

Technical Analysis on Mechanical Model Based Football Curveball

Qiang Li
Tianjin University of Sport, Tianjin 300381, China

Abstract: Exercise load research that test heart rate of 13 athletes from the men's hockey team in Tianjin who wear sun to Team Edition game state, the subjects in the game state in different time periods, different locations athletes, and high-strength heart rate load characteristics of the technical and tactical behavior. Research shows that, quantification of a hockey player in the first half, the second half of the game and the time period in which the total race time, pure competition time and intermittent time heart rate load index, as well as the game preparation and intermission non competition time heart rate load index. Through the comparison can know that the game time heart rate load significantly higher than playing time of heart rate load; Pure game heart rate load is obviously higher than that of the total playing time and intermittent playing time heart rate load; different position player heart rate are different , avant-garde athletes are the highest, the second highest defenders, forward players minimum; Quantify and analyze the behavior of high strength load game which game center is higher than 180 b/min.

Keywords: Mechanical model, simulation trajectory, the curveball

INTRODUCTION

For sports load research often from "load" and "load" to express, Load intensity research is undoubtedly the most important content of sports load. At present, such studies generally use heart rate as evaluation the intensity of load performance of physiology, especially in the evaluation of ball games load intensity (Liu, 2009). External load acting on the human body, the heart rate will produce a series of corresponding changing. According to the linear relationship between the sub maximal load exercise heart rate and the oxygen uptake using heart rate description of the load intensity, which is after sports exercise, heart rate increased with increasing exercise intensity. Early in the 1950s, A strand et al study proved that a linear relationship between heart rate and oxygen uptake. Tanaka et al. (1992) Study shows that the linear relationship between heart rate and external load in different exercise forms the performance is different, the heart rate is more dependent on the level of the body to adapt to this form. Therefore, it's generally accepted and widely used by many sports to reflect sports load by heart rate (Chen et al., 2010).

At present, heart Rate load rating in the evaluation of hockey load multi use a variety of average comparison of different hockey load, not more than hockey center rate changes to consider (Li and He, 2011). And hockey center rate rich changes information may be the real reason behind the average heart rate of training and competition load intensity differences. Hence, proven hockey center rate changes in the characteristics and patterns, clear the relationship between the main factors average heart rate change or

the main constituent elements and a variety of heart rate load indicators and sports training factors, which helps to conduct more in-depth discussion on the hockey project-specific heart rate load base and control means, and the ultimate key to effective control of the hockey heart rate load intensity (Yu et al., 2009). In this paper, starting from the similarities and differences of the game time and game interrupt time the hockey athletes' heart rate changes and to explore the impact of different technical movements on hockey game Heart Rate, so learn more about heart rate load characteristics of the hockey game.

RESEARCH OBJECT AND METHOD

Research object: China Tianjin men hockey team has 13 players, including 6 defenders, 4 avant-garde players, 3 forward players, who participated in the test player receive hockey professional training in more than 6 years, and athletic level for all of the level above.

Research method: Heart rate test method, Tianjin men's hockey team were divided into two teams of relatively equal strength squad scrimmaging game. The game completely according to the official hockey game rules requirements and game time. Using the SUNNTO team heart rate table record Athletes heart rate and sampling frequency for 1 times/5 sec. From the start of the preparation activities until the end of the game has been tested athletes with heart rate transmission belt, after the test, the storage of heart rate data through the data transmission device input to the computer to save, and then use SPSS statistical software for statistical analysis. What need to explain is that due to the athletes

Table 1: Different period hockey player's heart rate

Name	Preparation activities	Competition in the first half	Half time	The second half competition	The whole game
Forward	111.10±5.56	155.40±6.11	111.13±5.00	153.59±8.15	154.51±6.89
Avant-garde	116.87±8.47	165.15±5.43	120.09±8.86	165.09±9.06	165.11±7.05
Defenders	110.28±6.38	151.73±7.62	109.42±7.10	150.20±12.47	150.95±9.83
Overall	112.69±6.79	156.71±8.62	113.49±7.74	155.57±11.91	156.13±10.08

Table 2: Heart rate variability analysis in different time different and different position

	Preparation	Competition in the first half	Intermission	The second half competition	The whole game
P	0.360	0.000	0.109	0.000	0.000

constantly moving, inevitably sometimes appear chest strap and subjects skin contact don't close or mutual interference and lead to measured data distortion phenomenon (more for obvious low value, rare anomaly is higher or abnormal heart rate curve) when using remote sensing heart rate system collected heart rate in hockey game data. Therefore, test the statistics for the heart rate data and the reject the abnormal data.

Statistical methods, Statistical data by spss15.0 statistical software, descript variable use mean and standard deviation (\bar{x} () $\pm S$). Using single factor analysis of variance comparing the time heart rate differences.

RESULTS AND ANALYSIS

Hockey game load characteristics:

- Different period hockey players' heart rate:** In order to overall analysis of the hockey game load characteristics, this study divide hockey game into preparation activities, in the first half, the second half competition, break game and the whole game, Table 1. In this way, not only can analyze the game load characteristics, but also analyze a load indicator which is closely related with the game preparatory activities and intermission, and strive hockey game load from the perspective of overall system.

Normal person quiet state, heart rate is sixty-80/cent, moving heart rate may vary with the exercise intensity, the greater the strength of heart rate and faster. At the same motion load, the slower the heart rate increases the better athletes' body function state. For the same intensity sports training athletes after the maximum heart rate is reduced, indicates that the athletes' physical hyper function. From Table can be seen, Hockey player preparation activities, competition in the first half, half-time, the second half of the match and the while match rate average values are 112.69, 156.71, 113.49, 155.57 and 156.13 b/min, Competition in the first half, the second half of the game and game average heart rate is obviously higher than that of the preparation activities and break of the average heart rate, so, from the perspective of the hockey game average heart rate in high load. Intermission heart rate and the heart rate of the preparatory activities are close.

Intermission athletes in a state of rest without exercise load, but the load caused by the first half of the athletes in a short time is difficult to restore to the quiet level. Hockey players playing time heart rate higher than the netting against ball project tennis game heart rate is 146.8 b/min (Chen *et al.*, 2011) and young man football player 4000 m running training heart rate 154 b/min and min running training heart rate 152 b/min (Wang, 2009). Below the young man football player 12 min running training heart rate 181 b/min and 5000 m run of 164 b/min (Wang, 2009). This suggests that hockey game load is higher.

- Different time heart rate variance analysis:** Although different period of heart rate is different, but in order to further test the different indicators whether statistically significant differences, the study use variance analysis analyze different period heart rate, Table 2, the results are as follows. Not divided position, single-factor analysis of variance for multiple comparisons for the heart rate of the different time periods of all the athletes, the result is $p<0.01$, show different time has significant difference, the preparation activities and break have no significant difference, the second half and full match exist significant difference, no significant difference between the three time periods on the second half and full match. It's show on the second half and the match will load significantly higher than the preparatory activities and intermission load, On the one hand to show that the load of the activity was significantly lower than the game time load, on the other hand also indicated that the game in the first half of the load is higher, cause at the break even without doing any produce sports load action heart rate also has certain load. On the second half and full match three game period there was no significant difference in heart rate.

This research is divided into the hockey players forward, avant-garde and defender three position type players. Different position hockey players in preparation for the activities and break the heart rate time has no significant difference, the athletes prepare activity content is consistent, because the content of the activities to the same, no position distinguish, so different locations of the athletes heart rate no significant difference. But watch the international high-level hockey game, the latter part of the preparatory

Table 3: Hockey players total competition time, pure competition time and intermittent time heart rate list

		Competition in the first half	The second half competition	Whole competition
Total competition time	Forward	155.40±6.11	153.59±8.15	154.51±6.89
	Avant-garde	165.15±5.43	165.09±9.06	165.11±7.05
	Defenders	151.73±7.62	150.20±12.47	150.95±9.83
	Overall	156.71±8.62	155.57±11.91	156.13±10.08
Pure competition time	Forward	165.02±4.11	163.23±4.66	164.20±4.31
	Avant-garde	170.14±2.87	170.27±4.61	170.23±3.55
	Defenders	162.19±3.07	162.47±3.22	162.46±2.64
	Overall	165.29±4.63	165.05±5.15	165.26±4.64
Intermittent competition time	Forward	152.86±3.51	152.06±6.25	152.46±4.62
	Avant-garde	160.08±4.28	159.72±7.23	159.77±5.45
	Defenders	150.95±7.21	148.92±11.89	149.91±9.36
	Overall	154.20±6.75	152.97±10.10	153.5±8.2

Table 4: The compurgation heart rate of hockey player's game time, pure game time and intermittent playing time

Competition in the first half	The second half competition	The whole competition
P 0.001	0.006	0.002

activities of a high level team depending on field position, the special position of technical and tactical preparation activities, Therefore, it is recommended that hockey players in the preparatory activities to consider the characteristics of the athlete's position. And at half-time athletes are completely in the resting state, although the first half of the game heart rate load also has certain effect, but complete rest lead to break heart rate does not exist significant difference. The Danish scholar Bansbo on football players' study shows, At half-time in the second half before the start of the game do simple preparation activities can let players better in the second half in game mode, Therefore, it is suggested that in the second half hockey players before the start of the athletes at different positions do simple have position characteristic preparation activities, in order to better carries on the second half competition.

Hockey players' pure game time heart rate characteristics: Time characteristics of the hockey game is more game interrupted rid intermission, pause, substitutions, fouls, locate the ball, the athletes were injured, ball out of bounds game pauses time, athletes in these times to stand up, walk around, jogging and other sports-based, small exercise intensity. The research for the game play is interrupted time, substitution, foul, the ball, players injured and other situations occur, the referee whistle or race to stop the beginning, to start the end of the game, pure competition time for rest and play off match interrupt time. According to the method of statistical characteristics of athletes' heart rate as follows Table 3.

Hockey player's pure game time heart rate load characteristics (Table 4).

As the chart 4 shows, in the first half game, the second half game and the whole game total time, pure game time and interval time of heart rate variance analysis have significant difference, and a variety of comparison shows the same result, Pure game time heart rate is obviously higher than that of the total

playing time of heart rate and interval playing time of heart rate, Pure game time heart rate is obviously higher than that of the total playing time of heart rate and interval playing time of heart rate, while the total playing time of heart rate and heart rate interval time no significant difference, The possible reasons are that in the interrupt time, although the athletes don't the high intensity exercise, but at the beginning of interrupt time heart rate is still in a high level, and heart rate decline slowly, the interval time is shorter, the higher the degree of the heart rate decline is not obvious.

Athlete's high intensity analysis of heart rate: Science of sports training show that the heart rate more than 180 b/min belongs to the high intensity exercise (Tian, 2000), According to the heart rate table data, statistical athletes center rate more than 180 b/min time, through the game video, observation athletes heart rate more than 180 b/min of the technical movements. Explore the impact of the hockey game loads the main action and tactical forms of organization, as well as a comprehensive understanding of the hockey high intensity load.

In the modern hockey game, the pace of the game more and more quickly, and offensive and defensive speed often determines the outcome of the game, only fast attack in the defense can not ready to fully won good attacking effect. Overall, the game generates high intensity game heart rate most technical movements dribble attack, high-speed dribble from backcourt to frontcourt, accounting for 13.55%. Reilly. T and Seaton. A studies show that hockey players need to unique body posture and technology action, including running and dribbling all need trunk half equine posture movement.. They measure the physiological load caused by trunk flexion dribble technical movements, 7 men's hockey players running speed of 8-10 m/h on the treadmill for 5 min, subjects to dribble five minutes at the same speed, the dribble the energy consumption than running multi 15-16 KJ/min, heart rate and subjective feel the movement of the load is also increased. Torso bending and dribble action is the main reason for the increase in load. Therefore this research indicates that the high speed running, trunk bending and dribble action is a high strength match the main cause

of heart rate. The second is fast so, accounted for 12.79%. Therefore, this study suggests that high-speed running, trunk flexion and dribble action is the reason of the heart rate of the high-intensity. Followed by rapid retreat defense, accounting for 12.79%. As long as the rapid withdrawal defense can effectively restrict their opponents by a fast break or to play more and less easy to score, forcing the other into a positional attack. The front reverse proportion about 11.51%, the modern game of hockey game in the rush to be more and more teams use, the offensive side in the other half after throwing the ball immediately in front of the organization against rob, each other although took possession of the ball, but the original defensive formation has not been transformed into effective attack against rob, front reverse can break other attack; The front reverse can effectively delay the attack speed of the other party; Grab the ball down immediately turn defense into attack in the other half back to the first half of this side, and then the implementation of the defense, grab the ball and then attack, and from running away from the no corresponding increase in the athletes' body load. But the front reverse load is higher, because the athletes had been under attack state quickly transferred to a larger load the front reverse generation of athletes, which is a high heart rate front reverse. The proportion of get rid of the movement is 10.99%, With the increasing degree of game against, The race to form more and more bits to man, that man-to-man defender marking tight case you want to received a pass from fellow is very difficult, Such a player needs to be made or start or stop to get rid of the action, also need different direction, different speed direction and speed variable running, the emergency stop from anxiety and direction and speed variable running on hockey player generates load is relatively large, resulting in a high rate of production. Sealing ball produces a high heart rate is 10.48%, The sealing ball hockey players and other antagonistic ball games plugging vary, hockey player in blocking the ball as far as possible when the trunk bending, holding the club very possible let the club away from the body to enlarge the blocking ball defense area, doing plugging ball movement but also with different directions and different speed the direction and speed variable running, the cause may result in high strength of heart rate when hockey players plugging ball. Help and defending produce high heart rate ratio is 10.23%, Antagonistic ball games complex project feature decided to defend and help defense that often appear in the scene, there can always be a player rob other players, to help defend the scene. Help defense is a defensive player lost defensive position after he left the other team members to fill the gaps.

Dribbling breakthrough, dribbling get rid of and rob to intercept proportion under 10%, The main difference is that the dribble and dribble to get rid of the

dribble in the frontcourt offensive extraordinary formation of a shot or threatening passing, dribble direction is the direction of attack; And dribble out of goal mainly is to get rid of the opposing team defense, can in the frontcourt also can be in the backcourt, dribbling out of no fixed direction. Both dribble need athletes trunk flexion hand club dribbling, and completion of the running of the change of direction and the shift, which may be the main reason for heart rate produced to generate high intensity. Intercept the ball in the defensive process of the implementation of the initiative on grab, intercept the ball faster action frequency done on grab action, explosive action rate is the main reason for the high-intensity heart rate. The dribble shooting action heart rate accounted for only 1.28%, a mere dribble shooting action may not produce high intensity heart rate, and produce high-load heart rate are associated with high-intensity running dribble shot.

Forward players dribbling attack, offensive against the is, quick, get rid of the movement parameters such as the proportion of 10% above, Dribble and dribble out of proportion is close to 10%, the indicator includes a dribble attack and breakthrough, get rid of the movement, and get rid of dribble movement, The front Fanqiang and rapid movement back against two defensive form of a certain proportion, Show forward athletes completed attack mission also lost the ball in front after the active participation of defense, defensive range with more concentrated in the field, but the main high load rate is still on the offensive. The avant-garde players the first Fanqiang, fast retreat defense, get rid of post moves and robbery ball more than 10%; dribbling breakthrough, dribbling attack, sealing ball, dribbling and get rid of close to 10%, Avant-garde athletes high-intensity heart rate indicators reflected a more balanced offensive and defensive ends, both with the avant-garde athletes to participate in the attack but also relevant to the duties involved in a defensive position. The defender more than 10% high heart rate load index mainly concentrated in the dribble attack, retreat quickly prevent, defend and block the ball, The dribble attack mainly in the backcourt steals the ball quickly after dribbling advance to the midfield and attack, the other is defensive indicators that defenders produce high strength heart rate movement form mainly concentrated in defense.

CONCLUSION

Quantify the hockey players in preparation activities, in the first half, the second half competition; break game and whole game of heart rate load index.

Hockey game has higher game load, the game time load is obviously higher than that of the preparation activities and interval load. Heart rate load of different games period there was no significant difference.

Hockey player's race has obvious position load characteristics, from the heart rate load index, avant-garde athlete's have highest load, the second is forward athletes, defender athletes are minimum load.

Hockey players pure game time and total playing time heart rate, intermittent playing time heart rate have significant differences, pure game time heart rate is obviously higher than that of the total playing time and intermittent playing time. Hockey players interrupted game time heart rate value is also at a relatively high level; there is no significant difference between the total race time and intermittent game time heart rate.

Quantify and analyze the behavior of high intensity load game which game center is higher than 180 b/min.

REFERENCES

- Chen, C., D. Liu and Z. Fang, 2010. Chinese national women's soccer team athletes play in heart rate characteristics research. *Sports Sci.*, 30(5): 33-40.
- Chen, Z., P. Li and C. Li, 2011. Chinese women's tennis reserve players short-term training load characteristics of the preliminary study. *Chengdu Sports Coll. J.*, 37(10): 47-52.
- Li, Q. and Y. He, 2011. Men's hockey athletes running ability. *Chinese Sports Sci. Technol.*, 47(4): 49-56.
- Liu, D., 2009. Women's soccer world cup athletes running ability. *Sports Sci.*, 10: 51-60.
- Tian, M., 2000. *Sports Training Learning*. People's Sports Press, Beijing, pp: 157.
- Wang, H., 2009. Hubei youth football team running the study of the relationship between training methods and heart rate characteristics. PhD Thesis of Wuhan Institute of Physical Education Master's Thesis.
- Yu, S., D. Liu and Q. Li, 2009. Chinese man elite soccer players game Running Ability. *Chinese Sports Sci. Technol.*, 45(6): 34-40.