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Original Article

Offensive game-related indicators that differentiate winning and losing teams and their contribution to scoring a run in Olympic Softball

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Abstract:
Softball was played in the 2020 Olympic Games, after being excluded for two Olympiads, but with almost half of the games played in each Olympiad from 1996 to 2008. Thus, it is of interest to investigate the game-related indicators that differentiate winning and losing teams as well as their contribution to scoring a run, in an attempt to comprehend contemporary Olympic Softball using data from a past Olympic Tournament in which a much larger number of games was played. The purpose of the study was to examine the offensive game-related parameters that distinguish winning and losing teams in Olympic Softball tournaments and to identify the impact of offensive tactical situations where a run is more likely to be scored. Based on a notational analysis scheme, 2,946 game instants were processed using the Sportscout STA v.3.2 software. Crosstabulation analysis with the chi-square tests established that winning teams had significantly ($p < .05$) more fly ball batting occasions, had less batted balls in the catcher's area and more batted balls directed in the center outfield, as well as larger counts of players on bases, stolen bases and runs batted-in. A decision tree analysis using Chi-squared automatic interaction detection (CHAID) revealed that loading the bases with base-runners, batting the ball in the outfield, stealing a base when advancing the base-runners around the bases and using fly ball batting technique were essential to score a run in Olympic Softball. In conclusion, optimum batting action, fast sprinting, enhanced tactical decision making in batting, base-running and base-stealing contribute to the efficiency of the offensive game-related parameters that contribute to achieve a win at an Olympic Softball game.
Key Words*:* **- notational analysis; performance analysis; batting; decision tree analysis; team tactics**

Introduction

Softball is a team sport initially played in Chicago about 1887 (Arlott, 1975) in an effort to play baseball indoors (Hay, 1985). Thus, compared to baseball, softball is played in a field with smaller dimensions. In addition, a larger ball is used and it is batted with a smaller bat. Furthermore, the pitch should be executed with an underhanded motion and the duration of the game is shorter referred to the innings played (Kollias & Panoutsakopoulos, 2002).

As an Olympic sport, it is interesting to notice that baseball is played only by men, while softball, namely the fast-pitch softball, is played only by women. The inaugural official Olympic Softball tournament was held in 1996 and was consecutively conducted for four Olympiads (1996-2008), with the Olympic Team of the United States of America being the most successful as it won three gold medals. However, the International Olympic Committee (IOC) voted against its inclusion in the Olympic Games from 2012 onwards. The campaign organized by the International Softball Federation and the World Baseball Softball Confederation comprised an initiative for the reconsideration of the above IOC decision (Paton, 2010), that led to the inclusion of the Olympic Softball tournament in the Tokyo Olympic Games. However, almost half of the number of games played in each Olympiad of the 1996-2008 period was played in the 2020 Tokyo Olympic Games. Thus, it is of interest to examine the game-related indicators that differentiate winning and losing teams and their contribution to scoring a run, in an attempt to comprehend contemporary Olympic Softball using data from an Olympic Tournament.

A review of the literature suggested that less research evidence is present for softball compared to baseball (Flyger, Button, & Rishiraj, 2006). In general, softball is characterized by a low level of functional loading during competition (Huang, Li, & Liu, 1997). Recent studies conducted for the game of baseball examined either the association of fitness metrics with game-related parameters or the analysis of conventional game statistics in carefully-chosen combinations to evaluate the impact of a player in overall team performance, i.e., to score a run. As for the former, it was found that performance statistics in baseball are related with the outcomes of upper and lower limb strength and power tests (Papadakis, Padgett, Stamatis, & Karasch, 2021). As for the later, a large

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amount of the existing research evidence in baseball is referred to 'sabermetrics', namely the analysis of a baseball game using detailed performance data and relatively simple statistics, rather than qualitative methods based on the frequencies of common conventional statistics (Beneventano, Berger, & Weinberg, 2012). For example, it was found that the best predictor of runs scored for a team was the weighted on-base average, a primary statistic used in sabermetrics that combines, in just one parameter, all the different statistics that depict batting ability (Beneventano et al., 2012). No such analysis seems to have been conducted in Olympic Softball. Nevertheless, there is a growing number of studies examining the effect of game-related indicators on the outcome of specific tactical situations using Decision Tree Analysis (Koutsouridis, Lioutas, Galazoulas, Karamousalidis, & Stavropoulos, 2020; Symeonidou et al., 2021). Decision Tree Analysis is proposed to be a method with good applicability and results interpretation in team sports (Iván-Baragaño, Maneiro, Losada, & Ardá, 2021; Maneiro, Casal, Ardá, & Losada, 2019; Sarabia, Roldan, Henríquez, & Reina, 2021).

In order to win the game, a team has to bat the ball, to advance its players around the bases without awarded an out and to score more runs than the opponent (Kollias & Panoutsakopoulos, 2002). This is accomplished when the team is in offense and it is batting the ball. Thus, the first requirement to increase the possibility to score a run is the good batting performance. However, batting is quite a challenging task in fast pitch softball due to the proximity of the pitcher's plate to the batter's box (12.19 m) and the ability of the opponent pitchers to deliver a fast pitched ball that attains a speed of 24-27 m/s (Oliver & Plummer, 2011; Werner, Jones, Guido Jr, & Brunet, 2006; Wu, Semler, Russell, & Lu, 2019). The combination of these factors results to a limited time to react and to execute the swing of the bat (Flyger et al., 2006; Takamido, Yokoyama, & Yamamoto, 2019). In addition, the fast covering the base-to-base distance is important, as this technique element is comprised by the sprinting start/leading off the base, the fast base-running time and, if needed, the sliding towards the base (Coker, 1998; Haag, 2020; Marquardt et al., 2018; Massey, Brouillette, & Martino, 2018). An alternative manner to advance the base-runners around the bases is to steal a base, namely the case when a base-runner "attempts to advance to the next base or home plate during or after a pitch to the batter" (WBSC, 2017). It is suggested that base-stealing is a differentiating parameter between winning and losing teams in softball (Coker, 1998).

In Olympic Baseball, batting performance was found to be related with the number of runners on the bases (Papadimitriou, Nanakis, Kosta, & Taxildaris, 2007). In the same study, this factor had an effect on the batters' actions to direct the batted ball to specific areas of the infield and the outfield, in order to assist as many players to proceed to the next bases and, eventually, to score a run. To the best of our knowledge, no such information exists in the literature concerning Olympic Softball. As the game of softball is not widely known among Physical Education Teachers in Southeast Europe, it is necessary to identify the important elements of the game that need to be taught in an educational environment (Panoutsakopoulos, Alexandris, & Kollias, 2007). Thus, the purpose of the present study was to examine the game related parameters that distinguish winning and losing teams in Olympic Softball. A secondary aim was to identify and to quantify the offensive tactical situations that have an increased significance in the progress of the game and result to score a run. It was hypothesized that, alike Olympic Baseball, the existence of runners on the bases and directing the ball in the outfield will increase the chances to score a run.

Material & methods

Sample

The sample comprised of all 32 softball games played in the 2004 Olympic Games Softball Tournament that was held in Athens, Greece. Of those, 28 games were played during the preliminary round of the Olympic Softball tournament and four games were played during the play-offs that decided the Olympic medal winning teams. The data of the games were retrieved from the official reports and the notational analysis service ('*sportscout'*) that was active during the Athens 2004 Olympic Games (Papanikolaou, Kalliris, & Avdelidis, 2007; Sfingos & Tsimpiris, 2005). The study was conducted in line with the Declaration of Helsinki and the Institution's Research Committee Ethics Code. Informed consent from the competing athletes was not obtained, as the study was performed using data retrieved from publicly available broadcasts that it was to the players' knowledge upon participation in the event.

Instruments, data collection and analysis

The games were analyzed using the Sportscout STA v.3.2 (SportScout Group, Thessaloniki, Greece) software (Figure 1). An analysis scheme was created, taking as inputs eight game-related performance categories reflecting the efficiency of the batter and the behaviour of the base-runners, exploiting the in total 3,276,800 different ratings that can be entered in the software (Tsimpiris, Tsamourtzis, & Sfingos, 2001). In detail, the game-related parameters that describe the offensive performance were grouped in the following performance categories:

(1) Scoring, including i) the runs scored, and ii) the instances where no runs were scored.
(2) Inning, namely the inning in which the run was scored.
(3) Count on batter, including counts of i) 0-0, ii) 1-0, iii) 2-0, iv) 3-0, v) 0-1, vi) 0-2, vii) 2-1, viii) 3-1, ix) 3-2, x) 1-2, xi) 1-1, and xii) 2-2 balls and strikes, respectively.

(4) Type of the batting technique, including i) fly ball, ii) pop fly, iii) ground ball, and iv) bunt.
(5) Direction of the batted ball, including i) the pitcher's area, ii) the catcher's area, iii) the 1st base area, iv) the 2nd base area, v) the 3rd base area, vi) the short-stop's area, vii) the left field, viii) the center field, ix) the right field, and x) the foul territory.
(6) Outcome of the at bat performance, including i) base on balls, ii) force play, iii) single hit, iv) double hit, v) triple hit, vi) home-run, and vii) runs batted in.
(7) Presence of base runners, including i) base runner on 1st base, ii) base runner on 2nd base, iii) base runner on 3rd base, iv) base runners on 1st and 2nd base, v) base runners on 1st and 3rd base, vi) base runners on 2nd and 3rd base, vii) bases empty, and viii) bases loaded.
(8) Base stealing during the build-up of the run, including i) stealing 2nd base, ii) stealing 3rd base, iii) stealing 2nd and 3rd base, iv) stealing home-plate, and v) no base stolen.

Figure 1. Representational depiction of the inputs inserted in the analysis software.

In total, 2,946 game instances, as defined by pitched balls, were analyzed. The instances where the ball was batted into foul territory were excluded from the analysis, since this event comprises a game situation where no evolution to the game is allowed.

Statistical analysis

The statistical analyses were conducted using the IBM SPSS Statistics v.25 software (International Business Machines Corp., Armonk, NY), with the level of significance set at $a = .05$. At first, frequency and crosstabulation analysis using the χ^2 (chi-square) test were conducted to identify the differences concerning the groups of offensive performance categories between winning and losing teams. The strength of these differences was evaluated using the Cramer's V effect size that was interpreted according to the degrees of freedom (Kim, 2017). Two-sided pairwise Z-Tests for independent proportions after Bonferroni correction were run to examine winning vs. losing teams differences in each of the eight examined performance categories.

In addition, a decision tree analysis using CHAID (Chi-squared automatic interaction detection) growing method was utilized to examine the relationship of the examined game-related parameters (independent variables) with scoring a run (dependent variable). The lowest adjusted p value for each of the optimally merged category predictors was selected using the Bonferroni correction in order to split the nodes. The maximum tree depth, the minimum cases in the parent node and the minimum cases in child nodes were set to be 3, 10 and 5, respectively.

Results

In total, 133 runs were scored in the tournament (118 in the preliminary round and 15 in the play offs). The winning teams scored in total 120 runs against 13 runs scored by the losing teams.

Over half of the total runs scored occurred during the first, second and fourth inning (Figure 2). No differences ($\chi^2_{1,7} = 12.715$, $p = .079$, $V = .309$, large effect size) revealed for scoring within innings. However, winning teams scored significantly ($p = .002$) more runs in the 1st inning compared to the losing teams.

According to the inclusion criteria, 1,789 game instances were identified. Of those, 510 were not analyzed. These were the cases where the pitched balls were not batted and no offensive play (i.e., base-stealing) occurred.

In the remaining 1,279 instances, where an offensive action was observed, 104 were identified as including the occurrence of scoring one or more runs (8.2%), whereas no runs were scored in 91.8% of the studied cases.

Although the used types of the batting technique were not different ($\chi^2_{1,3} = 8.687$, $p = .122$, $V = .082$, small effect size), the winning teams directed the batted ball towards the outfield more frequently ($\chi^2_{1,8} = 22.503$, $p = .004$, $V = .133$, medium effect size) compared to the losing teams (Table 1).

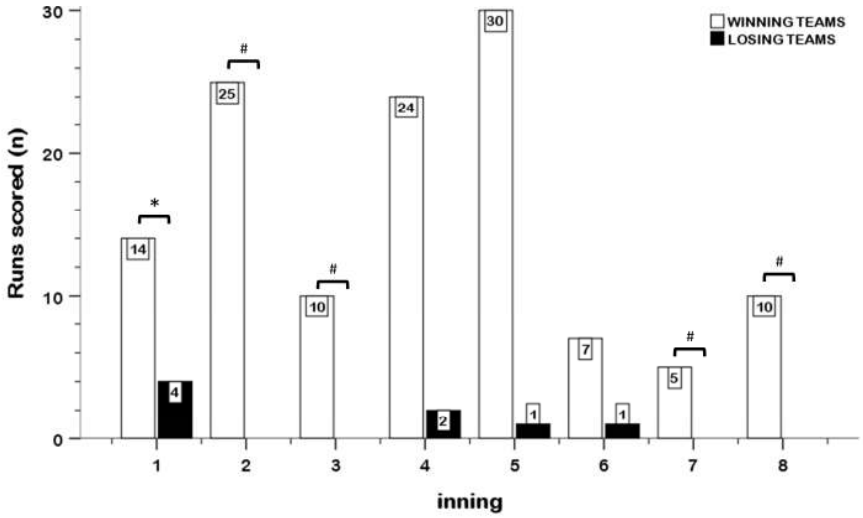

Figure 2. Frequencies of the runs scored per inning (n = 133). *NOTE:* *: $p < .05$ winning vs. losing teams; #: not used in the comparison as the proportion for the losing teams was equal to zero.

The losing teams also had inferior performance concerning the advancing of the batter to a following base, to achieve a home-run and to have a run batted-in ($\chi^2_{1,5} = 65.726$, $p < .001$, $V = .227$, large effect size). No significant differences ($\chi^2_{1,12} = 16.136$, $p = .136$, $V = .112$, small effect size) between the losing and the winning teams were observed concerning the count on the batter when an offensive action occurred (Figure 3). However, the pairwise comparisons after Bonferroni correction revealed that the losing teams had significantly ($p = .010$) more offensive actions than the winning teams when the count on the batter was 1-2 (balls and strikes, respectively).

Table 1. The offensive variables that depict the game-related parameters for batting performance and the difference between winning and losing teams.

OFFENSIVE VARIABLE	WINNING TEAMS *n*	WINNING TEAMS % within variable	LOSING TEAMS *n*	LOSING TEAMS % within variable	*p* (pairwise *Z*-test)
Batting technique					
i. fly ball	248	35.2	154	28.5	.013
ii. pop fly	67	9.5	69	12.8	ns
iii. ground ball	315	44.7	265	49.1	ns
iv. bunt	75	10.6	53	9.8	ns
Direction of the batted ball					
i. pitcher's area	141	20.0	101	18.2	ns
ii. catcher's area	9	1.4	20	3.7	.005
iii. 1st base	130	18.4	114	21.1	ns
iv. 2nd base	0	0.0	0	0.0	†
v. 3rd base	118	16.7	106	19.6	ns
vi. short-stop's area	75	10.6	7.2	13.3	ns
vii. left field	88	12.5	56	10.4	ns
viii. center field	88	12.5	43	7.9	.010
ix. right field	56	7.9	29	5.4	ns
Outcome of the at bat performance					
i. base on balls	58	16.4	39	24.1	ns
ii. single hit	156	44.2	102	63.0	ns
iii. double hit	21	5.9	11	6.8	ns
iv. triple hit	6	1.7	2	1.2	ns
v. home-run	11	3.9	0	0.0	#
vi. runs batted in	101	28.6	8	4.9	<.001

NOTE: ns: $p > .05$; #: not used in the comparison as the proportion for the losing teams was equal to zero. †: not used in the comparison as the proportion for the winning and losing teams was equal to zero.

The presence of base-runners was also different between the losing and the winning teams (Table 2), since the winning teams had proportionally more instances of runner(s) on a base ($\chi^2_{1,7}$ = 73.674, p < .001, V = .239, large effect size). Nevertheless, the pattern of base stealing was not significantly different between the winning and the losing teams ($\chi^2_{1,4}$ = 6.079, p = .108, V = .069, small effect size).

The CHAID analysis revealed a decision tree with a depth of 2 levels of branching, 12 nodes and 8 terminal nodes (adjusted p < .001, $\chi^2_{1,4}$ = 349.048). The decision tree included four independent variables, namely the presence of base runners, the direction of the batted ball, the occurrence of base stealing during the build-up for scoring the run and the type of the batting technique (Figure 4). The CHAID model correctly classified 92.2 % of the examined cases.

Table 2. The offensive variables that depict the game-related parameters for base-running performance and the difference between winning and losing teams.

OFFENSIVE VARIABLE		WINNING TEAMS *n*	WINNING TEAMS % within variable	LOSING TEAMS *n*	LOSING TEAMS % within variable	*p* (pairwise *Z*-test)
Base runners						
i.	bases empty	345	47.7	382	68.8	ns
ii.	on 1st base	129	17.8	89	16.0	ns
iii.	on 2nd base	80	11.0	29	5.2	<.001
iv.	on 3rd base	33	4.6	11	2.0	.012
v.	on 1st and 2nd	60	8.3	21	3.8	.001
vi.	on 1st and 3rd	25	3.5	11	2.0	ns
vii.	on 2nd and 3rd	27	3.7	4	0.7	.001
viii.	bases loaded	25	3.5	8	1.4	.025
Base stealing						
i.	No base stealing	710	98.1	545	98.2	ns
ii.	2nd base stolen	10	1.4	6	1.1	.045
iii.	3rd base stolen	3	0.4	4	0.7	ns
iv.	2nd and 3rd base stolen	1	0.1	0	0.0	#
v.	home-plate stolen	0	0.0	0	0.0	†

NOTE: ns: p > .05; #: not used in the comparison as the proportion for the losing teams was equal to zero. †: not used in the comparison as the proportion for the winning and losing teams was equal to zero.

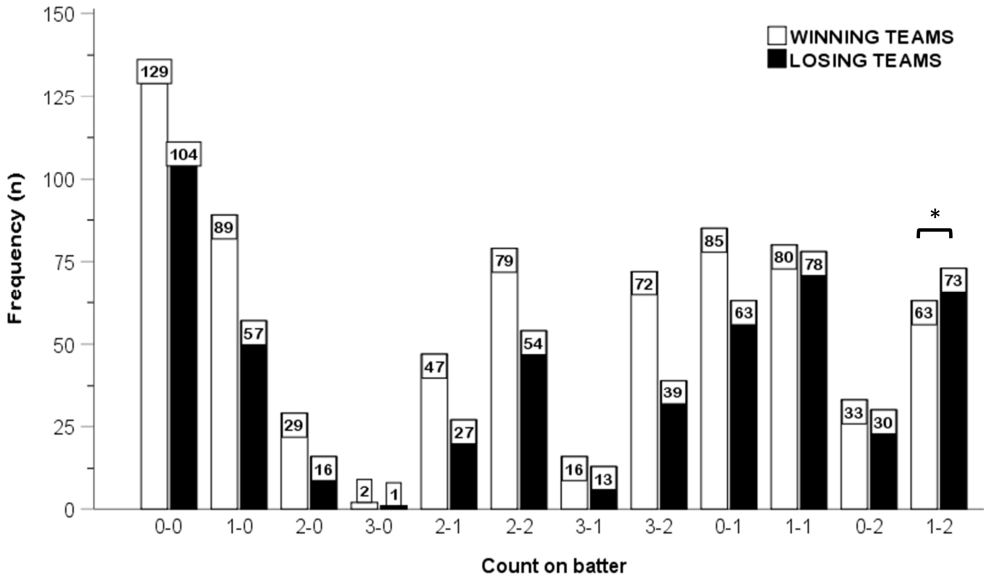

Figure 3. Ball and strike count on the batter in the analyzed game instances (n = 1,279).
NOTE: *: p < .05 winning vs. losing teams.

The presence of base runners comprised the first level of branching, while the other three independent variables were included in the second level. The concurrent existence of base-runners on the 2nd and 3rd base could predict the scoring of a run (n = 22, probability within the case: 71%). Nevertheless, the most occasions of run scoring (n = 36) were observed when there were base-runners on either both the 1st and 2nd base or in the situations where a base-runner was either on 2nd base or on 3rd base. As for the second level of branching, in the

case where a base-runner was on 1st base only, then a team needed a fly-ball hit or a pop-fly hit to score a run ($\chi^2_{1,1}$ = 10.890, adjusted p = .030). Stealing 2nd base, the instance when base-runners were concurrently on 1st and 3rd base and the game situation where all bases were loaded did not result to the occurrence of scoring a run ($\chi^2_{1,1}$ = 6.961, adjusted p = .025). Finally, the odds to score a run when all bases were empty were favorable towards scoring a run only if the ball was batted in the outfield ($\chi^2_{1,1}$ = 23.684, adjusted p < .001).

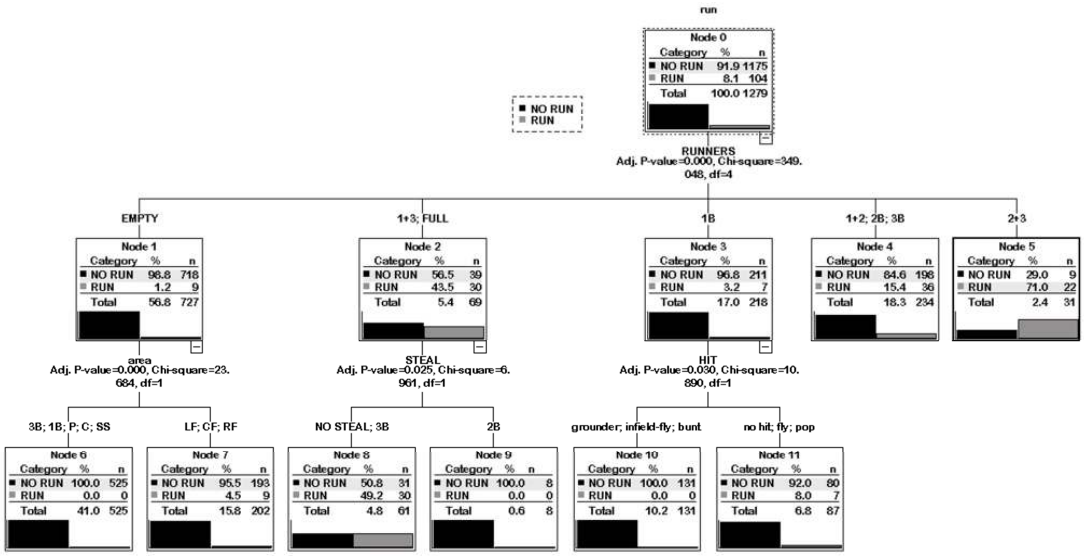

Figure 4. Decision tree diagram based on the examined run scoring instances analyzed in the Softball tournament of the Athens 2004 Olympic Games. *NOTE*: 1B: first base, 2B: second base; 3B: third base; 1+2: first and second base; 2+3: second and third base; 1+3: first and third base; P: pitcher's area; C: catcher's area; SS: short stop's area; LF: left fielder's area; CF: center fielder's area; RF: right fielder's area.

Discussion

The present study was conducted to identify the offensive game-related indicators that differentiate the winning and the losing teams and their contribution to scoring a run in Olympic Softball. Results revealed that winning teams significantly directed the batted ball towards the outfield more frequently, besides showing significantly larger occurrences of advancing players to bases, home-runs and runs batted-in. As for the game-related parameters associated with scoring a run, the majority of runs were scored with a concurrent existence of base-runners on two or more bases, while the ball had to be batted in the outfield in order to score a run when all bases were empty. Based on the above findings, the hypothesis of the study was confirmed.

The winning teams were shown to have more fly-ball batting technique occurrences than the losing teams. Fly-ball batting is used to direct the ball to the outfield. It was found that the winning teams led the batted ball in the center outfield twofold compared to the losing teams. In addition, the combination of the longer distance from the home-plate and the lesser the time for the outfielders to estimate the batted ball trajectory decreases the ball catch probability (Gerlica, LaDuke, O'Shea, Pluemer, & Dulin, 2020). Based on the above, hit-ball speed is essential to direct the ball in the outfield and to avoid a fly out. Hit-ball speed is suggested to be largely depended on the batting technical ability of the players (Smith & Kensrud, 2014). Thus, due to the limited time for swinging the bat (usually 0.2–0.3 s; Flyger et al., 2006; Messier & Owen, 1984; Milanovich & Nesbit, 2014), softball players, when at bat, should be able to rapidly acquire and process visual information based on peripheral vision, dynamic visual acuity, enhanced visual reaction time and coincidence-anticipation timing (De Lucia & Cochran, 1985; Kelling & Corso, 2018; Millslagle, 2000; Molstad et al., 1994; Takamido, Yokoyama, & Yamamoto, 2020). The above will assist them to execute their batting technique accordingly, given the high temporal constraints (Takamido et al., 2019). Another factor that determines hit-ball speed is the velocity of the pitched ball (Hay, 1985). It was found that a trend of decline in fastball pitched ball's velocity in multiple games exists, as this type of pitching requires maximal effort resulting in postgame fatigue in upper and lower limb muscles (Corben et al., 2015; Wu et al., 2019). This, along with the implementation of the mercy rule in five games and the 18 occasions of not playing the bottom of the 7th inning, since the winning team was already decided, could provide an explanation for the decreasing instances of scoring a run after the 5th inning.

The 3-0 and 3-1 ball and strikes count, respectively, are suggested to be good opportunities for the batter not to swing and to walk on balls to the first base (Albert, 2010b; Kneer & McCord, 1995; Noel & Jordan, 2004). In addition, the 3-1 count is suggested to be optimal for a base-runner to steal a base (Noel & Jordan, 2004). However, these counts had the least frequency of appearance in the examined game instances. Furthermore, the 3-2 count is believed to be an advantage for the batters, as the pitcher has to pitch in the strike zone (Kneer &

McCord, 1995). The present results revealed that the losing teams had almost half batting instances in the 3-2 count compared to the winning teams. Nevertheless, the losing teams had significantly larger proportion of batting actions when the count was 1-2 than the winning teams, namely when a strike-out was imminent. On the 0-0 count, the majority of balls were placed in play, confirming previous findings (Albert, 2010b). In baseball, the 3-2 and 3-1 counts correspond to high variability of the corresponding run values (Albert, 2010b). In the present study, CHAID analysis did not confirm an association of ball and strike count with scoring a run.

In professional baseball, the offensive average index, namely the bases a batter advances either by the outcome of his batting ability or by walking and stealing a base, divided to the times the player was at bat, was suggested to be a relatively adequate evaluator of offensive performance of a player due to its simplicity in calculation and its association with run scoring (Bennett & Flueck, 1983). The results of the CHAID analysis revealed that, in Olympic Softball, the number of players and their positioning around the bases, besides the direction of the batted ball that reflects the player's batting ability, should be considered as an important factor for scoring a run. This confirms the findings for the Athens 2004 Olympic Baseball tournament (Papadimitriou et al., 2007). In detail, CHAID analysis showed that all runs scored when the bases were empty was due to batting the ball in the outfield. In addition, the vast majority of run scoring instances were observed when the bases were fully loaded or with at least two base-runners on bases. The reason for this is that, as the team in offense loads the bases with more base-runners, the team in defense is obliged to solve multiple tactical problems that decreases its defensive effectiveness (Kollias & Panoutsakopoulos, 2002).

Besides avoiding being fly-out, running through rather than sliding to the first base was found to be significantly faster (Haag, 2020), aiding for the avoidance of being put-out at the 1st base. Among other cases, seven instances of run scoring when a base-runner was on 1st base were identified. Thus, sprinting for being safe on the 1st base is an important element when at offence. Sprinting ability is in general important for fast base-running in softball (Massey et al., 2018; Nimphius, Mcguigan, & Newton, 2010). However, when base-stealing, players cover the base-to-base distance slower than when they sprint an equal distance, due to the tentative tactical situation in the game (Craig & Johnson, 1985). It is of interest to note that it is suggested that slow base-runners, especially in baseball, should steal a base in close games in order to provide the team the opportunity to score a run (Katsunori, 2001). Nevertheless, stealing the 3rd base is not as frequently attempted as stealing the 2nd base (Turocy, 2005). The outcome of the present CHAID analysis could not confirm this. It was found that when the bases were fully loaded, or with base-runners on 1st and 3rd base, stealing the 2nd base did not result to score a run. In any case, the optimum technique for the start of the sprint during the lead-off from the base, when aiming to a base-steal, should be selected (Marquardt et al., 2018; Massey et al., 2018; Miyanishi, Endo, & Nagahara, 2017).

As already discussed, the area where the batted ball is directed after the hit is defined by the batting ability of the players. Spatiotemporal adjustments in the stance and the timing of the swinging of the bat, along with selecting when to hit the ball during the swing is a technique element (i.e., place-hitting technique) that allows batters to direct the ball in selected areas of the field (Kneer & McCord, 1995). It is evident from the CHAID analysis that runs were not scored with a base-runner on 1st base if the batter selected to bunt or the ball was either batted on the ground or high in the air, causing an infield-fly. Control pitchers are suggested to keep the ball down, aiming for limiting the occasions of long ball hits and enhancing the opportunities for ground-outs (Craig & Johnson, 1985).

There are some limitations in the study, as the batters' performance and its fluctuations due to the interaction with the opponent pitchers' performance (Craig & Johnson, 1985) was not considered in the analysis. Although the method to simultaneously model both batter and pitcher performance in the same analysis comprises a common unsolved methodological topic in the respective baseball literature, no correlation was found between the number of runs allowed and batters faced in different innings of the same game (Rosner, Mosteller, & Youtz, 1996). In addition, a possible shifted defensive alignment of the fielders was not adopted for the input regarding the area of direction of the batted ball. The shifted defensive alignment is suggested to increase the probabilities to catch a batted ball in the outfield (Gerlica et al., 2020). The lateral dominance for executing the batting and the exit from a base or from the batter's box alone or in combination with the arm dominance of the pitcher was also not examined. It is suggested that these factors have an effect in performance and the outcome of various offensive skills (Albert, 2016; Hay, 1985; Kollias & Panoutsakopoulos, 2002).

Besides taking into consideration the above limitations, future research should consider matching the team's batting line-up against the opposing pitcher (Chang, 2021). It will be also of interest to further investigate the possibilities to score a run in a play-by-play and/or a pitch-by-pitch sequence (Albert, 2010a), taking also into consideration the type of pitch thrown (i.e., fast-ball, curve-ball, etc.) and the exact bunting actions (i.e., sacrifice bunt, squeeze bunt, drag bunt, push bunt, etc.).

Conclusions

The present analysis of the games played in the Athens 2004 Olympic Softball tournament revealed that loading the bases with base-runners is essential in order to score a run. Nevertheless, further game-related parameters are also important to score a run in Olympic Softball. These parameters were the direction of the

batted ball, the stealing of a base when advancing the base-runners around the bases and the type of the batting technique. Based on the present findings, it was concluded that the winning teams had more fly-ball batting occasions, had less batted balls in the catcher's area and had more batted balls directed in the center outfield, besides having larger counts of players on bases, stolen bases and runs batted-in. A run was most probable to be scored with base-runners on the 2nd and the 3rd base and scoring a run was associated with the tactical situation to direct the batted ball in the outfield when the bases were empty, added the action to steal the 3rd base in the process to load all bases with runners and to bat the ball with a fly-ball technique when a base-runner was on 1st base.

The differences observed in the present study between the winning and the losing teams provide an insight about the important elements of performance in order to win an Olympic Softball game. Optimum batting action, fast sprinting, enhanced tactical decision making in batting, combined with efficient base-running and base-stealing are suggested to be contributing to the efficient appearance of the offensive game-related parameters that result to win an Olympic Softball game. All these factors can be optimized through a better training plan, in order for Olympic Softball players to improve their performance in the offensive game-related parameters and to exploit their chances to contribute to scoring run and thus to win a game in Olympic Softball tournament.

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