Revista de Psicología del Deporte/Journal of Sport Psychology Vol. 30. n.°2. 2021. pp. 263–272
Universidad de Almería / Universitat Autónoma de Barcelona. ISSN 1132–239X ISSNe 1988–5636

Investigating Tactics Characteristics of Mass-Start Event of Speed Skating in Pyeongchang Winter Olympics

Wang Jin[1], Su Yanhong[1*]

Abstract

The mass start event is the longest cross-country skiing event added first time in the Pyeongchang Winter Olympics held in 2018. This study aimed to highlight tactics characteristics of the event by making a statistical analysis of the points and competition results of athletes who participated in this event in the Pyeongchang Winter Olympics. For this purpose, the ranks, points, lap time, and final results of 16 male and 16 female athletes were taken as research objects in the final mass-start event of speed skating of the 2018 Pyeongchang Winter Olympics. The speed and speed coefficient of this segment were calculated by Pearson correlation analysis applying the Origin 9.4 software for nonlinear curve fitting. The results showed that athletes adopted different speed pacing strategies in each race. The analysis was based on a comparison of points and speed rhythms of different rounds. This enabled to identify and optimize tactics that might improve the probability of winning the event. This study contributes significantly with both theoretical and practical implications. The study findings specify such optimization tactics to provide a theoretical basis for sports practices as well as giving practical insights important to practitioners and sports officials. The study recommends that physical fitness should be strengthened to ensure athletes' speed endurance in speed-skating; teammates should work together tactically to get rid of the impact caused by physical exertion, and a training platform should be built to train athletes.
Keywords: Mass start speed skating; optimization tactics, speed coefficient; tactical ability; Winter Olympics

Introduction

The mass start event is the longest cross-country skiing event in the Winter Olympics (Sandbakk, Solli, Talsnes, & Holmberg, 2021). As racing has a key importance in sports, mass start is a significant sports competition in the Winter Olympics. Winter Olympic games are held every four years and majorly comprises snow and ice sports games. The first Winter Olympic Games were held in Chamonix, France in 1924. The races in mass start event vary in distance: the women race is run for 30 kilometers while the men race runs for 50 kilometers. In addition, contrary to the individual start races, all skiers in the mass start race begin together in a single line. After its inclusion in the Winter Olympics, the mass start events have become important spectator sports (Noordhof et al., 2021). The mass start competition is also related to other racing competitions including long-distance running in athletics, speed skating, and long-distance cross-country sports activities. The current study is based on speed skating in the Winter Olympics (Xiao-ying & Zhan-yu, 2017).

Speed skating is one of the competitive forms of ice skating (Stoter, Hettinga, Otten, Visscher, & Elferink-Gemser, 2020). In speed skating, players race with each other and travel a pre-defined distance on skates. It is a sport in which individuals, pairs, or groups perform on ice on their skates (Figure 1). There are various types of speed skating such as long track speed skating, short track speed skating and marathon speed skating.

Figure 1. Speed Skating
Source: https://www.olympic.org/pyeongchang-2018

The focus in the current is on the Pyeongchang Winter Olympics held in 2018, where mass-start event of Speed Skating was also included. Pyeongchang is one of the counties in Gangwon Province, South Korea. The Pyeongchang Winter Olympics, formally known as the XXIII Olympic Winter Games, 2018 or PyeongChang 2018 (Sung et al., 2021) took place as an international winter multi-sport event between 9 and 25 February, 2018.

This study is an attempt to identify tactics characteristics of Mass-start event of Speed Skating in the Pyeongchang Winter Olympics. Athletes usually optimize tactics to improve the chance of their winning by comparing the points and speed rhythms of different rounds. Several

[1] Teaching and Research Office of Human Movement Science, School of Physical Education, Liaoning Normal University., Dalian, Liaoning, China, 116029 Email: 87468224@qq.com
[*]Correspoding author: 101063@lnnu.edu.cn

previous studies exist on Winter Olympics (Huang, Zhao, He, Yin, & Meng, 2019; Kim, Choe, Kim, & Kim, 2019), however, very few studies have examined the mass-start event of Speed Skating. Those few studies on Speed Skating (Han, Liu, Shi, & Li, 2021; van der Kruk, Schwab, van der Helm, & Veeger, 2018), however, did not discuss the tactics characteristics. This study would prove to be a useful contribution to fill this research gap in the domain of Winter Olympics in general, and mass-start event of Speed Skating, in particular.

Literature Review

The mass start of speed skating was a new official event added to the 2018 Pyeongchang Winter Olympics. No more than two participants from each ISU Member State, i.e., 24 athletes from each of the male and female can participate in mass start events. It is very different from traditional speed skating competition because the athletes slide on a 400-meter ice track for a total of 16 laps after a mass start, regardless of the size of the track. The semi-finals are divided into two groups, with 12 players from each group starting at the same time. The top 8 players advance to the final, regardless of tracks in the skating process. Four points are set for the whole course, and three points on the way are set for the 4th, 8th, and 12th laps. The destination is the last point. The top three athletes at each point are awarded 5, 3, and 1 point respectively. For the points of the last lap (lap 16), the top three athletes receive 60, 40, and 20 points respectively. The top three athletes who reach the spot will get the corresponding points and be sorted according to the number of points. Those who do not get points will be ranked behind the athletes with points according to the time score.

As a tactical speed skating competition, the result of mass start event of Speed skating is full of uncertainty and more ornamental. This event is similar to the speed-skating event of 10,000 m. It follows similar elimination points during the competition and athletes adopt similar tactics such as short-track speed skating. This makes the competition more ornamental, requiring athletes to be more physically and tactically minded. Due to the popularity of the game, representative roller skaters have switched over to such speed-ice mass start events. For instance, the Chinese athlete Guo Dan, the Italian athlete Francesca Lollobrigida are a few successful transition players. The Italian athlete Francesca Lollobrigida won 5 medals (1 gold, 1 silver, and 3 bronzes) in the mass start events. For many good athletes, it is an opportunity and challenge to win medals.

The mass start event of Speed skating can draw on the tactical strategies of the short-track speed skating events, which manly utilize tactical guidance theory and tactical application theory (Hai, 2010). A team's tactic is one of the strategic plans that the team employs to attain its tactical objectives. A tactic can be analyzed in terms of a playing system or a playing style. The former includes tactical concepts, tactical guiding ideology, and tactical awareness; while the latter includes tactical operation principles, tactical method, and tactical action. According to the competition rules, the change of skating positions and time of each lap of the athletes in the race is the basic expression of the implementation of tactics (Jiabin, 2008).

This was visible in the win of the Japanese women's team, whose tactics of pursuit and collective departure won them the championship. This required, besides individual ability and teamwork, a few tactics like the starting tactics, the alternating lead skating tactics, and the trailing-following skating tactics (Pengfei, Sheng, Xufeng, Mengxue, & Zizheng, 2019). Under these tactics, the work mainly starts with the key factor for winning, that is, how to get more points. The team then induces the speed rhythm and position changes of elite athletes throughout the game to explore the tactical strategy for excellent results and the winning rules. Tactics could only help the mass-start event of speed skating at the 2022 Beijing Winter Olympics to achieve a historic breakthrough. At the event, the Chinese athletes would depend more on the competition guidance and their improved tactical training. If the probability of winning increases, it also enhances the potential advantages of the Chinese athletes.

Methodology

Research Objects

The research objects of this study included the points, lap times, final results, and ranks of a total of 32 athletes (top 8 athletes from each group of men's and women's semi-finals), of the mass-start event of speed skating of the 2018 Pyeongchang Winter Olympics.

Research Methods

Document Retrieval Method

The research data mainly comprised documentation showing the rules of the game and videos of competitions collected through the official websites of the Pyeongchang Winter Olympics https://www.olympic.org/pyeongchang-2018 and International Skating Union (https://www.isu.org). In addition, the key search items included "speed skating", "collective departure", "tactical ability", "mass start "speed pacing", and "velocity pacing" were searched and screened in the databases of CNKI (China National Knowledge Infrastructure), Google, Wanfang, and Ebsco. The relevant literature was studied to provide the theoretical basis for the work.

Expert Interviews

One of the instruments of the study was to conduct interviews with China's well-known speed-skating experts, national coaches, international-level referees, relevant scientific researchers and two women participating athletes. All these informants were experts in their respective fields and provided with multi-angle, in-depth analysis of the competition. The purpose of these interviews was to examine the technical weaknesses, loss factors, physical ability, tactical strategies and other quantitative evaluation methods and other issues of the athletes at the collective departure competitions in Pyeongchang Winter Olympics.

Data Statistics

Origin 9.4 software was used for nonlinear curve fitting of the data. According to the Pearson correlation analysis of SPSS21.0, the correlation coefficient between the lap time of finals and the final result for the significance test was already obtained. Excel 2010 was applied for statistical analysis of data. The whole distance was divided by the sprint spots to calculate the speed coefficient as follows and draw corresponding statistical charts.

$$E_S = \frac{V_S - V_A}{V_A} \times 100\%$$

where E_S is the speed coefficient; V_S the average speed of each segment; V_A the average of the whole game.

Data Analysis and Results

Analysis of Finalists' Point Statistics and Promotion Strategy

In the mass start events, athletes always try to find a way of scoring more points than their opponents. Only by qualifying for promotion in the semi-finals can they get a chance to compete for a better place in the finals. In the Winter Olympics, the application of tactics is very important for the competition at an equivalent level. Therefore, the points become the focus of competition among athletes. The fundamental purpose of tactics is to get more final points. Table 1 shows the statistical points of finalists in the semi-finals and finals (women).

Table 1.

Statistical points of finalists in the semi-finals and finals (Women)

Rank in the finals	**Delegation**	**Name**	**Points in the finals**				**Sum of points**	**Sum of points in the semi-finals**	**Rank in the semi-finals**	**Results in the finals**
			Spot 1	**Spot 2**	**Spot 3**	**Spot 4**				
1	Japan	NT				60	60	5	SF 1#5	8:32.87
2	Korea	KBR				40	40	4	SF 1#6	8:32.99
3	Netherlands	IS				20	20	5	SF 1#4	8:33.02
4	Estonia	SA	5	5	5		15	3	SF 2#7	8:47.46
5	China	LD	3	3			6	24	SF 2#3	8:50.48
6	Belarus	MZ			3		3	0	SF 1#8	8:41.73
7	Italy	FL	1				1	68	SF 1#1	8:33.30
8	Czech Republic	NZ			1		1	60	SF 2#1	8:41.35
9	Poland	LZ		1			1	3	SF 2#8	8:47.34
10	China	GD						43	SF 1#2	8:33.90
11	USA	HB						5	SF 2#5	8:35.80
12	Canada	KM						21	SF 1#3	8:41.38
13	Germany	CP						5	SF 2#4	8:41.45
14	Netherlands	AVDW						40	SF 2#2	8:42.19
15	USA	MM						1	SF 1#7	8:54.40
16	Italy	FB						5	SF 2#6	9:04.82

Table 1 shows only 9 out of 16 finalists scored points for top nine places in the women's finals. This means that only the top three athletes could score points at the last spot (end spot) in the finals; the remaining 6 ranked in descending order of points. Although having scored the highest points of the first 3 spots, the fourth athlete could not surpass the third one. The total points of the top three finalists in the semi-finals were checked, with the highest and lowest points of 5 and 4 respectively. The remaining finalists were ranked beyond the top three in the finals, with the highest and lowest points of 68 and 0 in the semi-finals.

It suggests that top three athletes only qualified for the finals in the semi-finals, rather than striving to score for more points. With a total of 24 points in the semi-finals, the Chinese athlete, Li Dan, surpassed all athletes who had scored higher points in the finals. Guo Dan, another Chinese skating cross-athlete, got second place by scoring

43 points in the semi-finals. In the finals, Guo Dan ranked fifth in time to finish the slide. However, he failed to score points and only could reach the tenth position after based on the points scored. Table 2 shows the statistical points of finalists in the semi-finals and finals (men).

Table 2.
Statistical points of finalists in the semi-finals and finals (Men)

Rank in the finals	Delegation	Name	Points in the finals				Sum of points	Sum of points in the semi-finals	Rank in the semi-finals	Results in the finals
			Spot 1	Spot 2	Spot 3	Spot 4				
1	Korea	LSH				60	60	5	SF 1#6	7:43.97
2	Belgium	SB				40	40	5	SF 2#5	7:44.08
3	Netherlands	VK				20	20	5	SF 1#5	7:44.24
4	Switzerland	WL	3	3	5		11	5	SF 2#7	8:13.08
5	Denmark	TVH		5	3		8	5	SF 1#4	7:57.10
6	Austria	HL	5	1			6	60	SF 1#1	7:52.38
7	Belarus	MV	1				1	20	SF 2#3	7:53.38
8	Korea	CJ			1		1	5	SF 2#6	8:32.71
9	USA	MJ						3	SF 2#8	7:45.21
10	France	CA						3	SF 1#8	7:45.64
11	Japan	WS						20	SF 1#3	7:46.19
12	Italy	GA						41	SF 1#2	7:46.83
13	Denmark	SSD						40	SF 2#2	7:47.53
14	Canada	JO						4	SF 1#7	7:49.30
15	Nz	MP						60	SF 2#1	7:49.33
16	Netherlands	KS						6	SF 2#4	8:13.95

Table 2 shows that only 8 athletes scored points in the men's finals, accounting for 50% of the total finalists. In terms of points, they were ranked at top eight positions in the finals. The top three in the finals followed the same rules as the top three in the women's finals. Without getting points on the way, they won the top three positions for the finals, relying only on the points at the end spot. Among the 8 athletes who scored points in the finals, two athletes stood at the sixth and seventh positions, with higher points (60 and 20 points) in the semi-finals. The rest advanced to the finals with a sum of 5 points in the semi-finals. The athletes with high points in the semi-finals were ranked beyond the top 5 in the finals. Four athletes with high points in the semi-finals even failed to score points in the finals. The results of the semi-finals determined the qualifications for the finals. If the top three athletes in the semi-finals score endpoints, the athletes with accumulated 5 points would be ranked within the top eight, with the promotion probability of 100%. The athletes with accumulated 4 points have a promotion probability of 98.9%.

If the top three athletes also scored intermediate points, the athletes who cumulatively earned 4 points would have a higher probability of promotion, and other athletes without scoring any points may also be promoted. For example, a Belarusian player MZ, from the first group of women's semi-finals, advanced to the final with zero point. The athletes with 3 points may not advance to the final as they have the promotion probability of 88.4%. For example, the Latvian athlete SH, from the first group of men's semi-finals, failed to qualify for the finals despite scoring 3 points in the semi-finals.

According to statistics, the top three athletes in the men's and women's finals would not score high points in the semi-finals. Except for one person who won 4 points, all of them advanced to the finals with 5 points and finally won medals. On the contrary, other athletes did not rank among the best in the finals although with high points in the semi-finals. It is even difficult for them to get intermediate points. Due to the schedule, there was only one hour between the semi-finals and the finals. The athletes with higher points in the semi-finals failed to perform at their best level in the final due to premature consumption of physical energy. Therefore, the top three athletes showed the same point strategy, namely qualifying for the finals. The racers used variable-speed tactics in laps 1-3 to score points or more points first in the semi-finals. This suggests points can be obtained to qualify for the finals and improve the ranking. The battle to score points to reach the finish-line is the key to win a race.

Analysis of the Difference Between Speed Rhythms of Finalists

Speed rhythm refers to the process of controlling the speed by changing the proportion and numerical rate of energy output (De Koning, Bobbert, & Foster, 1999). In a mass-start event, the overall speed fluctuates greatly due to the competition for points. The speed rhythm changes with the setting of spots, showing a unique change law. Based on the current concept and classification of speed rhythm (Abbiss & Laursen, 2008; Dawu, Chen, & Ying, 2012; Weifeng, 2011; Yuhua, 2013), it was necessary to analyze the characteristics of the event through the segmented speed rhythms in the finals.

Statistical Results and Analysis of the Correlation Between Single Lap and Total Points

By calculating the correlation between single lap and total variables, we found the laps greatly impacting the results of the game. The speed rhythm strategy commonly used athletes was revealed to achieve the implementation law of winning tactics in the finals based on the commonality. Table 3 presents the correlation between single lap and total points in women's finals.

Table 3.

Correlation between single lap and total points in women's finals

	Lap 1	Lap 2	Lap 3	Lap 4	Lap 5	Lap 6	Lap 7	Lap 8
Correlation with total point (*r*)	.259	-.193	-.192	.178	.136	-.180	-.294	-.077
	Lap 9	Lap 10	Lap 11	Lap 12	Lap 13	Lap 14	Lap 15	Lap 16
Correlation with total point (*r*)	.371	.433	-.580*	.487	.449	.664**	.884**	.916**

Note: * is significant correlation (P<0.05); ** very significant correlation (P<0.01). When $0.5 \leq r < 0.8$, it is moderately correlated; when $r \geq 0.8$, it is highly correlated; n=16.

Table 3 shows that the P-value of the correlation coefficient between the point of Lap 11 and the total point is less than 0.05 in women's finals. Therefore, the point of Lap 11 is significantly correlated with the total points. The P values of Laps 14, 15, and 16 are less than 0.01, indicating that the points of Laps 14, 15, and 16 are very significantly correlated with the total points. There is no significant correlation between the points of other laps and the total points. The r- values of Laps 11 and 14 are greater than 0.5 and less than 0.8, indicating that the points of Laps 11 and 14 are moderately correlated with the total points. The r values of Laps 15 and 16 are greater than 0.8, indicating that the points of Laps 15 and 16 are highly correlated with the total points. Table 4 presents the correlation between single lap and total points in men's finals.

Table 4.

Correlation between single lap and total points in men's finals

	Lap 1	Lap 2	Lap 3	Lap 4	Lap 5	Lap 6	Lap 7	Lap 8
Correlation with total point (*r*)	-.043	-.255	-.190	-.158	.234	.160	-.357	-.291
	Lap 9	Lap 10	Lap 11	Lap 12	Lap 13	Lap 14	Lap 15	Lap 16
Correlation with total point (*r*)	-.012	-.323	-.376	.313	.162	.298	.810**	.982**

Note: * is significant correlation (P<0.05); ** very significant correlation (P<0.01). When $0.5 \leq r < 0.8$, it is moderately correlated; when $r \geq 0.8$, it is highly correlated; n=16.

Table 4 shows that the P value of Laps 15 and 16 is less than 0.01 in men's finals. Therefore, the points of Laps 15 and 16 are significantly correlated with the total points. There is no significant correlation between the points of other laps and the total points. The r value of Laps 15 and 16 is greater than 0.8, indicates that the points of Laps 15 and 16 are highly correlated with the total point.

The rules stipulate that the total point determines the ranking of the top three, the athletes with the same points and without points in the competition. Therefore, the total points also play an important role in the competition. According to the tactics and strategies, the points of Laps 15 and 16 are highly correlated with the total points in men's or women's finals. It was found that the last two laps (Laps 15 and 16) were the key to improving the total points, namely the key node of the final stage.

In women's finals, the points of Laps 11 and 14 were moderately related to the total point because Lap 11 was the second lap ahead of Spot 3. With the intermediate points, some female athletes did not have the continuous sprint ability to strive for the endpoint. The points of the first three spots were competed for to improve the final ranking, thus achieving better results. In addition, the women's team accelerated one lap earlier (Lap 14) than the men's team before the finish sprint. It is probably because the female athletes at the equivalent level need to accelerate in advance to compete for a more favorable sprint position. Therefore, tailing tactics are very important. Especially for the elite athletes, the longer the skating distance of tailing, the more sustained acceleration or early sprint ability will determine the medal, which also guarantees victory in the game.

Impact of the Difference in Speed Rhythms to Tactics Application

The final ranking of a mass-start event is more meaningful than timing results. Therefore, it is particularly important to control the position throughout the course, thus scoring a better ranking in the finals (Muehlbauer, Schindler, & Panzer, 2010; Yuhua, 2013). The speed coefficient reflects the changing rhythm of average speeds of each segment distance and the whole course (Zhenyan, Xiaomei, & Na, 2013). The segment speed coefficient of the athlete is conducted with nonlinear fitting. The degree of fitting R2 is the determining coefficient of the fitting. The closer to 1 it is, the better is the fitting accuracy. If R2 is greater than 0.5, then the fitting is modest (Zhang & Kunag, 2011).

For the convenience of analysis of this study, the finalists were divided into top three athletes, the athletes with/without points (excluding the top three). The segmented speed coefficients were measured with nonlinear fitting to intuitively express the changing law of speed rhythm during the competition (Dapeng et al., 2012). According to the setting of spots, the whole game naturally consisted of four timing sections where each one had four laps. Figure 2 displays the nonlinear fitting curve of the average speed coefficient of women's finals of mass-start event at the Pyeongchang Winter Olympics.

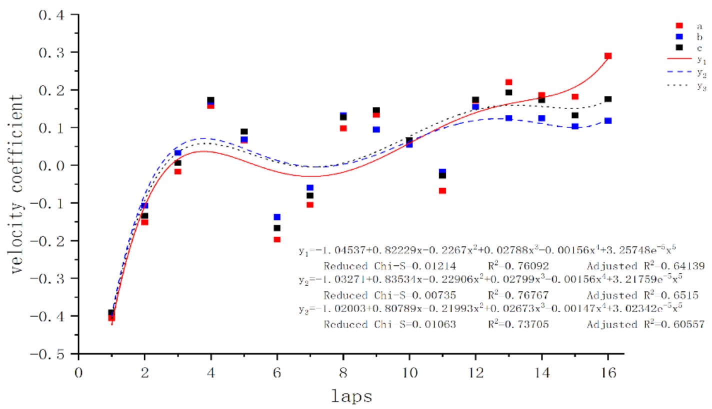

Figure. 2 Nonlinear fitting curve of average speed coefficient of women's finals of mass-start event of the Pyeongchang Winter Olympics

Note: ▪ represents the velocity coefficients of top three female athletes at different stages; ▪ the velocity coefficients of scored female athletes at different stages; ▪ the velocity coefficients of unscored female athletes at different stages

Figure 2 shows that the female athletes accelerated lap by lap from the starting to the spot of the first stage. The speed coefficient reaches the peak value in Lap 4. The athletes with points have the highest speed coefficient, followed by athletes without points. The speed coefficient decreases at the first two laps of the second stage. After that, the athletes gradually accelerate at the last lap of the second sprint point (Lap 7). At this stage, the athletes without points, have the highest speed coefficient, with changed positions. From the third stage, the minimum speed coefficient gradually increases with the number of laps. Compared with the previous segment, the decrement of speed coefficient greatly reduces in the fourth stage, thus showing a speed rhythm characteristic of "full rush-fall-full rush-maintenance".

The speed coefficients of the top three athletes decrease in the second stage, reaching the minimum value. The speed coefficient of the later segment constantly increases to reach the maximum in the last point lap, showing the speed rhythm characteristic of "speed up-fall-full rush-maximum". According to three fitting curves of average speed coefficients, the top three athletes choose to accelerate before the spot of the third stage and then compete for the last spot. For the rest athletes, the competition for points is fiercest at the first and second spots. Figure 3 displays the nonlinear fitting curve of average speed coefficient of men's finals of mass-start event of the Pyeongchang Winter Olympics

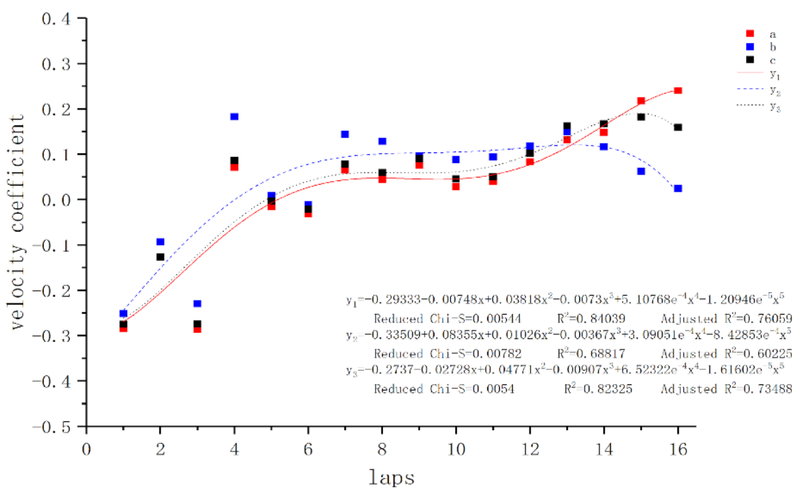

Figure. 3 Nonlinear fitting curve of average speed coefficient of men's finals of mass-start event of the Pyeongchang Winter Olympics

Note: ▪ represents the velocity coefficients of top three female athletes at different stages; ▪ the velocity coefficients of scored female athletes at different stages; ▪ the velocity coefficients of unscored female athletes at different stages

Figure 3 shows that the average fitting curves of speed coefficients of three types of athletes are almost synchronized in the first three stages of men's finals, with the changed position in the fourth stage. The speed coefficients of athletes with points (excluding the top three) in the first three stages are higher than the average. At the spot of the first stage, the speed coefficient is significantly higher than the average. In the fourth stage, the speed coefficients are lower or slightly higher than the average. According to the positions of curves, y1 is below y2 and y3 before the fourth stage. The speed coefficient is close to and much higher than the average in the third and fourth stages, respectively. The top three athletes adopt trailing sliding tactics, which can also be intuitively seen from the fitting curve. The top three athletes start to accelerate lap by lap after passing the third spot. The leading athletes with points continue to decelerate due to a lack of physical strength. The athletes without points also actively accelerate for a not long time after the third spot. This shows that athletes of this type are short of speed endurance after long-term exercise, failing to finish the lap-by-lap acceleration strategy later in the game according to a predetermined plan.

According to comprehensive characteristics of speed coefficients of male and female athletes, the speed rhythm can be divided into two types. The first is the fast start-up type by which the athletes get more points to improve the rankings. The athletes of this type fail to get the endpoints because their speed rhythms are greatly affected by the intermediate points. The speed coefficients in the first three stages are higher than the average in men's and women's finals. In the fourth stage, the average speed coefficient decreases. Women's team has a more significant fluctuation of average speed coefficient than the men's team, where the speed peak only appears in the first stage. The reason is that the male athletes with equivalent strength compete for the first spot more intensely. It is believed that the longer distance (time) leads to the larger gap from a world-class level in the middle and long-distance event characterized by mixed metabolic energy supply. The speed decreases a lot in the late stage, thus causing a large difference from the result of the early stage (Xiaoping, 2004). The athletes with poor performance adopt an "active" rhythm in the first half segment, which leads to disorders of functional and nervous systems. Therefore, the speed slows down in the second half (Muehlbauer, Panzer, & Schindler, 2010; Tong, 2017). There is high consumption of total energy in rhythm adjustment. The leading skater will eventually lose the position with the decrease of physical energy in the sprint stage (Da-wu, Lu, Wen-tao, Xin-bao, & Yue-liang, 2015; Morin, Samozino, Edouard, & Tomazin, 2011).

Some studies have concluded that based on the characteristics of speed-skating of around 1,500-m full-speed change, the speed rhythm is mainly the positive strategy of speed distribution. Athletes accelerate at a speed slower than the peak speed at the beginning of the race. During the race, if the peak speed is reached and gradually reduced and maintained until the finish line, it increases the exercise intensity and fatigue accumulates (Menting, Konings, Elferink-Gemser, & Hettinga, 2019). Premature or passive acceleration is accompanied by fierce competition for intermediate points in the competition. Therefore, high consumption of physical energy makes a low contribution to the total result, which is not conducive to winning. Through intervention intensity training of speed rhythms at different stages, athletes can strengthen the ability of repeated sprints. The muscle is then improved in lactic acid tolerance to enhance the continuous sliding ability of high intensity at the final stage.

The second is the slow start-up type by which the athletes get more endpoints to win the medals finally. With similar tactics, the athletes adopt this type of speed rhythm to win the top three in the competition. Among four stages, the differences in speed coefficients are all within 0.006. At the end of the third stage, the athletes gradually accelerate to reach the maximum at the endpoint. The type of speed rhythm is consistent with the previous correlation analysis result. It is found that the slow start-up type reduces the accumulation of metabolic by-products at the initial stage and the excessive oxygen consumption, thus slowing down the emptying rate of energy-supply materials. In the tactical form of trailing sliding, the athletes keep synchronous speed rhythm with most players to get a longer sliding distance by low energy consumption (Brooks, 2013; Lamoureux, Tomkinson, Peterson, & Fitzgerald, 2018). Therefore, athletes use occupation tactics to resist interference. This tactic is mostly used on the outside of the straightaway or the inside of the curve, and the timing of the occupation is mostly before the points lap or the sprint lap (Zhen-wei, Jia, & Hai-xia, 2020). This tactic also helps to obtain the most advantageous position and control the variable speed so that it is easier to overtake the opponents with temporary shifts and prevent being dumped by small groups.

Cooperating with the occupation tactics to seize the middle and front positions of large groups can save physical energy. Individual athletes with excellent physical ability choose different timing to occupy the position to play their level, mainly concentrating on laps 1-3 before the point lap and preparing for points. In the final race, they mostly use the trailing slide to observe the opponents gain more points. Staying in the leading group on the way is more conducive to competing for points of the finish line. Generally, athletes with fine speed burst will use it several times. In one of the videos sampled for this study, the top 1 athlete from Korea in the men's team was spotted always leading the skating at the fourth stage with the assistance of another teammate CJ. It is thus easier to hide while consuming the physical energy of others. The teammate skates behind the leading athletes to occupy a favorable position. Then, the strength is saved to compete for the highest point of the end spot. The athlete is easier to get a good result and win the game when accelerating at the stage close to the endpoint.

Therefore, the tactics are more important for the competition of high level. Under the guarantee of physical energy, the athletes design tactical goals and specific methods of implementing tactics according to their characteristics. Other interference factors are resisted to make full use of limited physical energy, thus achieving better results.

Conclusion

This study reveals several tactics to play and win the mass-start competitions of Speed Skating. It begins by suggesting that speed pacing strategies adopted for different races should be relatively different. Variable-speed tactics are used to see the right time to gain points on the way as early as possible to avoid excessive consumption in the semi-finals. Since the semi-final is the step to advance to the finals requiring only 5 points, the last point (finish) in the final is the key to determine the winner. That athlete is the winner who uses tailing tactics and occupation tactics, which are especially important for controlling the backstretch speed. The sprinting ability must be maintained as athletes reach close to the finish. The more you get closer to finish, the better you have to play your maximum speed. Besides, teammates can work together to defend against interference, which is beneficial to the shifting-skating occupation in the final sprint. Last, but not the least, the team's ability to collaborate on the leading-slide tactics is a guarantee of victory in increasing competition in the same lane.

Implications of the Study

This study focused on the mass-start event of Speed Skating in the Pyeongchang Winter Olympics. The tactics characteristics in the mass-start events of Speed Skating at the Pyeongchang Winter Olympics were mainly dwelt upon in this study. By examining the tactics characteristics of the mass-start event of Speed Skating, this study has thus contributed to this domain which will lead to both theoretical and practical implications While it studied the tactics used by the athletes, the study simultaneously specified such optimization tactics to improve the chance of winning such as comparing points and speed rhythms of different rounds or controlling the speed or maintaining the sprinting ability to utmost. These tactics provide a theoretical basis for sports practice of this game. Several previous studies (K. Kim et al., 2019; van der Kruk et al., 2018), though have examined mass-start event of Speed Skating; however, literature missed detailed studies specifying tactics characteristics of mass-start event of Speed Skating. Hence, this study also filled the much-awaited literature gap. This study will additionally provide important insights for practitioners to make strategies about the game of Speed Skating.

Recommendations

Several recommendations can be given based on the findings of this study. First, it is suggested that physical fitness should be strengthened for the athletes' speed endurance training in speed-skating project trainings. Efforts should be made to maximize individual variable speed, overtaking, and sprinting ability to achieve tactical cooperation for victory. Teamwork should also be strengthened along with coping strategies for unexpected situations such as the strain caused due to mistakes and sudden acceleration of opponents. Teammates should work together tactically to get rid of the impact caused by physical exertion, particularly when the main runner accelerates to break away from the big group. In usual training programs, there is a need to increase a variety of tactical training, such as leading breakaways and leading skating tactics. The limitation in this study was that it analyzed data from a single competition. Future studies may be carried out to explore targeted tactical strategies and tactical rules of other games in high or middle-level competitions.

By enriching the tactical theory of the game, a platform will be ready to build a scientific and reasonable training system for speed-skating project. In recent years, China is lacking in the speed skating training in spite of a few advantageous projects in the past, which were of little advantage. Besides, there are a very small number of athletes in China with international competitiveness and they do not form a group advantage, which results in lack of competitiveness in the international arena. In addition, the current overall competitive strength and level of the Chinese athletes have also declined severely which poses a huge challenge to the sustainable development of Chinese speed skating. There is also a lack of training to the budding and reserved talents. The tactical theory is also not rich enough. This study has not only enriched the tactical theory to further construct a scientific and reasonable training system for the collective departure of speed skating, but also provided practical guidance for obtaining excellent results in the 2022 Beijing Winter Olympic Games. It is hoped that this study will motivate Chinese reserved talents to involve more in training.

References

Abbiss, C. R., & Laursen, P. B. (2008). Describing and understanding pacing strategies during athletic competition. *Sports Medicine, 38*(3), 239-252. doi:https://doi.org/10.2165/00007256-200838030-00004

Brooks, C. M. (2013). Sorting through the motor performance abilities maze. *New Studies in Athletics, 3*(4), 135-142.
Da-wu, H., Lu, L., Wen-tao, Z., Xin-bao, W., & Yue-liang, C. (2015). Key-Link Pacing Feature and Theoretical Design for Full Course Pacing in Women's 500m Speed Skating. *Journal of Beijing Sport University, 38*(7), 133-139.
Dapeng, B., Yang, H., Jialin, H., Junhong, Z., Jue, Z., & Yan, C. (2012). Nonlinear analysis on variability of pressure center to elite modern pentathlon athletes in the combined event. *Sports Science, 32*(7), 18-21,38. doi:http://dx.chinadoi.cn/10.3969/j.issn.1000-677X.2012.07.003
Dawu, H., Chen, M., & Ying, W. (2012). Research Progress on the Speed and Rhythm of Sports Events. *Journal of Tianjin Sport University, 27*(2), 154-157. doi:http://dx.chinadoi.cn/10.3969/j.issn.1005-0000.2012.02.013
De Koning, J. J., Bobbert, M. F., & Foster, C. (1999). Determination of optimal pacing strategy in track cycling with an energy flow model. *Journal of Science and Medicine in Sport, 2*(3), 266-277. doi:https://doi.org/10.1016/S1440-2440(99)80178-9
Hai, W. (2010). Overtaking Tactics of Short Track Speed Skating between Chinese and Korean Women Teams in the Vancouver Winter Olympics [J]. *Journal of Shenyang Sport University, 6*.
Han, J., Liu, M., Shi, J., & Li, Y. (2021). Construction of a Machine Learning Model to Estimate Physiological Variables of Speed Skating Athletes Under Hypoxic Training Conditions. *Journal of Strength and Conditioning Research*. doi:https://doi.org/10.1519/jsc.0000000000004058
Huang, Q., Zhao, X., He, C., Yin, D., & Meng, S. (2019). Impacts of urban expansion on wetland ecosystem services in the context of hosting the Winter Olympics: a scenario simulation in the Guanting Reservoir Basin, China. *Regional Environmental Change, 19*(8), 2365-2379. doi:https://doi.org/10.1007/s10113-019-01552-1
Jiabin, Z. (2008). The construction and application of the theory system of short track speed skating tactics. *Beijing Sport University*.
Kim, H., Choe, Y., Kim, D., & Kim, J. J. (2019). For sustainable benefits and legacies of mega-events: A case study of the 2018 PyeongChang Winter Olympics from the perspective of the volunteer co-creators. *Sustainability, 11*(9), 2473. doi:https://doi.org/10.3390/su11092473
Kim, K., Kim, J. S., Purevsuren, T., Khuyagbaatar, B., Lee, S., & Kim, Y. H. (2019). New method to evaluate three-dimensional push-off angle during short-track speed skating using wearable inertial measurement unit sensors. *Proceedings of the Institution of Mechanical Engineers, Part H: Journal of Engineering in Medicine, 233*(4), 476-480. doi:https://doi.org/10.1177%2F0954411919831309
Lamoureux, N. R., Tomkinson, G. R., Peterson, B. J., & Fitzgerald, J. S. (2018). Relationship between skating economy and performance during a repeated-shift test in elite and subelite ice hockey players. *The Journal of Strength & Conditioning Research, 32*(4), 1109-1113. doi:10.1519/JSC.0000000000002418
Menting, S. G. P., Konings, M. J., Elferink-Gemser, M. T., & Hettinga, F. J. (2019). Pacing Behavior of Elite Youth Athletes: Analyzing 1500-m Short-Track Speed Skating. *International Journal of Sports Physiology and Performance, 14*(2), 222-231. doi:https://doi.org/10.1123/ijspp.2018-0285
Morin, J.-B., Samozino, P., Edouard, P., & Tomazin, K. (2011). Effect of fatigue on force production and force application technique during repeated sprints. *Journal of biomechanics, 44*(15), 2719-2723. doi:https://doi.org/10.1016/j.jbiomech.2011.07.020
Muehlbauer, T., Panzer, S., & Schindler, C. (2010). Pacing Pattern and Speed Skating Performance in Competitive Long-Distance Events. *The Journal of Strength & Conditioning Research, 24*(1), 114-119. doi:10.1519/JSC.0b013e3181c6a04a
Muehlbauer, T., Schindler, C., & Panzer, S. (2010). Pacing and performance in competitive middle-distance speed skating. *Research quarterly for exercise and sport, 81*(1), 1-6. doi:https://doi.org/10.1080/02701367.2010.10599622
Noordhof, D. A., Danielsson, M. L., Skovereng, K., Danielsen, J., Seeberg, T. M., Haugnes, P., . . . Sandbakk, Ø. B. (2021). The Dynamics of the Anaerobic Energy Contribution During a Simulated Mass-Start Competition While Roller-Ski Skating on a Treadmill. *Frontiers in Sports and Active Living, 3*(184). doi:https://doi.org/10.3389/fspor.2021.695052
Pengfei, X., Sheng, L., Xufeng, Y., Mengxue, C., & Zizheng, W. (2019). Research on the Rise of Japanese Speed Skating in the Pyeongchang Winter Olympics. *Sports Research, 40*(3), 8-14.
Sandbakk, Ø., Solli, G. S., Talsnes, R. K., & Holmberg, H.-C. (2021). Preparing for the Nordic Skiing Events at the Beijing Olympics in 2022: Evidence-Based Recommendations and Unanswered Questions. *Journal of Science in Sport and Exercise*, 1-13. doi:https://doi.org/10.1007/s42978-021-00113-5
Stoter, I. K., Hettinga, F. J., Otten, E., Visscher, C., & Elferink-Gemser, M. T. (2020). Changes in technique throughout a 1500-m speed skating time-trial in junior elite athletes: Differences between sexes, performance levels and competitive seasons. *PLOS ONE, 15*(8), e0237331. doi:https://doi.org/10.1371/journal.pone.0237331
Sung, H., Kang, J.-h., Moon, S., Choi, J., You, M., & Choi, I. (2021). Emotional change, satisfaction and attachment to a sport mega-event: The PyeongChang 2018 Winter Olympics. *Journal of Hospitality and Tourism Management, 48*, 240-247. doi:https://doi.org/10.1016/j.jhtm.2021.06.010
Tong, Z. (2017). The Performance and Rhythm Strategy of Chinese Men's Marathon Athletes in Major Events. *Journal of*

Chengdu Sport University, 43(5), 87-93.

van der Kruk, E., Schwab, A., van der Helm, F., & Veeger, H. (2018). Getting in shape: Reconstructing three-dimensional long-track speed skating kinematics by comparing several body pose reconstruction techniques. *Journal of biomechanics, 69*, 103-112. doi:https://doi.org/10.1016/j.jbiomech.2018.01.002

Weifeng, G. (2011). Types and Application of Speed Rhythm in Timing Sports. *Sports Science, 31*(5), 91-96, back cover 93. doi:http://dx.chinadoi.cn/10.3969/j.issn.1000-677X.2011.05.014

Xiao-ying, L. I. U., & Zhan-yu, Y. (2017). Research on Developing the Competitive Talents of Short Track Skating in Shandong Province from the Viewpoint of Beijing Winter Olympics. *China Winter Sports, 39*(6), 10-16. doi:https://doi.org/10.3969/j.issn.1002-3488.2017.06.004

Xiaoping, C. (2004). Aerobic training--the key to improving the exercise level of endurance events in my country. *Sports Science, 24*(11), 45-50. doi:http://dx.chinadoi.cn/10.3969/j.issn.1000-677X.2004.11.011

Yuhua, G. (2013). Study on the Tactical Rhythm of Men's 1500m Freestyle Swimmer in the 30th London Olympic Games. *China Sports Technology, 49*(1), 122-126. doi:http://dx.chinadoi.cn/10.3969/j.issn.1002-9826.2013.01.020

Zhang, W., & Kunag, C. (2011). Basic course of SPSS statistical analysis *China Higher Education Press: Beijing, China* (pp. 263-275).

Zhen-wei, L. I., Jia, Y., & Hai-xia, L. I. (2020). Research on Women's Collective Starting Tactics in Speed Skating. *China Winter Sports, 42*(3), 12-16. doi:https://doi.org/10.16741/j.cnki.bxyd.2020.03.003

Zhenyan, Q., Xiaomei, Z., & Na, Z. (2013). Analysis of Ye Shiwen's 400m Medley Winning Advantages in London Olympic Game. *Journal of Nanjing Institute of Physical Education (Natural Science Edition), 12*(1), 77-82. doi:http://dx.chinadoi.cn/10.3969/j.issn.1671-5950.2013.01.017