Abstract: The notational analysis is used to investigate teams' performance in water polo, especially focused on the determinants of success. Recently, a new topic has emerged "the situational variables", this term includes the game conditions that may influence the performance at a behavioural level. Then, the aim of this study was to identify the interactive effects of Starting Quarter Score (SQS: i.e., score difference at the beginning of each quarter and at the final score) and Game Location (GL: i.e., home and away teams) in relation to Quality of Opposition (QO: i.e., positions of difference between opposing teams at the end-of-season rankings) in elite men's water polo games. Data comprised 528 games (n=2,112 quarters) from the first Spanish water polo division. A linear regression analysis was applied to show the impact of SQS and GL in relation to QO (unbalanced and balanced) for quarter (all quarters, and second, third, and fourth quarter). Results showed that SQS has an important effect for all quarters (0.16), and for the second (0.14) and third (0.14) quarters in balanced games (while the fourth quarter has an unpredictable outcome), and for each quarter (all quarters: 0.33; second quarter: 0.55; third quarter: 0.44; fourth quarter: 0.26) in unbalanced games. In addition, GL effects emerged for balanced (0.31) and unbalanced (0.45) games for all quarters, and specifically for the second quarter of the unbalanced games. Therefore, this study showed the elite water polo game dynamics, indirectly providing a reference for coaches (i.e., effective tactical approach) and physical trainers (i.e., high performance intensities) plans to improve their players' performance.
Answer: The manuscript was changed according to JSCR instructions to the authors. One paragraph was included in subjects subsection with characteristics of the classical physical training of the water polo players. “The conditioning training is based on overload exercises with rather high loads, and moderate numbers of series (i.e., 3-4) and repetitions (i.e., 7-8). The sessions were focused on the most recruited muscle groups (i.e., pectoral, dorsal, leg, deltoid, abdominal, and lumbar muscles) during a game, either by using unspecific (i.e., pectoral machine, lat machine, leg press, upper limb movements with various type of overloads), and specific exercises (i.e., overload balls to shot against a wall/mattress; duel phases to resist to the opponent’s pushes/pulls/grasps)."


Also, in line with these references and the results found, we included a paragraph in practical applications to better explain our main research and the practical question. “In particular, these results reveal the need to consider the strength and conditioning dynamics by using accurate information about tactical and technical determinants, in opposition to classical physical training in water polo. For example, training focused on performing high speed swimming bursts, quick defensive action to recover ball possession, specific and power water polo movements (i.e., overload balls to shot against the edge of pool; duel phases to resist to the opponent’s pushes/pulls/grasps, dressing weight belts) can improve the tactical strategies, contributing to gain advantage during the first half of the game. Therefore, it may be beneficial to coaches to stress the need to perform at the highest level (i.e., balanced and unbalanced team games), but particularly at the first part of the training drills that simulate competition scenarios.”

Answer: We have changed several paragraphs, and reformulated the specific practical applications for coaches and physical trainners in order to clarify the relationships between tactical and physical constraints in elite water polo. “In particular, these results reveal the need to consider the strength and conditioning dynamics by using accurate information about tactical and technical determinants, in opposition to classical physical training in water polo. For example, training focused on performing high speed swimming bursts, quick defensive action to recover ball possession, specific and power water polo movements (i.e., overload balls to shot against the edge of pool; duel phases to resist to the opponent’s pushes/pulls/grasps, dressing weight belts) can improve the tactical strategies, contributing to gain advantage during the first half of the game. Therefore, it may be beneficial to coaches to stress the need to perform at the highest level (i.e., balanced and unbalanced team games), but particularly at the first part of the training drills that simulate competition scenarios.”
The data needs to be put in context of what and how the Strength and Conditioning professional needs to act on from your data for conditioning practice. This is key to any final acceptance.

Answer: Yes, we understand the point. Our results enhance clearly the need to perform at high intensities at the beginning and at the end of the training drills to simulate competition scenarios, and also the importance of the first half of games. By understanding these dynamics, the strength and conditioning professionals can change the conditioning drills accordingly.

Reviewer 1

No further comments except that how is this related to the strength coach?

Answer: Yes, we understand the point. Our results enhance clearly the need to perform at high intensities at the beginning and at the end of the training drills to simulate competition scenarios, and also the importance of the first half of games. By understanding these dynamics, the strength and conditioning professionals can change the conditioning drills accordingly.

Reviewer 2

Thanks you for your revisions. The terminology and meaning to the strength and conditioning professional seems too general and stretched as if the author(s) really as if you do not know what strength coaches do and how they will be able to use this study for developing conditioning programs in the weight room beyond the typical use of general resistance exercises such as squats, cleans etc.

So now how do I use this information as a strength coach to impact practical applications as I assume these are conditioned polo athletes already.... so maybe it is more important for the polo coach a not the strength and conditioning coach as this is the trouble I am having as you have presented it.

What were these athletes doing in the first place with their current conditioning program? You should LIST it and then show how this study will alter their current program that they do to make them better in the matches. I fear without you telling us that here is the program they use, here is what they currently do and here is what we learned and now they should alter their program in this way to help them... otherwise this it is of low impact for the strength coach. Shows how will your data will change the exercise prescription on both of these areas of conditioning (strength training and water conditioning)? This determines impact of the study.

Answer: Yes, we understand the point. Our results enhance clearly the need to perform at high intensities at the beginning and at the end of the training drills to simulate competition scenarios, and also the importance of the first half of games. By understanding these dynamics, the strength and conditioning professionals can change the conditioning drills accordingly.

“In particular, these results reveal the need to consider the strength and conditioning dynamics by using accurate information about tactical and technical determinants, in opposition to classical physical training in water polo. For example, training focused on performing high speed swimming bursts, quick defensive action to recover ball possession, specific and power water polo movements (i.e., overload balls to shot against the edge of pool; duel phases to resist to the opponent’s pushes/pulls/grasps, dressing weight belts) can improve the tactical strategies, contributing to gain advantage during the first half of the game. Therefore, it may be beneficial to coaches to stress the need to perform at the highest level (i.e., balanced and unbalanced team games), but particularly at the first part of the training drills that simulate competition scenarios.”
**Running head:** Situational variables in elite water polo.

**Title:** Effects of Game Location, Quality of Opposition and Starting Quarter Score in the outcome of elite water polo quarters.
ABSTRACT

The notational analysis is used to investigate teams’ performance in water polo, especially focused on the determinants of success. Recently, a new topic has emerged “the situational variables”, this term includes the game conditions that may influence the performance at a behavioural level. Then, the aim of this study was to identify the interactive effects of Starting Quarter Score (i.e., score difference at the beginning of each quarter and at the final score) and Game Location (i.e., home and away teams) in relation to Quality of Opposition (i.e., positions of difference between opposing teams at the end-of-season rankings) in elite men’s water polo games. Data comprised 528 games (n = 2,112 quarters) from the first Spanish water polo division. A linear regression analysis was applied to show the impact of Starting Quarter Score and Game Location in relation to Quality of Opposition (unbalanced and balanced) for quarter (all quarters, and second, third, and forth quarter).

Results showed that SQS has an important effect for all quarters (0.16), and for the second (0.14) and third (0.14) quarters in balanced games (while the fourth quarter has an unpredictable outcome), and for each quarter (all quarters: 0.33; second quarter: 0.55; third quarter: 0.44; fourth quarter: 0.26) in unbalanced games. In addition, GL effects emerged for balanced (0.31) and unbalanced (0.45) games for all quarters, and specifically for the second quarter of the unbalanced games. Therefore, this study showed the elite water polo game dynamics, indirectly providing a reference for coaches (i.e., effective tactical approach) and physical trainers (i.e., high performance intensities) plans to improve their players’ performance.

KEY WORDS: notational analysis, situational variables, team sport, performance analysis, water polo.
INTRODUCTION

Water polo was introduced into the Olympic program in 1900, and was the first team sport played at the Games along with football. European national men’s teams have won most of the gold medals at Olympic Games and World Championships. In particular, from 1990s, Spain won 2 medals (1 gold: Atlanta, 1996; 1 silver: Barcelona, 1992) at the Olympic Games, and 6 medals (2 gold: Perth, 1998, Fukuoka, 2001; 3 silver: Perth, 1991, Rome, 1994, Rome, 2009; and 1 bronze: Melbourne, 2007) at the Fédération Internationale de Natation (7) World Championships, showing Spain to be one of the most important water polo nations in the world. In Spain, 4 men’s water polo championships (i.e., Divisions) are organized according to the level of players (i.e., División de Honor; Primera División; Segunda División; Tercera División). División de Honor is the top Spanish water polo competition level and includes the participation of 12 clubs. The best 3 ranked clubs can compete in the LEN Champions League (Ligue Européenne de Natation; the most prestigious European water polo championship), whereas the 4th and 5th ranked clubs are allowed to take part in the Len Euro Cup; the last ranked team is relegated to the Primera División.

At present, water polo is an aquatic team sport played by two teams (6 field players and a goalkeeper) aiming to score more goals than the opponents during 4 game periods (i.e., 8 min clock time), with ball possessions limited to 30 s (7). From a conditional point of view, water polo is a very stressful body-contact team sport that combines high-intensity short duration efforts (i.e., swimming at maximum speed or shooting) and low-duration actions (i.e., ball retention strategies, substitutions or timeouts called by coaches). In fact, water polo requires high levels of physical fitness combined with the specificity of technical, tactical and strategic aspects of the game constraints that are decisive when the aim is to win a game (2).
Along these lines, the water polo teams’ performance is a complex, dynamic and non-linear process as was described in other team sports such as football, volleyball or basketball. Therefore, the need to capture the best performance indicators and situational variables that describe this modeling process is a determinant aspect for coaches’ decision making when planning trainings and during competitions (20).

The available research is mainly focused on static conditions, several authors investigated tactical water polo aspects to discriminate different competition levels (16,18), codes (17), and game outcomes (1,5,6,19). In particular, comparing International women’s water polo games in relation to final outcome (winning and losing teams) and Championship Phase (preliminary, classificatory, and semifinal/ bronze medal/gold medal), Escalante et al. (6) identified offensive (centre goals, power-play goals, counterattack goal, assists, offensive fouls, steals, blocked shots, and won sprints) and defensive (goalkeeper-blocked shots, goalkeeper-blocked inferiority shots, and goalkeeper-blocked 5m shots) characteristics, which discriminate performances for each phase and grade of efficacy elaborated on all the Championship Phases (i.e. preliminary, classificatory, and final phases: 92%, 90%, and 83%, respectively). At the same time, Lupo, et al. (14,15) analyzed the games of the 13th Water Polo Men’s World Championships, comparing technical and tactical aspects of winning and losing teams, during games with 1-3 (balanced games) or more than 3 (unbalanced) goals of difference at the end of the 4th quarter, and showing several effects (number of actions, mean duration of actions, action outcome, zone origin and technical execution of shots, offensive and defensive arrangements) for the two Types of Game. According to these authors, notational analysis may be a valuable tool for better coaching through the interpretation of technical and tactical aspects of water polo, helping coaches to plan training and competition. However, the research focused on water polo that has investigated the influence of situational variables is quite scarce and did not take into account interactive effects in dynamical and
complex conditions such as quarter specificity (6,14,15,27,36,37). Nevertheless, in other team
sports, the interactive effects of game location, score-line, game period, or Quality of
Opposition (QO) from a dynamical approach have been identified to have an effect on
performance (4,10,12,13,25,28).

In fact, water polo is divided into four game quarters (each 8 min. long) that allow
modifying the tactics and strategies according to game constraints and situational variables. In
particular, it is important to analyze the starting quarter score (SQS) during water polo games
(i.e., whether the team is winning, losing or drawing) that affect the players’ and teams
subsequent efforts and describe the final outcome of a game (32). The SQS situational
variable has showed different physiological profiles during elite soccer games, this variable in
game periods considerably influences the work-rate, even showing different trends for
winning, losing or drawing teams (25) and playing positions (30). In the NBA basketball
Championship, the analysis of the home advantage in quarters and at the end of the game
highlighted that teams playing at home accumulated in the first quarter two-thirds of the
advantage it achieved at the end of the game (10). In the Spanish professional basketball
league, a factor analysis highlighted effects for the starting score-line in unbalanced game
situations, the QO in the second and third quarters, and the game location in the second
quarter (32). These studies enhance the importance to control for SQS, QO and GL according
to game quarter due to that each game period may have different effects on the players’
behaviors (i.e., when controlling psychological stress during drawing score-lines at the end of
the game) or in the physiological responses (i.e., an expending of physical effort at the first
part of the game when playing away).

According to the complexity and dynamics of water polo, it may be possible that the
game variability can enhance the teams’ performance. Recently, Marcelino et al (20) studied
the attack and serve performances according to match period and QO in elite volleyball, and
they results showed that performance profiles differ according to match period, in particular the initial sets (i.e., the first moment of confrontation between both teams) and the final sets (i.e., where the game is decided and increase the importance of final outcome). Also, the high level teams showed better adaptation to the match period and strategies that low level teams. These results reinforce the idea that performance variations between periods of high a low-intensity are best than stability periods of energy expenditure (20).

However, in water polo there still exists limited knowledge about the teams’ performance variations according to situational variables during a game. The presence of differences related to game quarters, SQS, QO and GL, could provide new insights when designing specific training programs to prepare the teams for competing at the highest level. Consequently, the increased knowledge on tactical aspects could provide important references to improve the process of coach’s and physical conditioning’s plans (i.e., physical fitness and psychological routines according to game quarter, SQS, QO and GL) and decision-making during competitions (i.e., risky strategies during the first half of games). Thus, the present study aimed to investigate the interactive effects of Starting Quarter Score (i.e., score difference at the beginning of each quarter and at the final score; SQS) and Game Location (i.e., home and away teams; GL) in relation to QO (games between teams of unbalanced and balanced quality) in elite men’s water polo competitions. It has been hypothesized that: i) in balanced team games, score-line has an important effect until the third quarter, but not in the last quarter; ii) in unbalanced team games, score-line has an important effect for each quarter; and, iii) in balanced team games, GL effect negatively influence the away teams.

**METHODS**

*Experimental Approach to the Problem*
The notational analysis is used to investigate teams’ performance in team sports, especially focused on the determinants of success. Within this research framework, “the situational variables” emerged as new topic, which includes the game conditions that may influence the performance at a behavioural level, and includes the conditions of score-line (or match status), game quarter (or game period), type of competition and game location (9). Although, it seems reasonable to hypothesize that the game dynamics are influenced by the QO and the SQS, at present, elite men’s water polo has not been investigated according to this rationale, and the above mentioned game variables can be only inferred from the analyses of other team sports (10,25,30,33). Thus, to provide a first reference on this topic for elite water polo, variables such as QO, GL and SQS have been selected to highlight potential effects on water polo game dynamics. For this purpose, similarly to basketball (32), the linear regression models have been considered as the best approach to predict variables effects on each quarter outcome.

Subjects

The local Institutional Review Board approved this study to investigate the interactive effects of the SQS and GL in relation to the QO in Spanish men’s water polo División de Honor. This study comprised 528 games (n = 2112 quarters) played by twelve teams during the 2010-2011 and 2011-2012 regular seasons of the Spanish men’s water polo División de Honor. In particular, archival data were collected from the Spanish Royal Swimming Federation open access web domain (http://www.rfen.es). All data reported in this web domain were collected by professional technicians of the League, who applied a reliability test (kappa coefficients) on twelve games of the above-mentioned sample of games. The results of this test showed coefficients of agreement of 1.0 for goals scored and received for both teams in each game quarter.
Although only based on well-know water polo tradition (and not on published data), to better define the participants of this study, the players competing at the Spanish men’s water polo División de Honor usually perform a minimum of five to a maximum of eight 120 min training sessions per week, with at least 5 years of previous water polo practice. The conditioning training of elite water polo players is based on overload exercises with rather high loads, and moderate numbers of series (i.e., 3-4) and repetitions (i.e., 7-8). The sessions were focused on the most recruited muscle groups (i.e., pectoral, dorsal, leg, deltoid, abdominal, and lumbar muscles) during a game, either by using unspecific (i.e., pectoral machine, lat machine, leg press, upper limb movements with various type of overloads), and specific exercises (i.e., overload balls to shot against a wall/mattress; duel phases to resist to the opponent’s pushes/pulls/grasps).

**Procedures**

Each game has been analyzed by means of game-related statistics in order to record: SQS (i.e., score difference at the beginning of each quarter and the quarter final score), QO (i.e., difference at the end-of-season rankings between opposing teams) and GL (i.e., home or away teams). For QO, a classification analysis (k-means cluster) was performed to divide the sample into two groups: games between balanced (2.7 ± 1.4 positions of difference in teams’ rankings; $n = 360$ games) and unbalanced (7.7 ± 1.5 positions of difference in teams’ rankings; $n = 168$ games) teams. For example, if the team that leads the league faces the team ranked eighth, this game was scored as having an absolute quality ranking difference of 7.

**Statistical Analyses**

To analyze the SQS and GL impacts on QO on all quarters, and on the second, third, and fourth quarters, a linear regression model has been applied for all games, and balanced and
unbalanced games. When estimating the models, no heteroscedascity in residuals or multicollinearity among regressors was observed. Moreover, the RESET test of Ramsey (29) did not reveal specification problems. When interpreting the statistical results, positive or negative coefficients indicate a greater or lower propensity to increase/ decrease quarter outcome, respectively.

\[ QO_i = \beta_0 + \beta_1 \times SQS + \beta_2 \times GL + \varepsilon_i \]

Linear regression model to predict effects on each game quarter outcome: \( \beta_0 \) is the intercept; \( \beta_1 \) and \( \beta_2 \) are the impacts of each predictor variable of the independent variables (SQS: Starting Quarter Score, and GL: Game Location); and \( \varepsilon_i \) is the disturbance term. Statistical analysis was performed using SPSS 18 for windows. Statistical significance was set at \( p < 0.05 \).

**RESULTS**

Means and standard deviations in final goals difference between teams are presented in table 1, for unbalanced and balanced team games, and in relation to each quarter.

***Table 1 near here***

The effects of the independent variables on all games are showed in table 2. For “all quarters” situation, SQS and GL explained quarter outcome. For each goal of difference in accumulated score, the observed team increased QO by 0.26 goals. Playing at home increased QO by 0.31 goals compared with playing away.

The second and third QO (Table 2) was explained by the two situational variables included in the model. SQS increased 0.34 and 0.31 goals respectively, and playing at home
also increased QO by 0.34 and 0.27 goals respectively when compared with playing away. The fourth QO (Table 2) was explained by the SQS with 0.23 increased goals.

***Table 2 near here***

The effects of the independent variables on QO in unbalanced team games are shown in table 3. All quarters and the second quarter was explained by the two factors that compose the model (SQS and GL). For each goal of difference in the accumulated score at the start of each quarter, the studied team increased QO by 0.33 and 0.55, respectively. Playing at home was linked with an increase in the QO by 0.45 goals and decreased by 0.23 goals in the second quarter. The third quarter (table 3) was explained by the SQS that increased 0.44 goals. Finally, in the fourth quarter (table 3), SQS increased QO by 0.26 goals for each goal of differences accumulated at the start of the quarter.

***Table 3 near here***

The effects of the independent variables on QO in balanced team games are showed in table 4. Quarter outcome in all quarters, the second, and third quarters was explained by the SQS in 0.16, 0.14 and 0.14 goals respectively; and GL explained all quarters and the second quarter outcome in 0.30 and 0.60 goals respectively.

***Table 4 near here***

DISCUSSION
To our knowledge, this is the first study focused on the interactive effects of SQS (i.e., score difference at the beginning of each quarter) and GL (i.e., home and away teams) according to QO (i.e., all quarters, and games between teams of unbalanced and balanced quality) in elite men’s water polo competitions. In line with the experimental hypotheses, the present findings showed that: in balanced games, score-line effects until the third quarter (but not in the last quarter); in unbalanced games, score-line effects for each quarter; as well as, in balanced games, GL effect negatively influence the away teams. Generally, the present results confirmed that the game dynamics are determined according to the QO, and are influenced by situational variables when studying the SQS effects in water polo quarters.

Similarly to volleyball (20), the present findings lead to consider the precariousness of maintaining high intensity during an entire water polo game, and the importance to achieve a score advantage especially in the first quarters rather in the final part of a game, which results quite unpredictable. As consequence, coaches and physical trainers could consider these game dynamics, promoting useful technical and tactical, and physical strategies to stimulate a score advantage in the initial game phases, or, at list, to limit an opponents’ early score advantage.

As already mentioned, the available literature that studied the interactive effect of situational variables is quite scarce in water polo (6,14,15,27,36,38), especially because the dynamical and non-linear nature of water polo limit the play analyses in terms of replication (18). Nevertheless, the results of the present study highlight the importance of game dynamics that affect the teams’ performance in each quarter, finding full accordance to previous studies focused on the interactive effects of situational variables of other team sports such as handball (26), basketball (31,33), or football (12).

Firstly, the importance of controlling the data by QO increased the validity and interactive effects of GL and SQS in water polo as was previously studied by Oliveira et al. (26) in handball and Lupo et al. (14,15) in water polo. In fact, according to the Interacting
Performances Theory (24) performance analysis in team sports should account for the opponent’s QO. The results of the present study differentiated the analysis according to balanced games with confronting teams ranked in a similar position in final ranking (differences in score below 2 goals), and unbalanced games with confronting teams ranked in an open range of final ranking and hence different team ability. As was found by Oliveira et al. (26) the differentiation by QO by final ranking showed that during balanced team games the interactive effect of situational variables was stronger than in unbalanced team games.

In this regard, in balanced team games, score-line has an important effect until the third quarter, but not in the last quarter, this fact may be due to the pressure situations of maximum equality in score and/or the critical moments that usually occur at the end of games, especially with teams that are tied in the ranking. This equality of score reflects an unpredictable outcome in an opener becoming game. In fact, the game period is also a situational variable of great importance in team sports, as stated by research highlighting critical moments (11,21,22), and the importance from the starting and ending periods of the games (3,31,33). In the same way, in elite volleyball, Marcelino et al. (20) found that balanced games are mainly characterized by less risks in the beginning phases of game, providing an improvement of intensity only during the high pressure ending phase of games (i.e., last five minutes of a game) (20).

On the other hand, an intriguing result was the existence of significant effect of GL variable during the second quarter. This result enhances the importance of interactive effects of QO and GL by quarter. Then, as was found in balanced handball games (i.e., similarly ranked teams confront each other), playing at home will be an important advantage factor. Particularly, territorial theory stated that home players have higher testosterone levels than away players (23), and also the home players may act with dominant and assertive behavior and better visual-spatial performance (35,38). Thus, considering that the results pointed out
the influence of interactive effect during the first half of water polo games, it could be infer
that these territorial behaviors can be time- and opponent- dependent (26). Likely for
basketball (33), these results may suggest that during balanced team games the away teams
are more negatively influenced by home crowd support that are stronger in terms of noise at
the beginning of the game (especially for team sports generally played indoor like water
polo), potentially generating negative feelings and poor self-confidence. In addition, the
players’ familiarity with the swimming pool, lights, sound and court dimensions may have a
positive effect on the home teams’ performance especially at the beginning of the game,
whereas the away players could start the game with unfamiliar feelings with the above
mentioned environmental aspects, and progressively get more confidence as the game goes on
(31). These results enhance the importance of the home teams in increasing the physical
intensity and technical-tactical effectiveness during the first half (probably to attempt to
outperform the opponents and lead the score during all the game quarters).

For unbalanced team games, the SQS effect emerged for all quarters as well as for
each single quarter, showing a divergence with respect to previous studies in basketball
(31,32) and handball (26), where quarter score decreased as greater the difference at the
beginning of the quarter. In the present study, the analysis of all quarters in unbalanced team
games, reported that the winning teams leading 3-goals at the start of the second quarter will
increase their advantage of 1 goal, whereas the winning teams leading 4-goals at the start of
the second quarter will increase their advantage of 2.2 goals. Therefore, during the second
quarters, the effect of SQS in increasing the goal differences may be associated with higher
game intensity of winning teams as was found by previous notational analysis on water polo
(6,14,15,27,36,38). However, as the unbalanced team games go on, the influence of SQS
decreases its influence on quarter outcome reporting margin more and more low (second
quarter: 0.34 ± 0.04 goals; third quarter 0.31 ± 0.03 goals; fourth quarter: 0.23 ± 0.02 goals).
This fact may suggest that if a team goes winning by a larger margin of goals there might be a trend of playing tactics that reduce the game pace (31). This reduction is probably identified also in the psychological approach to the remaining playing time. In fact, as was previously found in football (25,34) given that the partial (at the beginning of the second, third, or fourth quarter) advantage represents a comfortable state for a team, it is possible that water polo players assume a ball retention strategy, slowing down the game pace, and resulting in lower speeds with players exhibiting more controlled responses that maintain the goal differences and the game pace. The knowledge of these results may add new insights into the process of physical conditioning by influencing coaches’ plans according to the most important aspects of balanced (i.e., high intensity activity during the first half of games, a great relevance of SQS during the second and third quarter, and an unpredictable outcome of the fourth quarter that generates variations of players’ effort and strategies) and unbalanced (i.e., the SQS is the most relevant variable that points out the importance of alternative periods of high and low intensity activities to reduce and/ or increase the differences in the score) team games.

Finally, the results showed that GL has only an effect in all quarter analyses for unbalanced team games. These results are in accordance with Gómez, Pollard, and Pascual (8) who found the influence of home advantage in water polo with values of 56.2% (from 2005-2006 to 2009-2010 seasons), however, as was previously presented, the influence of GL varied according to QO and game quarter. Then, when game outcome is already decided, the intensity of the dispute (i.e., challenging to obtain space and time with respect to the opposite team) loses significance, and it is only affects in an overall perspective (26).

The present study suggests that in water polo elite competition, game constraints and their interaction should affect team’s performance, and variables such as QO, GL and SQS have important effects on water polo game dynamics. Nevertheless, further research should be promoted to analyze the scoring efficiency, time spent per possession, the number of players
involved during each ball possession, and time motion parameters (i.e., swimming analyses) by means of an ecological approach, to enlarge knowledge about the performance in this sport also for other competitive categories (i.e., youth and women).

**PRACTICAL APPLICATIONS**

Even though the present findings are only able to show a performance scenario about particular game aspects (i.e., QO, GL, and SQS), coaches could consider these results to effectively developed training plans that are more coherent to the game dynamics. In particular, the present study can improve the coaches’ competences in terms of mental and tactical approach to the game. The great importance of the first three quarters (during games between teams of balanced and unbalanced quality) induces coaches to stimulate their teams in finding an advantage in these periods rather than in the final part of the game, which it could represent the most rational (i.e., manageable to maintain an advantaging score) and low intensity part of performance. In particular, coaches could improve the performance of their team in terms of quickness of actions (i.e., reduced number of players and passes to effectively shot), effective position of shooting (i.e., finding of shots performed inside the 5-m area) to maturate an advantage on the opponents. Then, to maintain the maturated advantaging score, coaches could enhance their player’s capability to quickly handle the ball, to recognize the most appropriate players to successfully pass and maintain the ball possession, and to develop aquatic abilities to maintain the appropriate body position under the defender’s pressure. In terms of psychological behavior, coaches could transfer important advices to avoid the negative supporters’ influence when playing away. Focusing on their tactical strategy could lead their players to exclusively fix their game task, avoiding any influence by any bother coming off the court. In particular, these results reveal the need to consider the strength and conditioning dynamics by using accurate information about tactical and technical
determinants, in opposition to classical physical training in water polo. For example, training focused on performing high speed swimming bursts, quick defensive action to recover ball possession, specific and power water polo movements (i.e., overload balls to shot against the edge of pool; duel phases to resist to the opponent’s pushes/pulls/grasps, dressing weight belts) can improve the tactical strategies, contributing to gain advantage during the first half of the game. Therefore, it may be beneficial to coaches to stress the need to perform at the highest level (i.e., balanced and unbalanced team games), but particularly at the beginning and at the end of the training drills that simulate competition scenarios.
REFERENCES


ACKNOWLEDGMENTS

The authors declare that they have no conflict of interest relevant to the content of this manuscript. The results of this study do not constitute endorsement of the product by the authors or the National Strength and Conditioning Association.
Table 1. Number of points of difference between teams in the final score in all games, and in games between teams of balanced and unbalanced quality.

<table>
<thead>
<tr>
<th>Game Quarter</th>
<th>All games (n=528)</th>
<th>Balanced Games (n=360)</th>
<th>Unbalanced Games (n=168)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>1.8 ± 1.5</td>
<td>1.6 ± 1.3</td>
<td>2.3 ± 1.9</td>
</tr>
<tr>
<td>Second</td>
<td>1.7 ± 1.5</td>
<td>1.5 ± 1.4</td>
<td>2.1 ± 1.8</td>
</tr>
<tr>
<td>Third</td>
<td>1.9 ± 1.6</td>
<td>1.5 ± 1.3</td>
<td>2.7 ± 2.0</td>
</tr>
<tr>
<td>Fourth</td>
<td>1.9 ± 1.7</td>
<td>1.6 ± 1.5</td>
<td>2.5 ± 1.9</td>
</tr>
</tbody>
</table>
Table 2. Effects of Starting Quarter Score and Game Location on quarter final outcomes in all games (coefficients means with standard errors in parentheses).

<table>
<thead>
<tr>
<th>Variables</th>
<th>All quarters</th>
<th>Second quarter</th>
<th>Third quarter</th>
<th>Fourth quarter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting Quarter Score</td>
<td>0.26** (0.01)</td>
<td>0.34** (0.04)</td>
<td>0.31** (0.03)</td>
<td>0.23** (0.02)</td>
</tr>
<tr>
<td>Game Location</td>
<td>0.31* (0.10)</td>
<td>0.34 (0.20)</td>
<td>0.27 (0.20)</td>
<td>0.08 (0.20)</td>
</tr>
<tr>
<td>Intercept</td>
<td>-0.15 (0.07)</td>
<td>-0.19 (0.13)</td>
<td>-0.13 (0.13)</td>
<td>-0.03 (0.14)</td>
</tr>
<tr>
<td>Number of observations</td>
<td>2112</td>
<td>528</td>
<td>528</td>
<td>528</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.16</td>
<td>0.13</td>
<td>0.24</td>
<td>0.26</td>
</tr>
</tbody>
</table>

*P<0.05. **P<0.01
Table 3. Effects of Starting Quarter Score and Game Location on quarter final outcomes in unbalanced team games (coefficients means with standard errors in parentheses).

<table>
<thead>
<tr>
<th>Variables</th>
<th>All quarters</th>
<th>Second quarter</th>
<th>Third quarter</th>
<th>Fourth quarter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting Quarter Score</td>
<td>0.33** (0.02)</td>
<td>0.55** (0.06)</td>
<td>0.44** (0.04)</td>
<td>0.26** (0.02)</td>
</tr>
<tr>
<td>Game Location</td>
<td>0.45* (0.20)</td>
<td>-0.23** (0.35)</td>
<td>0.68 (0.38)</td>
<td>0.23 (0.38)</td>
</tr>
<tr>
<td>Intercept</td>
<td>-0.23 (0.14)</td>
<td>0.01 (0.24)</td>
<td>-0.32 (0.27)</td>
<td>-0.11 (0.27)</td>
</tr>
<tr>
<td>Number of observations</td>
<td>672</td>
<td>168</td>
<td>168</td>
<td>168</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.30</td>
<td>0.35</td>
<td>0.48</td>
<td>0.43</td>
</tr>
</tbody>
</table>

*P<0.05. **P< 0.01
Table 4. Effects of Starting Quarter Score and Game Location on quarter final outcomes in balanced team games (coefficients means with standard errors in parentheses).

<table>
<thead>
<tr>
<th>Variables</th>
<th>All quarters</th>
<th>Second quarter</th>
<th>Third quarter</th>
<th>Fourth quarter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting Quarter Score</td>
<td>0.16** (0.20)</td>
<td>0.14* (0.05)</td>
<td>0.14** (0.03)</td>
<td>0.17 (0.03)</td>
</tr>
<tr>
<td>Game Location</td>
<td>0.30* (0.11)</td>
<td>0.60* (0.21)</td>
<td>0.22 (0.21)</td>
<td>0.08 (0.23)</td>
</tr>
<tr>
<td>Intercept</td>
<td>-0.15 (0.08)</td>
<td>-0.30 (0.15)</td>
<td>-0.11 (0.14)</td>
<td>-0.03 (0.16)</td>
</tr>
<tr>
<td>Number of observations</td>
<td>1440</td>
<td>360</td>
<td>360</td>
<td>360</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.05</td>
<td>0.04</td>
<td>0.06</td>
<td>0.10</td>
</tr>
</tbody>
</table>

*P<0.05. **P< 0.01
Running head: Situational variables in elite water polo.

Title: Effects of Game Location, Quality of Opposition and Starting Quarter Score in the outcome of elite water polo quarters.

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This study received no financial support