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Shane Malone

Kieran Collins

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The Influence of Pitch Size on Running Performance and Physiological Responses During Hurling-Specific Small-Sided Games

SHANE MALONE AND KIERAN D. COLLINS

Gaelic Sports Research Center, Department of Science, Institute of Technology Tallaght, Dublin, Ireland

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Abstract

Malone, S and Collins, K. The Influence of pitch size on running performance and physiological responses during hurling-specific small-sided games. *J Strength Cond Res* 31 (6): 1518–1524, 2017—The current study examined how the impact of pitch dimensions influences physiological and running performance during 4-minute small-sided games (SSGs). Twenty-four ($n = 24$) hurling players were monitored with global positioning system and heart rate monitors during the in-season training period. Total distance (in meters), high-speed running distance (in meters) ($\geq$17 km·h^{-1}), very high-speed running distance ($\geq$22 km·h^{-1}) (in meters), total accelerations (n), acceleration distance (in meters), and peak and mean velocity (in kilometers per hour) were calculated. Additionally, SSGs rate of perceived exertion (RPE_{SSG}; AU), % maximum heart rate, and individualized training impulse (iTRIMP; AU) were collected. The current results show that the manipulation of SSGs pitch size has an impact on the running performance and physiological responses. The data showed that SSGs played on large pitches ($SSG_{80 \times 20\ m}$) had greater running demands than medium ($SSG_{60 \times 20\ m}$) or small ($SSG_{40 \times 20\ m}$) pitches, with significantly more distance covered in all movement categories. Total distance covered at high speed was 354 ± 111 m on a large pitch, 254 ± 72 m on a medium pitch, and 198 ± 62 m on a small pitch. Large pitch dimensions resulted in greater physiological and perceptual demands on players (higher $\%HR_{max}$, iTRIMP [AU], and RPE_{SSG} [AU]) compared with medium and small pitches. The current data help applied practitioners to understand further how modifying different aspects of SSGs can alter the running and physiological responses of players. Moreover, applied practitioners now have consistent information to design and optimize their training time in mixing the physical, technical, and tactical elements within specific SSGs pitch dimensions.

Key Words heart rate, GPS, training games, team sport, intermittent activity

Introduction

Hurling is a team sport game played with stick (camán) and ball (sliothar); the skills required to successfully play the game are complex in nature (23,28). This is a high-intensity dynamic team sport where 2 goalkeepers and 14 outfield players compete on an average pitch dimension of 140 m × 88 m with a relative player area of 410 m^2. High catching of the sliothar with one hand is a feature of the game, as is striking it in the air, both skills requiring extraordinary hand-eye coordination (28). The camán can be used to block the ball or to "hook" an opponent attempting to strike it. In essence, hurling constitutes a form of intermittent exercise within which the timing of high-intensity efforts is acyclical following the ebb and flow of the game (28). This is a sport that requires players to engage in high-speed running, rapid acceleration and deceleration movements intertwined with changes of directions, jumping, and body contacts. These patterns of play are likely to contribute to the observed high levels of physiological load and energetic expenditure experienced by players during competitive match play (23,28).

Small-sided games (SSGs) provide an alternative methodology of training to traditional training methods within team sports such as hurling (6,16). Indeed, anecdotally these games represent a major component of the training process within hurling, with many teams using these drills for fitness and skill-based improvements in performance. Within SSGs training, it is common to manipulate the pitch area to achieve certain technical, tactical, and physiological adaptations. Indeed, this methodology of training is often regarded as a more time-efficient mode of training as it incorporates technical, tactical, and physical aspects while still including the ball (29,30), a factor that increases player motivation and sport specificity (13). In other field sports, such as soccer, the influences on physical and physiological demands in SSG have been investigated thoroughly; however, within hurling,

Address correspondence to Shane Malone, shane.malone@mymail.ittdublin.ie.

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there is a lack of in-depth understanding of these training methodologies (28).

Studies from other field sports have concluded that the manipulation of pitch dimensions and formats can elicit different physiological and perceptual responses as well as running profiles (8,13,17,19). Moreover, it has been reported that by altering pitch size, coaches can regulate athlete effort intensity during SSG (7,27). Accordingly, when the ratio of the playing area and number of players is increased, exercise intensity increases linearly (27). The explanation for which may be linked to an increase in the relative playing area of each player, which means more displacement and movements with higher speed. Previously, Rampinini et al. (27) and Casamichana and Castellano (4) observed significant differences in heart rate (HR) responses between SSGs played on pitches with different dimensions. Higher HR values were reported during SSGs played on large pitch dimensions when compared with medium- and small-sized pitch dimensions. However, the differences observed in these studies were relatively small. Indeed, well-controlled interventions by Kelly and Drust (18) comparing HR responses and technical demands of 5v5 SSGs played on small, medium and large pitches showed no difference in the HR profiles across varying pitch dimensions. In general, small-to-moderate variations in physiological and running performance variables have been observed when altering the pitch dimension of the same SSG format (1). However, many of these investigations have taken place in sports that are far removed from hurling with regard to player movement patterns and ball movement patterns. Indeed, within hurling, the ball can travel at 100 $m \cdot s^{-1}$ (28), thus impacting the physical and physiological dynamic within the confined spaces that are often prescribed for SSGs.

The advancement of technology now permits the assessment of running performance within training drills through the utilization of global positioning system (GPS) (3,14). These systems have been deemed valid for use within intermittent exercise (3,22). In this regard, recent investigations have revealed that larger game formats are associated with a greater range of total distances and higher maximum speeds; these findings have been mostly related to relative player area (3). However, despite extensive research, there is still a lack of understanding as to running performance-related information on typical SSG used by coaches in the hurling training process. Of particular interest is the crucial running components taxed during these games especially across different pitch dimensions. The unpredictable nature of SSG allows for explosive actions and changes in velocity that impacts the quantification of running and physiological performance during these games. Therefore, insight as to the mechanisms taxed and the physiological strain is warranted in specific hurling-type SSG to best aid practitioners in the application of these games within the hurling training process. Given the above information, the aim of the current investigation was to provide insight as to the impact that different pitch dimensions have on standardized hurling SSG with respect to running and physiological performance. It was hypothesized that larger pitch dimensions with larger relative player areas would result in higher running and physiological demands for players.

Methods

Experimental Approach to the Problem

One week before the start of the observational period, all players' anthropometric measurements and fitness characteristics were obtained. Height was measured to the nearest 0.1 cm using a free standing stadiometer, and body mass was determined to the nearest 0.1 kg on digital scales (Seca 702; Seca GmbH, Hamburg, Germany). All measurements were obtained using portable measurement devices and standardized laboratory procedures. Calibrated precision weighing scales (Seca Medical Measuring Systems, Birmingham, United Kingdom) were used to obtain body mass. Additionally players completed a Yo-Yo intermittent recovery test level 2 to obtain cardiovascular fitness and players' individual HR maximum.

During the observational period, a total of 1,560 individual SSGs drill observations were undertaken on outfield players with a median of 65 observations per player (range: 10–65). Three different dimension formats of SSGs were observed during the study period: $SSG_{40 \times 20 m}$ (player observations, $n = 520$), $SSG_{60 \times 20 m}$ (player observations, $n = 520$), and $SSG_{80 \times 20 m}$ (player observations, $n = 520$). The player numbers (4 vs. 4) and game rules were the same for each pitch dimension. The game rules were the following: the objective of the game was to keep possession and score in a designated end-zone area at the end of each pitch. Teams were selected based on player position to best replicate the man marking nature of competitive match play hurling. Each drill was performed in a randomized continuous manner within every training session during the observational period. Therefore, drills were not performed in the same order within every session to best counteract ordering effects on the physical and physiological data collected. During each SSGs, full competition rules applied. Additionally, each SSGs was completed under the supervision and motivation of coaches to keep the running performance of players high during SSG (27). During SSGs, multiple replacement balls were available by prompt replacement when hit out of play (4,5). Before the study period, SSGs were frequently performed by players in a number of sessions ($n = 20$) to ensure familiarization to the aims and objectives of the specific SSGs. All sessions were performed on the same pitch. In addition, all exercise games were performed at the same time during the day (6 PM to 8 PM) to limit to effects of circadian variations on measured variables (10). All SSGs were completed after a standardized warm-up of 20 minutes containing both technical and dynamic movements. Specifically at the start of the warm-up, players engaged in elements of dynamic stretching and low-intensity running. Players were then split into groups of 6 and completed 6 repeated shuttles

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over 45 m to expose players to maximal speed. After this, players began technical elements of the warm-up, specifically this included conditional elements with regard to the number of ball touches authorized per individual in possession, which was fixed for a period (from 1 touch to 6 touches). Finally, players engaged in a small element of free play within a condensed pitch of 20 × 20 m for 3 minutes. During this observational study, all games were standardized by time (4 minutes in length) with a 1 to 1 work-to-rest ratio used during all training sessions for these games. During the study period, an average of 6 repetitions of the SSGs were completed (range, 3–8 repetitions). During the SSGs, all players wore GPS (VXsport, New Zealand, Lower Hutt, Issue: 330a, Firmware: 3.26.7.0) and HR belts (Polar Team Sport System; Polar Electro Oy, Kempele, Finland) to best assess players' running and physiological performance during the SSG. During rest periods, the players were allowed to drink fluids "ad libitum." All the participants were advised to maintain their normal diet, with special emphasis being placed on a high intake of water and carbohydrates.

Subjects

Twenty-four hurling players competing at the top level of club hurling and who had recently won a championship (age 25.5 ± 3.2 years; height 181.9 ± 3.2 cm; body mass 81.5 ± 4.5 kg) volunteered for the study during the competitive period of the 2014 season. All players were notified of the aims and objectives of the study, research methods, requirements, benefits, and risks before giving written informed consent. The study was approved by the institutional ethics committee.

Running Performance Measurement During SSG. During all SSGs, participants wore an individual GPS unit (VXsport, Issue: 330a, Firmware: 3.26.7.0), sampling at 4 Hz and containing a triaxial accelerometer and magnetometer in all training sessions. The GPS unit (mass: 76 g; "48 mm" × "20 mm" × "87 mm") was encased within a protective harness between the player's shoulder blades in the upper thoracic-spine region. Fifteen minutes before the commencement of training, the GPS device was turned on and fixed to the athlete, to establish a satellite lock (21). The validity and reliability of this device has previously been communicated (3,22). Specifically, the VX Sport GPS unit has been examined by Malone et al. (22) for accuracy and reliability during intermittent activity. Test-retest (7 days apart) reliability for total distance covered, maximum speed, and average speed was quantified. Systematic differences were examined using a paired *t*-test on the test-retest data and revealed no significant differences for the total distance covered (300.5 ± 3.3 m; 303.6 ± 5.6 m), maximum speed (23.9 ± 1.9 $km \cdot h^{-1}$; 24.1 ± 1.3 $km \cdot h^{-1}$), and average speed (10.2 ± 1.0 $km \cdot h^{-1}$; 10.2 ± 0.9 $km \cdot h^{-1}$). The typical error (TE ± 95% confidence interval [CI]) was 0.84 ± 0.3 m for total distance covered, 0.75 ± 0.26 $km \cdot h^{-1}$ for maximum speed, and 0.55 ± 0.19 $km \cdot h^{-1}$ for average speed, respectively. The coefficient of variation (CV% ± 95% CI) was 1.0 ± 0.4% for the total distance covered, 4.2 ± 1.5% for maximum speed, and 4.4 ± 1.5% for average speed, respectively. The number of satellites for GPS was satisfactory during all sessions: range = 7–12, with an average of 9.5 ± 3 satellites per training, respectively. The horizontal dilution of position, which is a reflection of the geometrical arrangement of the satellites and is related to both the accuracy and the quality of the signal, was not collected, which is a limitation of the current study. Proprietary software provided instantaneous raw velocity data at 0.25-second intervals, which was then exported and placed into a customized Microsoft Excel spreadsheet (Microsoft, Redmond, WA, USA). The spreadsheet allowed analysis of distance covered (in meters) and speed calculated (in kilometers per hour) in the following categories: total distance, high speed running distance ($\geq$17 $km \cdot h^{-1}$), very high speed running distance ($\geq$22 $km \cdot h^{-1}$), and peak velocity (in kilometers per hour). The software allowed for the calculation of number of accelerations lasting 1 second ($\Delta t = 1$ s). The number of moderate (2–3 $m \cdot s^{-2}$) and high (>3 $m \cdot s^{-2}$) accelerations was recorded, along with total ($\geq$1 $m \cdot s^{-2}$) acceleration distance covered (14).

Physiological Performance Measurement During SSG. Physiological performance during SSGs was assessed on the basis of HR analysis (11), which was recorded every 5 seconds using a telemetric device (Polar Team Sport System; Polar Electro Oy). The HR maximum (HR_{max}) of each player was determined by means of the Yo-Yo intermittent recovery test level 2 (Yo-YoIR2) (2). The mean HRs (HR_{mean}) for each SSGs were recorded and expressed as a percentage of individual maximum to provide an indication of the overall intensity of the SSG in relation to the mean and maximum HR obtained in the Yo-YoIR2 (HR_{mean} and $\%HR_{max}$). The coefficient of variation of HR responses ($\%HR_{max}$) during small-sided games has been reported as 1.3–4.8% (20,27). Immediately after SSGs, each player was asked to manually register a rate of perceived exertion (RPE_{SSG}) value using the Borg scale (CR-10), which was printed on paper and used to help the players rate their exertion levels during the period (8). The reliability of RPE has been previously reported (13), with the TE expressed as a percentage of the mean (TE%) being 1–2 units. In addition to HR and RPE analysis, the individualized training impulse (iTRIMP) of the SSGs was calculated for each player as previously reported by Manzi et al. (24).

Statistical Analyses

All analyses were conducted using statistical software (SPSS, Version 22.0.0.0; IBM Corporation, Chicago, IL, USA). Assumptions of normality were verified by using a Shapiro-Wilk test. Data are presented as mean ± *SD* with 95% confidence limits. A repeated-measures analysis of variance was performed to understand the main effect of format type ($SSG_{40 \times 20\ m}$, $SSG_{60 \times 20\ m}$, or $SSG_{80 \times 20\ m}$) on the running and physiological parameters between SSGs drills. Significant

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Table 1. The distance, speed, and physiological parameters calculated during different pitch dimensions of SSGs.*†

	40 × 20 m (small)	60 × 20 m (medium)	80 × 20 m (large)
Relative player area per pitch dimension (m^2)	100	150	200
Player numbers	4 vs. 4	4 vs. 4	4 vs. 4
Running performance variables			
Peak velocity ($km \cdot h^{-1}$)	27.8 ± 1.4 (27.4–28.2)	28.1 ± 1.8 (27.4–28.9)‡	32.1 ± 1.1 (30.1–32.5)§
Total accelerations (n)	10 ± 4 (8–14)	16 ± 6 (14–20)‡	35 ± 10 (35–45)§
High accelerations (n)	4 ± 3 (3–6)	6 ± 4 (5–10)‡	15 ± 10 (15–21)§
Moderate accelerations (n)	6 ± 5 (3–8)	10 ± 8 (8–15)‡	20 ± 12 (19–21)§
Acceleration distance (m)	47 ± 25 (35–50)	81 ± 45 (75–110)‡	101 ± 56 (75–125)§
Physiological variables			
iTRIMP (AU)	33 ± 25 (25–50)	44 ± 34 (27–62)‡	65 ± 44 (30–85)§
Exercise intensity (% HR_{max})	86 ± 3 (80–88)	90 ± 3 (89–93)‡	98 ± 4 (95–100)§
HR_{mean} ($b \cdot min^{-1}$)	164 ± 14 (152–167)	178 ± 17 (169–176)‡	187 ± 13 (180–190)§
RPE_{SSG}	4.3 ± 2.1 (3.2–6.1)	6.1 ± 2.2 (4.5–8.4)‡	8.8 ± 1.3 (7.1–9.2)§

*iTRIMP = individualized training impulse; HR = heart rate; %HR_{max} = presented as a percentage of maximum on a Yo-YoIR2; RPE_{SSG} = specific SSG rating of perceived exertion; SSG = small-sided game.

†All data are scaled to 4-minute durations to represent within SSG parameters. Data are presented as mean ± *SD* (95% CI). Moderate accelerations (*n*; >2–3 $m \cdot s^{-1}$); high accelerations (*n*; >3 $m \cdot s^{-1}$).

‡Significant difference between small and medium pitch dimensions ($p \leq 0.05$).

§Significant difference between small and large pitch dimensions ($p < 0.001$).

main effects and interaction between factors were followed up with a least significant difference post hoc analysis (26). Statistical significance was set at $p \leq 0.05$. To make inferences about true values of the difference in the physical and physiological performance qualities of each pitch dimension, Cohen effect size (*d*) was reported. The uncertainty was expressed as $d \pm 95\%$ confidence limits. Effect sizes of <0.2, 0.2–0.6, 0.6–1.2, and 1.2–2.0 were considered trivial, small, moderate, and large, respectively (15).

Results

Selected physiological performance variables are reported as mean ± *SD* (95% CI) in Table 1. Players' average HR_{max} during the Yo-YoIR2 was 191 ± 8 $b \cdot min^{-1}$. During SSGs, HR responses were higher on large pitch dimensions when compared with all other dimensions, respectively ($SSG_{80 \times 20 m} > SSG_{60 \times 20 m} > SSG_{40 \times 20 m}$; $p = 0.004$; $d = 1.93 \pm 0.61$; large). The large pitch dimensions resulted in higher individual physiological responses and

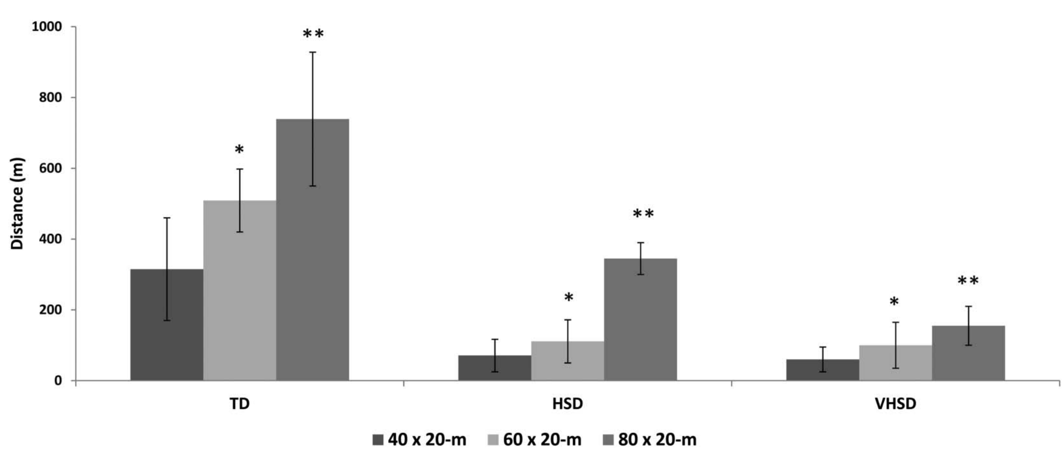

Figure 1. The total distance (in meters), high-speed running distance (in meters; ≥17 $km \cdot h^{-1}$), and very high-speed running distance (in meters; ≥22 $km \cdot h^{-1}$) covered during different dimensions of SSG. Data are representative of 4-minute SSG with 4 vs. 4 players. Data reported as mean ± *SD*.

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perceptual responses observed for iTRIMP ($SSG_{80 \times 20\ m}$ > $SSG_{60 \times 20\ m}$ > $SSG_{40 \times 20\ m}$; $p = 0.002$; $d = 2.67 \pm 0.41$; large) and RPE measures ($SSG_{80 \times 20\ m}$ > $SSG_{60 \times 20\ m}$ > $SSG_{40 \times 20\ m}$; $p = 0.04$; $d = 0.54 \pm 0.21$; small). Large main effects ($SSG_{60 \times 20\ m}$ > $SSG_{40 \times 20\ m}$; $p = 0.001$; $d = 1.83 \pm 0.91$, large) were observed for medium pitch dimension when compared against small pitch dimensions. Running performance for each pitch dimensions is reported in Table 1 and Figure 1. The larger pitch dimensions showed higher running performance for all variables measures. During SSGs, the total distance covered were 315 ± 89 (226–404) m, 509 ± 145 (364–654) m, and 739 ± 189 (550–928) m corresponding to a relative distance of 79 ± 22 (57–101) $m \cdot min^{-1}$, 127 ± 36 (91–163) $m \cdot min^{-1}$, and 185 ± 46 (139–231) $m \cdot min^{-1}$ for small, medium, and large pitch dimensions, respectively ($SSG_{80 \times 20\ m}$ > $SSG_{60 \times 20\ m}$ > $SSG_{40 \times 20\ m}$; $p = 0.03$; $d = 3.13 \pm 0.91$, very large). Very large main effects were observed for high-speed distance ($SSG_{80 \times 20\ m}$ > $SSG_{60 \times 20\ m}$ > $SSG_{40 \times 20\ m}$; $p = 0.003$; $d = 2.73 \pm 0.91$, very large) and very high-speed running distance ($SSG_{80 \times 20\ m}$ > $SSG_{60 \times 20\ m}$ > $SSG_{40 \times 20\ m}$; $p = 0.004$; $d = 1.73 \pm 0.91$, large), respectively, for larger pitch dimension resulting in higher running performance (Table 1). Finally, differences in the total distance covered in acceleration ranges were observed with distances being higher on large and medium pitches when compared with smaller pitch dimensions ($SSG_{80 \times 20\ m}$ > $SSG_{60 \times 20\ m}$ > $SSG_{40 \times 20\ m}$; $p = 0.003$; $d = 0.93 \pm 0.21$, large).

Discussion

The current investigation sought to characterize the running and physiological demands of different pitch dimensions in SSGs training. The study is the first to quantify these variables within hurling; additionally, the investigation quantified the acceleration demands of SSGs, thus providing an explanation for the well-documented efficacy of this training methodology in team sports for eliciting improvements in fitness of team sport players (13). In line with other studies (7,27), the current investigation found that for the same game format of SSGs, an increase in the individual playing area led to a concomitant increase in the running and physiological demands and ratings of perceived exertion. This was reflected in small pitch dimensions ($SSG_{40 \times 20\ m}$) being characterized by reduced running performance and physiological demand as highlighted by reduced distances and HR responses. Furthermore, medium pitch dimensions ($SSG_{60 \times 20\ m}$) seem to provide similar relative running demands to that of match play. Interestingly, large pitch dimensions ($SSG_{80 \times 20\ m}$) are characterized by a higher running and physiological demand. These data ultimately have important implications for coaches and practitioners using SSGs as a conditioning stimulus in hurling, as the data are the first to report consistent information on SSG demands in a hurling-specific training environment.

With regard to running performance, large pitch dimensions result in higher running volume with large to very large effects reported between small to large pitch dimensions for total distance ($p = 0.03$; $d = 3.13 \pm 0.91$, very large), high-speed running distance ($p = 0.003$; $d = 2.73 \pm 0.91$, very large), and very high-speed running distance ($p = 0.004$; $d = 1.73 \pm 0.91$, large). Additionally players covered more distance during acceleration movements in larger dimensions when compared with medium and small pitch dimensions. These data support previous findings in soccer (27) and handball (7) that shows as player area is increased, players cover more distance during SSGs; however, it should be noted that not all SSGs studies show these results (18). With respect to maximum velocity, the lowest values were reported on smaller pitch dimensions, something that needs to be taken into account when proposing training drills. The current data support previous findings in soccer that have shown that relative pitch area is an important factor for consideration by applied practitioners to best allow players to express maximal velocity characteristics during SSGs (4,5). Previously, Malone et al. (23) have reported that total relative match play running was 120 $m \cdot min^{-1}$, with 24 $m \cdot min^{-1}$ covered at high speed (≥17 $km \cdot h^{-1}$). Interestingly, medium pitch dimensions ($SSG_{60 \times 20\ m}$) seemed to provide similar total relative running demands (127 $m \cdot min^{-1}$) and similar relative high-speed running demands (27 $m \cdot min^{-1}$) to that of match play during this study; therefore, coaches should be aware of the possible efficiency of this dimension for replication of match play scenarios.

Interestingly, similar trends were reported for exercise intensity as measured by HR, with large pitch dimensions reporting the highest relative intensity when compared with medium and small pitch dimensions. The percentage of HR_{max} for players during SSG play ranged from 86% HR_{max} on the small pitch to 98% HR_{max} on the large pitch; these figures are also close to those required to improve oxygen consumption ($\dot{V}O_2max$) (90–95% HR_{max}) (16) and the anaerobic threshold (85–90% HRmax). Similar to the findings of Collins et al. (6) for Gaelic football, it seems that the SSGs used in the current study may be useful for improving the aerobic endurance capacity of hurling players. Additionally, the values reported in this study are in contrast with previous studies by Rampinini et al. (27) (87–91% HR_{max}), Kelly and Drust (18) (89–91% HR_{max}), Casamichana and Castellano (4) (93–95% of HR_{max}), and Hodgson et al. (14) (86–87% HR_{max}), which found no effect for pitch dimension on HR measures. The current study is the first to highlight the sensitivity of iTRIMP to SSGs pitch dimension change. As such, this study provides ecological validity for the measure as a method to monitor player responses to training drills. The data have shown that the manipulation of pitch dimensions have an impact on the internal physiological stimulus of SSGs, highlighted by significant changes in iTRIMP (AU) measures across the varying SSGs pitch dimensions. The data reported for internal responses in the current study

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are similar to data previously reported for rugby league players (31); the data suggest that iTRIMP (AU) is sensitive to change within the high-intensity hurling-specific SSGs environment, and the data may provide further credence for the use of iTRIMP (AU) within team sport environments.

Further analysis of perceptual demands using RPE_{SSG} showed greater perceptual effort by players during SSGs on larger pitch dimensions when compared with medium or smaller dimensions. These differences underlined a general trend for an increase in physiological demands with an increase of pitch dimension. Similar results were also reported in previous studies monitoring SSGs in soccer, with lower RPE values corresponding to smaller pitch dimensions (4,27). The linear increase of the RPE, in conjunction with the linear rise in HR as pitch area increased, is in agreement with previous studies conducted in a number of team sports (8,9,12,18) and highlights the value of RPE as a global indicator of exercise intensity within team sports. Nevertheless, a full in-depth comparison between studies has to be made carefully because of the differences in experimental procedures and sport types.

The use of a 4-Hz system has attached with it a degree of error for capturing the acceleration demands in confined spaces, such as those used in SSG (3). The current study has been unable to distinguish between acceleration movements commencing from different speeds, which have different mechanical and physiological consequences (25). Although it has not been possible to accurately characterize the incidence of different starting speeds, by reporting the distance covered in acceleration ranges (as opposed to time), the investigation has been able to proportionately discriminate between acceleration movements at high and low speeds. Thus, although the current study provides novel information to coaches, there still remains scope to more accurately quantify the running demands imposed on hurling players in training. The current data showed that as the relative player area was increased, players covered more distance during acceleration-type movements, with players covering more distance on large pitch dimensions when compared with other dimensions. Future research needs to further understand the technical component of hurling specific SSGs while also further analyzing the contextual factors of SSGs, such as winning or losing during competitive SSGs.

Practical Applications

The current study provides novel data on the running and physiological demands of SSGs in hurling and further support for the assessment of the acceleration demands within this mode of training. The distances covered during running movements within SSGs are relatively higher than match play for hurling players, supporting the use of SSG as a training tool in the sport. Manipulation of pitch dimensions can impact both the physical and the physiological demands of SSGs. A medium pitch dimension seems optimal, in that it imposes physiological and physical demands similar to that of match play. With regard to the periodization of these games for hurling coaches, it seems from the current data that large pitch dimensions can be used to increase the physical and physiological demands placed on players, allowing players to cover increased distance with higher physiological demands. Large pitch dimensions may be used with the aim of integrating both fitness and technical components for players at certain stages during the competitive season for coaches. Small dimensions, although having reduced physical and physiological demands, can be used as games for preparation and recovery, to ensure players are not over exposed to high running and physiological demands before and after competitive matches. Practitioners can now use the data presented here to more accurately prescribe appropriate hurling-specific training stimuli for players during the competitive season.

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