COLLINS, DK, REILLY, T, Morton, JP, McRobert, A and Doran, DA

Anthropometric and Performance Characteristics of Elite Hurling Players

Journal of Athletic Enhancement

Research Article

A SCITECHNOL JOURNAL

Anthropometric and Performance Characteristics of Elite Hurling Players

D Kieran Collins[1*], Tom Reilly[2], James P Morton[2], Allistair McRobert[2] and Dominic A Doran[2]

Abstract

The purpose of the present study was to examine variations in the anthropometric and performance characteristics of elite hurling players in relation to playing position. Forty-one male, elite inter-county hurlers (25 ± 4 years), 4 goalkeepers, 8 full-backs, 8 half-back, 6 midfielders, 8 half-forwards and 7 full-forwards underwent measurements of standard anthropometric (stature, body mass, sum of five skinfolds and adipose tissue percentage estimates (%AT)) and performance characteristics (counter-movement jump (CMJ), CMJ peak power, CMJ relative peak power, 5-, 10-, 20-m sprint times and estimated $\dot{V}O_{2max}$) during the later stages of the competitive season. A clear hierarchical anthropometric profile is evident with goalkeepers being the taller (184.3 ± 3.7 m), possessing the highest body mass (88.7 ± 5.7 kg) and adiposity (13.2 ± 3.1 %AT) than their outfield colleagues. Half-backs (47.4 ± 2.4 cm) and half-forwards (50.7 ± 5.9 cm) produced the highest CMJ scores; a similar profile was evident for sprint times. Midfielders (60.1 ± 1.4 $mL{\cdot}kg^{-1}{\cdot}min^{-1}$) exhibited a significantly ($p<0.05$) greater maximal oxygen uptake than all other playing positions. Differences in the anthropometric and performance characteristics of other playing positions whilst evident were non-significant. This study provides novel data, as it is the first report to present normative anthropometric and performance data for elite hurling players which to date has not been present in the literature. The enhanced maximal oxygen uptake in midfield players is likely due to different performance, technical and tactical demands associated with this position.

Keywords

Maximal oxygen uptake; Playing position; Gaelic games; Hurling

Introduction

The major sports in Ireland are hurling and Gaelic football and the major competition in each of these sports is the All-Ireland inter-county championship. The games are played in front of large domestic and international television audiences. The international expansion has led to competitions across Europe, Asia and the Americas. The stick and ball invasion games of field hockey, shinty and hurling have similar ancestry with hurling considered to be the oldest and thought to have been the original root of hockey in its various forms [1]. The game of hurling has been described as one of the world's most dynamic and skilled field games [2]. The rapid pace of play with few, usually brief interruptions make the game an entertaining spectacle.

Hurlers are allowed a remarkable freedom of expression due to few restrictive rules, which serve to protect the player and yet permit skilled performance (Figure 1). Despite the dynamic nature and spectator appeal of the game, research into hurling has lagged behind Gaelic football and other field games [3].

Time motion analysis indicates that hurling constitutes intermittent exercise where unpredictable bouts of high-intensity effort are interspersed with periods of low-intensity activity [4]. During a game a wide range of offensive and defensive skills are executed at high speed. These range from striking of the ball in the air or on the ground, lifting and catching the ball, and hooking or blocking an opponent when striking the ball. The play can change rapidly from end-to-end due to the large distance the ball can be hit, up to 90-100 m; this rapid change in play is unlike other field games [3]. Successful performance in competitive hurling requires an appreciation of the physical demands of the sport to inform effective training practice. Inadequate fitness or inappropriate conditioning of the participants to meet the demands of hurling has been hypothesized to be the reason for 60.8% of injuries occurring in the second half of match-play [5,6].

In relation to other intermittent team sports such as soccer, the performance characteristics and distance covered by soccer players indicates variance in accordance with positional role when such roles can be clearly differentiated [7]. Researches on the positional variation with regard to performance characteristics in Gaelic games are limited [8,9]. Whilst these studies have provided important information on the fitness of Gaelic footballers no studies have presented position specific data in relation to hurling [3,8,10]. An understanding of position-specific characteristics within a sport can be utilized to inform effective preparatory practices. Theoretically it can be extrapolated that individual playing positions and team rules will influence the demand placed on players in those positions, yet there is no scientific evidence supporting such positional differentiation in hurling.

The amateur status of hurling places a challenge on the strength and conditioning coach who must effectively balance keeping the

Figure 1: Hurling players contesting position (courtesy of G. Hatchell).

***Corresponding author:** Kieran Collins, Department of Science, Institute of Technology Tallaght, Tallaght, Dublin24, Ireland, Tel: 014042814; E-mail: kieran.collins@ittdublin.ie

Received: June 27, 2014 **Accepted:** October 11, 2014 **Published:** October 16, 2014

doi:http://dx.doi.org/10.4172/2324-9080.1000176

player injury free and training the energy systems utilized within the sport whilst balancing against the daily labor demands of the player and the implications on recovery. With this in mind, the objective of the study was to examine variations in the anthropometric and performance characteristics of elite hurling players in relation to playing position. Furthermore, this study is the first to provide normative anthropometric and performance data for elite hurling players. The research offers a unique insight into a sport that is principally a highly technical game that possesses similar performance characteristics of other intermittent professional sports.

Materials and Methods

Experimental approach

Elite inter-county hurling players (n=41) competing in division 1 of the national hurling league underwent measurements of standard anthropometric (stature, body mass, sum of five skinfolds and adipose tissue percentage estimates (%AT)) and performance characteristics (counter-movement jump (CMJ), CMJ peak power, CMJ relative peak power, 5-, 10-, 20-m sprint times and estimated $\dot{V}O_{2max}$). Players were categorized according to the line of the field in which they play. This approach allowed comparison across positions.

Participants

Following ethical approval by the Liverpool John Moores Research Ethics Committee and informed consent, forty-one male, elite inter-county hurlers (25 ± 4 years), 4 goalkeepers, 8 full-backs, 8 half-back, 6 midfielders, 8 half-forwards and 7 full-forwards participated in the study.

Procedures

Data collection was undertaken during the main competitive phase of preparation (June). All physical and performance tests were conducted indoors to avoid external interferences on data collection. Subjects performed no vigorous exercise or consumed any alcohol in the 24 hours prior to assessment. All tests were conducted at the same time of day to minimize the effects of circadian variations on the variables measured [11].

Anthropometry

Anthropometric measurements were taken prior to performance assessment and made in accordance with the standards of the International Society for the Advancement of Kinanthropometry (ISAK). Height and body mass were assessed using a Seca Stadiometer and weighing scales (Seca Instruments Ltd, Germany). Adipose tissue mass was estimated by measuring the thickness of subcutaneous fat tissue in millimeters at four sites (biceps, triceps, subscapular and suprailiac) using Harpenden skin-fold calipers (Harpenden Instruments Ltd, England). The %AT was calculated from the sum of four skinfolds using the equation of Durnin and Womersley [12]. The skinfold thickness of the anterior thigh was also recorded in accordance with guidelines of the British Olympic Association [13]. The technical error of measurement was taken from 24 subjects and calculated for all anthropometric measurements and was less than 3 % which is within acceptable measurement error [14].

Performance

Muscular leg power was measured using a modified Sargent vertical jump test [15]. A counter-movement jump (CMJ) for maximal vertical jump height was measured using a jump mat (Powertimer, Newtest Oy, Finland). Counter-movement jump peak power (CMJ PP) was calculated using the equation of Sayers et al. [16] and the counter-movement jump relative peak power (CMJ RPP) was also identified. The sprint times of a participant was measured over 20 m, timing gates being located at 5-, 10-, and 20-m (Newtest Oy, Finland). Cardio-respiratory fitness was assessed using the multi-stage fitness test, which gives an estimation of maximal oxygen uptake ($\dot{V}O_{2max}$) [17]. The multi-stage fitness test is regarded as suitable for testing games players as it incorporates movements similar to those made during competition [18]. The assessment of CMJ height and sprint speed preceded the multi-stage fitness test in the running order of the test battery.

Data analysis

Descriptive statistics (means and standard deviations) were calculated for all positional categories. A univariate analysis of variance (ANOVA) and a Scheffe post hoc test was performed using the Statistical Package for Social Sciences software (SPSS Version 20 program for MacOSX, Chicago, IL). Additionally, 95% confidence intervals were calculated to illustrate within-position variation. The intraclass correlation coefficient for test retest reliability were 0.96, 0.90, 0.92, 0.95, 0.95 and 0.90 for vertical jump, broad jump, sprint time over 5-, 10-, 20 m and $\dot{V}O_{2max}$ respectively.

Results

Measurements were categorized into two groups for analysis. These categories included anthropometric (stature, body mass, sum of five skinfolds and %AT) and performance characteristics (CMJ, CMJPP, CMJRPP, 5-, 10-, 20-m sprint times and estimated $\dot{V}O_{2max}$). Specific details of the categories are summarized in Table 1 according to positional roles.

The mean stature and body mass for all players were 181.7 ± 6.2 cm and 80.6 ± 8.0 kg respectively. No significant differences were detected among individual positions for stature ($F_{5,35}$= 2.036; p= 0.097) and body mass ($F_{5,35}$=2.124; p=0.086) (Table 1). The Goalkeepers were taller (184.3 ± 3.7 cm) and possessed a higher body mass (88.7 ± 5.7 kg) than outfield players. The sum of 5 skinfolds and adiposity for all players were 40.1 ± 5.6 mm and 12.7 ± 8.0 %AT respectively. No significant differences were detected across positions for adiposity ($F_{5,35}$=0.334; p=0.889) and AT% ($F_{5,35}$=0.499; p=0.775).

The mean CMJ height, CMJ PP and CMJ RPP for all players was 47.2 ± 5.1 cm, 4464 ± 490 w and 55.4 ± 3.8 wkg respectively. No significant differences were detected among individual positions for CMJ height ($F_{5,35}$=1.167; p=0.775), for CMJ PP ($F_{5,35}$=0.475; p=0.793) and CMJ RPP ($F_{5,35}$=2.154; p=0.082). The mean sprint speed over 5-, 10- and 20-m for all players were 1.00 ±0.04 s, 1.86 ± 0.04 s and 3.03 ± 0.06 s respectively. There were no significant differences detected among individual positions for 5-m ($F_{5,35}$=0.836; p=0.533), 10-m ($F_{5,35}$=1.585; p=0.19) and 20-m ($F_{5,35}$=0.077; p=0.995) sprint times. The mean maximal oxygen uptake for all players was 56.3 ± 2.9 $mL{\cdot}kg^{-1{\cdot}}min^{-1}$. Significant differences (p<0.05) was detected among individual positions ($F_{5,35}$=15.881; p=0.000). A Scheffe post-hoc analysis revealed that midfielders possessed a significantly higher maximal oxygen uptake than goalkeepers (50.3 ± 2 $mL{\cdot}kg^{-1{\cdot}}min^{-1}$; p=0.001), full-backs (56.2 ± 1.6 $mL{\cdot}kg^{-1{\cdot}}min^{-1}$; p=0.02), half-backs (57.1 ± 1.8 $mL{\cdot}kg^{-1{\cdot}}min^{-1}$; p=0.029), half-forwards (56.1 ± 1.9 $mL{\cdot}kg^{-1{\cdot}}min^{-1}$; p=0.02) and full-forwards (56 ± 1.8 $mL{\cdot}kg^{-1{\cdot}}min^{-1}$; p=0.02). The goalkeepers also possessed significantly lower values (p=0.001) to the full-back, half-back, half-forwards and full-forwards.

doi:http://dx.doi.org/10.4172/2324-9080.1000176

Table 1: The positional anthropometric and performance profile of elite hurling players (mean ± s and 95% confidence intervals).

	Goalkeeper (N=4)	95% CI	Full-Backs (N=8)	95% CI	Half-Back (N=8)	95% CI	Midfielder (N=6)	95% CI	Half-Forward (N=8)	95% CI	Full-Forward (N=7)	95% CI
Anthropometric characteristics												
Stature (cm)	184.3 ± 3.7	178.4–190	185.6 ± 5.1	181.4–190	179.9 ± 6	174.9–184.9	181.6 ± 4.6	176.8–186.5	177.3 ± 8.9	169.8–184.8	183.1 ± 2.9	180.4–185.8
Body Mass (kg)	88.7 ± 5.7	78.6–96.7	84.2 ± 9	76.7–91.8	79.9 ± 4.9	75.8–84	80.2 ± 5.8	74.1–86.3	75.5 ± 8.6	68.3–82.7	79.6 ± 5.6	74.4–84.8
Sum of 5 skinfolds (mm)	41.6 ± 9	27.2–56.1	39.4 ± 5.9	34.4–44.5	38.3 ± 5.3	33.8–42.7	41.6 ± 2.7	38.8–44.4	40.5 ± 4.9	36.4–44.5	40.6 ± 6.8	34.3–46.9
Adiposity (%AT)	13.2 ± 3.1	8.3–18.2	12.5 ± 1.7	11.1– 13.9	11.8 ± 2.1	10.1 – 13.6	13 ± 0.4	12.8–13.6	12.8 ± 1.8	11.3–14.3	12.8 ± 1.7	11.2–14.4
Performance characteristics												
CMJ (cm)	47.5 ± 3.9	41.4–53.7	45.2 ± 7.7	38.7–51.6	47.4 ± 2.5	45.3–49.4	46.5 ± 2.9	43.4–49.6	50.8 ± 5.9	45.8–55.7	45.9 ± 4.4	41.8–49.9
CMJ PP (w)	4800 ± 388	4182–5418	4501 ± 732	3889–5113	4439 ± 252	4199–4680	4398 ± 252	4133–4663	4446 ± 679	3878–5014	4335 ± 337	4023–4648
CMJ RPP (w·kg)	54.8 ± 2.5	50.8–58.7	53.4 ± 4.9	49.2–57.5	55.6 ± 1.9	53.9–57.2	54.9 ± 2.6	52.2–57.6	58.7 ± 4	55.4–62.1	54.5 ± 3.4	51.4–57.7
Sprint - 5 m (s)	1.02 ± .07	.9–1.14	1.01 ± .03	.99–1.04	.99 ± .04	.95–1.02	1.01 ± .01	.99–1.02	.99 ± .02	.97–1.01	1 ± .02	.98–1.02
Sprint - 10 m (s)	1.81 ± .05	1.72–1.89	1.78 ± .04	1.73–1.81	1.75 ± .03	1.73–1.78	1.76 ± .03	1.72–1.79	1.75 ± .04	1.72–1.79	1.77 ± .03	1.74–1.8
Sprint - 20 m (s)	3.04 ± .06	2.95–3.13	3.03 ± .08	2.97–.1	3.02 ± .03	2.99–3.04	3.04 ± .06	2.98–3.09	3.03 ± .07	2.97–3.08	3.03 ± .07	2.97–3.09
Estimated $\dot{V}O_{2max}$ ($mL \cdot kg^{-1} \cdot min^{-1}$)	50.3 ± 2*§	47.1–53.5	56.2 ± 1.6§	54.8–57.5	57.1 ± 1.8§	55.6–58.6	60.1 ± 1.4	58.7–61.5	56.1 ± 1.9§	54.5–57.7	56 ± 1.8§	54.4–57.6

Note: *Significantly different ($p<0.01$) from full-back, half-back, midfield, half-forward and full-forward's.
§ Significantly different ($p<0.05$) from midfielders

Discussion

The objective of the study was to examine positional differences in the anthropometric and performance characteristics of elite hurling players. The present study is the first to develop a performance profile of playing positions. Whilst the reported performance measures are essentially descriptive; nevertheless such information is important for applied practitioners as it provides reference values to compare players, implement appropriate training strategies and monitor existing training regimen.

Hurling players are relatively heterogeneous in respect to body size [3]. It has been hypothesized that anthropometric characteristics may vary with positional and/or tactical role assigned by the coach with tall players tending to have an advantage in certain playing positions and are therefore orientated towards these roles, notably in the six central positions [19]. The participants stature reported in the current study are taller than previously reported for hurling players and similar to what has been reported for Gaelic football players [3,19]. Stature may not be a key limiting factor in the choice of playing position as hurlers can utilize the hurley to intercept the ball in flight i.e. 'field the ball', effectively extending their reach. Body composition values previously reported for elite hurlers range from 13.1 % to 18.4 % [9,19]. Pronounced variations in body composition does not seem to exist across playing positions at the elite level of play. The participants in the current study possess lower adiposity than previously reported [10]. In contrast to the homogenous nature of outfield training, goalkeepers typically engage is position specific technical training. The highest percentage AT% being found amongst goalkeepers may reflect lower physical demands of preparation and match-play.

Hurlers are frequently required to produce high power output with only a brief period of recovery due to the intermittent nature of the sport. The power output is related to the strength of the muscles involved in the movement. Upper-body and lower body muscles are implicated in breaking through an opponent's tackle or contesting possession of the ball in the air or on the ground. The ability to produce this anaerobic component of match-play is expressed in terms of muscular power and sprinting speed. Whilst, no statistically significant differences are expressed, it is evident that a hierarchy exits with the backs, forwards and goalkeepers in the current study performing better than midfield players on a CMJ. When peak power was considered the goalkeepers outperformed their outfield counterparts. Despite variations in body mass a relative homogeneity was evident across the groups in regard of relative peak power. The mean performance on the vertical jump of the hurlers in the current study was inferior to performance of successful Gaelic footballers in other studies [8]. The outfield players possessed superior sprint speed times compared to the goalkeepers, which may be related to the higher body mass of the goalkeepers and the type of training undertaken. Elite hurling players possess faster sprint speeds than their sub-elite counterparts. Doran, Donnelly and Reilly [18] concluded that acceleration over an initial 10-m distance would seem to be a prerequisite of successful elite performance in hurling. Similarities exist between elite hurling and Gaelic football players in 10-m sprint results [8,19].

The only measure that was statistically influenced by playing position was the estimated maximal oxygen uptake. Similar variation in $\dot{V}O_{2max}$ across positional roles in other field games have been reported [7,9]. The midfielders had significantly higher aerobic power values than those of the other positions. The backs and forwards had similar relative values, whilst the goalkeepers possessed the lowest estimated $\dot{V}O_{2max}$. The results suggest that playing position influences the aerobic demands of elite hurling. The squad-based training does not obscure any specific positional adaptations in aerobic fitness and findings would seem related to positional demands. In field sports, a high level of aerobic fitness helps sustain the work rates associated with team play, supporting team-mates, running off the ball, and chasing opponents to regain possession [20]. The training protocols utilized in hurling are typically homogenous in nature and rarely focus on position specific characteristics with the exception of the goalkeeper. The homogeneity of training may be a factor in the high injury occurrence in the second half of match-play (60.8%) [6]. A greater understanding of the position specific physical demands of the game is required.

The estimated $\dot{V}O_{2max}$ values underline the need for a high work-rate in midfield players who link between defense and attack. The current findings are in line with those of McIntyre and Hall [9] who

doi:http://dx.doi.org/10.4172/2324-9080.1000176

found that maximal oxygen uptake of midfield Gaelic footballers (65.8 ± 5 mL·kg^{-1}·min^{-1}) to significantly differ from that of backs and forwards. The $\dot{V}O_{2max}$ of hurlers may be influenced by differences in standard of play and training regimens, the stage of the season should also be considered [3]. Successful hurlers seem to attain higher $\dot{V}O_{2max}$ values (58.9 ± 4.8 mL·kg^{-1}·min^{-1}), than their less successful counterparts (47.4 ± 7 mL·kg^{-1}·min^{-1}) supporting the large contribution from aerobic power to playing the game at the elite level [3,19].

Conclusion

The results of this study demonstrate that few statistically significant anthropometric and performance differences exist amongst hurling players. Where differences are apparent particularly in the aerobic power of midfield players this is likely to be related to the different technical and tactical demands of the position. The identification of positional specific performance characteristics may be useful for targeting, selecting and planning specific training programs that correctly consider the characteristics of the player. Future research should consider if the movement patterns and associated work-rate is position specific. A limitation of the study was the repeated high-intensity/ sprint running performance of the group was not assessed. The Yo-Yo intermittent recovery test has been widely used in many field sports [20] further research should consider the suitability of such a protocol for application to a hurling population.

Practical Implications

- Coaches should consider the normative data outlined when evaluating elite players.
- Coaches should consider the position specific demands when construction conditioning regimen.
- Midfield players need a higher aerobic capacity than other outfield players.

References

1. Brisch R (1977) How did Sports Begin. Longman, London.
2. Gilmore H (2008) The craft of the Caman, A notational analysis of the frequency occurrence of skills used in Hurling. Int J Perform Anal Sport; 8, 68-75.
3. Reilly T, Collins K (2008) Science and the Gaelic sports: Gaelic football and hurling. Eur J Sport Sci 1: 231-240.
4. O' Donoghue PG, Donnelly O, Hughes L (2004) Time-motion analysis of Gaelic games. J Sports Sci; 22: 255-256.
5. Newell M, Grant S, Henry A, Newell J (2006) Incidence of injury in elite Gaelic footballers. See comment in PubMed Commons below Ir Med J 99: 269-271.
6. Murphy JC, Gissane C, Blake C (2012) Injury in elite county-level hurling: a prospective study. See comment in PubMed Commons below Br J Sports Med 46: 138-142.
7. Reilly T, Gilbourne D (2003) Science and football: a review of applied research in the football codes. See comment in PubMed Commons below J Sports Sci 21: 693-705.
8. Reilly T, Doran D (2001) Science and Gaelic football: a review. See comment in PubMed Commons below J Sports Sci 19: 181-193.
9. McIntyre MC, Hall M (2005) Physiological profile in relation to playing position of elite college Gaelic footballers. See comment in PubMed Commons below Br J Sports Med 39: 264-266.
10. McIntyre MC (2005) A comparison of the physiological profiles of elite Gaelic footballers, hurlers, and soccer players. See comment in PubMed Commons below Br J Sports Med 39: 437-439.
11. Reilly T, Brooks GA (1986) Exercise and the circadian variation in body temperature measures. See comment in PubMed Commons below Int J Sports Med 7: 358-362.
12. Durnin JV, Womersley J (1974) Body fat assessed from total body density and its estimation from skinfold thickness: measurements on 481 men and women aged from 16 to 72 years. See comment in PubMed Commons below Br J Nutr 32: 77-97.
13. Reilly T, Maughan R, Hardy L (1996) Body fat consensus statement of the Steering Groups of the British Olympic Association. Sports Exerc Inj 2: 46-49.
14. Atkinson G (2003) What is this thing called measurement error? Kinanthropometry VIII: Proceedings of the 8th International Conference of the International Society for the Advancement of Kinanthropometry (ISAK). Taylor and Francis, London 3-14.
15. Bosco C, Luhtanen P, Komi PV (1983) A simple method for measurement of mechanical power in jumping. See comment in PubMed Commons below Eur J Appl Physiol Occup Physiol 50: 273-282.
16. Sayers SP, Harackiewicz DV, Harman EA, Frykman PN, Rosenstein MT (1999) Cross-validation of three jump power equations. See comment in PubMed Commons below Med Sci Sports Exerc 31: 572-577.
17. Ramsbottom R, Brewer J, Williams C (1988) A progressive shuttle run test to estimate maximal oxygen uptake. See comment in PubMed Commons below Br J Sports Med 22: 141-144.
18. Reilly T, Doran D (2003) Fitness assessment. Science and Soccer. (2ndedtn), E&FN Spon, London.
19. Doran D, Donnelly JP, Reilly T (2003) Kinanthropometric and performance characteristics of Gaelic games players. Kinanthropometry VIII: Proceedings of the 8th International Conference of the International Society for the Advancement of Kinanthropometry, Routledge, London 81-190.
20. Bangsbo J, Michalsik L (2002) Assessment of the physiological capacity of elite soccer players. Science and Football IV, Routledge, London.

Author Affiliation

Top

[1]Department of Science, Institute of Technology Tallaght, Tallaght, Dublin, Ireland

[2]Research Institute for Sport and Exercise Sciences, Liverpool John Moores University, Tom Reilly Building, Byrom Street, Liverpool, L3 3AF, United Kingdom