The variations in the anthropometric and performance characteristics of elite camogie athletes across a pre-season period

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Headline

Camogie is the female version of the sport hurling and constitutes a form of intermittent exercise (1), within which the timing of high-intensity efforts is intermittent in nature following the ebb and flow of the game similar to hurling (2,3,4). The sport requires athletes to engage in high speed running, rapid acceleration and deceleration movements intertwined with changes of directions, jumping and body contacts (5). Given the dearth of literature within camogie it would appear prudent to increase the dissemination of elite camogie player data to improve applied knowledge with respect to the anthropometric and performance profiles being observed. Successful preparation of team sport athletes requires an appreciation of the anthropometric and performance profiles (5, 6,7,8).

Aim

Currently, sport science and conditioning staff within elite camogie lack normative data standards for anthropometric and performance profiles (5). Therefore, the overall objective of the current investigation sought to determine the anthropometric and performance profiles of elite camogie athletes. The current data can be utilised by coaches to maximise position specific preparatory practices and training regimen. The current anthropometric and performance profile of elite camogie athletes will support coaches and athletes alike to gain an understanding into the general profile of a camogie player across positions.

Methods

Thirty-three elite intercounty camogie athletes were recruited for the investigation (mean ± SD: stature 164.3 ± 5.8 cm, body mass 62.6 ± 4.5 kg, age 22 ± 2 years). The participants were categorized by position on the playing field; 14 backs, 6 midfields and 14 forwards. After ethical approval was sought from the local institution, participants attended an information evening where they were briefed about the purpose, benefits, and procedures of the study. Written informed consent and medical declaration were obtained from participants prior to data collection commencement.

The athletes undertook measurements of standard anthropometric variables including stature, body mass, sum of 7 skinfolds (ΣSkf7) and estimated body fat percentage (bf%). Performance variables include 5-, 10-, 20- m sprint time, countermovement jump (CMJ) and Yo-Yo intermittent recovery test level 1 (Yo-YoIRTL2). The measures have been previously used in elite male hurlers and Gaelic footballers (5). Athletes were selected as they were members of the elite squad during the observational period and therefore were deemed the best athletes in the county at the time of data collection. Data collection took place at three time points in January, February and March between 18:00 and 20:00 hours. Prior to testing (24 - 48 hours) all athletes were requested to abstain from strenuous physical activity and were advised to maintain their normal diet, with special emphasis being placed on the intake of fluids. All anthropometric and performance testing were conducted at the same venue to avoid any external interferences, with anthropometric assessments preceding physical performance testing in all cases.

Anthropometric Assessments. Anthropometric measurements were taken in line with the International Society for Advancement of Kinanthropometry (ISAK) standard (3) and by a Level 3 ISAK qualified practitioner. Each athlete's stature and body mass were measured using a SECA stadiometer and digital weighing scales (SECA Instruments Ltd, Germany). The estimation of body fat percentage (%bf) was assessed using seven skinfold sites (tricep, bicep, subscapular, abdominal, supraspinale, thigh, calf), with the measurement taken in millimetres with a Harpenden skinfold callipers (Harpenden instruments Ltd, England). The %bf was calculated using the Reilly estimation equation (9). The technical error of measurement was <3%, which was within the acceptable error of measurement (10).

Performance Assessments. Sprint time was measured over 5- 10- and 20-m using timing gates (Microgate, Bolzano, Italy). Participants started from a stationary position and repeated three repetitions of maximal sprinting across the designated linear track, between each repetition participants were allowed a 5-min passive recovery interval (15). The fastest measurement from the testing repetitions was taken as the player's maximal speed across the designated distances. Vertical jump performance was assessed using the highest score (cm) of three attempts of a counter-movement jump (CMJ) (Optojump, Bolanzo, Italy). The rest period between each of the jump test attempts was standardised to 90 seconds. Athletes' peak countermovement jump power (CMJ_{peak}) was determined from the equation of Sayers et al. (11). Athletes' ability to perform high-intensity intermittent exercise was assessed using the Yo-Yo IRTL2. The Yo-Yo test is a suitable test as it involves movements similar to those experienced during game play (12, 13). Power and speed tests preceded aerobic/ anaerobic fitness tests in the testing order.

Statistical Analysis. Descriptive statistics are presented as mean ± standard deviations (SD) and were calculated for each testing session as well as for positional groupings. Maulchy's sphericity test was used and violations of the assumption of sphericity were corrected using the Greenhouse-Geisser adjustment. All statistical analysis was completed using the statistical package for social sciences software (SPSS, Version 24 for windows, SPSS Inc., Chicago, II.) Significance was set at $P \leq 0.05$. Due to the limited sample size in each position, estimates of effect size were also undertaken using a partial eta-squared ($\eta^2 p$) and categorised according to Cohen (14). A $\eta^2 p$ of 0.2, 0.5, 0.8 or 1.3 was considered small, moderate, large and very large difference respectively.

Results

Positional Anthropometric Profile. The mean stature and body mass for all athletes was 164.3 ± 5.9 cm and 62.6 ± 5.2 kg respectively. There was a significant effect detected for positions when analysed for stature ($F_{3,33} = 2.940$; $p = 0.023$) and body mass ($F_{3,33} = 2.139$; $p = 0.079$). When stature was considered, there were small but significant differences across position observed with midfield athletes (166.8 ± 3.9 cm) significantly taller when compared to backs (165.1 ± 6.1 cm; $p = 0.057$; $\eta^2 p$: 0.33; small) and forward athletes (164.3 ± 5.9 cm; $p = 0.097$; $\eta^2 p$: 0.49; small). Specifically, small to large significant differences were observed in both body mass and %bf across positions. Midfielders (60.8 ± 4.3 kg; $p = 0.001$; $\eta^2 p$: 0.23-0.91; small-large), showed a significantly lower body mass when compared to backs (64.4 ± 3.5 kg) with no significant difference reported between midfield and forward athletes. Furthermore, midfielders (21.9 ± 1.3 % bf; $p = 0.001$), showed a significantly lower % bf when compared to backs (23.1 ± 1.5 % bf; $\eta^2 p$: 0.85; large) and forwards (24.3 ± 2.1 % bf; $\eta^2 p$: 1.37; very large). When body mass, sum of 7 skinfolds (ΣSkf7) measurements and %bf were compared across the 3 month pre-season, there were small but significant differences present.

Positional Performance Profile. The mean values for all athletes for CMJ height, CMJ Peak Power (PP) and CMJ Relative Peak Power (RPP) were 25.5 ± 5.4 cm, 2308 ± 358 W, and 36.8 ± 3.6 $W \cdot kg^{-1}$ respectively. Significant differences across positions was observed within CMJ ($F_{3,90} = 3.113$; $p = 0.017$), CMJ PP ($F_{3,90} = 2.449$, $p = 0.049$), and CMJ RPP ($F_{3,90} = 2.816$; $p = 0.028$) respectively. Midfielders (27.4 ± 5.8 cm) were shown to have a significantly higher CMJ height compared to the forwards (23.3.0 ± 2.7 cm; $p = 0.013$; $\eta^2 p$: 0.89; large) and backs (25.7.0 ± 2.7 cm; $p = 0.013$; $\eta^2 p$: 0.29; small). Similar small to large significant differences were observed for CMJ PP ($\eta^2 p$: 0.29-0.81; small-large) and CMJ RPP ($\eta^2 p$: 0.39-0.87; small-large) with midfielders having greater absolute and relative power outputs when compared to other positions of play. The mean sprint times for 5-, 10-, and 20-m sprints for all athletes was 1.56 ± 0.41 s, 2.21 ± 0.72 s, and 3.59 ± 0.36 s respectively. There were no significant differences was observed across position for each of the three sprint variables, 5- ($F_{3,90} = 1.665$; $p = 0.164$), 10- ($F_{3,90} = 0.612$; $p = 0.655$) and 20-m ($F_{3,90} = 0.588$; $p = 0.672$). Figure 1 shows the Yo-YoIRTL2 with respect of position. The mean distance covered in the Yo-YoIRTL2 for all athletes was 633 ± 157 m, with significant differences observed across positions ($F_{3,90} = 15.999$; $p = 0.045$). The average measurements of both performance and anthropometric profiles over the three month testing period are illustrated in the table below.

Table 1. Average Measurements of the Performance and Anthropometric Variables of Elite Camogie Athletes over Three Month Testing Period

Variable	T1(Jan)	T2(Feb)	T3(Mar)
Weight (kg)	62.6 ± 4.8	62.8 ± 4.5	62.0 ± 4.1**
ΣSkf7 (mm)	83.3 ± 4.4	82.9 ± 4.2	82.1 ± 4.1
Body Fat %	23.7 ± 3.6	23.4 ± 3.4*	22.8 ± 3.3**
5 m (s)	1.5 ± 0.2	1.4 ± 0.2*	1.4 ± 0.2**
10 m (s)	2.7± 0.3	2.5 ± 0.2*	2.4 ± 0.2**
20 m (s)	4.8 ± 0.5	4.6 ± 0.6*	4.5 ± 0.6**
CMJ	22.9 ± 5.4	25.5 ± 4.1*	26.9 ± 4.0**
Peak power (w.kg)	2403.3 ± 1.6	2055.1 ± 1.1*	2406.5 ± 1.8**
Relative peak power	35.3 ± 1.4	35.6 ± 1.2*	36.5 ± 1.1**
YoYo IRTL2 (m)	552 ± 159	634 ± 155*	706 ± 151**

*significantly greater that T1, P<0.05.
**significantly greater than T2, P<0.05.

Discussion

The aim of the current investigation was to examine the variations in the anthropometric and performance variables of an elite camogie team across playing positions and across a 3 month pre-season. The present study is one of the first to investigate the anthropometric and performance characteristics of an elite camogie cohort (5). There were significant differences across all positional anthropometric and performance characteristics.

Camogie athletes are relatively heterogeneous with respect to body shape and size (15). Midfielders are seen as the tallest, whilst defenders are generally shorter and forwards are usually the shortest. The previous findings are supported within our investigation with small but significant differences across position observed for stature with midfield athletes (166.8 ± 3.9 cm) significantly taller when compared to backs (165.1 ± 6.1 cm; p = 0.057; η^2p: 0.33; small) and forward athletes (164.3 ± 5.9 cm; p = 0.097; η^2p: 0.49; small). It is interesting to note that these anthropometric profiles are reflective of the positional roles of athletes with the tallest athletes occupying the middle of the field of play within camogie, which may be related to the tactical role of these positions to contest possessions and engage in aerial duels of the ball during match play. In addition to these observations for stature this investigation found small to large differences in body mass and %bf across position. Midfielders (60.8 ± 4.3 kg; p = 0.001; η^2p: 0.23-0.91; small-large), showed a significantly lower body mass when compared to backs (64.4 ± 3.5 kg) with no significant difference reported between backs and forward athletes. Furthermore, midfielders (21.9 ± 1.3 %bf; p = 0.001), displayed a significantly lower %bf when compared to backs (23.1 ± 1.5 % bf; η^2p: 0.85; large) and forwards (24.3 ± 2.1 % bf; η^2p: 1.37; very large). These findings are in accordance with the typical running profiles of elite Gaelic sports athletes with midfield athletes expected to act as transitional runners in attack and defence as such these athletes have the highest running performances across match-play (3, 4, 5, 7, 16). Therefore, lean body mass and reduced body fat will aid these athletes in completing their tactical and performance roles during match and training situations. The body mass and body fat % of an athlete has a significant role in their training and match-play running performances with body mass affecting an athlete's speed, endurance, power, jumping, agility and repeatability characteristics (17,18). Excess body fat can be related to injury which may lead to an overall reduction in their athletic performance; reducing their speed and efficiency of movement (19). When the changes from testing period 1 to testing period 3 were considered with respect of position small to moderate differences in %bf were observed specifically, backs (6 ± 2%) were shown to have the largest reduction in %bf when compared to midfield (3 ± 1%; p = 0.067; η^2p: 0.34; small) and forwards (2 ± 1%; p = 0.047; η^2p: 0.44; moderate). The small to moderate differences of the anthropometric findings in this study are similar to previous work by Shortall et al. (21) who identified training regimes are ineffective in changing an athlete's body composition during the start of the competitive season. Greater improvements may not have been observed due to the short period of testing.

Speed and vertical jump ability are required in a number of key components of camogie match-play during such as jumping to compete for possession, sprinting to create and close down space for opponents. Ultimately high power is a requirement of elite camogie athletes and was assessed via a CMJ. The data observed in this investigation are similar to the findings within Connors recent paper (1) and similar studies carried out on female soccer populations (17,21). Differences in CMJ performance were observed between positional lines. Midfielders (27.4 ± 5.8 cm) had a significantly higher CMJ height compared to the forwards and backs. Similar small to large differences were observed for CMJ PP and CMJ RPP with midfielders having greater absolute and relative power outputs when compared to other positions of play. These findings may be related to the natural positional requirements of midfield athletes to jump at more regular intervals when compared to other positions, as such these components may be trained more consistently within midfield athletes. There were evident variations observed across the training periods. The phase of the training period has a moderate to large significant effect on CMJ, CMJ PP, and CMJ RPP. The increase in the athlete's jump measurements across the seasonal phases is not surprising and in line with literature within soccer populations (21,22). Speed is an important requirement for elite camogie athletes with regular quick bursts of anaerobic activity which have an important bearing on match play outcome (23). Interestingly within the current data there was no significant differences observed for each of the three sprint variables, 5-, 10- and 20-m. However, when the training phases were considered across 5-,10- and 20-m sprint time there was a moderate to large main effect observed irrespective of position.

Most coaches and practitioners within elite camogie have training models that aim to combine technical and athletic performance development as such an assessment of a player's ability to perform high-intensity intermittent exercise is warranted (15, 24, 25). Within the current data set the mean distance covered in the Yo-YoIRTL2 for all athletes was 633 ± 157 m, with significant differences observed across positions. There was a significant main effect for player position on Yo-YoIRTL2 distance covered with midfielders having increased performance within the YoYoIRTL2 when compared to other positions. All positions showed an increase in Yo-YoIRTL2 running performance across the 12-week training period with backs showing the greatest improvement when compared to forwards and midfield athletes. Interestingly our data is lower than those reported by Bangsbo and colleagues (12) for elite female athletes in soccer. The findings support data from match play suggesting midfielders have greater activity profiles compared to other positions within camogie (5) and other Gaelic sports (3,4,26).

Practical Applications

- The findings of the study can be used to gain an understanding of the positional and pre-season alterations in an elite camogie athlete's profiles.
- The findings presented in the current study can be employed by coaches and practitioners in evaluating both anthropometric and performance profiles of the elite athletes in Camogie.
- Positional specific characteristics of performance may be useful for selecting and planning training to best fit the player.
- Coaches should be aware of the different positional demands in both anthropometric and performance characteristics in order to plan training accordingly to maximise adaptations.

Limitations

Although the current investigation bridged a gap in the lack of research in this field, this study contains several limitations:

- A single squad was used to examine the research question and thus reduced the sample size per position on the playing field. Nevertheless, the study provides a significant insight into the profiles of camogie athletes across the different playing positions in a squad.

- The current study observed 3 positions on the playing field: forwards, midfields and backs. Although this research gained a significant insight into these profiles, further demarcation of positions such as half back and full back would be advantageous for future research.

- The current paper provides a holistic overview of camogie player performance profiles and fails to elucidate the changes in the profiles across the competitive season.

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