Original Article

**The connection between the success of a team at one-on-one battles
in the defensive phase of the game and the final results of ice hockey matches
in the National Hockey League and the 2018 Winter Olympic Games**

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Abstract

The objective of this research was the outcome of one-on-one battles between players in the defensive phase of the game. We conducted an indirect observation of 10 National Hockey League matches and 10 2018 Winter Olympic Games matches, focusing on the frequency of successful one-on-one battles in the defensive phase of the game and how and in which zone they occurred. We recorded each successful one-on-one battle in the defensive phase of the game, in all three zones of the ice hockey rink. We assumed that there is a statistically significant relationship between the successful one-on-one battles in the defensive phase of the game and the final result of an ice hockey match. We used the Mann-Whitney U-Test to determine a relationship between success in one-on-one battles and the final result of a match and we used the significance test of two relative values to compare the acquired data. To find out the effect size, we calculated Cohen's *r*. We determined the 5% statistical significance level in both statistical tests. The relationship between success at one-on-one battles in the defensive phase of the game and the final result of a match has proven to be statistically significant. We calculated the number of successful one-on-one battles according to methods of stealing the puck and the zones of the ice rink, and confirmed our hypotheses. In the matches of the National Hockey League we observed that there was a higher number of successful one-on-one battles than at the Winter Olympics Games in 2018. Using the information that we obtained, we concluded that it is possible to gain an advantage when creating a training programme by instructing players of each position what is required of them in one-on-one situations during matches, and increasing the amount of training in the one-on-one situation according to player position and zone.

Key words: ice hockey, one-on-one battles, defensive phase of the game, National Hockey League, Winter Olympic Games

Introduction

Ice hockey is a team sport full of unique actions, goals, technique, tactics, one-on-one battles and according to Montgomery, Nobes, Pearsall and Turcotte (2004) also a sport characterised by high-intensity intermittent skating and rapid changes in direction and velocity with frequent body contact. Despite the fact that ice hockey is a game played in a limited space, it is so quick and exciting that a spectator only finds himself disinterested or bored during interruptions in the game or commercial breaks. This is the product ice hockey offers to the world market.

Ice hockey is basically a really simple sport, however, it is constantly evolving, forcing players to achieve higher performance levels. Achievement of the highest performance level is a fundamental requirement of the training process in every sport. Even the success of the most talented players depends on him consistently achieving the highest levels of performance as in every team sport, the talent of an individual player is just a drop in the ocean. Ice hockey is a team sport and the performance of the team is determined by the individual performance level of the players. A team performance is defined as a complex conduct that depends on the capability of a player to deal with the various facets of the game, including fitness requirements, specific motor skills and decision-making, in terms of conjunction with partners and opposition to objectors (Nadeau, Godbout, Richard 2008). Lehnert, Novosad and Neuls (2001) claim that the individual game performance is displayed in the individual skills of the player in every occurrence. Individual game performance is limited by a distinctive motoric and psychological predisposition and also by an ability to enforce them in a game. The individual playing skills of a player are determined by various factors. We could mention bioenergetic, biomechanical, somatic, psychological deformation factors and requirements of coaches.

According to Kačáni (2000), in the collective meaning of team sport, the players are interdependent. The failure of an individual is also the failure of the whole team. Peyer, Pivarnik, Eisenmann and Vorkapich (2011) define the difference between an individual game performance and the game performance of the team.

In individual sports, particularly in those where the aim is quite direct, there are fewer aspects of performance to be reviewed. In team sports, the opposite is true, as the skills of many different players need to be in harmony with the tactics of the coach in order to be successful. In ice hockey, according to Tóth (2002), the game which you see is a result of the game performance of the team and also of the individuals. Pavliš (2000) claims, that ice hockey as a team sport is markedly limited by the level of the game performance of the team. Teams that do not have expressive, talented players can win against teams with highly skilled players, if they are on a higher individual game performance level. According to Michel and Mooreová (1999) game performance in ice hockey is denoted as a multi-dimensional phenomenon with a considerable level of force, speed and coordination components. Players are, according to Chan, Cho and Novati (2012) also usually differentiated by their individual game performance. According to Šiška and Kováčiková (2017) the level of game performance is determined by many factors. One of the most important of them is the physical performance of the player that affects the performance level of young ice hockey players.

Quinney, Dewart, Game, Snyder, Warburton and Bell (2008) studied the physiological profile of professional players of the National Hockey League (NHL). In a period of 26 years they came to the conclusion, that most of the anthropometric and physiological indicators emerged within this period. After considering this study, we are able to claim that for the physical contact and nature of the NHL there is a need for heavier and taller players. According to Sigmund, Kutáč, Kudláček, Kvintová, Kohn and Sigmundová (2016), body height and body weight are the elementary somatic indicators that primarily inform about dispositions of athletes, taking into account their specialisation and gaming position. Tóth (2003) claims that probably the most important determinant in the final outcome is the mental condition of a player. Thomas (2006) claims, that in sports such as ice hockey, it is difficult to separate offence and defence, as control of the play is often difficult to determine.

Tóth, Andrejkovič, Bača, Filc, Jurčenko, Jurica, Kožanová, Munka, Pokovič, Šťastný and Výboh (2010) state that it is important for every ice hockey coach to be interested in the objective analysis of the game. According to Peráček (2018), analysis of the sport must be complex, otherwise a possibility of distorted reality arises and conclusions that could be in discrepancy with sport practice. Peráček (2004) states that we recognise two phases of the game in matches and they run simultaneously. According to McSorley (2009), game transition from the offensive phase of the game to the defensive phase of the game (DFG) is the most important of all game sections.

If a player wants to be successful in the DFG, it is necessary for him to limit the space and time of the attacking player and persistently steal the puck. The next important point is to get the opponent with the puck into a harmless position and prevent him from shooting on goal (Gendron and Stenlund, 2002). The defenseman needs to have a high level of skating skills according to Lafontaine, Lamontagne and Lockwood (1998) and in their comparison of the frequency of ice-skating skills of different playing positions, they found that defensemen spent more time travelling backwards and changed their skating direction more often than attacking players.

Tabrum (2014) claims, that a one-on-one situation occurs in five consecutive cases if every player fulfils their defensive duties accordingly. According to Vajja (2016), in defence there always should be at least one player responsible for an opposition player when the attacking team is in possession of the puck. The responsibility of this defensive role dramatically changes if we realise where the opponent's player is at any moment. Defence mostly depends on calculating the weaknesses of your opponent's offence.

Besides that, the purpose of the defence is to eliminate the chance of conceding a goal, according to Kostka (1984) the next purpose is to get possession of the puck and take the opportunity for transition to offence.

One of the breakpoints and also most important characteristic signs of a game performance are one-on-one battles and the productiveness of a team at one-on-one battles (Martikainen 2011). Eskola and Piispanen (2014) agree with this claim, that ice hockey is a sport full of various situations with one-on-one battles. We can see various ways to steal the puck from the opponent.

Eskola and Piispanen (2004) differentiate various ways of stealing the puck from the opponent on brush, bump, body contact, body-check, blow up hit and incidental contact.

MacPherson, Rothman and Howard (2006) define a one-on-one battle as an individual defensive tactic attempting to steal the puck from the opponent's possession within the rules. Tuominen, Stuart, Aubry, Kannus and Parkkari (2015) in their 7-year study of ice hockey injuries on World Championship and Winter Olympic Games tournaments stated, that 528 injuries in 511 incidents were reported in 844 games. What was probably unexpected, was that 68.5 % of injuries occurred away from the boards. The three most common causes of injuries were body-checking (27.2%), stick (21.1%) and puck (12.3%) contact. Bukač and Šafařík (1971) define one-on-one battles in ice hockey as a direct battle for the puck, which has combative character. It is not only ice hockey on a professional level that is associated with injuries. Pfister T., Pfister K., Hagel, Ghali, Ronksley (2016); Emery, Black, Kolstad, Martinez, Nettel-Aguirre et al. (2017); Black, Macpherson, Hagel, Romiti, Palacios-Derflinger et al. (2016); Black, Hagel, Palacios-Derflinger, Schneider, Emery (2017); Krolkowski, Black, Palacios-Derflinger, Blake, Schneider et al. (2017) claim that in ice hockey youth age groups, the rate of injury and concussion are the highest in youth sport, with rates of injury as high as six injuries/1000 game-hours in leagues, where body checking is allowed by the rules. As ice hockey is a sport played at high speed and body

contact is common, the risk of injuries such as concussion has been the subject of much research (McCrory, Meeuwisse, Dvořák, Aubry, Bailes et al. 2016; Kontos, Elbin, Sufrinko, Dakan, Bookwalter et al. 2016; Smith, Stuart, Dodick, Roberts, Alford et al. 2015).

Material & Methods

The aim of the research was to determine the relationship between the success of a team in one-on-one battles in the DFG and the final result of ice hockey match in NHL and WOG (Winter Olympic Games) 2018.

Research hypotheses:

1. We assume, that winning teams will attain a significantly higher number of successful one-on-one battles in the DFG than defeated teams.
2. We assume, that a significantly higher number of successful one-on-one battles will occur in the defensive zone in the DFG than in two other zones.
3. We assume, that the number of ways of stealing the puck „using the hockey stick” will be significantly higher than the number of ways of stealing the puck „using body-checking”.
4. We assume, that in the NHL matches, there will be a significantly higher recorded number of one-on-one battles in the DFG than in the matches of Winter Olympic Games 2018 according to the difference in the size of the ice hockey rink, set by the rules of the NHL and the IIHF (International Ice Hockey Federation).

Research tasks:

1. Determination of the relationship between the number of successful one-on-one battles in the DFG and the final result of the match.
2. Determination of number of successful one-on-one battles in the DFG according to the separate zones of an ice hockey rink.
3. Determination of the number of different ways of stealing the puck in the DFG.
4. Determination of differences in number of successful one-on-one battles in the DFG between the NHL and Winter Olympic Games 2018.

The observed research group consisted of the following 15 NHL teams in 10 matches ($n_1 = 10$) of the regular 2018/2019 season. Arizona Coyotes, Buffalo Sabres, Carolina Hurricanes, Chicago Blackhawks, Colorado Avalanche, Dallas Stars, Detroit Red Wings, Minnesota Wild, Nashville Predators, New York Islanders, New York Rangers, St. Louis Blues, Tampa Bay Lightning, Vegas Golden Knights and Winnipeg Jets, and also of the following 11 national teams competing in 10 matches ($n_2 = 10$) in the 2018 Winter Olympic games main championship groups. Canada, Czech Republic, Finland, Germany, Norway, Olympic Athletes from Russia, Slovakia, South Korea, Sweden, Switzerland and United States of America. Selection of the observed matches was random but with the aim of capturing the widest possible scale of teams.

The main method of obtaining research data was the indirect observation of matches in the NHL and the 2018 Winter Olympic Games. Due to the easy availability we were able to observe ice hockey matches and acquire our data from the official website of the IIHF (<http://www.iihf.com/>), as did Barilla, Tóth, Peráček and Babic (2019) in their research and we recorded NHL matches during the direct broadcast, so we were able to stop or replay various game situations in the matches. Due to this fact we had the opportunity to correctly and objectively record the successful one-on-one battles in the DFG.

We were focusing on the observation and recording of successful one-on-one battles in the DFG, ways of stealing the puck and localisation of the successful one-on-one battles. The recordings were stopped and repeatedly viewed to achieve the highest possible objectivity in our observation.

The first parameter that we focused on was the successful one-on-one battle in the DFG and the ways of stealing the puck.

We registered the battle if:

1. the offensive player tried to overcome the defensive player using offensive individual playing skills,
2. the situation was 1 on 1,
3. the defensive player stole the puck using the hockey stick, the skate or body-checking,
4. the defensive player stole the puck while complying with the rules,
5. after the one-on-one battle, the offensive player was no longer in possession of the puck.

There were 3 variables of the first parameter. Stealing the puck using the hockey stick, the skate and body-checking. The second parameter that we focused on was the playing zone of the ice rink where the successful one-on-one battle in the DFG was achieved and we observed and registered it in all three zones of ice rink. In the defensive, neutral and offensive zones.

The Mann – Whitney U- Test was used to evaluate the statistical significance. The level of significance that we selected, was $p \leq 0.05$. Subsequently we calculated and determined the value of Cohen's "r" (effect size). The significance test of two relative values was used to compare the acquired data.

Results

The relationship between the number of successful one-on-one battles in the DFG and the final result of the match

As was mentioned, we focused on the observation and recording of successful one-on-one battles in the DFG. The number of successful one-on-one battles in the DFG was 1813. The average number of successful one-on-one battles in the DFG of winning teams was 51.4 per match. The average number of the same observed parameter of defeated teams was 39.25 successful one-on-one battles per match, though in two cases, the defeated teams had a higher number of successful battles than the winning teams. The relationship between success in one-on-one battles in the DFG according to Mann - Whitney U - Test confirmed an assumption of hypothesis No. 1 and the final result has shown as statistically significant at 5 % level and $U = 80$ on $p \leq 0.05$ ($p = 0.00124$). The z- score was calculated as $z = 3.23249$ and the effect size $r = 0.48$ showed us a large effect.

Fig. 1

Comparison of the mean number of successful one-on-one battles in the DFG

The occurrence of successful one-on-one battles in the DFG in terms of localisation

During every observed match we were recording the indicators of both teams and since we are conscious that the DFG relates only to the team that is currently not in possession of the puck and it is not limited only to the defensive zone, we focused our observation on the whole ice hockey rink and the indicators were divided to all three zones. Hypothesis No. 2 was created due to preconditions resulting from the usual game process.

Fig. 2 The number of successful one-on-one battles in the DFG according to the zones of the ice rink and the statistically significant differences of zones

The total number of successful one-on-one battles in the DFG occurred was 1813. The values divided by zones are displayed in figure No. 2. The highest number, 890, occurred in the defensive zone. According to the results we confirmed an assumption of hypothesis No. 2.

The significance test of two relative values showed that the number of occurrences of successful one-on-one battles in three zones of the ice hockey rink are significantly different at 5% level ($p \leq 0.05$).

The occurrence of successful one-on-onebattles in theDFG in terms of ways of stealing the puck

Fig. 3 The number of successful one-on-onebattles in the DFG in terms of ways of stealing the puck and statistically significant c

The comparison of the occurrence of successful one-on-onebattles in the DFG in terms of how the puck was stolen confirmed our assumptions, that „stealing the puck using the hockey stick” is the most common method. The final number of 1101 was 60.7 % of the total number of 1813.

Hypothesis No. 3 was confirmed and the significance test of two relative values showed that values of all three observed and recorded ways of stealing the puck are significantly different at 5% level ($p \leq 0.05$).

The occurrence of successful one-on-onebattles in theDFG in terms of comparison of the NHL and the 2018 Winter Olympic Games

The assumption of hypothesis No. 4, that the number of occurrences of successful one-on-onebattles in the DFG in the NHL will be higher than at the 2018 Winter Olympic Games was substantiated by differences between the size of the ice hockey rink in NHL (60.96 x 25.908 meters) and IIHF (60-61 x 29-30 meters). The difference in the number of successful one-on-onebattles in the DFG is displayed in figure No. 4 below.

Fig. 4 The difference in the number of occurrences of successful one-on-onebattles in the DFG between NHL and 2018 WOG

In 10 matches in the NHL, we registered 1046 successful one-on-onebattles, which is 57.69 % of the total number of observed successful one-on-onebattles in the DFG. Compared to the number of successful one-on-onebattles recorded in 10 matches of the Winter Olympic Games, there is a difference of 279 battles.

The significance test of the two relative values confirmed our assumption in hypothesis No. 4 and stated the two compared pieces of data as significantly different at 5% level ($p \leq 0.05$).

Discussion

The aim of the research was to refer to the activity of the team in the DFG by an analysis of its results. Through the observation of selected matches, we analysed a ratio of the number of successful one-on-one battles in the DFG of both teams concurrently during every observed match. In 20 matches, of which 10 were regular season games in the NHL and 10 were at the 2018 Winter Olympics in PyeongChang, we observed 1813 successful one-on-one battles in the DFG. We recorded 1046 successful one-on-one battles in the NHL and 767 successful one-on-one battles at the 2018 Winter Olympic Games. The average of the absolute value was 90.65 successful one-on-one battles in the DFG per match. By averaging the absolute value of observed one-on-one battles only in NHL, we got 104.6 successful one-on-one battles in the DFG per match. In the Winter Olympics we got 76.7 successful one-on-one battles in the DFG per match. This comparison confirms the assumption displayed in hypothesis No. 4. Using this obtained data, we can pose a question. How many times per match will the defensive phase change to offensive and vice versa? Due to the fact that we only observed successful one-on-one battles in the DFG and we are conscious that one-on-one battles are not the only case when the phases of the game change, we can only imagine how many times per match the phase of the game can change after a successful one-on-one battle. Peráček (2000) claims that the main goal is to reach the request on a reasonable load, which in our case creates the definition of a content load and this is the reason why according to Kopecký (2018) the significance of similar researches in team sport rises. If we are able to achieve the kind of results we obtained in our research, coaches and trainers could use it during the creation of training processes in the future.

Comparison to other researches

Kopecký (2018) in his research, where he observed defensive individual playing skills in NHL, assumed in one of his hypotheses, that according to the style of defence of the NHL defensemen, the most common way of stealing the puck will be stealing the puck using body-checking. According to many researches, including research by Donaldson, Asbridge and Cusimano (2013) showing a yearly rise in the number of concussions and head injuries in general in the NHL this prediction was obvious. From obtained results in his research, it is absolutely obvious that the most used way of stealing the puck was stealing the puck using the hockey stick. These results agree with the results in our research and we succeeded in the confirmation of hypothesis No. 3. Rollins (2010) mentioned the International Ice Hockey Centre of Excellence (IIHCE) study completed in 2008 in her research, where the results showed four ways how the possession of the puck is gained, including stolen pucks, opponent dump, rebounds and face off wins. From the total number of goals, 40 % were scored after stolen pucks, in other words after successful one-on-one battles in DFG. The same research showed that most of the attacks originated in the defensive zone. The quantity was 75 from a total of 125. Both results show the importance of successful one-on-one battles in DFG and these partial results agree with the results in our research.

Solmosi (2012) observed a selection of final game situations in the DFG at the 2011 World Championship in Slovakia of teams playing shorthanded. He focused only on the defensive zone and on the periods that did not end in a draw. The author observed the individual defensive skills and the defensive combinations. We can clearly compare our partial results to his. The most used way of stealing the puck in our research was stealing the puck using the hockey stick and in the 2011 World Championship, observed by Solmosi (2012) it was similar. A more frequent parameter was just „shooting the puck from the defensive zone“. We did not observe and record this parameter because we focused only on one-on-one battles in the DFG.

Huntata (2011) states in his research, where he studied the indicators of the game performance in group B and C matches at the 2010 Winter Olympic Games that winning teams were markedly more successful at one-on-one situations. There were only one-on-one game situations in the complex meaning in the offensive phase of the game. In terms of localisation, for the offensive phase of the game the offensive zone was the most important. When the author focused entirely on one-on-one battles in DFG, he did not find any significant differences between the winning and defeated teams. It is questionable and disputable what factor has influenced this result. Differences in the methods can play a significant role.

It is relatively difficult to compare researches and scientific publications comprehensively, due to significant differences of methods used in researches. In most cases it is possible and proper to compare just partial results. Most authors focused specifically on one league or tournament, one zone, one position. We chose complexity and observed the highest level ice hockey league in the world (the NHL) and one of the most prestigious ice hockey events, the Winter Olympic games. We focused on the observation of one-on-one battles on the entire ice hockey rink. We limited our observation in order to reach the highest level of objectivity by focusing only on successful one-on-one battles in the DFG and to record them by elementary dividing.

Conclusions

During the planning and optimisation of the training process, the tracking of successful one-on-one battles in the DFG can be useful in the case of confirmation of its statistical significance. The relationship between successful one-on-one battles and the final result of the match has shown to be statistically significant which confirmed hypothesis No. 1. In 20 observed matches we registered only 2 matches,

when the defeated team had more successful one-on-one battles in the DFG than the winning team. The fact that the game performance of the team is built by partial game performances and success in one-on-one battles are also an indicator of it, gave us the idea that it can positively influence the final result.

Due to assumptions resulting from game action, we created hypothesis No. 2. It predicted the defensive zone as a zone with the most recorded successful one-on-one battles in the DFG. According to the result that in the defensive zone, the occurrence of successful one-on-one battles was the highest, we confirmed hypothesis No. 2.

The reason why we decided to create hypothesis No. 3, was the fact that the toughness of ice hockey and the style of the play especially in the NHL creates the assumption that stealing the puck using body-checking should be the most effective way to gain possession of the puck. We wanted to prove and show how important it is to use the hockey stick while stealing the puck through hypothesis No. 3 which assumed that the way of stealing the puck with the hockey stick will occur more often than stealing the puck using body-checking. The total number of successful one-on-one battles in the DFG in the NHL and Winter Olympics was 1813. 1101 successful one-on-one battles from this total were won by stealing the puck with the hockey stick, which means, that our hypothesis was confirmed and showed as statistically significant at 5% level using Mann – Whitney U-Test.

Since we were observing two different competitions, we decided to compare the number of successful one-on-one battles which occurred. We saw 20 matches altogether, 10 in each competition. Due to the fact that the style of play in the NHL is different to world ice hockey tournaments, we assumed that in 10 matches in the NHL we would record more successful one-on-one battles in the DFG than in 10 matches of Winter Olympics 2018. The rules set by the NHL and the IIHF and the difference in rink sizes, makes the style of the game in the NHL quicker, tougher and with a higher number of one-on-one battles. Due to the results of our research, this hypothesis was confirmed on a 5% statistical significance level.

Based on the results we obtained, we recommend for future theory and training practice:

1. to practice exercises focused on the one-on-one game situation more frequently in training,
2. to have more frequent practice matches with a reduced number of players per side focusing on one-on-one battles,
3. to practice exercises focused on stealing the puck with the hockey stick to improve the technique of this individual defensive skill,
4. to practice exercises containing forechecking, because a team who is successful at this defensive activity has a higher chance of scoring goals,
5. to use a theoretical preparation focused on one-on-one game situations in the DFG and its possible solutions.
6. to use video - analysis during the theory.

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