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Comparing reach distance between the Y-Balance Test-Lower Quarter and Star Excursion Balance Test: Are practitioners using the correct protocol?

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ABSTRACT

Objectives: To compare reach distances between the YBT-LQ and SEBT using the correct protocols as outlined by the developers. This will provide an accurate insight on the actual magnitude differences in reach distance between the movement screen tests and will safeguard practitioners on the subsequent use of these outcomes to inform clinical decision making.
Design: Observational.
Setting: Laboratory.
Participants: Participants included sixteen healthy female subjects from the university and amateur sports teams.
Main outcome: Reach distances in the anterior direction (ANT), posterior medial (PM) and posterior lateral (PL) between participants on the YBT-LQ and SEBT.
Results: The principal findings highlighted that a statistically significantly greater reach distance on the left and right side for the YBT-LQ compared to the SEBT in the ANT, PM, and PL directions ($p < 0.0005$).
Conclusion: The results of this study suggest that the YBT-LQ and SEBT are not comparable tests due to the differences in reach distance and methodological differences. Therefore, previous, and future research using the YBT-LQ and SEBT cannot be used interchangeably. Not following developed guidelines questions the applicability of the findings of reach distance scores to infer on performance and assessment of injury risk.

1. Introduction

Movement screening tools are commonly used to identify functional deficits that may predispose athletes to injury (Butler, Lehr, et al., 2013; Gribble et al., 2016; Plisky et al., 2006; Smith et al., 2015; Stiffler et al., 2017). The Star Excursion Balance Test (SEBT) is a unilateral test that assesses dynamic single leg balance in several reaching directions. However, due to the significant amount of time required to conduct the test, modifications have been established and the SEBT typically utilises three reach directions: anterior (ANT), posteromedial (PM) and posterolateral (PL) (Gribble et al., 2012). While the PM and the PL directions are associated with injury risk (Attenborough et al., 2017; De Noronha et al., 2013), recent studies have focused on the ANT direction alone due to the higher predictability of lower extremity injury (Bliekendaal et al., 2019; Gribble et al., 2016; Plisky et al., 2006; Stiffler et al., 2017). Alternatively, the SEBT is recommended as a unilateral test to assess movement competency following ACLR (Herrington et al., 2013). Indeed, the SEBT has the ability to identify adaptations on postural control in ACLR patients (Clagg et al., 2015; Delahunt et al., 2013) and in people who are ACL deficient (Herrington et al., 2009).

However, while the SEBT has demonstrated good inter/intra-rater reliability (van Lieshout et al., 2016), the practitioner is required to simultaneous record the reach distance whilst ensuring the movement protocol of the SEBT is adhered to (Gribble et al., 2012). This is further confounded by the judgement of the practitioner to accurately mark the reach distance achieved by the participant. Therefore, to address the limitations of the SEBT, a commercially available device was developed known as the Y-Balance Test (YBT, Move2Perform, Evansville, IN, USA). The YBT can be used to assess single leg balance (YBT-Lower Quarter/YBT-LQ) or shoulder mobility/stability (YBT-Upper Quarter/YBT-UQ). The YBT-LQ has demonstrated good to excellent inter/intra-rater reliability (Greenberg et al., 2019; Plisky et al., 2009).

Whilst the simplicity of the YBT-LQ reduces the demand on the practitioner and provides an accurate account of reach distance, the ability of the YBT-LQ to predict injury is questionable as several studies chose not to follow the standardised protocol. For example, in

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comparison to the standardised guidelines (Plisky et al., 2009), some studies place hands on the hips (Hartley et al., 2018; Lai et al., 2017; Luedke et al., 2020; O'Connor et al., 2020; Read et al., 2020) as opposed to allowing the arms to move freely. Whereas other studies do not allow the foot to move during the test (Gonell et al., 2015; Nakagawa et al., 2020), and in one study the authors allowed the participants to perform the YBT-LQ in footwear (Wright et al., 2017). However, even when the correct protocol was used, conflicting evidence on injury prediction is evident in current studies. (Brumitt et al., 2019; Butler, Lehr, et al., 2013; Cosio-Lima et al., 2016; Lisman et al., 2018; Smith et al., 2015). Nevertheless, like the SEBT, the YBT-LQ can expose asymmetries in people following ACLR (Myers et al., 2018; Oleksy et al., 2021) and it is important to consider the sub-optimal scores from the YBT-LQ as these are correlated with reduced function and strength (Garrison et al., 2015; Wilson et al., 2018).

The objective of both the SEBT and YBT-LQ from a movement screening perspective is to assess balance and to measure reach distance of the supporting limb. In several studies that compared reach distance on the SEBT and YBT-LQ, significant differences were noted between the tests regarding reach distance (Bulow et al., 2019; Coughlan et al., 2012; Gabriel et al., 2021; Ko et al., 2020) and lower limb kinematics (Bulow et al., 2021; Fullam et al., 2014; Ko, 2017). However, like protocol inaccuracies highlighted previously on injury prediction, the lack of consistency to use the standardised YBT-LQ protocol (Plisky et al., 2009) in all the above studies may explain the contradictory findings. In addition, practitioners commonly use the SEBT and YBT-LQ as outcome measures in post-operative rehabilitation (Garrison et al., 2015; Herrington et al., 2013; Oleksy et al., 2021; Rambaud et al., 2017) and as pre-participation screening (Bliekendaal et al., 2019; Butler, Lehr, et al., 2013; Gribble et al., 2012; Lehr et al., 2013; Smith et al., 2015; Steffen et al., 2013; Stiffler et al., 2017). Therefore, comparing reach distances from the SEBT and YBT-LQ to the varied observations in current literature may have clinical implications on management strategies to inform exercise prescription and return to sport.

Despite the plethora of studies published in this area, most of the current literature do not implement the correct protocols for both the YBT-LQ and SEBT. In addition, there has been no research to date that has compared the reach distance between the YBT-LQ and SEBT using the correct standardised protocols as outlined by the developers. Therefore, the purpose of this study was to compare the ANT, PM and PL reach distances using the correct protocols to provide an accurate insight that reflects the actual magnitude differences in reach distance between the YBT-LQ and SEBT. It could be hypothesised that greater reach distance will be achieved for the YBT-LQ in comparison to the SEBT in all directions due to the unrestrictive movements of the foot and upper limbs. This is the first structured study to examine reach distances between two popular movement screen tests using established protocols with a view to influence practice and inform clinical decision making.

2. Methods

2.1. Participant information

Following ethical approval from the University Ethics Committee, a convenience sample of sixteen healthy females (age, 25.13 ± 4.80 years; height, 1.66 m ± 0.05; mass, 63.77 kg ± 8.67) from university or local amateur sports teams (netball, football) were recruited to participate in this study via emails, posters and adverts. All participants provided full informed consent prior to any testing. Females were selected for this study due to their increased risk of lower extremity injury compared to males and both the SEBT and YBT have demonstrated clinical benefit in female populations along with male counterparts (Gribble et al., 2012; Plisky et al., 2006). The inclusion criteria for this study required participants to be between 18 and 30 years of age, to be actively competing in a team sport, and to have no current injury or previous injury in the last 3 months (Coughlan et al., 2012). Participants were excluded if there was a history of chronic ankle instability (CAI) (Gribble et al., 2007), ACL injury, had ACLR (Delahunt et al., 2013; Herrington et al., 2009) or presented with a neurological or vestibular disorder that effects balance. As there are no such studies that has compared the YBT-LQ to the SEBT, with some studies using incorrect protocols, it was not possible to provide reasonable *apriori* estimate of the sample size. However, a sample of sixteen is comparable to similar studies within the literature (Coughlan et al., 2012).

2.2. Procedures

Based on the home location of the participant, the movement screen tests were conducted at the same time of day (Gribble et al., 2007), either at the Biomechanics laboratory or at a local training facility. Participants were required to complete the YBT-LQ or the SEBT using a randomised cross over design approach. All procedures were carried out by one rater (JB) who was experienced in conducting the SEBT and had completed the online certification-training course for the YBT (move2perform.com, Evansville, IN).

2.3. Leg length

The participant was in supine lying with the hips and knees flexed to 45 and 90° respectively. The participant raised the hips off the floor and returned them to starting position. The tester then passively straightened the legs to align the pelvis. The participants limb length was then measured in centimetres from the anterior superior iliac spine to the most distal portion of the medial malleolus with a tape measure (Plisky et al., 2009).

2.4. YBT protocol

The YBT-LQ followed the correct standardised protocol (Plisky et al., 2009) using a commercially available device (Y Balance Test, Move2-Perform, Evansville, IN). All participants stood unilaterally and barefoot on the YBT platform behind the red line. Six practice trials were used for each leg prior to data collection. Participants were instructed to reach as far as possible with the free limb by pushing with the red indicator in the standardized testing order. A trial for YBT-LQ was classed as invalid if the participant (1) failed to maintain unilateral stance on the platform, (2) lost contact with the reach indicator in the red target area, (3) touched down with the reach foot on the surrounding floor, (4) if the participant used the reach indicator for support during the trial, (5) kicked the reach indicator, or (6) failed to return the reach foot to the starting position. The author's feel it important to highlight that upper limb movement was allowed and not standardized to hands on hips. Additionally, stance foot movement was allowed and not standardized to heel in contact with the board (Plisky et al., 2009). The YBT-LQ has demonstrated good to excellent inter/intra-rater reliability using this standardised protocol (Greenberg et al., 2019; Plisky et al., 2009).

2.5. SEBT protocol

The SEBT followed the correct standardised protocol as described (Gribble et al., 2012; van Lieshout et al., 2016). A tape measure is fixed to the floor in the ANT, PM, and PL directions. Participants stood barefoot with hands placed on hips. For the ANT direction, the stance foot was aligned at the most distal aspect of the toes and for the posterior directions the stance foot was aligned with the most posterior aspect of the heel (Cuğ, 2017; Gribble et al., 2012; van Lieshout et al., 2016). The foot positions described above are aimed at minimizing differences in foot length that would influence reach distances (Cuğ, 2017; Gribble et al., 2012). Following 4 practice trials, the participants were asked to reach along the tape with the free leg as far as possible and lightly touch the tape with the most distal part of the big toe whilst maintaining unilateral stance. A trial for SEBT was classed as invalid if the participant (1) failed to maintain unilateral stance, (2) the examiner perceived the participant gained support from the ground using the reaching leg, (3) failed to return the reach foot to the starting position, (4) removed hands from hips, and (5) lifted the stance foot (Gribble et al., 2012; van Lieshout et al., 2016). Following the set amount of practice trials, the greatest reach distance from 3 acceptable trials for the left and right leg was recorded for each reach direction and a maximum of 6 trials were allowed in each direction. The stance leg was always identified as the tested leg (Gribble et al., 2012; van Lieshout et al., 2016). The SEBT has demonstrated good inter/intra-rater reliability using this standardised protocol (van Lieshout et al., 2016).

2.6. Data analysis

Reach distances were normalised to limb length by calculating the percentage maximized reach distance (%MAXD) using the formula (distance/limb length) x 100 = %MAXD. This method takes into consideration limb-length differences between individuals that allows for a comparison of reach distance (Gribble et al., 2012; Plisky et al., 2009; van Lieshout et al., 2016). Reach distance for the YBT-LQ and SEBT was determined by the final position of the reach indicator. For the SEBT reach distance was noted by a visual inspection of the toe touching the tape and a mark was applied on the tape accordingly adjacent to the measuring tape.

2.7. Statistical analysis

Means and standard deviations were calculated for the right and left leg. No outliers were detected that were more than 1.5 box-lengths from the edge of the box in a box plot. The assumption of normality was not violated, as assessed by the Shapiro-Wilk's test in all reach directions (p = 0.276 to 0.937). Tests for normality were conducted in SPSS **version** 27 (**SPSS** Inc., Chicago, IL, USA). Paired-sample t-tests were used to determine whether there was a statistically significant mean difference between performance on the SEBT and YBT-LQ on both the right and left legs in the ANT, PM and PL directions. Confidence intervals and effect size were used to quantify the range and magnitude of the difference in reach distance between the YBT-LQ and SEBT, respectively. The importance of the effect size was interpreted using Cohen's *d* (Cohen, 1988) values as follows: 0.2 as small, 0.5 as medium and greater than 0.8 as large. An Unbiased *d* was chosen to account for the small sample size. Paired-sample *t*-test statistics for differences and effect size calculations were generated using a customized Excel spreadsheet (Cumming, G. Calin-Jageman, 2016).

3. Results

All participants tolerated testing well with no withdrawals due to pain or fatigue. Individual participants mean normalised reach distance and differences between the SEBT and YBT-LQ in the ANT, PM and PL directions on the left and right leg are presented in Table 1.

Participants reached further during the YBT-LQ in the ANT direction on the left ($M = 76.388$, *SD* 5.340 cm) and right ($M = 76.287$, *SD* 5.629 cm) leg compared to the reach distance of left and right leg during the SEBT ($M = 67.163$, *SD* 3.113 cm, $M = 66.817$, *SD* 2.580 cm, respectively), noting a statistically significant mean increase in reach distance on the left leg of 9.225 cm, 95% CI [6.457 to 11.995], $t(15) = 7.102$, $p < 0.0005$, Unbiased $d = 2.003$, and 9.470 cm, 95% CI [6.529 to 12.411], $t(15) = 6.862$, $p < 0.0005$, Unbiased $d = 2.053$ on the right leg (Fig. 1a and b).

Participants reached further during the YBT-LQ in the PM direction on the left ($M = 115.927$, *SD* 4.075 cm) and right ($M = 115.726$, *SD* 4.492 cm) leg compared to the reach distance of the left and right leg during the SEBT ($M = 89.156$, *SD* 5.399 cm, $M = 89.119$ *SD* 4.820 cm, respectively), noting a statistically significant mean increase in reach distance on the left leg 26.771 cm, 95% CI [24.865 to 28.677], $t(15) = 29.935$, $p < 0.0005$, Unbiased $d = 5.311$, and 26.607 cm, 95% CI [23.971 to 29.243], $t(15) = 21.511$, $p < 0.0005$, Unbiased $d = 5.422$ on the right leg (Fig. 1c and d).

Participants reached further during the YBT-LQ in the PL direction on the left ($M = 115.996$, *SD* 5.240 cm) and right ($M = 115.201$, *SD* 5.492 cm) leg compared to the reach distance of the left and right leg during the SEBT ($M = 83.104$, *SD* 6.360 cm, $M = 83.812$, *SD* 7.451 cm, respectively), noting a statistically significant mean increase in reach distance on the left leg 32.892 cm, 95% CI [29.344 to 36.440], $t(15) = 19.761$, $p < 0.0005$, Unbiased $d = 5.361$ and 31.389 cm 95% CI [28.571 to 34.206], $t(15) = 23.748$, $p < 0.0005$, Unbiased $d = 4.551$ on the right leg (Fig. 1e and f).

4. Discussion

This study set out to strengthen the potential of the YBT-LQ and SEBT to assess reach distance with the aim to safeguard practitioners on the

Table 1
Individual participants mean normalised reach distances between the SEBT and YBT-LQ in the ANT, PM and PL directions and composite scores on the left and right leg.

	ANT				PM				PL				COMPOSITE			
	Left		Right		Left		Right		Left		Right		Left		Right	
Participant	SEBT	YBT	SEBT	YBT	SEBT	YBT	SEBT	YBT	SEBT	YBT	SEBT	YBT	SEBT	YBT	SEBT	YBT
1	64.5	74.9	64.1	72.8	79.8	111.5	77.2	113.0	76.5	110.4	77.2	110.9	80.0	107.5	79.2	107.5
2	68.2	71.7	66.5	69.4	83.2	107.5	85.0	106.4	76.3	107.5	71.7	105.2	87.8	110.5	86.0	108.3
3	69.4	80.9	66.1	82.0	98.4	121.3	92.9	118.0	87.4	119.1	95.6	121.3	93.0	117.1	92.8	117.1
4	64.7	79.2	65.3	82.1	81.5	111.6	87.9	114.5	83.2	113.9	80.9	111.6	88.4	117.4	90.2	118.7
5	64.2	82.1	63.4	76.3	92.1	119.0	87.1	116.5	87.9	117.9	88.7	115.5	85.7	111.9	83.9	108.2
6	72.5	81.4	71.3	80.8	91.6	122.8	92.8	121.0	79.0	116.2	78.4	121.0	97.1	127.9	96.8	128.9
7	71.1	84.4	70.0	86.7	88.9	118.9	91.1	125.6	81.1	123.3	86.7	125.6	89.3	121.0	91.8	125.1
8	68.3	72.0	66.7	72.0	90.9	112.9	87.6	111.8	83.9	110.8	84.4	111.8	87.1	106.0	85.6	106.0
9	65.7	82.6	66.3	83.7	90.1	115.1	86.6	112.8	75.6	122.1	82.0	116.3	89.7	123.9	91.0	121.2
10	66.7	78.7	65.5	77.0	90.8	119.5	86.8	117.2	89.7	126.4	89.7	120.7	94.7	124.4	92.7	120.7
11	68.8	68.8	68.2	68.2	95.9	118.8	96.5	120.0	94.1	117.7	95.9	120.0	101.5	119.7	102.2	120.9
12	66.3	78.7	69.7	77.5	90.5	116.9	87.6	119.1	84.3	115.7	88.8	116.9	90.3	116.6	92.2	117.4
13	69.2	73.6	68.7	70.3	85.7	113.2	93.4	112.1	87.4	118.7	85.7	113.2	88.8	111.9	90.8	108.3
14	66.8	73.0	66.3	77.0	82.0	113.5	85.4	113.5	76.4	110.1	71.4	110.1	84.4	111.1	83.5	112.6
15	68.8	73.9	69.3	75.0	95.5	115.9	94.3	115.9	92.6	112.5	87.5	114.8	97.3	114.5	95.1	115.8
16	59.4	66.3	61.7	69.7	89.7	116.6	93.7	114.3	74.3	113.7	76.6	108.6	85.1	113.0	88.4	111.5
Mean	67.2	76.4	66.8	76.3	89.2	115.9	89.1	115.7	83.1	116.0	83.8	115.2	90.0	115.9	90.1	115.5
SD ±	3.1	5.3	2.6	5.6	5.4	4.1	4.8	4.5	6.4	5.2	7.5	5.5	5.5	6.3	5.7	6.9

*SD – Standard deviation.

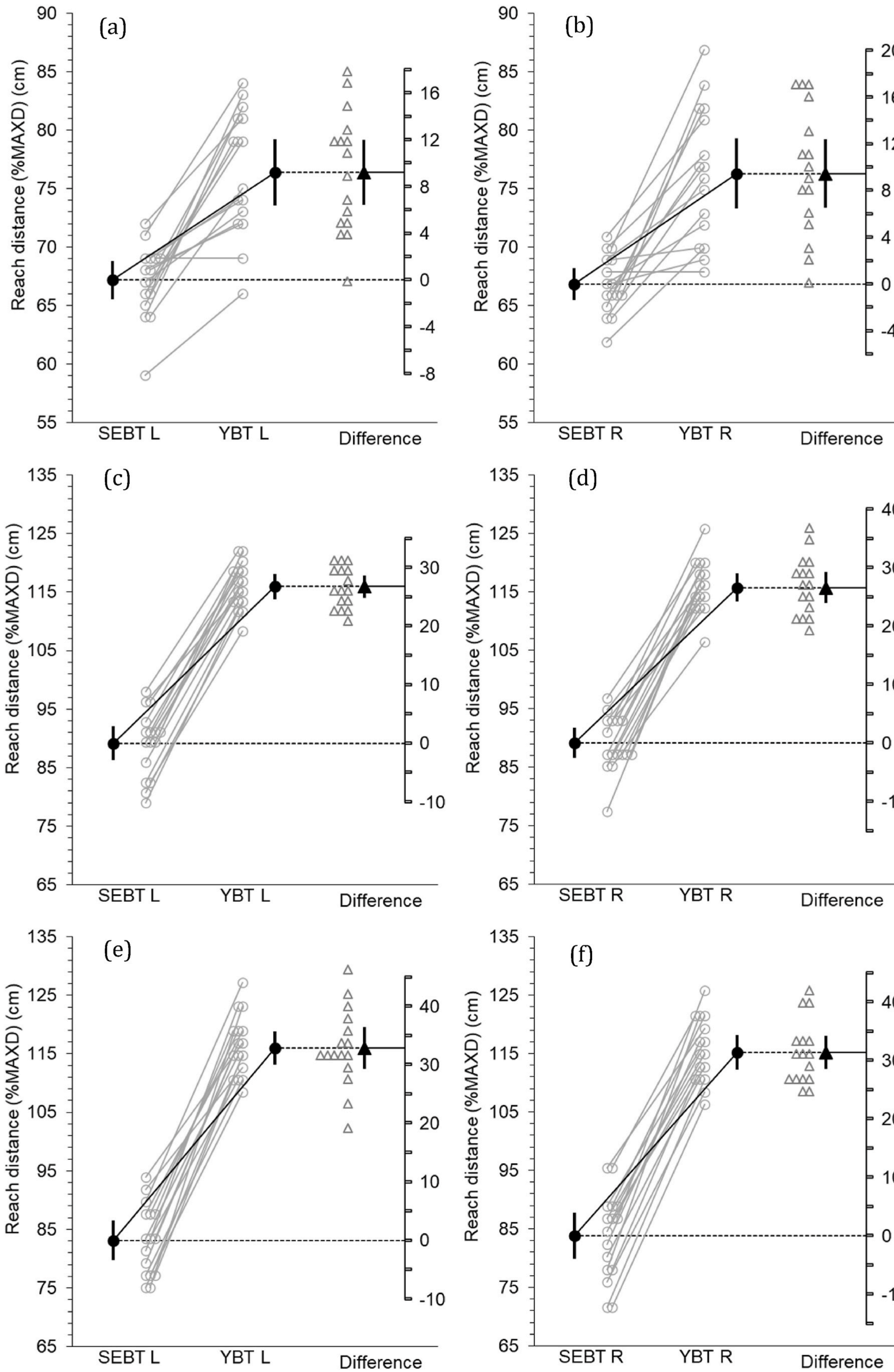

Fig. 1. Mean (black) and individual participant (grey) reach distance (cm) on the SEBT and YBT-LQ in the ANT direction (a-left leg/b-right leg), in the PM direction (c-left leg/d-right leg) and in the PL direction (e-left leg/f-right leg).

application of quantitative measures to inform clinical decision making relating to movement screening and rehabilitation. The principal findings of the current study support the hypothesis that a significantly greater reach distance can be achieved on the YBT-LQ compared to the SEBT in healthy female athletes in the ANT, PM, and PL directions (Table 1; Fig. 1). To the author's knowledge, this is the first study to compare reach distances on the YBT-LQ and SEBT using standardized protocols based on the most recent methodological guidelines.

4.1. Anterior reach

Recent standardized guidelines on foot position for the SEBT in the ANT direction now states that the foot should point forwards with the most distal aspect of the toes aligned with the start point of the reach distance (Cuğ, 2017; Gribble et al., 2012; van Lieshout et al., 2016). This modification on foot position for the SEBT is now identicle to the foot position guidelines for the YBT-LQ (Plisky et al., 2009). Since this study utilized current guidelines on foot position, this allowed for a direct comparison of reach distance between test protocols in the ANT direction.

The current study demonstrated a significantly greater reach distance in the ANT direction for the YBT-LQ in comparison to the SEBT that is not in agreement with previous research findings on this topic (Bulow et al., 2019; Coughlan et al., 2012; Fullam et al., 2014; Gabriel et al., 2021). For example, the results of the current study in the ANT direction of the YBT (Left 76.3 and Right 76.4 cm) are significantly greater than Fullam et al. (Fullam et al., 2014), (59.7 cm), Coughlan et al. (Coughlan et al., 2012), (64.8 and 64.9 cm) and Gabriel et al. (Gabriel et al., 2021), (61.6 cm). It is worth highlighting that a simple methodological shortcoming used in all aforementioned studies could explain the conflicting findings as all authors controlled for hands on hips and heel in contact with the board during the YBT-LQ, contrary to protocol recommendations (Plisky et al., 2009).

This likely explanation is strengthened due to comparable SEBT ANT results; right and left SEBT ANT reach distance results of this study (66.8 cm; 67.2 cm) were similar to figures reported in a mixed gender healthy population (67.1 cm) (Fullam et al., 2014) and female soccer and volleyball athletes (66.8 cm) (Stiffler et al., 2015). But inferior to that of physically active males (69.92 cm; 69.49 cm) (Coughlan et al., 2012) and male high school and collegiate American football players (69.9 cm; 70.3 cm) (McCann et al., 2015). Therefore, observations on reach distance ability appear similar when sex and athletic status are accounted for.

Restricting stance foot movement on the YBT-LQ requires a greater closed chain ankle dorsiflexion range of motion to gain superior scores in the ANT direction (Hoch et al., 2011; Kang et al., 2015) and unrestricted arm movement to assist with balance compared to hand on hips has demonstrated greater ANT reach distances on the SEBT (Cuğ, 2017).

Previous research that utilized the correct YBT-LQ protocol demonstrates comparable outcomes to the current study. For example, the right and left YBT-LQ ANT reach distance results of this study (76.3 cm; 76.4 cm) compared to that of high school athletes (75.5–76.4 cm) (Butler et al., 2012; Gorman et al., 2012) and adolescent male soccer players (76.5 cm) (Butler, Queen, et al., 2013). However, YBT-LQ ANT reach distance were superior to that of healthy females (70.3 cm) (Alnahdi et al., 2015) and slightly greater than female athletes of similar age (73.4 cm) (Engquist et al., 2015).

Even though findings in this study oppose that of the studies (Bulow et al., 2019; Coughlan et al., 2012; Fullam et al., 2014; Gabriel et al., 2021) there is still merit that informs on the practical use of the YBT-LQ and SEBT. For instance, when these studies applied the SEBT instructions to both the SEBT and YBT-LQ, differences in reach distance were still identified in favor of the SEBT. Therefore, this research can be valuable to clinicians as there is a plethora of research that has used the YBT-LQ testing kit and applied the SEBT protocol and criteria (A. Bulow et al., 2021; Gonell et al., 2015; Hartley et al., 2018; Kang et al., 2015; Lai et al., 2017; Luedke et al., 2020; Nakagawa et al., 2020; O'Connor et al., 2020; Read et al., 2020). Although this is an incorrect use of the YBT-LQ based on strict guidelines (Plisky et al., 2009), it could justify a change in practice as difficulties arise when recording the reach distance whilst observing movement compensations on the SEBT (Ness et al., 2015). Therefore, combining the test protocols could be a viable option to reduce confusion within the literature and improve reliability.

There is a paucity of research investigating the combination of movement quality and reaching distance on the YBT-LQ and SEBT; one study within the literature identified participants who were classified at risk of injury based on quantitative lower reach distance scores had fewer movement compensations (Ness et al., 2015). This could be a protective mechanism as athletes were working within their own stability limits and were reluctant to push themselves. Also, the scoring criteria were overly simplistic, and a more sensitive scoring criterion could be needed. Although beyond the scope of this study, individual data analysis between participants and tests supports a consistent superior performance on the YBT-LQ compared to the SEBT and demonstrates a greater variability during the YBT-LQ. The less stringent protocol on the YBT-LQ, allowing greater freedom of movement, could be a plausible explanation for this and justifies the need for both a qualitative and quantitative analysis.

4.2. Posterior reach

Foot position aligning the most posterior aspect of the heel for the PM and PL directions was applied to this investigation to negate participant foot size that could confound reach distance (Cuğ, 2017; Gribble et al., 2012). It would therefore be unreasonable to draw direct comparisons between the tests due to the dissimilar stance foot alignment of the YBT-LQ in the PM and PL directions. For example, data that use toe alignment for all directions on the SEBT recorded up to a 17% greater reach distance in the posterior directions (Cuğ, 2017; Stiffler et al., 2015) compared to data that used heel alignment (Munro & Herrington, 2010). Data for the PM and PL directions were presented to provide reference of the consequence foot position has on reach distance. Furthermore, the ANT direction on the YBT-LQ and SEBT has a stronger association to lower extremity injury risk (Bliekendaal et al., 2019; Gribble et al., 2016; Plisky et al., 2006; Stiffler et al., 2017).

4.3. Limitations

On the first limitation, a specific sample of healthy females were used from netball and football team sports. Therefore, the findings of this study may not be transferrable and future research should aim to investigate general, pathological, and rehabilitating populations. While a small sample size and no power calculation may be considered a limitation, the present study recruited a similar sample size to previous studies on this topic. In addition, the current study presented individual data to outline trends in the results that support the statistical outcomes of the mean data.

5. Conclusions

This novel study compared reach distance between YBT-LQ and SEBT using the correct protocols. The reported findings will have substantial impact on practice and highlights that reach distance for the YBT-LQ and SEBT are not comparable and crucially, cannot be used interchangeably. Furthermore, given the fact that the YBT-LQ and SEBT are being applied clinically as post-operative outcome measures and in the assessment of injury risk, it is imperative that in the future practitioners and researchers use the correct protocols as defined by the developers of the respective tests. This is to safeguard patients and clinicians who are using the results of these tests to inform return to sport and clinical practice.

Ethical statement

The author confirm work described in the manuscript has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki). In addition, ethical approval was sought and granted by the Institution Research Ethics Committee.

CRediT authorship contribution statement

James G. Bodden: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing. **Robert A. Needham:** Formal analysis, Methodology, Supervision, Validation, Visualization, Writing – review & editing. **Nachiappan Chockalingam:** Formal analysis, Methodology, Resources, Supervision, Visualization, Writing – review & editing.

Declaration of generative AI and AI-assisted technologies in the writing process

The authors disclose that generative AI and AI-assisted technologies were not used in the writing process.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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