DO FENCERS REQUIRE A WEAPON-SPECIFIC APPROACH TO STRENGTH AND CONDITIONING TRAINING?

INTRODUCTION

There are three types of weapon used in Olympic fencing: the épée, foil, and sabre. In épée the entire body may be targeted, in the foil discipline scoring is restricted to the torso, and in sabre only hits above the hips are scored. Furthermore, épée and foil use the tip of the sword, while in sabre hits may be made with the whole blade. Across all weapons, competitions take place over an entire day (often lasting around 10 hours) and consist of around 10 bouts with a break of anywhere between 15 min to 3 hours between each (Roi & Bianchedi, 2008), but can be as short as 5 min, which is the least the rules allow (British Fencing Association, 2015). Poule bouts are contested as the first to five hits within a 3 min round, while knockout stages are the first to 15 hits contested within three rounds of 3 min. In team competitions, fencers face each member of the opposing team once over a 3 min bout or until one team's score reaches a multiple of five (team bouts are first to 45 hits). Bouts and actual fight time consist of only 13% and 5% of actual competition time respectively (Roi & Bianchedi, 2008).

Differences in weapons do occur however, when examining within-bout time-motion analysis data. Rio & Bianchedi (2008) analyzed the winners of the men's and women's épée and men's foil at an international competition, and Aquili and Tancredi (2013) analyzed male and female sabre fencers during elimination bouts across world cup competitions. They found a bout work:rest ratio (WR) of 1:1 and 2:1 in men's and women's épée respectively, 1:3 in men's foil, and 1:6 for sabre (men's and women's); the former is also supported by the work of Bottoms et al., (2013). Working times differed as well, with on average épée fencers working for 15 s, foil for 5 s, and sabre for 2.5 s. The weapons also had varying numbers of attacks and changes of direction (COD) per bout (Aquili & Tancredi, 2013; Roi & Bianchedi, 2008). The number of attacks ranged between 11-28 in women's épée, 16-30 in men's épée, 23-35 in men's foil, and 21 for sabre. Similar divergences occur in the number of COD and reported as 35-97, 17-49, 20-30, and 8 respectively.

Technical and tactical differences between each weapon may in part explain some of the variance in the aforementioned time-motion analysis data. However, differences in the required physical preparation may not exist as in each discipline the same high-intensity movements are consistently performed, i.e., lunging and various patterns that define COD (Turner, et al., 2014). These movements must all be executed as quickly as possible to score the hit or avoid being hit, and while WRs vary (from 1:1 to 1:6), the "work" component only ranges from 2.5 to 15 s, with the longer work periods consisting of predominately submaximal work. For example, Wylde et al., (2013) who examined time-motion analysis data during competitive bouts of elite women foilists (WR of 1:1.1), reported that low (stationary or stepping), medium (engaged e.g., bouncing and stepping forward or backward) and high-intensity (bursts of attack or defense) movements accounted for 58.4, 35.9, and 5.7% of total bout time respectively, with a mean duration of 6.1, 5.4, and 0.7 s respectively.

Therefore the aim of this study was to determine if fencers exhibited different physical characteristics across weapons. This information is critical to determine whether strength and conditioning training should be weapon specific. Given the similarities in bout intensity and time, typical movements performed and the need to execute these movements as explosively as possible, it was hypothesized that no significant differences exist between them; thus all weapons could be trained the same. Such an assumption warrants investigation, as anecdotally it is contradictory to the thoughts of many coaches and was the subject of a recent rebuttal (Bottoms, In press); the (logical) argument is that technical and tactical differences, and variations in WRs demand a differing approach to strength and conditioning between weapons.

METHODS

Experimental approach to the problem

National standard cadet and junior épée, foil and, sabre fencers were chosen, who trained regularly (~ 4 times per week). Coupled with sufficient experience (~ 6 years) in their chosen weapon, this would enable any differences in physical characteristics to be noted should they exist. Furthermore, these fencers had not engaged in strength and conditioning training, either currently or previously, which may have altered physical characteristics beyond that determined from fencing training and competition alone. Lunging, Change of direction speed (CODS), and repeat lunge ability (RLA) are considered critical to performance in fencing and have previously been associated with anthropometry and assessments of lower body power and reactive strength (Gholipour, Tabrizi, & Farahmand, 2008; Gresham-Fiegel, House, & Zupan, 2013; Guilhem, Giroux, Chollet, & Rabita, 2014; Gutierrez-Davila, 2011; Stewart & Kopetka, 2005; Tsolakis & Vagenas, 2010; Tsolakis, Kostaki, & Vagenas, 2010; Turner, et al., In press). The aforementioned performance tests were therefore the dependent variables, with weapon and gender the independent variables. Analyzing differences between performance tests, separated by weapon, would thus test the hypothesis of this research. While utilizing cadet (U17) and junior (U20) fencers limits result to adolescent fencers, it does provide the opportunity to test a sample not yet undergoing structured strength and conditioning training, which may bias results in performance tests beyond that dictated by their weapon specific approach to training.

Subjects

Seventy-nine male (n = 46) and female (n = 33) national standard cadet and junior fencers took part in this study. Fencers from each weapon (male and female), i.e., épée (n = 19 and 10), foil (n = 22 and 14) and sabre (n = 13 and 10) were tested, and on average (± SD) were 15.9 ± 0.7 years of age, 178.5 ± 7.9 cm tall, 67.4 ± 12.2 kg in mass and had 6.3 ± 2.3 years fencing experience in their respective weapon. The Middlesex University Ethics Committee approved the study and their parent, guardian or carer provided written informed consent before taking part in the research. All participants were familiar with the testing protocol as it was regularly completed throughout their season at training camps. In order for fencers to participate in this study, they had to be considered free from injury and illness at the time of testing, healthy, and of good fitness.

Anthropometric data

Body mass was measured to the nearest 0.1 kg with a pre-calibrated electronic weighing scale (Seca Alpha 770, Birmingham, UK). Stature was measured to the nearest 0.1 cm with a stadiometer (Seca 220, Birmingham, UK). The measurement was taken as the maximum distance from the floor to the highest point (vertex) on the skull.

Lower-body Power

Jump height was measured in the countermovement jump (CMJ) and single leg-countermovement jump (SLCMJ) for both the front (or lead) and back leg. The SLCMJ scores were used to identify any asymmetries between legs and used the following equation: (stronger leg – weaker leg)*100/stronger leg (Impellizzeri, Rampinni, & Marcora, 2007; Fort-Vanmeerhaeghe, Gual, Romero-Rodriguez, & Unnitha, 2016). For most fencers, the front leg is strongest but this is not always the case (Turner, et al., In press); a finding also found in volleyball and basketball players (Fort-Vanmeerhaeghe, Gual, Romero-Rodriguez, & Unnitha, 2016). Therefore an equation that defines asymmetry values on strength rather than leg dominance is preferred. Reactive strength index (RSI) was measured following a drop jump from a box height of 30cm (Flanagan & Comyns, 2008). During the test, fencers were instructed to minimize ground contact time and then jump as high as possible. The RSI was calculated as flight time in milliseconds divided by ground contact time in milliseconds. For all jumps (drop jump, CMJ, SLCMJ), fencers were instructed to keep their hands in contact with their hips for the duration of the test. Any movement of the hands away from the hips would have resulted in the jump being disqualified. Following take-off, fencers were also instructed to maintain full extension until contact had been made with the floor upon landing. All scores were recorded to two decimal places and were measured using an optical measurement system (Optojump, Microgate, Italy). Compared to force plate measures, Optojump has shown intraclass correlation coefficients (ICC) for validity of r = 0.997-0.998. Furthermore, test-retest reliability had ICC ranging from 0.982 to 0.989 with low coefficients of variation (2.7%) (Glatthorn, Gouge, Nussbaumer, Stauffacher, Impellizzeri, & Maffiuletti, 2011).

Change of direction speed

Change of direction speed was measured using a 4-2-2-4 m shuttle (Turner, et al., In press) as illustrated in Figure 1. This has been previously used within fencing (Turner, et al., In press; Turner, et al., In press) with good reliability (ICC = .95 - .99) For this, fencers started behind one set of timing gates (Brower timing systems, Utah, USA) set at hip height. Using footwork patterns typically performed in competition, they travelled as fast as they could up to a 4 m line, ensured their front foot crossed the line, then travelled backwards ensuring the front foot crossed the 2 m line. Again they travelled forward to the 4 m line, before moving backwards past the start line. The test was immediately stopped if the athlete used footwork deemed by the fencing coach to be unrepresentative of proper form, if the beam was broken at the start or finish line with any part of their body other than their hips, if the athlete failed to pass either line with their toes, or lunged in order to reach the line. All fencing coaches (also used during RLA testing as described below) were national level coaches and were thus familiar with movements that deviated from correct technique.

Figure 1. The 4-2-2-4 m shuttle used to measure change of direction speed.

Repeat Lunge Ability

The RLA test (Fig 2) is a measure of speed-endurance and has previously been validated, with a between day ICC of *r* = 0.83 (Turner, et al., In press). Using fencing footwork, athletes travelled 7 m towards a mannequin where they performed a lunge to hit either its chest or head. They then changed direction, traveling backwards until their lead toe was behind a 4 m line. From here they continued to advance, lunge and hit the mannequin 4 more times, traveling back to the 4 m line between hits; only following the fifth and final hit did they then travel back past the start line (positioned 7 m from the mannequin). This was repeated 5 times with 10 s rest between sets. The score was recorded as the average time across the 5 sets. Timing gates (Brower timing systems, Utah, USA) were positioned at hip height at the start line, which fencers broke to both start and conclude each interval. The test was void if the fencer used footwork or a lunge technique deemed by the fencing coach to be unrepresentative of proper form, or if the fencer failed to pass either line with their toes. Given that the ICC value for this test was quite low (considering the length of trials i.e., ~ 15 s) it was investigated again as part of this study using a small sample (*n* = 12). For this the test was run at the same time (afternoon, post training) on two days, separated by two days rest. Finally, an aerobic test was not used as an increase in aerobic capacity is considered to indirectly improve the recovery between high intensity intervals via mitochondrial biogenesis and thus improvements in the creatine phosphate shuttle and lactate threshold (Turner, et al., 2014). The RLA test thus measures a physical capability directly relevant to the sport of fencing (Turner, et al., In press).

Figure 2. The repeat lunge ability test used to measure speed endurance

Statistical Analysis

Measures of normality were assessed using the Shapiro-Wilk statistic, with normality assumed when $p > .05$. To determine the relative and absolute reliability of all tests of lower-body power including CODS, three trials were performed and single measures ICC (two-way random with absolute agreement) and standard error of the measurement (SEM) were calculated; the best test score was used for subsequent analysis. Differences between gender and between weapons split by gender were assessed using a MANOVA, with Bonferroni post hoc analyses used if appropriate. Similarly, effect size (ES) magnitudes were also analyzed between gender and between weapons split by gender. Effect sizes were calculated as per equation 1 and interpreted according to Hopkins (2004), whereby < 0.2 = trivial; 0.2 – 0.6 = small; > 0.6 – 1.2 = moderate; > 1.2 – 2 = large. Statistical analysis was conducted using SPSS version 21 with the level of significance set at $p < .05$. Effect sizes were calculated using Microsoft Excel. Post hoc statistical power calculations were performed using G*Power 3.1 (Faul & Erdfelder, 1992).

Equation 1. Effect size (*d*) calculation

$d = (M_{group1} - M_{group2})/SD_{pooled}$

Where $SD_{pooled} = \surd([SD^2_{group1} + SD^2_{group2}]/2)$

RESULTS

All data were normally distributed and ICCs demonstrated a high level of rank-order repeatability between trials: CMJ = .943, RSI = .845, SLCMJ front foot = .932, SLCMJ back foot = .926, CODS = .911, and RLA = .931. Absolute measures of reliability (SEM) were calculated as: CMJ = 1.01 cm, RSI = 0.20, SLCMJ front foot = 0.78 cm, SLCMJ back foot = 0.71 cm, CODS = 0.18 s, and RLA = 0.26 s. Post hoc statistical power for these analyses was high (95%) in determining small effects (f = 0.25). Table 1 shows the test scores separated by gender, and by gender and weapon. There was no significant main effect for weapon in males (p = .63) or females (p = .232), but a significant main affect for gender (p < .001). Pairwise comparisons revealed that males scored better during the CMJ, CODS, and RLA (p < .001). Table 2 shows ES magnitudes and descriptors, separated by gender and by gender and weapon. In general, differences were trivial and small, but the majority of differences were regarded as moderate for CODS and RLA tests.

Table 1. Test scores for fencers, separated by gender, and by gender and weapon. No significant difference was noted between weapons for males or females (*p* ≤ .05), however, males performed significantly better than females (*p* ≤ .001).

CMJ = countermovement jump; RSI = reactive strength index; SLCMJ = single leg-countermovement jump, both front (F) and back (B) legs; CODS = change of direction speed; * = males performed significantly better at *p* = ≤ .001.

Table 2. Effect size analysis separated by gender, and by gender and weapon.

Effect size descriptors are as follow: < 0.2 = trivial (T); 0.2 – 0.6 = small (S); > 0.6 – 1.2 = moderate (M); > 1.2 – 2 = large (L). Negative values imply direction of difference.

DISCUSSION

The aim of this study was to determine if fencers exhibited different physical characteristics across weapons. This information could be used by practitioners to determine if strength and conditioning training should be weapon specific. In agreement with our hypothesis, no significant differences in performance of the investigated tasks were shown between weapons. Significant differences were found however, when comparing gender, with males performing better during the CMJ, CODS, and RLA ($p < .001$). Furthermore, ES analysis revealed trivial and small differences in general, but the majority of differences for CODS and RLA were moderate. That said, these differences do not seem to show a clear pattern among weapons, with épée moderately faster at CODS than foil in males, but vice versa in females; this is also the case when comparing foil and sabre and indeed when looking at the RLA test. Results appear to indicate that fencing training and competition evokes similar physical adaptations in fencers, regardless of discipline. These findings may be due to similarities in bout intensity and time, movement types, and the need to execute competition actions as explosively as possible.

Fencing coaches have anecdotally recommended that the physical preparation of each weapon should differ, a point raised in a recent rebuttal (Bottoms, In press). However, while the technical and tactical demands are notably different, all fencers are required to lunge, change direction, and recover to *en garde* as fast as possible. These physical characteristics amongst others, are common goals across all weapons and may explain why research in fencing typically looks to quantify the time of a lunge or the speed of a movement for example, irrespective of weapon (Gholipour, Tabrizi, & Farahmand, 2008; Gresham-Fiegel, House, & Zupan, 2013; Guilhem, Giroux, Chollet, & Rabita, 2014; Gutierrez-Davila, 2011; Stewart & Kopetka, 2005; Tsolakis & Vagenas, 2010; Tsolakis, Kostaki, & Vagenas, 2010). In addition, some studies have not even defined the weapon type being tested (Tsolakis & Vagenas, 2010; Tsolakis, Kostaki, & Vagenas, 2010; Tsolakis, Bogdanis, Vagenas, & Dessypris, 2006). The strength and conditioning coach will thus train each component (i.e., lunge, CODS etc.) and aim to maximize the capacity (e.g., for speed or distance) of each.

Contention to a more a generalized approach to strength and conditioning comes in part, from the perceived difference in energy system preference between weapons (Bottoms, In press). Given the WRs, it is certainly conceivable that épée has a higher aerobic demand than foil and sabre. In fact, this association may be supported by ES analysis whereby in males, épée demonstrates small and moderate differences in speed-endurance (RLA) when compared to foil and sabre respectively; also foil is moderately better than sabre. That said, this is not noted in females where the opposite is true. It may therefore be argued that, while work periods are indeed longer in épée *vs.* sabre for example (15 *vs.* 2.5 s), much of the additional work performed is low intensity and as such, actions when engaged with the opponent would still largely be powered by anaerobic metabolism. Also, the higher-intensity nature of sabre, may place greater emphasis on within-bout recovery, and thus actually tax and develop the aerobic system to a greater extent; these suggestions can be gleaned from research investigating high intensity interval training (e.g., (Baker, 2011; Helgerud, Hoydal, Wang, Karlsen, Berg, & Bjerkaas, 2007; Wisloff, Stoylen, & Loennechen, 2007)) and is an association supported by ES analysis, whereby female sabruers demonstrate moderately better times than épée in RLA. Furthermore, in female international épée fencers, a peak oxygen uptake of only 47 ± 5 ml/kg/min was noted, with simulated bouts working at 74% of this (Bottoms, Sinclair, Gabrysz, Szmanthan-Gabrysz, & Price, 2011). Such low values (e.g., see (Pluim, Zwinderman, van der Laarse, & van der Wall, 2000)) support a low reliance on aerobic capacity despite some WRs being 1:1. As such, training cannot be based off WRs without taking in to consideration the actual durations and intensity of each. We also acknowledge the need for future investigations to directly investigate differences in bioenergetics, rather than the inferences reported herein.

It should also be acknowledged that differences between weapons could become evident as experience extends beyond that of the participants in the current study. As the sample was cadet and junior fencers, their age and experience (relative to elite senior fencers) is a limitation of this study. However, it does provide the opportunity to test a sample not yet undergoing structured strength and conditioning training, which may bias results in performance tests beyond that dictated by their weapon specific approach to training. Despite this limitation, it may still be inappropriate to adopt a more weapon-specific approach to strength and conditioning programming, as the demands of competition and weapon specific training would naturally make these adjustments. For example, the high anaerobic nature of sabre, predominantly taxing the ATP-PC system (Turner, et al., 2014), may suggest that they will retain strength and power qualities best amongst weapons and eventually score better in tests of lower body power and CODS; the latter does appear to be partly supported in males through ES analysis. Conversely, foil and épée may tax the lactic acid system more, thus retain conditioning based fitness better, and eventually score better in the RLA test (again supported by ES analysis in males). Of course, it may also be that no changes will materialize despite training experience and frequency.

In the current study, measures of jump height during the SLCMJ were used to examine strength asymmetry across weapons. Previous data indicates a limb difference of 15% as a clinical marker of bilateral strength asymmetry that may significantly increase the risk of injury (Impellizzeri, Rampinni, & Marcora, 2007). In the current cohort of fencers, asymmetry was not significantly different, indicating a proportionally equal risk of injury across weapons should one exist, with asymmetry averaging at 10.6%. This is comparable with Guilhem *et al.,* (2014) who found greater maximal hip (+10%) and knee (+26%) extensor strength in the front *vs.* the rear leg ($p < 0.05$) and Chang *et al.,* (2009) who found a difference in cortical bone thickness and muscle cross-sectional area of the dominant *vs.* non-dominant thigh (+5.4% and +12.2% respectively, $p < 0.05$). Given the asymmetrical nature of fencing, it would be prudent for practitioners to include exercises into the strength and conditioning programme that guard against injuries subsequent to bilateral strength deficits. However, it does not appear that one weapon requires more attention to this relative to the others.

Arguably, one final question remains regarding the specificity of strength and conditioning within fencing. Do we need to train fencers differently for knockout (15 hits) *vs.* poule (5 hits) *vs.* team bouts? This has been investigated by Wylde et al., (2013) who looked at the differences between them with respect to time spent engaged in low, moderate and high intensity movements. Low intensity accounted for 58.4% or 6.1 s, 51.2% or 4.5 s, and 50.3% or 4.6 s respectively, moderate intensity for 35.9% or 5.4 s, 40.7 or 4.5 s, and 43.9 or 6.2 s and high intensity for 5.7% or 0.7 s, 8.1% or 0.8 s, and 5.7% or 0.7 s. The authors thus concluded that the only “large” difference between the bouts was found for the greater mean duration of the low-intensity movements in the 15 hit bouts (6.1 s *vs.* 4.5 and 4.6 s; of note this included the rest periods not available in the others). All other differences were “moderate”, “small”, or “trivial”. They therefore suggested that similar training plans could be used to physically prepare fencers for 15 hit, five hit, and team bouts.

PRACTICAL APPLICATIONS

Based on the findings of the current study and based on cadet (U17) and junior (U20) fencers, it is suggested that épée, foil, and sabre fencers do not require a weapon specific approach to strength and conditioning training. All fencers require the ability to explosively lunge at an opponent, change direction at speed, and repeat these actions numerous times throughout a bout and competition day. Each fencer would be advised to train based upon their physical profile, rather than the perceived demands of their specific weapon.

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Table 1. Test scores for fencers, separated by gender, and by gender and weapon. No significant difference was noted between weapons for males or females ($p \leq .05$), however, males performed significantly better than females ($p \leq .001$).

	Male			Female				
	Epee	Foil	Sabre	Epee	Foil	Sabre	Male	Female
Age (yr)	16 ± 0.8	15.6 ± 0.7	15.7 ± 0.8	15.9 ± 0.5	16.1 ± 0.8	16.3 ± 0.9	15.8 ± 0.2	16.1 ± 0.2
Mass (kg)	74.0 ± 15.3	68.0 ± 11.6	73.8 ± 8.9	6.1 ± 6.1	68.1 ± 10.9	63.7 ± 8.9	71.9 ± 3.4	65.3 ± 2.4
Height (cm)	178.6 ± 7.9	172.5 ± 8.5	173.2 ± 9.11	171.5 ± 5.2	171.3 ±6.5	168 ± 5.1	174.8 ± 3.3	170.3 ± 2.0
Experience (yr)	5.9 ± 2.3	6.3 ±2.1	6.7 ± 3.1	7.6 ± 3.14	5.9 ± 0.6	6.25 ± 0.5	6.3 ± 0.4	6.3 ± 1.3
CMJ (cm)	25.6 ± 2.4	26.4 ± 5.1	27.2 ± 3.1	22.5 ± 5.3	22.3 ± 2.8	20.1 ± 2.0	26. ± 0.8*	21.6 ± 1.3
RSI	2.2 ± 0.4	2.1 ± 0.4	2.0 ± 0.3	1.7 ± 0.7	1.6 ± 0.7	1.6 ± 0.2	2.1 ± 0.1	1.6 ± 0.1
SLCMJF (cm)	13.1 ± 1.3	14.4 ± 4.1	13.6 ± 2.4	13.2 ± 2.7	12.5 ± 2.6	10.9 ± 1.9	13.7 ± 0.7	12.2 ± 1.2
SLJCMJB (cm)	11.9 ±1.5	13.3 ± 4.1	12.4 ± 2.0	12.9 ± 2.5	10.7 ± 1.6	10.2 ± 1.7	12.5 ± 0.7	11.3 ± 1.4
Asymmetry (%)	9.4 ± 8.2	12.6 ± 9.0	10 ± 7.5	6.8 ± 3.5	16.8 ±8.0	8.0 ± 3.5	10.7 ± 1.7	10.5 ± 5.5
CODS (s)	6.0 ±0.4	6.3 ± 0.4	5.8 ± 0.6	6.9 ± 0,4	6.1 ± 0.6	6.5 ± 0.7	6.0 ± 0.3*	6.5 ± 0.4
RLA (cm)	15.4 ± 1.2	16.0 ± 1.2	16.9 ± 1.6	18.6 ± 0.9	17.4 ± 0.5	17.9 ± 1.0	16.1 ± 0.8*	18.0 ± 0.6

CMJ = countermovement jump; RSI = reactive strength index; SLCMJ = single leg-countermovement jump, both front (F) and back (B) legs; CODS = change of direction speed; * = males performed significantly better at $p = \leq .001$.

Table 2. Effect size analysis separated by gender, and by gender and weapon.

	Male			Female			
	Épée *vs.* Foil	Épée *vs.* Sabre	Foil *vs.* Sabre	Épée *vs.* Foil	Épée *vs.* Sabre	Foil *vs.* Sabre	Male *vs.* Female
Age (yr)	0.53 (S)	0.38 (S)	-0.13 (T)	-0.30 (S)	-0.55 (S)	-0.23 (T)	-0.49 (S)
Mass (kg)	0.44 (S)	0.02 (S)	-0.56 (S)	-0.45 (S)	0.05 (T)	0.44 (S)	0.58 (S)
Height (cm)	0.74 (M)	0.63 (M)	-0.08 (T)	0.03 (T)	0.68 (M)	0.56 (S)	-0.08 (T)
Experience (yr)	-0.18 (T)	-0.29 (S)	-0.15 (T)	0.75 (M)	0.60 (M)	-0.63 (M)	-0.09 (T)
CMJ (cm)	-0.20 (S)	-0.58 (S)	-0.19 (T)	0.05 (T)	0.57 (S)	0.79 (M)	1.12 (M)
RSI	0.25 (S)	0.57 (S)	0.28 (S)	0.14 (T)	0.19 (T)	0.00 (T)	1.08 (M)
SLCMJF (cm)	-0.43 (S)	-0.26 (S)	0.24 (S)	0.26 (S)	0.99 (M)	0.70 (M)	0.40 (S)
SLJCMJB (cm)	-0.45 (S)	-0.28 (S)	0.28 (S)	0.29 (S)	0.35 (S)	0.30 (S)	0.34 (S)
Asymmetry (%)	-0.37 (S)	-0.08 (T)	0.31 (S)	-1.62 (L)	-0.34 (S)	1.43 (L)	0.07 (T)
CODS (s)	-0.75 (M)	0.39 (S)	0.98 (M)	1.37 (L)	0.70 (M)	-0.61 (M)	-0.98 (M)
RLA (cm)	-0.50 (S)	-1.06 (M)	-0.64 (M)	1.65 (L)	0.74 (M)	-0.63 (M)	-1.63 (L)

Effect size descriptors are as follow: < 0.2 = trivial (T); 0.2 – 0.6 = small (S); > 0.6 – 1.2 = moderate (M); > 1.2 – 2 = large (L). Negative values imply direction of difference.