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Original Research

Eccentric knee flexor strength profiles of 341 elite male academy and senior Gaelic football players: Do body mass and previous hamstring injury impact performance?

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ABSTRACT

Objective: Report eccentric knee flexor strength values of elite Gaelic football players from underage to adult level whilst examining the influence of body mass and previous hamstring injury.
Design: Cross-sectional study.
Setting: Team's training facility.
Participants: Elite Gaelic football players ($n = 341$) from under 14 years to senior age-grades were recruited from twelve teams.
Main outcome measures: Absolute (N) and relative ($N \cdot kg^{-1}$) eccentric hamstring strength as well as corresponding between-limb imbalances (%) were calculated for all players.
Results: Mean maximum force was 329.4N (95% CI 319.5–340.2) per limb. No statistically significant differences were observed in relative force values ($4.4\,N \cdot kg^{-1}$, 95% CI 4.2–4.5) between age-groups. Body mass had moderate-to-large and weak associations with maximum force in youth ($r = 0.597$) and adult ($r = 0.159$) players, respectively. Overall 40% (95 CI 31.4–48.7) presented with a maximum strength between-limb imbalance >10%. Players with a hamstring injury had greater relative maximum force (9.3%, 95% CI 7.0–11.8; $p > 0.05$) and a 28% (95% CI 10.0–38.0) higher prevalence of between-limb imbalances ≥15% compared to their uninjured counterparts.
Conclusions: Overlapping strength profiles across age-groups, combined with greater strength in previously injured players, suggests difficulties for establishing cut-off thresholds associated with hamstring injury risk.

1. Introduction

Gaelic football is a multidirectional, running-based field sport that originated in Ireland. Since 1884, Gaelic football has been governed by the Gaelic Athletic Association (GAA). Presently, there are over 334,000 players with 2600 registered clubs (GAA, 2014). Community clubs represent sub-elite levels of Gaelic football, while select players aged 14 years and upwards are chosen to participate with their county team, representing the elite levels of Gaelic games.

During match-play two opposing teams of 14 outfield players and a goalkeeper play on a grass pitch 145 m long by 90 m wide. The aim is to outscore the opposition at H-shaped goal posts by kicking or striking a round ball over (1 point) or under (1 goal equating to 3 points) a crossbar. Match-play consists of two 30 min periods separated by a 10 min interval, however, at the elite senior level two 35 min periods are played. Shoulder-to-shoulder contact is permitted, yet 68% of injuries are incited by non-contact mechanisms (Murphy et al., 2012).

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Elite underage players (15 ± 0.7 years) run on average 5700 m or 93 m min^{-1} during match-play, with 15% of the total distance performed at high-speed (>17 km h^{-1}) (Reilly, Akubat, Lyons, & Collins, 2015). Additionally, elite senior players run on average 9200 m (131 m min^{-1}) with 18% of the total distance performed at high-speed (Malone et al., 2015). It has been hypothesised that these workrates may contribute to the high incidence of non-contact lower limb injuries in Gaelic football and field sports with similar demands (Roe, Murphy, Gissane, & Blake, 2017). For instance, elite Australian football players covering >653 m at ≥24 km h^{-1} each week are 3.3 times more likely to sustain a hamstring injury compared to their peers (Ruddy et al., 2016).

Hamstring injuries are the most common injury in elite Gaelic football affecting 21% of players per 32 week season (Roe, Murphy, Gissane, & Blake, 2016). An elite Gaelic football squad of 38 players can expect to sustain 9 hamstring injuries per season, each resulting in an average of 26 time-loss days (Roe et al., 2016). Furthermore, following return to sport players with a previous hamstring injury are 230% more likely to sustain a future hamstring injury in comparison to their uninjured peers (Roe et al., 2016). Hamstring injury incidence have been illustrated to be greater among elite Gaelic football players aged 18–20 and ≥ 30 years identifying the need for modifiable risk factors and characteristics across age groups (Roe et al., 2016).

Modifiable risk factors for hamstring injuries have been identified in other elite field sports using metrics derived from eccentric knee flexor strength assessment. For example, in elite rugby union, between-limb imbalances of ≥15% and ≥20% were associated with a relative risk ratio (RR) of 2.4 and 3.4 for future injury, respectively (Bourne, Opar, Williams, & Shield, 2015). Similarly, preseason eccentric knee flexor strength of <256 N was associated with increased injury risk in elite Australian football players (RR = 2.7) (Opar et al., 2015a, 2015b). Conversely, van Dyk et al. (2017) found no association between knee flexor strength and hamstring injury risk in soccer players. Although targeting interventions at players presenting with these characteristics may mitigate hamstring injury risk, the absence of normative data makes it difficult for practitioners to compare a player's characteristics to their peers to individualise interventions (Fox et al., 2014; Chalker et al., 2016). Such data may guide clinical practise in performance-orientated environments where stakeholders seek information for establishing intervention targets (Roe, Malone, 2017; Roe, Murphy, 2017).

Considering that 1-in-5 elite Gaelic football players will sustain a hamstring injury per season, and that metrics derived from assessing eccentric knee flexor strength have been shown to alter risk of injury, it is important that these mechanical characteristics are described. Therefore, the primary aim of the current study was to describe eccentric knee flexor strength in elite male Gaelic football players from under-age to senior level. The secondary aim was to determine the influence of body mass and previous hamstring injury on eccentric knee flexor strength.

2. Methods

A cross-sectional study was designed to measure eccentric knee flexor strength in elite Gaelic football players from under 14 years to senior level.

3. Participants

Players (n = 341; 20.8 yrs ± 6.0; 75.3 kg ± 13.1) were recruited from twelve inter-county male teams. The number of participants varied between age groups: under 14 years (n = 26; 13.6 years ± 0.3; 55.0 kg ± 11.2), under 15 years (n = 33; 14.8 years ± 0.3; 62.6 kg ± 8.7), under 16 years (n = 21; 15.5 years ± 0.5; 68.6 kg ± 8.4), under 17 years (n = 25; 16.5 years ± 0.5; 69.7 kg ± 6.4), under 21 years (n = 88; 20.2 years ± 0.8; 81.6 kg ± 6.7), and senior level (n = 148; 26.6 years ± 3.1; 84.0 kg ± 7.1).

4. Ethical approval and consent

Ethical approval for this study was granted by the Human Research Ethics Committee at the respective university.

5. Procedures

Players were required to complete a questionnaire prior to strength testing to establish their dominant leg and previous injury history. Testing was completed during the preseason or initial competitive cycle of the 2016/17 season. A prototype of the portable strength testing device (Nordbord, Vald Performance, Australia) has previously shown high-to-moderate reliability (intraclass correlation coefficient = 0.83–0.90; typical error, 21.7–27.5 N; typical error as a coefficient of variation, 5.8%–8.5%) (Opar, Piatkowski, Williams, & Shield, 2013). A previously described protocol was utilised for the current study (Opar et al., 2015a, 2015b). That is, following a warm-up set, participants performed one set of three maximal repetitions of the Nordic hamstring exercise on the device. Participants were instructed to gradually lean forward at the slowest possible speed while maximally resisting the fall with both legs and maintaining an upright posture with their spine and pelvis in a neutral position ("stay as tall as you can", "imagine a straight line from your knees to head"). The proprietary software provided instantaneous raw data that were then exported into a customised Microsoft Excel spreadsheet (Microsoft, Redmond, USA). Data relating to maximum force and average force for each leg, as well as between-limb imbalances, were derived from the excel sheet.

6. Analysis

All data were analysed using SPSS (version 21.0; IBM, Inc., Chicago, IL, USA). Descriptive statistics were used to report performance markers per age grade. Data are presented as mean values with 95% confidence intervals (95% CI). The presented strength metrics are the mean between left and right limbs. Quartiles were used to report performance markers across 25th, 50th, and 75th percentile intervals. The maximum and average forces between limbs across all three repetitions were compared to report percentage imbalances. Between-limb imbalances were graded as <5%, ≥5% to <10%, ≥10% to <15%, or ≥15%. Strength metrics were standardised to body mass to report the relative force (N·kg^{-1}) for each player and these were termed relative maximum and relative average force. To compare metrics between age grades, data for each age grade were compared to the mean for all others producing a relative strength ratio. Players with a previous hamstring injury within 12 months prior to testing were compared to their uninjured peers using the mean values for maximum and average force of both limbs. Previous hamstring injuries were stratified according to severity based time-loss as mild (1–7 days), moderate (8–28 days), or severe (>28 days). Return to sport was considered once medical clearance was obtained for full participation in all team training and matches. Maximum force was also investigated following return to play in previously injured players.

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