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Ball possessions and game rhythm in basketball games involving players with and without intellectual impairments

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Abstract

Background Ball possessions and game rhythm are promising variables to better understand teams' collective behaviour during a basketball game. However, the role of these variables is not well documented in teams with intellectual impairments (II). This study aimed to explore ball possession and game rhythm differences between II and non-II basketball games.

Methods Data were obtained through video observations (53 II games) and the International Basketball Federation records (53 non-II games).

Results Independent *t*-tests ($P \leq 0.05$) revealed that the number of ball possessions was higher and game rhythm was faster in II games. Two-way repeated-measures analysis of variance ($P \leq 0.05$) showed that ball possessions and game rhythm developed differently throughout the II games compared with the non-II games.

Conclusions The differences may be due to the decision-making, tactical and self-regulatory limitations of players with II. These limitations adequately explain why players with II respond differently to the environmental cues and monitor insufficiently their actions compared with players without II. Additionally, the higher number of ball possessions and the faster game rhythm in II games could be an indicator of more intuitive, and thus faster, game-related decision-making. In conclusion, the study provides further understanding of the role of cognition in basketball and contributes to better explain the differences between II and non-II games.

Keywords decision-making, intellectual disabilities, pacing, self-regulation, team sports

Introduction

To shed some light on how intellectual impairments (II) impact basketball performance and develop evidence-based classification relevant to Paralympic sports (Tweedy & Vanlandewijck 2011), there has been a growing interest in research of basketball for people with II (Pinilla *et al.* 2016; Polo *et al.* 2017). Individuals with II experience critical limitations in intellectual function (IQ ≤ 75) and in adaptive behaviour, which manifest themselves before the age of 18 [American Association on Intellectual and Developmental Disabilities (AAIDD) 2010].

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Moreover, this population is dealing with sports-specific cognitive limitations, which impact their performance (Van Biesen *et al.* 2016).

In basketball settings, ball possession is defined as the time a basketball team gains possession of the ball until they score, commits a violation or loses the ball (Oliver 2004) while game rhythm can be expressed based on the average ball possessions of the two opponent teams within a basketball game (Sampaio *et al.* 2010; Csátaljay *et al.* 2011). The relationship between ball possessions and game rhythm is complementary. Ball possessions provide information about each team's collective behaviour (team variable) and are related to game-related statistics and performance (Pelton 2008). On the other hand, game rhythm takes into consideration both teams' collective behaviour and interaction within a game (game variable), but it does not directly relate to performance (Oliver 2004; Sampaio *et al.* 2010; Csátaljay *et al.* 2011). During a ball possession, players must work collectively, make appropriate decisions and adequately regulate their actions (Tamminen & Crocker 2013; Renfree *et al.* 2015). Teamwork is an essential component of success when a basketball team gains ball possession, as collective behaviours like defensive assertiveness (Pelton 2008; Sampaio *et al.* 2010), screens (Courel-Ibáñez *et al.* 2017) and inside passes (Courel-Ibáñez *et al.* 2016) are most common in successful teams. However, collective behaviours, decision-making and self-regulation are impaired in people with II (AAIDD 2010; Van Biesen *et al.* 2016; Pinilla *et al.* 2017; Polo *et al.* 2017; Khudair *et al.* 2021). This could lead basketball players with II to pace their actions and respond to environmental cues differently within a basketball game compared with players without II (Micklewright *et al.* 2017; Pinilla *et al.* 2017; Khudair *et al.* 2021; Sakalidis *et al.* 2021). However, more research is needed, as there is a lack of evidence on the influence of II on basketball's ball possessions and game rhythm. To our knowledge, only the study of Pinilla *et al.* (2017) investigated ball possession differences between teams with and without II, and the results revealed that ball possessions are higher in games of basketball teams with II. It is worth mentioning though that this study did not take into consideration the game rhythm variable, did not explore if the ball possession metric used in non-II games (Oliver 2004) is appropriate in II games and did not also investigate the differences in how II and non-II teams pace their ball possession and game rhythm throughout the game. A more thorough investigation will provide a better understanding of the role of II in basketball and will elucidate the basketball performance differences between II and non-II teams.

Thus, with a purpose to expand upon the basketball team performance differences between II and non-II games, the current study aims to explore the influence of ball possessions on games' outcome (II and non-II games) and to better understand how ball possessions and game rhythm develop over the course of a basketball game in both populations. Previous research has suggested that ball possessions may not directly predict match success in team sports (Wang *et al.* 2022). Moreover, the concept of ball possessions in basketball refers to the time a team holds the ball until they score, commits a violation or loses possession (Oliver 2004). Based on this, we hypothesise that (1) ball possessions between the opponent teams (winning and losing teams) will be similar in both II and non-II games. Moreover, (2) II games will have a significantly faster game rhythm and will demonstrate more ball possessions compared with non-II games. It is also expected that (3) ball possessions and game rhythm will be distributed differently within the game between II and non-II basketball games (per quarter). Through the comprehension of how II impacts basketball variables, we will gain a better insight into the role of cognition in basketball-specific decision-making and performance. This is critical for creating an inclusive basketball environment, as it can facilitate the development of more tailored coaching strategies that are adapted to each player's needs and cognitive abilities, provide fair competition opportunities, re-introduce players with II in elite competitions (e.g. Paralympics), and foster positive attitudes towards people with II (Tweedy & Vanlandewijck 2011; Pérez-Tejero *et al.* 2020). As it is the responsibility of an inclusive society to ensure that persons with II can participate and compete in the sport activity of their choice and master their sport-related skills (Misener & Darcy 2014), utilising this knowledge becomes essential. Coaches, who may be struggling to offer appropriate sport experiences to players with II (Sakalidis *et al.* 2023), could use this knowledge to provide more appropriate training experiences to

people with II and successfully include and train basketball players with and without II together (Pérez-Tejero *et al.* 2020).

Methods

Participants and procedures

Ball possessions are calculated by the Turcoliver equation (validated through video observations): ball possessions = (field goals attempted) − (offensive rebounds) + (turnovers) − 0.4 × (free throws attempted) (Turcoliver 1991; Oliver 2004). Additionally, game rhythm can be expressed based on the average ball possessions of the two opponent teams (Sampaio *et al.* 2010; Csátaljay *et al.* 2011). Thus, game-related statistics data (field goals attempted, offensive rebounds, turnovers and free throws attempted) were collected and ball possession and game rhythm data were calculated based on the earlier equations (Oliver 2004; Sampaio *et al.* 2010).

The game-related statistics data for II games were obtained through video observations from the Virtus Games (5 × 5) in Ankara, Turkey (2013), Guayaquil, Ecuador (2015), Loano, Italy (2017), and Brisbane, Australia (2019), as the four top international competitions for II basketball worldwide. Teams that participated in Virtus games were consisted of basketball players with II (men) and played 53 games in total (22 teams, 223 players) as Virtus is the international organisation of sport of people with II. The IQ of the players with II was Mdn = 62 (inter-quartile range = 12). Basketball players with II met the criteria for diagnosis of II as set by the AAIDD (2010): intellectual functioning impairment (IQ ≤ 75), adapted behaviour limitations and evidence of the impairment during the developmental period of individual (before the age of 18; AAIDD 2010). All players followed the Virtus federation eligibility process (provision of evidential requirements); thus, they were eligible to participate in Virtus competitions as they fulfilled the AAIDD (2010) criteria. Additionally, game-related statistics data (field goals attempted, offensive rebounds, turnovers and free throws attempted) were collected through open-access official International Basketball Federation (FIBA) play-by-play records for the FIBA U18 European Championships (non-II games; men) in Samsun, Turkey (2016), Bratislava, Slovakia (2017), Liepāja, Riga and Ventspils, Latvia (2018), and Volos, Greece (2019), and ball possession and game rhythm data were calculated. The researchers obtained ball possession and game rhythm data from 53 games in total (31 teams, 372 players). We chose U18 non-II teams as they are more comparable in terms of training volume, training age and sports-specific cognitive abilities with II teams than adult non-II teams (Pinilla *et al.* 2017). For instance, while U18 players and players with II differ in terms of cognitive development, specific cognitive abilities that are critical in basketball, like attention and problem solving, are still underdeveloped in U18 players but more advanced in adult players (Sakalidis *et al.* 2021). Additionally, even if previous studies showed that there are basketball performance differences between II teams and U16 non-II teams (Pinilla *et al.* 2015, 2017), the comparison with U18 non-II teams may offer less variability in the analysis, increase the precision of statistical estimates and improve interpretability (Pinilla *et al.* 2017). This study was based on secondary data (already collected data from another institution and/or data that were available online). Ethics approval was not required, but the authors ensured that the data were de-identified, that participants' consent reasonably presumed and that the use of these data did not cause any damage or distress. All data were gathered by one researcher. Two weeks later, the researcher randomly selected two games per competition to test the intra-rater reliability. Additionally, with a purpose to explore the inter-rater reliability, the data from eight random games were gathered from different observers and compared with the researcher's data. The results showed excellent intra-rater and inter-rater reliability (kappa above 0.88) for all the ball possession data (Landis & Koch 1977; Mchugh 2012).

Statistical analysis

To test our first (winning teams will demonstrate non-significant ball possessions than the losing teams in II and non-II games) and second hypotheses (II games will have more ball possessions and will demonstrate a significantly faster game rhythm compared with non-II games), an independent *t*-test was used (two analyses). Moreover, with a purpose to investigate our third assumption that ball possessions and game rhythm will be distributed differently within the game for basketball teams with and without II, a

two-way repeated-measures analysis of variance (ANOVA) was used (two analyses). Quarters of the game were considered as the within-subjects factor while the type of population as the between-subjects factor. A Bonferroni correction test was also used to determine significant group differences if the two-way repeated-measures ANOVA yielded any significant results. When the assumption of sphericity was violated (according to Mauchly's test of sphericity), the Greenhouse–Geisser correction was applied to adjust the results. Partial eta squared (η^2) was also calculated with the following values interpretation: small = 0.01, medium = 0.06 and large = 0.14 (Cohen 1988). The statistical analysis was performed on SPSS v.26.0, and the level of significance was set at $P \leq 0.05$. Prior to the data analysis, a log-scaling normalisation technique was applied to all values.

Results

The first two independent *t*-tests showed that there are no significant ball possession differences between the winning [$M = 1.82$, standard deviation (SD) = 0.06] and losing conditions ($M = 1.83$, SD = 0.08) in II games, $t(104) = -1.15$, $P = 0.25$, nor a significant difference between the winning ($M = 1.16$, SD = 0.05) and losing conditions ($M = 1.17$, SD = 0.05) in non-II games, $t(104) = -1.25$, $P = 0.21$. Moreover, the other two independent *t*-tests showed that II games have

Table 1 Descriptive statistics of ball possession and game rhythm variables over different time periods of the games for (1) II teams and (2) non-II teams

Variable	Source	Game rhythm	*N*	Min.	Max.	*M*	SD
Ball possessions	II teams	1st quarter	106	1.03	1.43	1.23	0.09
		2nd quarter	106	0.87	1.49	1.21	0.11
		3rd quarter	106	0.81	1.43	1.20	0.11
		4th quarter	106	0.98	1.46	1.22	0.09
		1st half	106	1.33	1.75	1.52	0.08
		2nd half	106	1.27	1.70	1.52	0.08
		Whole game	106	1.61	2.03	1.82	0.07
	Non-II teams	1st quarter	106	0.94	1.35	1.17	0.09
		2nd quarter	106	0.85	1.37	1.17	0.10
		3rd quarter	106	0.88	1.33	1.16	0.09
		4th quarter	106	0.53	1.36	1.11	0.12
		1st half	106	1.27	1.63	1.48	0.06
		2nd half	106	1.15	1.61	1.45	0.08
		Whole game	106	1.58	1.89	1.76	0.05
Game rhythm	II teams	1st quarter	53	1.10	1.41	1.23	0.07
		2nd quarter	53	1.04	1.45	1.22	0.09
		3rd quarter	53	0.89	1.42	1.20	0.09
		4th quarter	53	1.02	1.42	1.23	0.08
		1st half	53	1.39	1.70	1.52	0.07
		2nd half	53	1.28	1.66	1.52	0.07
		Whole game	53	1.67	1.94	1.82	0.06
	Non-II teams	1st quarter	53	1.05	1.31	1.18	0.06
		2nd quarter	53	0.97	1.32	1.17	0.07
		3rd quarter	53	1.01	1.27	1.17	0.06
		4th quarter	53	0.81	1.29	1.12	0.09
		1st half	53	1.37	1.59	1.48	0.04
		2nd half	53	1.26	1.56	1.45	0.05
		Whole game	53	1.65	1.85	1.77	0.04

II, intellectual impairment; *M*, mean; Max., maximum value; Min., minimum value; *N*, number of items (game rhythm expressed by ball possessions); SD, standard deviation.

significantly higher number of ball possessions, $t(210) = 6.47$, $P < 0.001$, and a significant faster game rhythm, $t(104) = 5.32$, $P < 0.001$, compared with non-II games. For the descriptive data, please see Table 1.

The results of the two-way repeated-measures ANOVA confirmed that there are significant ball possession differences (II and non-II games; more ball possessions per quarter for II games), $F_{2.87, 604.29} = 6.90$, $P < 0.001$, $\eta^2 = 0.03$, and game rhythm differences between the groups (II and non-II games; faster game rhythm per quarter for II games), $F_{2.81, 292.39} = 5.71$, $P = 0.001$, $\eta^2 = 0.05$. A further analysis though revealed statistically significant ball possession differences within the non-II games, $F_{2.85, 300.22} = 8.10$, $P < 0.001$, $\eta^2 = 0.06$, but non-significant ball possession differences within the II games, $F_{2.84, 298.97} = 2.64$, $P = 0.05$, $\eta^2 = 0.02$. *Post hoc* test using the Bonferroni correction revealed that non-II games are dealing with significant game rhythm differences between the first and fourth quarters ($P < 0.001$), between the second and fourth quarters ($P = 0.00$) and between the third and fourth quarters ($P = 0.00$). Specifically, for the game rhythm, the analysis found statistically significant game rhythm differences within the non-II games, $F_{2.72, 141.60} = 7.72$, $P < 0.001$, $\eta^2 = 0.12$, but non-significant game rhythm differences within the II games, $F_{2.70, 140.86} = 2.00$, $P = 0.12$, $\eta^2 = 0.03$. *Post hoc* test using the Bonferroni correction revealed that non-II games are dealing with significant game rhythm differences between the first and fourth quarters ($P < 0.001$), between the second and fourth quarters ($P = 0.01$) and between the third and fourth quarters ($P = 0.01$). For the ball possession and game rhythm fluctuations of II and non-II games, please see Fig. 1.

Discussion

This study aimed to shed light on the basketball variables differences between II and non-II games. Based on the results, we can confirm the hypothesis that ball possessions would not significantly differ between winning and losing II teams (similarly to non-II teams), which aligns with the ball possession terminology (Oliver 2004). Therefore, we can assume that the standard metric for measuring ball possessions in non-II games, ball possessions = (field goals attempted) − (offensive rebounds) + (turnovers) − 0.4 × (free throws attempted), is also appropriate as a ball possession indicator in II games (Oliver 2004). Our second hypothesis was supported, as II basketball games demonstrate significantly more ball possessions and faster game rhythm compared with non-II games. The results also supported our third hypothesis: ball possessions and game rhythm were distributed differently within II and non-II basketball games, with only non-II games to demonstrate significant ball possession and game rhythm differences across the four quarters of the games. This study was the first that thoroughly demonstrated ball possession and game rhythm differences in different time periods of a basketball game between the two populations. These differences could occur because of the game intelligence deficits of individuals with II (Burns 2015). Game intelligence is a critical component of a player's performance and can be expressed by two related attributes: decision-making and tactical skills (O'Connor & Larkin 2015). Decision-making in sports is a complex and dynamic process where players choose, modify and evaluate their behaviour based on numerous action invitations (affordances) that the environment offers (e.g. opponents and teammates; Araujo *et al.* 2006). Tactical skills related to decision-making and are dealing with how players should perform the correct actions at the right moment (Kannekens *et al.* 2011). Both decision-making and tactical skills are critical in basketball (Pinilla *et al.* 2017) but seem deteriorated in individuals with II (Pinilla *et al.* 2016). Previous studies revealed that basketball players with II make slower (and less) accurate decisions compared with basketball players without II with similar training volume and experience (Pinilla *et al.* 2016, 2017). Moreover, coaches and referees report that basketball players with II are dealing with significant offensive and defensive tactical limitations (Polo *et al.* 2017). Decision-making and tactical limitations could lead basketball players with II to plan their actions differently (deliberate actions; Pinilla *et al.* 2016). They might respond differently to the environmental cues (intuitive actions; Pinilla *et al.* 2016; Khudair *et al.* 2021) and adopt fewer collective behaviours. Additionally, they may make quicker offensive decisions and attempt more field shots during the game (Pinilla *et al.* 2017) compared with basketball players without II. These factors could explain the

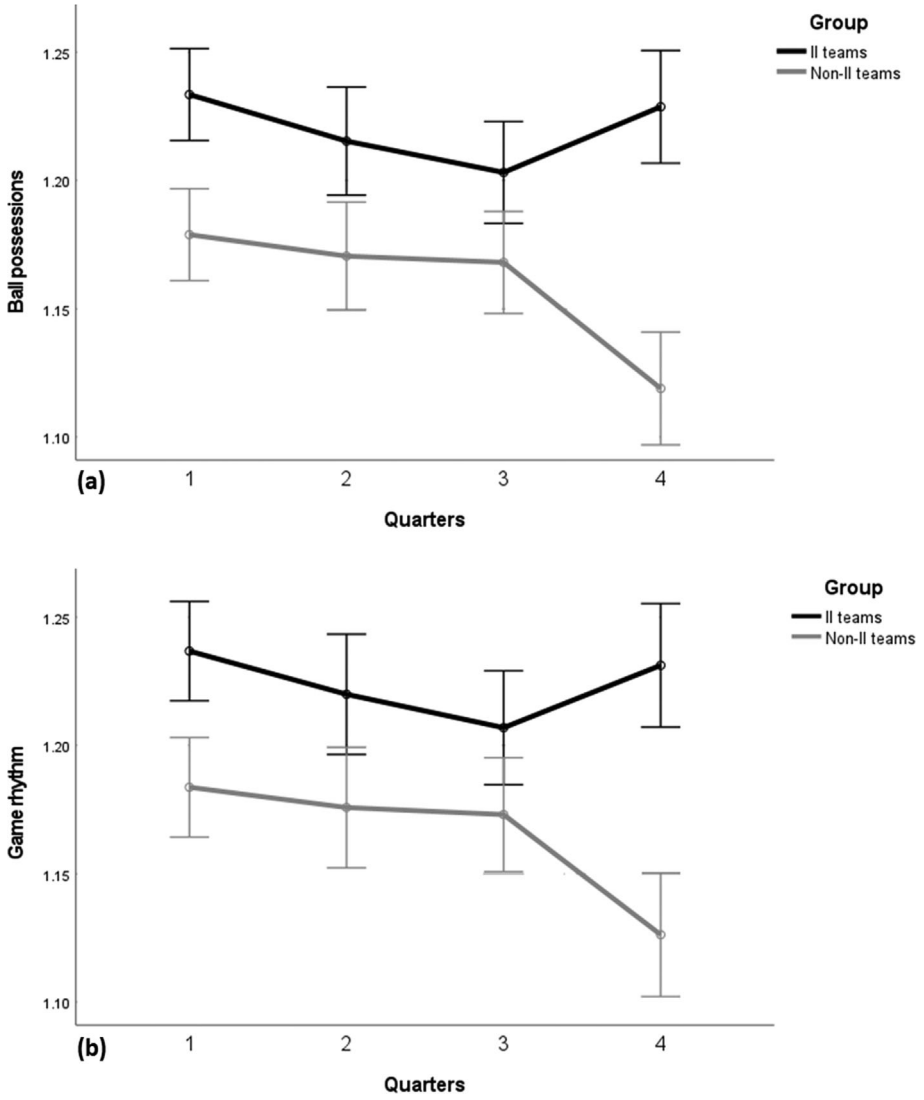

Figure 1. (a) Ball possession and (b) game rhythm differences within (and between) the game of intellectual impairment (II) and non-II games. II, intellectual impairment.

ball possession and game rhythm differences between the II and non-II games. Moreover, the higher number of ball possessions, the faster game rhythm and the slower decision-making ability of players with II compared with players without II (Pinilla *et al.* 2016) could indicate that the basketball games of II teams are based more on intuitive than deliberate decision-making (Khudair *et al.* 2021). Thus, the behaviour of athletes in this constantly changing environment significantly depends on various perceptual affordances (e.g. opponents) that invite players to adapt their pace and their actions (Araujo *et al.* 2006; Hettinga *et al.* 2017). The fast pace of II teams though could lead their players to commit more turnovers, while their quicker offensive decisions may lead to low shooting percentages (Garcia *et al.* 2013). Thus, coaches who want to efficiently coach players with II and offer them adequate training opportunities, tailored to their needs, should use techniques to reduce the fast pace of their players (e.g.

more focus on teamwork and passing the ball) and give them the time to make more accurate decisions (Pinilla *et al.* 2016, 2017).

The ball possession and game rhythm differences might also have occurred because of self-regulatory deficits that players with II are dealing with (Hartman *et al.* 2010; Sakalidis *et al.* 2021). This could be important in sports environments where collective actions are required, as the implementation of self-regulatory strategies improves the team performance and the cooperation within the team (Wieber *et al.* 2012). During a basketball game, players within a team need to pay attention to their actions and exert self-control to perform sufficiently and reach their goals (Kitsantas *et al.* 2018). Inadequate attention span is a common characteristic of players with II that alters and deteriorates their performance (Van Biesen *et al.* 2016) and impacts their ability to self-monitor their actions and maintain on-task behaviours (Coughlin *et al.* 2012). Moreover, the low levels of inhibition (Lanfranchi *et al.* 2010), impulse behaviours and lack of strategies to maintain self-control of individuals with II (Di Nuovo *et al.* 2018) could justify the different ball possession and game rhythm distribution differences within the game between teams with and without II. The shortfalls of individuals with II in problem solving, reasoning, judging and shifting between tasks (Van Biesen *et al.* 2016) could significantly affect the behaviour of players with II against their opponents and force them to respond differently compared with individuals without II: an assumption that provides an additional explanation of the ball possession and game rhythm distribution differences within the game between the two populations. It is worth mentioning that people with II often experience challenges in processing information and acquiring new skills (Van Biesen *et al.* 2016). Consequently, II can influence players' ability to learn complex sports strategies or tactics (Van Biesen *et al.* 2017), which, in turn, could indicate that the ball possession and game rhythm differences between II and non-II teams will be sustained over time. Thus, coaches who want to successfully offer inclusive pathways and train basketball players with and without II together should explore less cognitive demanding ways to support the self-regulation of players with II and minimise the ball possession and game rhythm differences between the two populations. As the social environment can influence the behaviour of players during an exercise task, carefully pairing players with and without II and asking them to guide and assist each other can positively impact on their ability to self-monitor their actions and maintain self-control (Sakalidis *et al.* 2022).

From the aforementioned statements, it would be interesting highlighting that the number of ball possessions could be characterised as a representation of a team's collective activity throughout a basketball game that depends on the on-court players' actions and could be affected by their decision-making, tactical proficiency and self-regulatory skills. Thus, ball possessions could be interpreted as an aspect of pacing, decision-making and self-regulatory ability of people (with or without II) to distribute effort across an exercise task (Smits *et al.* 2014; Elferink-Gemser & Hettinga 2017). In athletic competitions (like running), pacing is usually expressed by the velocity or power output of the athlete during the trial (Abbiss & Laursen 2008). Basketball though requires a broader range of cognitive skills (Gu *et al.* 2019) and demands from players to react appropriately in a dynamically changing and unpredictable environment (Wang *et al.* 2013). To our knowledge, there is only one other research study that observed the pacing ability of basketball players with II and investigated the pacing differences between players with and without II (Khudair *et al.* 2021). It is likely that the two studies came to different findings, probably due to the different methodologies and approach to pacing used. More specifically, Khudair *et al.* (2021) focused on the individuals' actions of the players and coded pacing in different movement categories and used time-motion analysis to investigate the pacing behaviour differences between basketball players with and without II. The findings indicated that the pacing behaviour of the two groups was similar, but players with II demonstrated a lower frequency and duration in high-intensity activities than players without II (Khudair *et al.* 2021). This approach though is completely different to our methodology, in which we took into consideration ball possessions: an aspect of pacing that depends on the teams' collective actions (Oliver 2004). The pacing (ball possession) differences that we found between II and non-II teams provide a better idea of the role of cognition in teamwork and collective actions during basketball games (Araujo *et al.* 2006; Wang *et al.* 2013). These

findings indicate the necessity for coaches to adapt their tactics and appropriately use the affordances (e.g. opponents and/or teammates) when training players with II (Sakalidis *et al.* 2022). Thus, these two studies together provide a broader representation of pacing, suggest that decision-making related to individual and collective actions could differ, confirm the complexity of pacing in this specific sport and indicate the necessity to investigate the concept of pacing in team sports from different perspectives.

The International Paralympic Committee (IPC) is using an evidence-based approach to determine which athletes are eligible to compete in a Paralympic sport and how athletes are classified for competition (Tweedy & Vanlandewijck 2011). At present, the classification of athletes with II is an individual process, whereas the impact of their II on sports performance needs to be determined (Tweedy & Vanlandewijck 2011). By taking into consideration the difficulties to develop an evidence-based classification for II team sports (Pinilla *et al.* 2016, 2017; Polo *et al.* 2017) and the importance of collective behaviour in team sports (Caldeira *et al.* 2020), the investigation of team performance variables could be an additional classification stage that facilitates the process. Ball possession is a team variable that is related to players' collective behaviour (Sampaio *et al.* 2010; Csátaljay *et al.* 2011; Renfree *et al.* 2015) and significantly differs between basketball teams with and without II. Thus, this variable could demonstrate the impact of II in the classification procedure and help re-include teams with II in Paralympics, but further investigation is needed to explore the impact of ball possessions in basketball performance. This is critical for creating an inclusive basketball environment, as the promotion of sport participation for people with II should also be considered at the elite level (Pérez-Tejero *et al.* 2020). The (re)introduction of players with II in elite competitions (e.g. Paralympics) could provide them with more sports participation pathways and offer additional opportunities for their sports development (Misener & Darcy 2014).

This study also presented some limitations that need to be addressed. Specifically, it justified the ball possession and game rhythm differences between II and non-II games based on the decision-making and self-regulatory skill deficits of individuals with II (Van Biesen *et al.* 2016). However, it only indirectly explored how and to what extent these skills could affect the frequency of ball possessions and game rhythm of basketball teams with and without II. Thus, we need to consider necessary future research to investigate, through valid measurements, the impact of cognitive skills on basketball performance (e.g. game outcome), pacing and game rhythm of basketball players with and without II. This approach will provide a clearer picture of the role of II in basketball. Additionally, as we mentioned before, this study did not thoroughly take into consideration the role of ball possessions and game rhythm in basketball performance. Future studies that want to focus on the ball possessions should consider if the ball possession variable could be a predictor of specific game-related statistics (e.g. successful field shots). Additionally, researchers should investigate how both balanced and unbalanced games (in terms of points differences) can influence ball possession and game rhythm patterns. Another limitation is that we did not address if and how the behaviour (e.g. dribbling and shooting) and the tactical strategies (e.g. zone defence) of the opponents could affect the game-related statistics (e.g. turnovers) and the ball possessions of a team. Additionally, this study did not take into consideration the impact of training and experience on the tactical decision-making process during a ball possession. For this reason, time-motion analysis looking at the reactions to the spatial configuration of elite and novice basketball teams could be a good starting point for discussion and further research. Moreover, future research should make a comparison of game-related statistics in different game rhythm intensities to provide a better justification of the importance of a game rhythm in basketball performance of teams with and without II. It should also explore the ball possession/game rhythm differences among different competitions (e.g. by analysing the data of major competitions in every decade) to determine if there are any changes in patterns and if new directions are needed. Lastly, it is important for future research to intensively explore the complex and cognitive demanding concept of pacing in basketball settings, with a purpose to explore the role of pacing in basketball performance. Pacing could be also investigated through global positioning system units and the average speed displacements of the basketball players, from a similar methodology that Ferraz *et al.* (2018) used in football. To take a step further, an exploration of pacing

differences between teams with and without II through this method and a comparison between the suggested study, our study and Khudair *et al.*'s (2021) study could provide a clearer picture of pacing and the pacing differences between teams with and without II.

Conclusions

We hypothesised that II games will have a significantly faster game rhythm and will demonstrate more ball possessions compared with non-II games and that ball possessions and game rhythm will be distributed differently within the game between the two groups. In summary, this paper highlights the impact of cognitive differences between players with and without II by arguing that II games demonstrate more ball possessions and faster game rhythm compared with non-II games and that the frequency of ball possessions and game rhythm develops differently between II and non-II games. These results might have emerged because of the decision-making, tactical proficiency and self-regulation deficits of individuals with II and could indicate also that II games might be associated with more intuitive than deliberate decisions. Additionally, this paper expands upon how teams distribute their energy during an exercise bout and how principles related to pacing are relevant in a team sport like basketball. In conclusion, the study is taking a step further to understand the impact of cognition on important teams' sports variables (e.g. ball possessions and game rhythm) and provide valuable information to people of interest who wish to offer inclusive sports environments.

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Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability statement

The data that support the findings of this study are openly available in Northumbria University research repository at https://figshare.northumbria.ac.uk/, reference number https://doi.org/10.25398/rd.northumbria.22891196.v1.

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