ABSTRACT

Despite Flag Football being the fastest-growing format of American Football and its recent inclusion in the 2028 Olympics, there is extremely limited research available on the sport, particularly in the female format. The aim of this study was to be the first of its kind to assess physical fitness qualities in female British Flag Football players. Fourteen participants (age 27.6 ± 4.6 years; height 165.9 ± 8.4 cm; body mass 79.1 ± 29.2 kg) currently playing in a national league Women's Flag team performed the following testing battery; Countermovement Jump (CMJ), Squat Jump (SJ), Broad Jump, 20-yard sprint, Pro Agility, and Isometric Mid-thigh Pull (IMTP). Mean ± SD of physical tests were as follows; CMJ jump height (cm) 25.1 ± 5.9 and peak power ($w.kg^{-1}$) 39.1 ± 7.1; SJ jump height (cm) 24.6 ± 6.3 and peak power ($w.kg^{-1}$) 39.3 ± 6.6; Broad Jump distance (m) 1.89 ± 0.28, and IMTP relative peak vertical force 30.1 ± 4.1 ($N.kg^{-1}$), respectively. Lastly, 20-yard sprint and Pro Agility times were 3.43 ± 0.28 (s) and 5.36±0.38 (s), respectively. Trivial-to-small positional differences in performance variables were observed. Several significant large and very large correlations between jump, sprint, and change of direction were noted. This study is the first to report the physical capabilities of female British Flag Football players. The findings of this study may help develop the understanding of a growing and soon to be Olympic sport. Further research may wish to explore strength-training interventions and longer-term monitoring in female flag football.

Key words: Flag Football; American Football; strength; power; fitness testing; female athlete

INTRODUCTION

Flag Football is the fastest growing format of Football globally.[1] It is the latest sport to be added to the Los Angeles 2028 Olympic Games. The rise in popularity is apparent in the female format in the United Kingdom, where the Women's Flag Football League (WFFL) currently hosts 17 teams.[2] The Flag format is a fast paced, non-collision version of tackle American Football, where tackles are made by removing flags from players hips. Current rules dictate that a maximum of 5 players are to be fielded at any one time,[3] though different formats include 4 v 4, or 7 v 7. Flag was introduced in Arizona, United States of America (USA) in 1953 as a non-contact alternative to tackle American Football following concerns around the physical nature of the game, most notably the potential negative effects of accumulative head impacts and concussion.[4] Despite a large surge in popularity in more recent years, to the authors best knowledge, there appears to be a real lack of literature on the sports demands or physical qualities of players, particularly in female players.

Our current understanding of Flag Football may be borrowed from research conducted in tackle football formats. For example, there is a large amount of research from the National Football League (NFL), the highest form of American Football, and from college level American Football. The sport is predominantly anaerobic in nature, [5] and as in many team sports, Pincivero and Bompa[6] noted the activity profile of American Football includes accelerations, decelerations, maximal sprinting, jumping, explosive muscle actions, change of direction (COD), and agility-based movements. In NFL games, there are 4.6 – 5.6 plays run per series, and each play lasts ~5.49 seconds in duration,[5-7] whilst Iosia and Bishop identified a work:rest ratio of 1:7.[8] Wellman et al., examined positional differences in the activity profile, reporting that Wide Receivers achieved a greater total distance (5,530 ± 997 m), average maximal speed (31.5 ± 2.2 km/h), and a greater number of sprints (12.7 ± 5.7), and both accelerations and decelerations (21.9 ± 8.1;15.8 ± 5.4), compared to Offensive Lineman, Running Backs, and Tight Ends.[7] Regardless of position, the above examples of American Football activity require adequate levels of strength, power, and speed, as such there is a large focus on the development of these qualities. This is reflected in the importance of the combine.[9,10] Research in team sports routinely shows relationship between select physical qualities,[11-13] further suggesting the need for strength and conditioning programmes to target improvements in said physical qualities. Work by Robbins et al., analysing NFL draft combine data suggests that performance in several physical performance tests is similar between Offensive and Defensive positions, if only slightly favouring the latter.[13] Positional comparisons are inherently difficult, the method of categorising players varies between studies, for example it is challenging to appropriately statistically compare positional differences in a single cohort where specific positions are used, as opposed to grouped positions. As such, exploring positional differences in Flag Football in a grouped manner, may provide valuable insights.

There may be similarities between tackle Football, and Flag Football, with its intermittent and multi-directional nature, which for athletes in both sports, may necessitate well-developed physical qualities such as lower-limb strength and 'power'. However, our scientific understanding of the specific physical demands and characteristics of flag football matches is extremely limited. Perhaps more importantly, as highlighted in much of the sport science and strength and conditioning literature,

research is heavily biased towards male athletes. The previous literature base of tackle formats, dominated by research on male athletes, cannot be generalised to female Flag Football athletes. Thus, there is a real need for researchers to develop the scientific understanding of the female format of the sport.[14] Emmonds, Heyward and Jones perceived a need to start with descriptive research to understand the current level of performance within female sport, which could lead to targeted interventional research, or the development of frameworks to enhance physical development.[15] Therefore, the primary aim of the project is to assess the physical capabilities of female National League British Flag Football players. A secondary aim was to explore potential relationships between performance in several physical fitness tests. As part of the first aim, positional differences in physical performance will also be explored.

METHODS

Experimental Approach to the Problem

An observational cross-sectional study design was used to explore the physical fitness qualities of national level female Flag football players, currently competing in the British American Football Association (BAFA) Women's Flag Football League (WFFL). All tests that were chosen to assess the physical fitness qualities of the cohort were based on prior team sport literature, in some cases their use in the NFL combine, and their validity, reliability, and logistical feasibility. Testing took place at the end of the 23/24 season.

Subjects

Fourteen female Flag footballers (age 27.6 ± 4.6 years; height 165.9 ± 8.4 cm; body mass 79.1 ± 29.2 kg; position n = 8 Offensive, n = 6 Defence) took part in a physical fitness testing battery. The experience level varied between the squad, though all players had > 2-years experience playing flag football. Participants were taking part in one skill-based training session per week, and all players were regularly performing resistance training once per week. Participant criteria required players to be over the age of 18, and free from recent (within the past 6 months) or current injury and illness. Participants were verbally recruited in person during a scheduled training session. The study was completed during the 2023 WFFL season. Prior to taking part in physical activity, participants completed a comprehensive health screening procedure, comprising the completion of a Physical Activity Readiness Questionnaire (PAR-Q), and an institutionally approved medical health questionnaire under the supervision of the lead researcher. This also involved measuring resting blood pressure and heart rate (HR) (Omron. Mx3 plus, Netherlands) with inclusion criteria for the former set at < 140 mmHg (systolic blood pressure), < 90 mmHg (diastolic blood pressure). If any measure exceeded these criteria, participation was not permitted, with the participant advised to seek medical clearance to take part in the future. Participants were advised to wear suitable footwear for jump and sprint-based assessments, prior to attending the testing session. All participants were informed of the benefits and potential risks of the investigation prior to signing an institutionally approved informed consent document to participate in the study. This study was granted ethical approval by the

lead authors current institution (UA-S-0011) and was conducted in accordance with the Helsinki Declaration.[16]

Procedures

The participants were asked to attend the testing session having avoided vigorous exercise and consumption of alcohol or stimulants for 48-hours prior to each testing session.[17] Following initial screening procedures outlined in the previous section, participants performed a standardised RAMP warm-up comprising a 6-minute cycle at a moderate pace, 10-minutes of full-body dynamic stretching, culminating in low-to-high intensity jumps, plyometrics, and 5-metre acceleration build-ups with deceleration. Following the standardised warm-up participants were allowed two familiarisation trials of the CMJ, prior to recorded efforts. As part of a related research project, some athletes were accustomed to the testing battery within the present study. Additionally, as mentioned above, most subjects routinely perform foundational level strength-based activity and plyometric activity within their typical strength and conditioning programme. To further aid in familiarisation, participants were allowed two practice trials of each test.[17] As mentioned earlier, the physical fitness tests selected for this study were influenced from prior team sport research and the NFL combine, and their practicality in a team setting.[9-13] The order of the tests was as follows; CMJ, squat jump, broad jump, 20-yard sprint, Pro agility, Isometric Mid-thigh Pull (IMTP). The following paragraphs will outline the testing battery and experimental measures in detail.

Experimental Measures

Countermovement Jump (CMJ), Squat Jump (SJ), and Broad Jump

Participants performed 3 maximal effort CMJ's (no arm-swing) and 3 SJ's via dual portable force plates (ForceDecks Vald Performance, Brisbane, QLD, Australia) to assess lower body neuromuscular function. In the CMJ, participants were initially asked to remain still in the stand tall position to ensure a minimum "quiet phase" of 1 second.[18] Participants were instructed to rapidly squat to a comfortable depth,[19] before rapidly extending the hips, knees, and ankles aiming to achieve maximum height. This was to ensure participants completed the countermovement and propulsion phase as 'fast' as possible. In the SJ, participants were similarly asked to remain in the stand tall position, before squatting to a self-selected depth and pausing for 3 seconds, prior to rapidly extending their hips, knees, and ankles aiming to achieve maximal height. Technical demonstrations of both jumps from the lead researcher, and further familiarisation attempts preceded the recorded jump attempts. An intraset recovery period of 30-seconds was administered, with a 3-minute recovery period interspersing the CMJ and SJ tests. Mean scores of jump height (cm), relative peak power (w/kg), and concentric force (N) were recorded, as these have been shown to be highly reliable when using the same portable force plates.[20] Mean broad jump distance (m) was also recorded, whereby participants performed 3 maximal effort jumps on an indoor Mondo running track. Athletes were instructed to perform a 'pre-stretch' or 'countermovement' to a self-selected depth and rapidly propel themselves forward with arm swing permitted, with an aim of achieving maximal horizontal distance. The CMJ, SJ, and broad jump have previously shown high levels of reliability (ICC range

0.95 – 0.98, and low within-subject variability, coefficient of variation – expressed as a percentage (CV% range 2.4 – 3.3).[21]

Sprints and Pro Agility tests

Participants completed 3 maximal 20-yard sprints, with 2-minutes rest in-between. Separately, participants performed 3 attempts of the Pro Agility, a valid and reliable assessment of change of direction performance,[22] commonly used in American Football.[23,24] A recovery period of 2-minutes interspersed each repetition, with 3-minutes recovery provided between the cessation of the last sprint, and the first Pro Agility. Both tests were performed on an indoor track, and monitored via photocell gates (Witty System, Microgate, Bolzano, Italy).

Isometric Mid-thigh Pull (IMTP)

The IMTP is a whole-body strength assessment, used commonly in applied research. A recent review showed the IMTP to have good-to-excellent test re-test reliability with regards to absolute (ICC range = 0.84 – 0.99) and relative peak force (ICC range = 0.73 – 0.99),[25] with most studies reporting ICCs ≥ 0.90 and CV% of ≤ 5%. Peak relative force obtained by the force plates used in the current study (ForceDecks Vald Performance, Brisbane, QLD, Australia) has been shown to be highly reliable in previous research,[20] and as such, is reported in the current study. Participants applied wrist straps[26] and performed 3 maximal attempts via the force plates that were embedded into a purpose-built isometric testing rig. The rig comprised a bar that could be repositioned allowing for an ~ knee angle of 140° for each participant,[26] measured with a goniometer by the same researcher. Once body position with minimal pre-tension on the bar produced a stable force baseline,[26] the participant was given a 3 second countdown, followed by a 5 second maximal effort. Participants were instructed to pull vertically against the bar with maximal effort and push feet down into the force plates.[27] A period of 1-minute recovery interspersed each attempt.

Statistical Analyses

Descriptive data were inputted into a custom-made MS Excel spreadsheet, whereby mean ± SD for all physical performance variables were calculated. Prior to correlation analysis, the normality of data was confirmed via the Shapiro Wilks test ($p > 0.05$). A correlation matrix of mean data across all physical tests was produced, with statistical significance and Pearsons r reported. Finally, an independent t-test was performed to assess differences in physical performance across all tests, between Offensive and Defensive positions, inclusive Effect Sizes (Hedges *g*) with the following thresholds; trivial = 0-0.19, small = 0.20-0.49, moderate = 0.50-0.79, and large = ≥ 0.80. All analyses were performed in Jamovi (The Jamovi Project, Australia) with statistical significance assumed at $P \leq 0.05$. All data are reported as mean ± SD, unless otherwise stated.

RESULTS

Physical Performance

Participants jump, sprint, change of direction, and strength performance, inclusive of comparisons between Offensive and Defensive positions, can be seen in Table 1.

Table 1 Mean ± SD and CV% data from jump, sprint, COD, and strength performance assessments.

		Team Data		Positional Differences		
Test	Variable	Team	CV%	Offensive	Defensive	ES (*g*)
CMJ	Jump Height (cm)	25.1 ± 5.9	4.2	26.6 ± 6.8	23.6 ± 4.9	0.47
	Peak Power (W/kg)	39.1 ± 7.1	2.1	40.8 ± 8.2	37.4 ± 5.9	0.45
	Peak Concentric Force (N)	1624 ± 216	3.4	1709 ± 273	1539 ± 101	0.32
SJ	Jump Height (cm)	24.6 ± 6.3	3.7	25.7 ± 7	23.5 ± 5.6	0.32
	Peak Power ($W.kg^{-1}$)	39.3 ± 7.1	2.5	40.4 ± 7.4	38.2 ± 6.2	0.30
	Peak Concentric Force (N)	1441 ± 187	2	1493 ± 234	1389 ± 120	0.52
Broad Jump	Distance (m)	1.89 ± 0.28	3	1.93 ± 0.34	1.85 ± 0.23	0.26
Pro Agility	Time (s)	5.36 ± 0.38	1.2	5.28 ± 0.40	5.44 ± 0.37	0.38
20- yard sprint	Time (s)	3.43 ± 0.28	1.2	3.37 ± 0.32	3.48 ± 0.25	0.36
IMTP	Peak Force (N)	2201 ± 422	4.8	2257 ± 440	2145 ± 430	0.24
	Peak Force ($N.kg^{-1}$)	30.1 ± 4.1	4.8	30.4 ± 3.8	29.8 ± 4.6	0.13
DSI (a.u.)	-	0.75 ± 0.12		0.77 ± 0.12	0.74 ± 0.13	0.22

cm = centimetres; CMJ = Countermovement Jump; ES = Effect Size (*g* = Hedges g); DSI = Dynamic Strength Index; IMTP = Isometric Mid-thigh Pull; N = Newtons; $N.kg^{-1}$ = Newtons relative to body mass; s = seconds; SJ = Squat Jump; $W.kg^{-1}$ = Watts per kilogram.

No significant differences between Offense and Defensive players were noted across all variables, though ES ranged from trivial-to-small (0.13 to 0.47) across performance-based variables.

Select significant correlations between physical performance variables can be found in figure 1, whilst a complete correlation matrix is observed in table 2.

Insert Figure 1 about here

Table 2 Correlation matrix of all physical performance variables.

		CMJ JH	CMJ PP	CMJ PF	SJ JH	SJ PP	SJ PF	Broad Jump	Pro Agility	20-yard Sprint	IMTP Relative PF
CMJ JH	r	-									
	p	-									
CMJ PP	r	0.986***	-								
	p	< .001	-								
CMJ PF	r	-0.040	0.000	-							
	p	0.891	1.000	-							
SJ JH	r	0.951***	0.949***	-0.079	-						
	p	< .001	< .001	0.789	-						
SJ PP	r	0.952	0.958	-0.136	0.993	-					
	p	< .001	< .001	0.643	< .001	-					

SJ PF	r	0.005	0.061	0.830***	-0.027	-0.047	-				
	p	0.987	0.835	< .001	0.928	0.872	-				
Broad Jump	r	0.911***	0.908***	-0.121	0.877***	0.870***	-0.076	-			
	p	< .001	< .001	0.681	< .001	< .001	0.798	-			
Pro Agility	r	-0.857***	-0.847***	0.357	-0.844***	-0.872***	0.219	-0.870***	-		
	p	< .001	< .001	0.211	< .001	< .001	0.452	< .001	-		
20-yard Sprint	r	-0.780**	-0.768**	0.418	-0.774**	-0.872***	0.294	-0.869***	0.922***	-	
	p	.001	< .001	0.137	0.001	< .001	0.308	< .001	< .001	-	
IMTP Relative PF	r	0.462	0.421	-0.120	0.438	0.412	-0.114	0.588*	-0.533	-0.460	-
	p	0.096	0.134	0.684	0.117	0.143	0.697	0.027	0.050	0.098	-

* denotes significant difference (p < .05); ** denotes significant difference (p < .01); *** denotes significant difference (p < .001). CMJ = Countermovement Jump; JH = Jump Height; PF = Peak Force; PP = Peak Power; SJ = Squat Jump, IMTP = Isometric Mid- Thigh Pull.

DISCUSSION

The main purpose of this study was to explore the physical fitness capabilities of a national league female Flag Football team. This study presents data from several physical fitness tests, providing novel data for this cohort. A secondary aim was to assess the potential relationships between performance in several physical fitness tests. Performance in select physical fitness tests were generally comparable to female athletes of other sports, and typically inferior to male collegiate or NFL football athletes. Trivial-to-small differences in performance variables were observed between position, with Offensive players consistently achieving greater performance compared to Defensive athletes. Though, no significant positional differences were observed. Large-to-very-large correlations between jump, sprint, and change of direction performance was found, in agreement with team sport literature.

As mentioned, the CMJ is a test commonly used to assess lower body neuromuscular performance in athletes. The mean CMJ jump height (25.1 ± 5.9 cm) and peak power (39.1 ± 7.1 $W.kg^{-1}$) observed in the current study was comparable to that achieved by Elite female Handball players,[28] with the former also comparable to female academy soccer players.[29] In contrast, CMJ jump height was slightly lower than that reported in third-tier Norwegian female soccer players,[30] and Italian national level soccer players.[31] The SJ jump height achieved by players in the current study was similar to that seen in female volleyball,[32] but lower than that seen in female academy rugby players.[29] The aforementioned invasion sports (e.g., sports where the objective is to invade the opponent's territory while trying to score points and minimise the opposition's scoring),[33] requires intermittent bouts of high-intensity actions involving rapid force application in multi-directions. As such, it may not be surprising to see similar, though sometimes inferior, physical performance standards in Flag Football, a sport that also requires intermittent bouts of high-intensity, multi-directional activity. It is worth noting that Flag Football is a relatively young sport, and as such, focus on physical fitness development may not match that of some of the established invasion sports mentioned above. Likewise, whilst select participants in the current study were competing at a high level of the sport, the cohort included grassroots level players. This may explain some of the inferior physical capacities when compared to academy and national level athletes mentioned above. Much of the literature pertaining to tackle American Football utilises the vertical jump, perhaps due to its use in the NFL combine, and so comparison across CMJ and the vertical jump may prove difficult. In most cases, jump performance in the current cohort was lower than that seen in the American Football literature, though as expressed in earlier sections, the literature largely comprises analysis of male football athletes. It must be stressed of course, that

NFL athletes are elite level athletes playing in the highest format of their sport. Within their preparation, they regularly train for some of the assessments included (or similar assessments) in the current testing battery.[13] Conversely, the participants in the current study recorded performing resistance training only once per week.

Jump height and peak power in the CMJ and SJ in the current study were extremely similar, which may indicate either a reduced efficiency in the utilisation of elastic energy during the CMJ, or perhaps a heightened ability to reduce the degree of muscle slack and build up stimulation in the SJ.[34] For this reason, there is typically a greater jump height in the CMJ compared to SJ. Regardless of the potential mechanisms that may explain the similarities in jump performance in the current study, it should be noted that the SJ may be a more novel jumping technique in the current cohort as compared to the CMJ, therefore caution must be applied when comparing performance in the two jumps.[35] Peak force produced during the CMJ in relation to the IMTP, is discussed later. In relation to horizontal jump performance, the mean broad jump distance of 1.89 ± 0.28 cm achieved by athletes was similar to that reported in female Division I College Soccer athletes (1.94 ± 0.22 cm).[36] Research has shown relationships between sprint speed and broad jump distance, perhaps owing to the shared requirement of rapid horizontal force production in the broad jump, and in sprint acceleration.[37,38]

Developing sprint performance is essential for evading defenders and creating scoring opportunities.[39] The mean 20-yard sprint time of 3.43 ± 0.28 in the current study was markedly slower than that achieved by NFL combine participants between 2004-2009, reported as 2.74 ± 0.31. This is not surprising when you consider that the participants were males and were playing at a higher standard of a different football format. In relation to change of direction performance, averaged over a 5-year period, male NFL athletes completed this test in 4.38 ± 0.25 (s),[13] compared to 5.36 ± 0.38 s by female Flag players in the current study. Comparisons with female athletes in other sports may be more insightful, where possible. Indeed, the scores produced by athletes in the current study were closer, yet still inferior to that achieved by female division 1 athletes from the USA across basketball, soccer, volleyball, and gymnastics,[40] NCAA Division III female lacrosse players, and US-based female soccer players.[36] The team sports described above are also intermittent and multi-directional invasion sports in some cases, whereby rapid change of direction ability, as we see in American Football,[41] and indeed in Flag football, is required.

In the IMTP, relative peak force of the team was 30.1 ± 4.1 $N.kg^{-1}$, which was slightly greater than that reported in Netball, Cricket and Soccer players.[42] An athlete's ability to express force is key to several sporting movements, such as acceleration and changes of direction discussed earlier. The athletes in the current study have shown high levels of force production in a commonly used assessment of maximal strength, compared to literature in other female sports.[42] Practitioners often calculate an athletes Dynamic Strength Index (DSI), which is a ratio metric of peak forces achieved in isometric and ballistic activity.[42,43] Whilst this method may understandably be deemed simplistic, it may contribute to effective decision making in future training phase design for practitioners. A DSI of 0.75 ± 0.12 a.u. found in the current study was lower than that reported across female sports (range 0.80-0.91 a.u.).[43] If practitioners did subscribe to this method, it would suggest that the team may benefit from

increasing their maximal strength capabilities, perhaps serving as a foundation for the development of other physical fitness qualities in subsequent training phases.[44]

Significant and large-to-near perfect correlations between all CMJ, SJ, and broad jump variables were found. The significant and very large negative correlations found between 20-yard sprint performance and height and distance, and peak power achieved in all jump tests, is consistent with prior literature across a variety of sports.[11-13,45] This may be due in part to the shared requirement of rapid production of large forces in both jumping and sprinting tasks.[12,38] The importance of the direction of force may also explain why broad jump distance can show a stronger relationship with sprint time compared to vertical jump height,[12] was was evident in the current study. Horizontal force application may be more important to acceleration, whereas vertical force application may be more important to maximal velocity.[12,37,38] Significant and very large negative correlations were also found between Pro Agility time and jump height and power in the CMJ and SJ, and distance in the broad jump, in agreement with previous literature.[45] As with most COD tests, the Pro Agility comprises a sprint element, and so perhaps unsurprisingly, a near perfect positive correlation between sprint and Pro Agility time was evident. Relative peak force exhibited in the IMTP was only moderately correlated with jump height and power in the CMJ and SJ. In line with Towsend et al., (-0.657; $p < 0.001$),[46] large correlations with IMTP and the ProAgility was found in the current study. Similarly, a large correlation between the IMTP relative peak force and broad jump distance was shown. The relationship between IMTP and 20-yard sprint in the current study was moderate, as opposed to large seen in previous literature.[46] The findings of the current study highlight the relationships between several physical performance variables in female Flag Football. More generally, the data collected in this study has practical implications, being the first of its kind in this sport. It provides coaches, practitioners, and athletes within Flag Football, with important normative values to compare and contrast, and benchmark physical capabilities.

A potential limitation of the study, though attempts were made to control for this, is the lack of familiarity of select tests for some individuals. Most participants performed the tests as part of their routine assessment and monitoring, and indeed in a related longitudinal research project with the lead authors institution, minimising the potential for learning effects.[47] Additionally, in the rare case an athlete had not performed a specific test previously, all participants were given the opportunity to perform practice repetitions prior to the tests itself. A further limitation is the potential effect of repetitive testing on the subsequent neuromuscular and task-specific performance. The authors aimed to order physical tests appropriately, with more dynamic, high velocity movements coming first, whilst maximum strength assessments were performed at the end. Another limitation of this study is its cross-sectional design. This design captures data at a single point in time, at the end of the season. Longitudinal studies are needed to verify the findings and observe potential trends over time, where within-season changes in physical capacities may also be explored. Lastly, the small sample size may have impacted the correlational and positional differences analyses. Future research may wish to refine and further develop a specific testing battery for Flag Football. Likewise, a larger study encompassing multiple teams may further our understanding of the physical qualities of female Flag Football athletes. Lastly, research on the development of physical fitness qualities via training interventions and long-term monitoring are needed, as the sport continues to grow.

CONCLUSIONS

In summary, this study is the first to report the physical qualities of female British Flag Football athletes, and as such advances our knowledge and understanding of this rapidly growing sport. Physical performance in several performance tests were similar to that reported in other female team sports; however, this was markedly lower than the male-dominated literature on tackle Football. Several large-to-very-large relationships were found between sprint, jump, and change of direction performance. With the foreseeable growth of, and increased access to the sport of Flag Football, it will be interesting to observe physical development of its athletes. Coaches and practitioners may use this information when assessing and monitoring physical qualities in female Flag Footballers, and in using such data to inform strength and conditioning practices, for example informing which physical adaptations to focus on improving, and when.

STATEMENTS AND DECLARATIONS

Ethical considerations

This study was granted ethical approval by the Ethical Review Committee at the lead researchers' current institution (UA-S-0011) on 02/02/2024.

Consent to participate

As per the ethical review process, following the reading and signing of a participant information sheet, all participants signed an institutionally approved informed consent form.

Consent for publication

As per the ethical review process, all participants signed an institutionally approved informed consent form which stated that anonymous data may be used for dissemination in scientific journals and poster presentations.

Declaration of conflicting interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Data availability

All data is presented within the results section of the manuscript

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606 **FIGURE LEGENDS**
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608 **Figure 1** - Correlation plots showing the significant correlations between select
609 variables of jump, sprint, and change of direction performance. a) Pro agility and CMJ
610 jump height, b) 20-yard sprint and CMJ jump height, c) Broad jump distance and CMJ
611 jump height, d) Pro agility and SJ peak power.
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