** | **3.91** | **107.40** |
| **SD** | **3.08** | **2.63** | **2.10** | **4.31** | **1.74** | **4.20** | **3.56** | **3.18** | **2.18** | **1.86** |
| **Smooth** | **6** | | **4** | | **4** | | **5** | | **4** | |

| ANKLE | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | -18.06 | -68.74 | -25.53 | -43.17 | -13.58 | -54.50 | -2.08 | -28.30 | -8.97 | -28.64 |
| 2 | -21.36 | -74.26 | -20.49 | -41.11 | -23.07 | -51.22 | -7.11 | -22.24 | -15.05 | -26.81 |
| 3 | -23.88 | -74.66 | -24.47 | -41.58 | -11.65 | -54.77 | -1.30 | -24.71 | -14.30 | -29.89 |
| 4 | -21.21 | -65.33 | -22.54 | -37.82 | -15.38 | -51.03 | -4.54 | -27.99 | -13.40 | -25.43 |
| 5 | -21.50 | -69.82 | -28.19 | -42.46 | -15.06 | -52.31 | -4.88 | -32.69 | -15.27 | -28.13 |
| 6 | -24.79 | -63.28 | -22.59 | -32.26 | -22.50 | -53.27 | -4.08 | -25.75 | -12.82 | -29.53 |
| 7 | -22.62 | -73.43 | -22.49 | -38.80 | -18.01 | -52.79 | -6.47 | -31.26 | -17.27 | -27.79 |
| 8 | -21.61 | -72.26 | -24.17 | -42.15 | -19.66 | -50.81 | -6.89 | -35.10 | -18.18 | -31.65 |
| 9 | -20.46 | -71.42 | -25.03 | -43.56 | -19.08 | -46.57 | -7.50 | -27.78 | -14.29 | -30.62 |
| 10 | -24.21 | -71.19 | -17.46 | -41.18 | -14.73 | -49.09 | -4.18 | -27.64 | -10.03 | -32.73 |
| **Mean** | **-21.97** | **-70.44** | **-23.30** | **-40.41** | **-17.27** | **-51.64** | **-4.90** | **-28.35** | **-13.96** | **-29.12** |
| **SD** | **2.00** | **3.75** | **2.94** | **3.38** | **3.81** | **2.49** | **2.12** | **3.82** | **2.86** | **2.22** |
| **Smooth** | **2** | | **2** | | **2** | | **3** | | **3** | |

## TABLE K9: JOINT ANGLES - SUB 20

| HIP | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| Stride | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| 1 | -10.49 | 33.20 | 17.10 | 67.49 | 29.84 | 71.89 | 10.01 | 60.74 | 8.17 | 57.01 |
| 2 | -13.94 | 34.59 | 19.93 | 78.06 | 31.76 | 80.43 | 4.36 | 62.00 | 7.60 | 51.83 |
| 3 | -11.04 | 32.41 | 17.76 | 74.14 | 29.19 | 78.27 | 7.75 | 56.81 | 9.66 | 56.67 |
| 4 | -13.64 | 39.04 | 18.27 | 68.59 | 32.32 | 72.54 | 8.56 | 58.20 | 9.27 | 57.23 |
| 5 | -11.59 | 36.17 | 13.73 | 64.56 | 29.60 | 83.00 | 8.05 | 61.10 | 12.10 | 64.29 |
| 6 | -14.00 | 32.84 | 12.81 | 71.52 | 31.18 | 73.93 | 5.79 | 64.09 | 10.53 | 61.09 |
| 7 | -14.49 | 35.39 | 17.35 | 69.91 | 24.46 | 81.07 | 7.65 | 59.37 | 15.35 | 66.05 |
| 8 | -11.65 | 35.25 | 13.76 | 66.78 | 28.83 | 74.05 | 8.54 | 55.75 | 14.17 | 60.05 |
| 9 | -11.51 | 35.85 | 17.14 | 63.36 | 31.25 | 78.86 | 6.73 | 62.69 | 11.64 | 60.71 |
| 10 | -14.28 | 36.05 | 14.03 | 71.42 | 30.45 | 78.83 | 4.06 | 54.47 | 12.15 | 59.20 |
| **Mean** | **-12.66** | **35.08** | **16.19** | **69.58** | **29.89** | **77.29** | **7.15** | **59.52** | **11.06** | **59.41** |
| **SD** | **1.53** | **1.96** | **2.40** | **4.44** | **2.22** | **3.89** | **1.91** | **3.16** | **2.50** | **4.06** |
| **Smooth** | **5** | | **4** | | **4** | | **4** | | **4** | |
| **KNEE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | 9.21 | 106.49 | -5.94 | 119.11 | -7.78 | 118.61 | 15.35 | 143.64 | -6.71 | 130.62 |
| 2 | 10.39 | 105.83 | -4.46 | 122.22 | -10.13 | 119.03 | 11.78 | 143.47 | -5.65 | 128.68 |
| 3 | 9.72 | 109.22 | -9.44 | 119.38 | -9.11 | 117.71 | 8.98 | 140.03 | -7.79 | 132.95 |
| 4 | 9.48 | 109.90 | -8.20 | 122.49 | -7.35 | 116.67 | 8.77 | 145.17 | -5.73 | 131.61 |
| 5 | 11.47 | 108.61 | -3.43 | 119.47 | -12.15 | 113.72 | 11.45 | 140.57 | -1.28 | 133.71 |
| 6 | 9.31 | 106.84 | -3.57 | 120.49 | -8.51 | 121.44 | 11.99 | 141.44 | -3.81 | 131.18 |
| 7 | 9.28 | 106.92 | -4.99 | 122.87 | -9.34 | 123.02 | 17.30 | 143.03 | -2.58 | 131.38 |
| 8 | 9.70 | 104.06 | -8.38 | 115.93 | -12.85 | 117.04 | 14.49 | 138.38 | -3.67 | 131.36 |
| 9 | 9.12 | 105.37 | -9.60 | 119.59 | -12.09 | 116.08 | 10.79 | 140.89 | -1.31 | 133.55 |
| 10 | 8.62 | 107.06 | -14.27 | 120.95 | -12.08 | 120.35 | 9.56 | 141.55 | -4.75 | 133.71 |
| **Mean** | **9.63** | **107.03** | **-7.23** | **120.25** | **-10.14** | **118.37** | **12.05** | **141.82** | **-4.33** | **131.88** |
| **SD** | **0.80** | **1.79** | **3.41** | **2.06** | **2.02** | **2.74** | **2.84** | **2.01** | **2.20** | **1.62** |
| **Smooth** | **6** | | **4** | | **4** | | **5** | | **4** | |
| **ANKLE** | **TR** | | **SCC** | | **BCC** | | **SHK** | | **BHK** | |
| **Stride** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| 1 | -10.40 | -48.27 | -17.49 | -61.74 | -11.94 | -65.04 | -14.65 | -58.05 | -10.66 | -63.34 |
| 2 | -10.11 | -48.27 | -14.75 | -61.75 | -5.03 | -70.06 | -10.63 | -60.75 | 1.09 | -54.33 |
| 3 | -14.08 | -48.74 | -15.35 | -59.95 | -10.48 | -64.40 | -10.62 | -57.46 | -12.54 | -55.91 |
| 4 | -9.63 | -45.75 | -15.55 | -59.73 | 0.10 | -58.74 | -3.66 | -56.69 | -6.31 | -60.26 |
| 5 | -10.95 | -45.19 | -16.85 | -65.64 | -5.89 | -63.43 | -8.29 | -53.70 | -5.75 | -56.93 |
| 6 | -10.09 | -49.01 | -20.39 | -62.15 | -2.86 | -62.22 | -6.32 | -54.07 | -4.62 | -55.52 |
| 7 | -9.75 | -51.71 | -13.64 | -64.08 | -7.72 | -67.05 | -3.74 | -50.70 | -6.93 | -54.07 |
| 8 | -10.53 | -45.60 | -21.26 | -70.24 | -5.09 | -60.99 | -8.47 | -56.51 | -5.08 | -58.14 |
| 9 | -12.58 | -45.31 | -21.47 | -65.10 | -8.68 | -62.96 | -8.56 | -52.65 | -8.15 | -55.33 |
| 10 | -11.75 | -48.27 | -25.22 | -67.80 | -8.14 | -63.19 | -4.39 | -55.82 | -2.21 | -58.43 |
| **Mean** | **-10.99** | **-47.61** | **-18.20** | **-63.82** | **-6.57** | **-63.81** | **-7.93** | **-55.64** | **-6.12** | **-57.23** |
| **SD** | **1.42** | **2.11** | **3.72** | **3.42** | **3.58** | **3.14** | **3.52** | **2.92** | **3.91** | **2.90** |
| **Smooth** | **2** | | **2** | | **3** | | **2** | | **3** | |

TABLE E.72: Hip Joint Angle Summary

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| Sub | | | | | | | | | | |
| 1 | -17.03 | 13.03 | 8.34 | 71.72 | 4.76 | 60.23 | 10.24 | 55.14 | 8.71 | 56.02 |
| 2 | -24.42 | 16.85 | 2.48 | 45.32 | 6.44 | 49.89 | 10.37 | 60.67 | 15.44 | 61.96 |
| 3 | -19.80 | 24.21 | 19.67 | 62.51 | 18.31 | 64.86 | 26.80 | 77.50 | 13.92 | 71.21 |
| 4 | -12.98 | 21.80 | 12.83 | 65.38 | 16.94 | 61.18 | 17.13 | 71.55 | 17.61 | 72.04 |
| 5 | -8.14 | 27.98 | 31.01 | 91.77 | 27.90 | 90.42 | 21.67 | 92.59 | 28.70 | 92.54 |
| 6 | -9.88 | 21.79 | 22.19 | 93.82 | 4.48 | 77.94 | 26.36 | 91.58 | 22.02 | 85.20 |
| 7 | -9.60 | 29.54 | 12.73 | 77.53 | 16.39 | 92.29 | 12.56 | 69.78 | 11.12 | 71.09 |
| 8 | -13.84 | 31.56 | 18.67 | 85.05 | 14.01 | 88.02 | 23.41 | 83.18 | 22.23 | 83.47 |
| 9 | -17.84 | 23.27 | 12.82 | 74.37 | 15.84 | 71.50 | 3.46 | 58.76 | 9.52 | 62.28 |
| 10 | -16.41 | 24.76 | 2.87 | 58.70 | -0.38 | 64.81 | 10.27 | 75.72 | 9.32 | 68.76 |
| 11 | -17.15 | 31.17 | 14.06 | 83.97 | 12.62 | 73.37 | 15.12 | 91.74 | 15.99 | 86.35 |
| 12 | -15.62 | 16.95 | -2.62 | 48.57 | -9.76 | 44.75 | 11.02 | 72.64 | 14.30 | 78.57 |
| 13 | -16.80 | 20.67 | 6.43 | 59.23 | 14.33 | 81.91 | 12.13 | 75.83 | 22.36 | 85.60 |
| 14 | -9.04 | 29.75 | 15.12 | 105.29 | 7.93 | 81.58 | 12.53 | 105.35 | 9.34 | 99.55 |
| 15 | -8.63 | 28.28 | 16.85 | 64.17 | 18.27 | 69.06 | 12.67 | 70.93 | 6.56 | 55.24 |
| 16 | -21.11 | 31.88 | 19.48 | 66.69 | 5.14 | 48.47 | 20.01 | 78.81 | 20.19 | 74.98 |
| 17 | -11.64 | 33.12 | 18.00 | 76.46 | 16.65 | 67.56 | 12.34 | 68.00 | 3.99 | 65.48 |
| 18 | 0.02 | 26.53 | 19.09 | 76.36 | 17.44 | 66.97 | 24.06 | 79.57 | 23.74 | 79.68 |
| 19 | -9.49 | 18.23 | 14.08 | 64.23 | -0.91 | 46.25 | 13.01 | 81.64 | 10.84 | 67.70 |
| 20 | -12.66 | 35.08 | 16.19 | 69.58 | 29.89 | 77.29 | 7.15 | 59.52 | 11.06 | 59.41 |
| Mean | -13.60 | 25.32 | 14.01 | 72.04 | 11.81 | 68.92 | 15.12 | 76.03 | 14.85 | 73.86 |
| SD | 5.6 | 6.2 | 7.7 | 15.0 | 9.6 | 14.4 | 6.5 | 12.8 | 6.6 | 12.3 |

TABLE E.73: Knee Joint Angle Summary

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max |
| Sub | | | | | | | | | | |
| 1 | 6.97 | 74.60 | -13.07 | 134.65 | -11.76 | 113.07 | 1.52 | 129.39 | -4.32 | 123.81 |
| 2 | 3.17 | 75.51 | -9.12 | 130.76 | -14.18 | 108.82 | 1.79 | 134.38 | -4.00 | 124.72 |
| 3 | 5.87 | 83.98 | -7.65 | 137.50 | -11.96 | 129.60 | 17.22 | 129.90 | 11.58 | 132.18 |
| 4 | 4.90 | 100.10 | 3.80 | 134.36 | -6.85 | 125.32 | 1.87 | 132.39 | -3.13 | 127.06 |
| 5 | 11.40 | 91.46 | -3.18 | 104.50 | -3.47 | 103.02 | 20.20 | 148.20 | 17.70 | 143.81 |
| 6 | 7.48 | 96.91 | -13.06 | 128.31 | -16.97 | 122.73 | -4.42 | 142.47 | -8.80 | 134.82 |
| 7 | 9.84 | 98.81 | 6.07 | 133.51 | 8.96 | 128.65 | 9.36 | 130.84 | 15.90 | 130.21 |
| 8 | 10.42 | 92.95 | -4.45 | 132.23 | -1.80 | 115.25 | 8.35 | 137.46 | 7.80 | 131.40 |
| 9 | 6.93 | 100.22 | -8.36 | 113.22 | -5.94 | 93.03 | 12.91 | 117.75 | 16.47 | 108.26 |
| 10 | 3.10 | 87.88 | -12.05 | 132.25 | -13.08 | 123.71 | 10.36 | 143.14 | -5.30 | 124.12 |
| 11 | 11.00 | 105.74 | -14.46 | 123.01 | -10.20 | 113.05 | 0.48 | 142.58 | -1.98 | 135.57 |
| 12 | 8.67 | 80.23 | -8.21 | 116.32 | -7.39 | 113.21 | -6.34 | 118.12 | -6.88 | 122.73 |
| 13 | 3.31 | 104.04 | -8.01 | 117.85 | -6.02 | 112.77 | 13.27 | 140.36 | 9.28 | 137.53 |
| 14 | 9.34 | 95.68 | 2.00 | 128.17 | -5.74 | 125.10 | 5.97 | 141.59 | 6.25 | 131.29 |
| 15 | 2.69 | 91.70 | -3.20 | 144.64 | -6.72 | 137.38 | 6.07 | 143.22 | -1.37 | 132.84 |
| 16 | 10.06 | 103.01 | -1.16 | 120.03 | -7.17 | 102.73 | 16.91 | 143.29 | 11.30 | 142.31 |
| 17 | 10.21 | 104.45 | -3.88 | 119.83 | -4.40 | 107.70 | 5.98 | 146.70 | 0.70 | 146.69 |
| 18 | 4.78 | 74.38 | -7.96 | 107.03 | -8.24 | 101.66 | 8.09 | 115.06 | 10.10 | 118.78 |
| 19 | 1.95 | 86.43 | -6.65 | 106.02 | -7.12 | 109.90 | 5.61 | 121.48 | 3.91 | 107.40 |
| 20 | 9.63 | 107.03 | -7.23 | 120.25 | -10.14 | 118.37 | 12.05 | 141.82 | -4.33 | 131.88 |
| **Mean** | **7.09** | **92.76** | **-5.99** | **124.22** | **-7.51** | **115.25** | **7.36** | **135.01** | **3.54** | **129.37** |
| **SD** | **3.1** | **10.7** | **5.6** | **11.2** | **5.4** | **11.1** | **7.0** | **10.3** | **8.5** | **10.3** |

**TABLE E.74: Ankle Joint Angle Summary**

| | TR | | SCC | | BCC | | SHK | | BHK | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** |
| **Sub** | | | | | | | | | | |
| **1** | -14.66 | -58.54 | -30.83 | -63.09 | -33.20 | -73.40 | -19.35 | -58.01 | -23.86 | -57.30 |
| **2** | -23.79 | -56.13 | -21.16 | -60.23 | -50.19 | -74.56 | -13.40 | -48.23 | -19.80 | -47.57 |
| **3** | -20.48 | -56.36 | -22.32 | -63.40 | -21.76 | -70.00 | -19.95 | -61.08 | -32.86 | -66.26 |
| **4** | -18.09 | -62.07 | -8.96 | -57.07 | -11.68 | -54.93 | -19.19 | -65.70 | -24.77 | -62.05 |
| **5** | -13.25 | -43.11 | -29.72 | -81.58 | -28.98 | -74.32 | -14.93 | -54.96 | -16.49 | -44.58 |
| **6** | -20.79 | -47.59 | -12.70 | -56.04 | -31.50 | -67.85 | -21.78 | -62.48 | -32.27 | -69.03 |
| **7** | -10.78 | -41.99 | -20.00 | -59.51 | -8.99 | -63.48 | -17.74 | -56.18 | -16.96 | -58.63 |
| **8** | -15.49 | -49.79 | -25.44 | -49.87 | -14.53 | -45.21 | -22.70 | -52.88 | -18.46 | -60.39 |
| **9** | -22.97 | -62.45 | -45.96 | -78.33 | -48.43 | -78.42 | -34.20 | -61.75 | -46.40 | -72.39 |
| **10** | -16.40 | -44.53 | -7.97 | -75.90 | -25.69 | -67.13 | -2.56 | -45.37 | -15.04 | -52.17 |
| **11** | -11.14 | -54.75 | -38.33 | -69.98 | -24.17 | -67.71 | -38.54 | -70.23 | -35.91 | -75.44 |
| **12** | -15.59 | -49.24 | -42.76 | -80.43 | -34.37 | -69.62 | -26.58 | -61.59 | -48.83 | -69.04 |
| **13** | -11.72 | -54.67 | -44.78 | -75.94 | -42.11 | -74.29 | -26.49 | -60.81 | -38.39 | -68.47 |
| **14** | -15.14 | -43.94 | -39.05 | -76.78 | -43.68 | -77.81 | -24.36 | -56.00 | -20.77 | -71.78 |
| **15** | -16.35 | -54.08 | -12.67 | -52.34 | -14.24 | -46.79 | -11.46 | -51.05 | -11.04 | -47.10 |
| **16** | -12.72 | -53.13 | -42.59 | -78.63 | -42.42 | -76.92 | -2.67 | -37.91 | -13.88 | -51.48 |
| **17** | -22.42 | -55.54 | -43.30 | -67.55 | .45.68 | -80.09 | -26.49 | -63.60 | -36.26 | -64.83 |
| **18** | -16.81 | -51.38 | -42.21 | -72.49 | -47.09 | -82.68 | -27.58 | -41.24 | -21.10 | -38.35 |
| **19** | -21.97 | -70.44 | -23.30 | -40.41 | -17.27 | -51.64 | -4.90 | -28.35 | -13.96 | -29.12 |
| **20** | -10.99 | -47.61 | -18.20 | -63.82 | -6.57 | -63.81 | -7.93 | -55.64 | -6.12 | -57.23 |
| **Mean** | **-16.58** | **-52.87** | **-28.61** | **-66.17** | **-28.78** | **-68.03** | **-19.14** | **-54.65** | **-24.66** | **-58.16** |
| **SD** | **4.3** | **7.3** | **13.0** | **11.5** | **14.2** | **10.9** | **9.9** | **10.2** | **11.9** | **12.3** |

## TABLE E.75: Joint Angle Digitizing Summary

| | TR | | | SCC | | | BCC | | | SHK | | | BHK | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sub** | **HIP** | **KNEE** | **ANKLE** | **HIP** | **KNEE** | **ANKLE** | **HIP** | **KNEE** | **ANKLE** | **HIP** | **KNEE** | **ANKLE** | **HIP** | **KNEE** | **ANKLE** |
| **1** | 4 | 6 | 3 | 4 | 4 | 2 | 4 | 4 | 2 | 4 | 5 | 3 | 4 | 4 | 2 |
| **2** | 5 | 7 | 2 | 4 | 4 | 3 | 4 | 4 | 2 | 5 | 5 | 2 | 5 | 5 | 4 |
| **3** | 5 | 6 | 2 | 4 | 4 | 2 | 5 | 4 | 2 | 4 | 5 | 2 | 4 | 5 | 3 |
| **4** | 5 | 7 | 3 | 4 | 4 | 3 | 5 | 4 | 3 | 5 | 4 | 2 | 4 | 4 | 2 |
| **5** | 7 | 7 | 2 | 4 | 4 | 2 | 4 | 4 | 2 | 4 | 4 | 2 | 4 | 5 | 2 |
| **6** | 2 | 7 | 2 | 4 | 4 | 3 | 4 | 4 | 2 | 5 | 5 | 2 | 4 | 4 | 3 |
| **7** | 6 | 6 | 2 | 4 | 4 | 3 | 4 | 4 | 3 | 5 | 4 | 2 | 5 | 5 | 2 |
| **8** | 6 | 6 | 3 | 3 | 4 | 3 | 4 | 4 | 2 | 4 | 5 | 2 | 4 | 5 | 2 |
| **9** | 5 | 6 | 2 | 4 | 4 | 2 | 4 | 4 | 2 | 5 | 4 | 2 | 4 | 5 | 2 |
| **10** | 5 | 7 | 2 | 4 | 3 | 2 | 4 | 4 | 2 | 4 | 5 | 2 | 4 | 4 | 2 |
| **11** | 5 | 6 | 2 | 4 | 4 | 2 | 4 | 4 | 2 | 4 | 4 | 2 | 4 | 4 | 2 |
| **12** | 5 | 7 | 2 | 5 | 5 | 2 | 5 | 5 | 2 | 5 | 4 | 3 | 6 | 4 | 2 |
| **13** | 4 | 7 | 3 | 4 | 4 | 2 | 4 | 4 | 2 | 5 | 5 | 2 | 5 | 5 | 2 |
| **14** | 5 | 6 | 2 | 4 | 4 | 2 | 4 | 4 | 2 | 4 | 4 | 2 | 4 | 4 | 2 |
| **15** | 5 | 6 | 2 | 4 | 4 | 3 | 4 | 5 | 2 | 4 | 5 | 3 | 5 | 5 | 4 |
| **16** | 5 | 6 | 3 | 4 | 4 | 3 | 4 | 4 | 2 | 5 | 5 | 3 | 5 | 4 | 3 |
| **17** | 6 | 7 | 2 | 4 | 4 | 2 | 4 | 4 | 2 | 4 | 4 | 2 | 5 | 5 | 2 |
| **18** | 6 | 6 | 2 | 5 | 5 | 2 | 5 | 4 | 2 | 4 | 4 | 2 | 4 | 5 | 3 |
| **19** | 4 | 6 | 2 | 5 | 4 | 2 | 4 | 4 | 2 | 4 | 5 | 3 | 5 | 4 | 3 |
| **20** | 5 | 6 | 2 | 4 | 4 | 2 | 4 | 4 | 3 | 4 | 5 | 2 | 4 | 4 | 3 |
| **Mean** | **5.0** | **6.4** | **2.3** | **4.1** | **4.1** | **2.4** | **4.2** | **4.1** | **2.2** | **4.4** | **4.6** | **2.3** | **4.5** | **4.5** | **2.5** |
| **SD** | **1.0** | **0.5** | **0.4** | **0.4** | **0.4** | **0.5** | **0.4** | **0.3** | **0.4** | **0.5** | **0.5** | **0.4** | **0.6** | **0.5** | **0.7** |

## APPENDIX F
## Definitions

Acceleration: The change in velocity divided by the time it took for that velocity change to take place (81).

Ankle Angle: The relative interior angle formed between the shank (lower leg) and the foot/shoe, i.e. fifth metatarsal and lateral malleolus (55, 60).

Buoyant Force: The upward force that acts on an object or body in a fluid medium that is equal to the weight of the fluid displaced by that object or body (81).

Center of Buoyancy: The point through which the buoyant force acts (63).

Density: Mass of an object divided by its volume (81).

Drag Force: Component of resultant dynamic fluid force that acts on an object in opposition to the relative motion of the object through the fluid (81).

Deep Water Running (DWR): Running in water depth that is greater than the subject's height, with the head maintained above the water line through the use of a buoyant device worn around the waist and no foot contact with the bottom of the pool (55).

Heart Rate: The frequency of a heart's beat (78).

Hip Angle: The relative interior angle formed between the thigh (upper leg) and the trunk segments (55, 60).

Hydrostatic Pressure: Fluid pressure is exerted equally on all surface areas of an immersed body at rest and the pressure is directly proportional to the depth of the body part below the surface (61).

Joint Angle: The relative angle between two adjacent joint segments (55, 60).

Knee Angle: The relative interior angle formed between the shank (lower leg) and the thigh (upper leg) (55, 60).

Pressure: External force divided by the area over which the force acts (81).

Rating of Perceived Exertion: A subjective estimation of effort sense as an accompaniment to physiological data (78).

Respiratory Exchange Ratio (RER): RER is a ventilatory measurement and reflects gas exchange between the lungs and the pulmonary blood and is calculated as $VCO_2$ divided by $VO_2$ (47).

Respiratory Quotient (RQ): RQ provides information about substrate utilization at the cellular level and is calculated as $VCO_2$ divided by $VO_2$ (47).

Specific Gravity (relative density): The relative density of a substance equals a ratio of the weight of that substance to the weight of an equal volume of water (61).

Stride Rate: The inverse of stride time which is the time between successive contacts of opposite feet (131).

Stride Rate (DWR): The cycle time in which the right knee returns to its fully flexed position.

Velocity: The displacement of an object divided by the time it took for that displacement (81).

Viscosity: A measure of the internal friction between layers of molecules of a fluid or the resistance of a fluid to shear forces opposite to the relative motion of the object through the fluid (81).

$VO_2$: The rate of consumption of a given volume of oxygen (15).