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**AN ANALYSIS OF TEMPORAL NUMERICAL SUPERIORITY IN THE PAN-AMERICAN JUNIOR MEN'S WATER POLO MATCHES****ANÁLISE DA SUPERIORIDADE NUMÉRICA TEMPORAL NO PAN-AMERICANO JÚNIOR DE POLO AQUÁTICO MASCULINO****Guilherme Tucher<sup>1</sup>, Marco Antônio Pardal<sup>1</sup>, Francine Caetano de Andrade Nogueira<sup>1</sup>, and Silvio de Cassio Costa Telles<sup>1</sup>**<sup>1</sup>Federal University of Rio de Janeiro, Rio de Janeiro-RJ, Brazil.**RESUMO**

Esse estudo teve por objetivo comparar a frequência, a quantidade de gols e a eficiência do ataque em superioridade numérica temporal entre equipes vencedoras e perdedoras e entre partidas equilibradas e desequilibradas em competição júnior de polo aquático masculino. Também foi testada a relação entre a ocorrência do placar equilibrado ou desequilibrado com a eficiência em realizar gols em superioridade numérica nos jogos das equipes vencedoras. Foram analisadas 56 partidas do Campeonato Pan Americano Júnior de Polo Aquático Masculino. As equipes foram classificadas como perdedoras ou vencedoras e o resultado da partida como equilibrado ou desequilibrado. Teste Mann-Whitney e o qui-quadrado foram utilizados. Não há diferença significativa na ocorrência de superioridade numérica entre vencedores e perdedores ( $p = 0,25$ ) apesar dos vencedores fazerem mais gols ( $p = 0,002$ ) e serem mais eficientes ( $p < 0,001$ ). Não há diferença significativa na ocorrência de superioridade numérica ( $p = 0,81$ ) e de gols ( $p = 0,03$ ) nas partidas equilibradas e desequilibradas. Entretanto, nas partidas desequilibradas encontrou-se maior eficiência no arremesso ( $p = 0,01$ ). Foi encontrada relação significativa ( $p = 0,04$ ) entre a eficácia das equipes vencedoras em realizar gol em superioridade numérica com o placar desequilibrado.

**Palavras-chave:** Desempenho atlético, Superioridade numérica temporal, Análise do desempenho, Análise de jogo.**ABSTRACT**

This study compared the frequency, number of goals and attack efficiency in temporal numerical superiority among winning and losing teams and among balanced and unbalanced matches in a junior men's water polo competition. Another analysed relationship was that between a balanced or unbalanced final score and the efficiency at scoring goals in numerical superiority in the winning teams' games. A total of 56 matches from the Pan-American Junior Men's Water Polo championship was analysed. The teams were categorised as losers or winners and the match results were classified as balanced or unbalanced. The chi-squared and Mann-Whitney tests were used for statistical treatment. There is no significant difference in the occurrence of numerical superiority between winners and losers ( $p = 0.25$ ) despite the winners scoring more goals ( $p = 0.002$ ) and being more efficient ( $p < 0.001$ ). There is no significant difference in the occurrence of numerical superiority ( $p = 0.81$ ) and goals ( $p = 0.03$ ) in balanced and unbalanced matches. However, there tends to be a higher shot efficiency ( $p = 0.01$ ) in unbalanced matches. A significant relationship exists ( $p = 0.04$ ) between the winning teams' efficiency at scoring goals in a situation of numerical superiority and an unbalanced score.

**Keywords:** Athletic performance; Power play; Performance analysis; Notational analysis.**Introduction**

Water Polo (WP) requires a high level of physical conditioning for its practice, as well as good technical and tactical levels<sup>1</sup>. Just as in other team sports, the goal of achieving numerical superiority when attacking is constantly sought as it makes it easier to score a goal<sup>2,3</sup>. In WP, numerical superiority tends to occur with more ease in counter-attacks and exclusions<sup>3</sup> for defensive fouls, giving the attacking team 20 seconds of temporal numerical superiority (H+). Despite H+ attacks being less frequent than those in numerical equality, they represent one of the best opportunities to score goals<sup>2,3</sup>.

The number of goals scored in a situation of numerical superiority (GH+) and the efficiency of an attack in this condition (IEH+) are also situations that can be analysed in the matches<sup>3-5</sup>. A team with a low IEH+ has higher chances of losing the match, while a medium or high IEH+ is associated with the team's victory<sup>4,5</sup>. Even so, the IEH+ can be considered low in different events, reflecting the need to improve the players' technical and tactical skills<sup>5,6</sup>. Despite recognizing the importance of IEH+ in victories and its use as an evaluation

tool<sup>4,5</sup>, studies on GH+ and IEH+ in competitions from different levels are still necessary in order to better understand the subject<sup>7</sup>. This need is even more relevant if we think of the development of young water polo athletes.

To analyse the frequency of H+, GH+ and IEH+ based on the difference in scores between teams becomes even more important than simply classifying the teams as winners and losers<sup>5,7</sup>. There are studies that discuss the occurrence of H+ in the adult male or female categories<sup>7,8</sup>, but only one of them touched upon the importance of IEH+<sup>5</sup>. To the present moment, this is the first study of this nature conducted with young water polo players that takes into account the difference in the final match scores in an official competition. Furthermore, it compares the performance of the winning teams with different score conditions with that of the losing teams.

The present study has three objectives: to compare the frequency of temporal numerical superiority (H+), the scoring frequency in temporal numerical superiority (GH+) and attack efficiency in temporal numerical superiority (IEH+) between (i) the winning and losing teams and (ii) between matches with a balanced or unbalanced score in the Pan-American Junior Men's Water Polo Championship. Another objective is (iii) to test the relationship between the occurrence of balanced or unbalanced scores with the numerical superiority efficacy index in the winning teams' games.

## Methods

### *Sample*

The study analysed a total of 56 matches from the Pan-American Junior Men's Water Polo Championship that occurred in 2014 (n=36) and 2018 (n=24) from a total of 60 matches. Four matches were not used as they ended with a tied score. The information was obtained from the match summaries available on the USA Water Polo website.

### *Procedures*

The teams were classified as "losers" or "winners" based on their results. However, due to the average difference in the number of goals scored by a team, the match was categorized as "balanced (when the difference in the number of goals was below or equal to the average) or "unbalanced" (when the difference in the number of goals was above average). The option was made to not adopt a preestablished value for the goal difference in the final score to consider a match balanced or unbalanced<sup>7</sup>. With this, it seems that the event's own characteristics can be considered.

The numerical superiority efficacy index (IEH+) was obtained through the following equation:  $IEH+ = (H+ / GH+) \times 100$ ; where IEH+ represents the numerical superiority efficacy index, H+ represents the number of situations that occurred in a state of temporal numerical superiority and GH+ represents the number of goals scored in H+. An IEH+ of up to 50% is considered "low" efficacy, while an IEH+ from 51% upwards receives the classification of "high" efficacy.

### *Statistical analysis*

Average and standard deviation were used to describe the data relative to the occurrence of H+, GH+ and IEH+ in two conditions: (i) comparisons between winning and losing teams and (ii) comparisons of the winning teams' matches classified as balanced or unbalanced. Afterwards, for the same cases, data normalcy was verified through the Shapiro-Wilk test. The Mann-Whitney exact test was employed to conduct comparisons between the groups. Due to the belief that (i) the winning teams have a higher opportunity for GH+ and IEH+ and (ii) in unbalanced matches there is a higher GH+ and IEH+, unilateral probability

was chosen and, in this case,  $p \leq 2$  was considered. However, for H+, as there was no type of prediction,  $p \leq 5$  was considered. The effect size was calculated with the equation  $r = \frac{Z}{\sqrt{n}}$ ; in which r represents the effect size, Z is the z-score and n is the sample size. An effect size is small when  $r = 0.1$ , medium when  $r = 0.3$  and large when  $r \geq 0.5$ <sup>9</sup>.

The chi-squared test was used with the objective of investigating the existence of a correlation between the classification of a match's goal difference and the IEH+. Cramer's V test measured the degree of association between these variables. In case of a positive association, the effect size was calculated using relative risk. Relative risk is the most useful measure of effect size for categorical data (Field, 2009) and was calculated through the ratio between the chance of a high IEH+ and the chance of a low IEH+.

That is:

$$\text{Chance}_{\text{highIEH+}} = \frac{\text{cases of high performance with large score difference}}{\text{cases of high performance with small score difference}}$$

$$\text{Chance}_{\text{lowIEH+}} = \frac{\text{cases of low performance with large score difference}}{\text{cases of low performance with small score difference}}$$

$$\text{Thus, the Relative Risk} = \frac{\text{Chance}_{\text{highIEH+}}}{\text{Chance}_{\text{lowIEH+}}}$$

## Results

The average difference in the number of goals between the winning and the losing teams was of  $7.98 \pm 5.81$  goals. Thus, the matches with up to eight goals of difference were considered balanced ( $\leq 8$ ). There was no significant difference in the frequency of H+ ( $p=0.25$ ) between the winning and losing teams. However, the winning teams had a significantly higher GH+ ( $p = 0.002$  e  $r = -0.26$ ) and IEH+ ( $p < 0.001$  e  $r = -0.33$ ) than the losing teams. No significant difference was found in the frequency of H+ ( $p = 0.81$ ) and GH+ ( $p = 0.03$ ) in both match classification conditions (balanced or unbalanced) for the winning teams. However, the teams that won the unbalanced matches had a significantly higher IEH+ ( $p = 0.01$  and  $r = -0.31$ ). The descriptive statistics pertaining to these variables for the winning teams vs losing teams and for the winners of the balanced matches vs unbalanced matches are shown in Table 1.

**Table 1** – Descriptive statistics for the temporal numerical superiority situations (H+), goals scored in temporal numerical superiority (GH+) and the index of numerical superiority efficacy (IEH+) for winner vs loser and winner in balanced match vs unbalanced match conditions

Variables	Winners	Losers	Balanced	Unbalanced
H+	$6.6 \pm 3.0$	$7.1 \pm 2.5$	$6.5 \pm 2.9$	$6.6 \pm 3.1$
GH+	$2.6 \pm 1.9$	$1.6 \pm 1.1\#$	$2.2 \pm 1.7$	$3.2 \pm 2.0$
IEH+ (%)	$38.2 \pm 22.7$	$24.2 \pm 16.4^*$	$32.2 \pm 20.0$	$46.8 \pm 24.0^{**}$

**Note:** differences #  $p = 0.002$  and \*  $p < 0.001$  in relation to the winning team; \*\*  $p = 0.001$  in relation to the balanced match

**Source:** Authors

When the winning team showed an IEH+ that is considered low, 66.7% of the matches ended with a balanced score ( $\leq 8$  goals) and 33.3% with an unbalanced score ( $> 8$  goals). On the other hand, when the winning team's IEH+ is high, only 35.7% of the matches ended with a balanced score and 64.3% ended with an unbalanced score, as shown in Table 2.

**Table 2** – Contingency table for the relationship between the variables pertaining to the classification of the score difference in a match and the Index of Numerical Superiority Efficacy (IEH+) in the winning teams' games

Difference in the score	Evaluation criterium	Index of Numerical Superiority Efficacy (IEH+)		
		Low	High	Total
Balanced	Frequency	28	5	33
	% in Group	84.8	15.2	100.0
	% in IEH+	66.7	35.7	58.2
	% of total	50.0	8.9	58.9
Unbalanced	Frequency	14	9	23
	% in Group	60.9	39.1	100.0
	% in IEH+	33.3	64.3	41.1
	% of total	25.0	16.1	41.1
Total	Frequency	42	14	56
	% in Group	75.0	25.0	100.0
	% in IEH+	100	100	100.0
	% of total	73.2	26.8	100.0

Source: Authors

A significant association (CP,  $X^2(1) = 4.15$ , ( $p = 0.04$ ) was found between the IEH+ of the winning teams and the classification of the matches' results. Cramer's V test was considered low and significant ( $r = 0.27$  and  $p = 0.04$ ). This seems to represent the fact that, from the relative risk, it is possible to state that a winning team with a high IEH+ has 3.6 more chances of finishing the match with a score difference larger than 9 goals (unbalanced match). That is, there were 3.6 times more chances to finish the match with more goals than the average of goals scored in the analysed matches.

## Discussion

The present study analysed the amount of temporal numerical superiority situations (H+), goals scored in temporal numerical superiority (GH+) and Index of Numerical Superiority Efficacy (IEH+) in 56 matches from the Pan-American Junior Men's Water Polo Championship in 2014 and 2018. Firstly, it was possible to observe that there is no significant difference in the occurrence of H+ between the winning and the losing teams ( $p = 0.25$ ) in a match. Despite this, the winning teams had a higher GH+ ( $p = 0.002$  and  $r = -0.26$ ) and IEH+ ( $p < 0.001$  and  $r = -0.33$ ). It was also possible to observe that there was no significant difference in H+ ( $p = 0.81$ ) and GH+ ( $p = 0.03$ ) between the balanced matches ( $\leq 8$  goals) and the unbalanced ones ( $> 8$  goals). However, the unbalanced matches had a significantly higher IEH+ ( $p = 0.01$  and  $r = -0.31$ ). There was also another significant correlation (CP,  $X^2(1) = 4.15$ , ( $p = 0.04$ ) found between the IEH+ of the winning teams and the match result classification.

The teams that won and lost the matches from the analysed championship had statistically equal chances of scoring goals in temporal numerical superiority (H+). The same occurred in matches with balanced and unbalanced scores. A similar result is found in various other studies involving players of both sexes and at different performance levels<sup>3,4,10,11</sup>. However, a study with women's teams in the world championship demonstrated that H+ was different for medallist and non-medallist teams in the competition's preliminary phase<sup>12</sup>.

In women's team with a similar performance level, more goals are scored in counter-attacks and in attacks with numerical equality than in H+<sup>12</sup>. On the other hand, with men's

teams, also in the world championship, the teams that won and lost the matches classified as balanced ( $\leq 3$  goals) had more H+ opportunities than the teams that won and lost with unbalanced scores ( $> 3$  goals). This is an indicator of a greater importance for H+ in men's teams when performance levels are similar<sup>3</sup>.

In unbalanced matches, the defences of losing teams generally do not offer much resistance and the goals happen due to counter-attacks and the use of defensive systems that wait for the attacking team's error, whether due to a poorly executed shot or a passing mistake. There isn't as much use of the total attack time, as the opportunities to score goals are more frequent. On the other hand, in balanced matches, the attacks use more ball possession time to obtain more scoring opportunities. Thus, in these circumstances, H+ becomes a differential, as there will be more chances for a shot to happen in conditions in which the attacker is not being marked.

Around 23.7% of shots in women's games in the world championship happened in an H+ situation. This frequency was only lower than that found for attacks in situations of numerical equality (57.5%)<sup>12</sup>. Thus, the situations with positional attacks in numerical equality that lead to the exclusion of defenders must be a part of the players' training routines. This can happen mainly through attack training that uses the centre player as a reference<sup>7</sup>. Either way, it is necessary to consider the team's performance level, the moment of the championship and the players' sex. Furthermore, the better physical and technical condition of higher performance athletes seems to allow higher quality defensive moves that impede the opponent's shots in H+ situations<sup>12</sup>.

The men's teams that won the balanced matches in the world championship did not score more GH+ than the losers in this group or the winners of unbalanced matches<sup>3</sup>. This may happen because in a balanced match, H+ times tend to be similar for both teams, as their technical and tactical levels are closely matched. As for not scoring more GH+ than the winners of unbalanced matches, this occurs because the fragility of the losing team's defence does not bring about situations that lead to H+ and the goals tend to happen under different circumstances, such as in counter-attacks, medium/long-distance shots or in shots scored by the centre player.

Also in world championships, women's teams that won the unbalanced matches score more GH+ and tend to not pass over this opportunity<sup>7</sup>. This result merely confirms that when losing teams offer an H+ situation, they cannot avoid a goal, either due to the other team's quality or due to their own inefficiency in marking the other team during H+. These same results were found in a study with women's teams that participated in another edition of the same championship. In this case, the winners of the unbalanced matches scored more GH+ than the winners and losers of balanced matches and the losers of unbalanced matches<sup>10</sup>. This can be explained by the technical and tactical discrepancies present among teams with higher score differences, with the opposite occurring with well-matched teams in which the defensive marking is well conducted, making it more difficult to score goals in an H+ situation. There are moves in which expulsion is chosen to avoid a goal, with the idea that a well-organized H+ defence can avoid the goal that was previously imminent.

Another study conducted with data from international women's championships found that there are significantly more GH+ scored by the winning teams than by the losing teams in the preliminary matches<sup>8</sup>. However, in the classifying and final stages, this GH+ difference did not exist<sup>8</sup>. In the present study, conducted with young male players, the GH+ was only different between winners and losers, but not between the winners of balanced and unbalanced matches. Considering this, it appears that GH+ must be analysed keeping in mind the players' sex, the competition stage and the teams' performance levels. Either way, the cited studies<sup>7,8,12</sup> did not consider the IEH+, which was shown to have a stronger influence

on match results in the championship that was analysed in this current study than the mere occurrence of GH+.

Even though the previous studies<sup>3,7,8,11</sup> consider the importance of H+ and GH+ as technical and tactical team performance indicators, they do not bother to calculate the IEH+. The IEH+ is possibly more important than the GH+ as it represents the team's efficacy in taking advantage of H+ occurrences. In this sense, this is a variable that should be considered in studies of this nature<sup>4,5</sup>. The eight best teams in the world championship were classified as winners (medalists), intermediate (fourth and fifth places) and losers (sixth to eighth places). Just as in our study, the amount of H+ was similar among the groups. However, the teams classified as winners ( $54.2\% \pm 12.7$ ) and losers ( $56.4\% \pm 18.9$ ) showed a higher IEH+ than the intermediate teams ( $34.3\% \pm 10.7$ )<sup>4</sup>. This result shows a higher average IEH+ than that of the present study (which varied from  $24.2 \pm 16.4$  for the losing teams to  $46.8 \pm 24.0$  for the winners of unbalanced matches).

Some of the studies analysed the behaviour of the variables in question in relation to the moment of the competition<sup>8,12</sup>. Although this question was not considered specifically, it is possible to believe that most unbalanced matches occurred in the teams' initial classification stage in the Pan-American Junior Men's Water Polo Championship. This occurs due to the participation of teams with lower performance and tradition in the sport<sup>8,10</sup>. Thus, this is a matter that should be considered in new studies.

The criteria that were used to classify a match as balanced or unbalanced were different from those used in the literature<sup>3</sup>. This procedure was adopted with the intent to consider the Junior Pan-American Championship's particularities. In various matches, the score difference was higher than 10 goals and in some, higher than 20 goals. This was to be expected as this competition has a lower technical and tactical level than senior competitions. What differentiates junior athletes from senior athletes is not the basic anthropometric conditions, but the specific technical and physiological performances. These conditions are acquired through intense and specific training throughout the years of preparation<sup>13</sup>.

It is important to highlight that water polo underwent some rule changes that are gradually being applied in the more recent competitions. These changes can alter the occurrence of H+ and even GH+<sup>14</sup>. Thus, it is important to conduct new studies, analysing the impact of these changes in the sport's dynamics and their effects on athlete behaviour. Furthermore, it is important to verify whether the results of the present study, especially those pertaining to IEH+, are similar in women's teams, in athletes of other age groups and in competitions of different magnitudes.

## Conclusion

There was no difference found in temporal numerical superiority situations among the winning and losing teams in the Pan-American Junior Men's Water Polo Championship. However, the winning teams scored more goals in numerical superiority and showed a better numerical superiority efficacy index. This index was also higher among the winning teams in the unbalanced matches. Furthermore, the winning team that possesses a high numerical superiority efficacy index has 3.6 times more chances of ending the match with an unbalanced score. These results show the importance of the numerical superiority efficacy index for a match's final score, serving as an incentive for enhancing such situations in routine practices.

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