Influence of track interval times on the total run time in skeleton and the sport of luge

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Summary

Performance of athletes in sliding sports is track-specific and influenced by various factors, including environmental conditions and choice of equipment. During this study track-specific influence of interval times on the outcome of the run was examined for men single events in luge and skeleton. Lake Placid sliding track is thoroughly familiar to elite athletes due to its long traditions in hosting international competitive events, and therefore it was chosen for the study. Correlation analysis was performed in order to determine which intervals of the track have a strong influence on the run time over the whole distance. Ratio of the interval times to the total run time was determined. Correlation was computed between interval times and remaining run times, in order to obtain independent variables for analysis. Results of the correlation analysis from Lake Placid track were compared to results obtained from competitions at Whistler track. This track, in contrary to Lake Placid track, has been opened recently and hosted just a few competitive events, therefore being new to athletes.

Results of the study had shown that starting interval at Lake Placid track influences the outcome of the run in luge more than in skeleton. Overall interval time influence at Lake Placid track is weaker for luge athletes than for athletes of skeleton. At Whistler track, however, correlation coefficients between interval times and remaining run times were at the same level both for skeleton and luge athletes. It was found that intervals crossed by athletes at shorter times influence the result as much and even stronger than intervals that take longer time to pass.

Interval times demonstrated stronger correlation with the remaining times for top-10 results in luge than for results from 11th to 25th place. A similar tendency was found for the sport of skeleton: correlation coefficients for top-10 athlete's group were slightly higher than for athletes at ranked from 11th to 20th place.

It was concluded that results of competitive runs at Lake Placid track for luge athletes are influenced by starting interval and the 3rd interval time stronger than by other intervals. For skeleton athletes interval between curves 12 and 15 have a major importance. Since just two luge and one skeleton competition took place at Whistler track, only preliminary conclusions can be done for this track. During skeleton competition athletes were mostly influenced by the part of the track including curves 9 and 10, but no conclusions can be drawn about correlation between starting interval and remaining rune time. Correlation coefficient of 0.46 was found between starting time and remaining run time for lugers at Whistler track.

Keywords: *the sport of skeleton, luge, interval times, correlation coefficient.*

Introduction

Three winter sports known as "sliding sports" make part of Winter Olympic Games program – bobsleigh, skeleton and the sport of luge. There are 19 sliding tracks in the world approved by International Luge Federation (FIL) for international competitions on artificial tracks; 15 tracks are approved by International Bobsleigh and Skeleton Federation (FIBT), including recently opened (opening year 2008) Whistler track in Canada that hosted 2010 Winter Olympic Games. 14 out of 15 tracks certified by FIBT are FIL-approved, however not all of them are actively used for international events.

FIBT requires measurement of five interval times along the track; the first interval time known as "start time" is measured 50 m after crossing the first pair of photo-electric cells (the first pair of the photocells is located at the end of the 15 m long push-off stretch). The next four interval time measurements are done evenly along the track, an additional measurement is for the final time; all interval times and final time measured up to one hundredth of a second are included into the official race protocol.

FIL rules require measurement of start time and at least three intermediate times; together with the final time it gives five time measurements in a race report done as exact as to 1000^{th} of a second. Time measurement initiates at 5 – 10 m distance from the start handles.

The whole run in sliding sports takes around one minute depending on the track; hundredths or even thousandths of a second often determine a winner, whilst difference between the first and the last place makes seconds. At given conditions success of an athlete depends on multiple factors, including not only appropriate technique, but also quality of equipment, ice surface, temperature, etc.

There is a common belief that a good start is a prerequisite for a successful run; there are published studies upon starting time influence on the total race time in skeleton (Zanoletti, La Torre, Merati, Rampinini & Impelizzeri, 2006), bobsleigh (Leonardi, Cecioni, Dal Monte & Komor, 1985; Morlock & Zatsiorsky, 1989), and luge (Brüggemann, Morlock & Zatsiorsky, 1997). These studies have proved that the start performance indeed has an important impact on the overall performance of the athletes, but still a good start does not necessarily lead to a top-ranking in a competition.

There have been attempts to find whether there is a "crucial" part on the track, which would determine the result of the competition (Brüggemann et al., 1997). This study, however, was limited to one specific race at Lillehammer track.

The aim of this study is to analyse impact of time spent on different intervals of the track on the total run time in order to determine whereas performance at any part of the track has a major influence on the overall performance despite varying environmental conditions. The study would also provide more detailed information on peculiarities of performance in sliding sports at given tracks. Two tracks in Lake Placid and Whistler have been chosen for this research.

Methods

Lake Placid combined bobsleigh-skeleton-luge track, rebuilt in 2000 was chosen for this study due to its long traditions in hosting competitive events and its high level of difficulty. According to New York State Olympic Regional Development Authority (ORDA) information, Lake Placid skeleton track is 1370 m long with 20 curves. In 2007 a new start ramp was built for men's luge events, thus making the length of the luge track 1356 m.

Competition results at Lake Placid track were compared to the results at the newest track built in Canada, Whistler. This track has 16 curves; it is 1450 m long for skeleton events and 1374 m long for men's luge singles events (official data of Whistler Sliding Centre).

Data for analysis was collected from results databases available on official FIBT and FIL websites. The study is limited to skeleton and luge male single disciplines; junior competitions were not considered in this study. Analysis was performed for the following competition types: World Championships, World Cups, Intercontinental Cups, America's Cups, Nations Cups and qualifications for major competitions (World Championships and World Cups are considered as major competitions).

Luge Data Samples

Top-25 results of each heat from World Championship 2009 and World Cup #7 of season 2007/08 were analysed (these Lake Placid events consist of two heats, thus giving samples of 50 data sets for each competition); 25 results were chosen, because best 25 athletes from the first heat of World Championship are admitted for the second heat. Additionally first 17 places were added to the study from one-heat events: World Championship 2009 qualification competition, and the Nations Cup #7

2007/08 (according to FIL rules 17 fastest athletes from qualification participate in World Cup or World Championship).

Since the new luge start ramp in Lake Placid was built in 2007, making luge starting time significantly shorter than before (more than 4 seconds in earlier years versus less than 2 seconds in 2007 and 2009), data from earlier years are not included into this study.

At the time this study was performed, there have been available results from only two official FIL competitions at Whistler track: Nations Cup and World Cup #7 that took place in early 2009. Top-25 results of each World Cup's heat and top-25 results of Nations Cup were included into the study.

Skeleton Data Samples

15 skeleton competitive events that took place at Lake Placid track during seasons 2004/05 – 2008/09 were analysed in this study: one World Championship, two Intercontinental Cups, four World Cups and eight America's Cups. All these were two-heat events; an exception was World Cup #2 in season 2005/06, which had only one heat, and World Championship in 2009 with three heats. Best 20 athletes from the first heat in skeleton competitions are admitted to the second heat, therefore top-20 results of each heat at every competition were concerned in the study, except for the cases with fewer participants (in these cases all the results were taken into account).

One skeleton competitive event at Whistler track was added to the study – a two-heat World Cup #7 in season 2008/09, giving a sample of 40 data sets for analysis.

Data Analysis

Correlation analysis was performed between time spent on the segments of the track (interval times) and the total run time. In order to achieve independent data ranges for correlation analysis, interval times were compared to the run time remaining after the given interval, not the total run time (time shown on a pair of photocells at the end of the interval of interest is subtracted from the total run time). Interval times were computed as follows: time shown on the pair of photocells at the beginning of an interval is subtracted from the time shown on the subsequent pair of photocells at the end of an interval. Start interval time is shown in the competition protocols in the column START; to compute the 2nd interval time data from START column are subtracted from data in the next column, etc. This gave four time intervals for luge events (starting interval and 3 intermediate intervals), and five time intervals for skeleton events; final time interval between the last intermediate pair of photocells and the finish line was not included into the correlation analysis.

Kolmogorov-Smirnov test for normal distribution was performed for data samples in order to define an appropriate correlation calculation method. Since data was not normally distributed, a non-parametric Kendall tau rank correlation coefficient was used to measure the strength of association between interval times and remaining times. The coefficient was calculated using free statistics software developed by Wessa (2009); the significance check of computed coefficients was performed in Microsoft Excel environment on the basis of recommendations found in statistics literature (Abdi, 2007). Significance level for correlation coefficients is set to $p<0.05$ throughout this study.

In addition to correlation analysis, percent ratio of interval times to the total run time was determined. The final interval time that was excluded from the correlation analysis, was taken into account in this computation, thus giving a total of 5 time segments for the sport of luge, and 6 segments for skeleton.

Results

Luge

Analysis of data from four luge events at Lake Placid track showed that time spent by lugers on the last two intervals during Nations Cup significantly differed from the corresponding time during other three competitive events. At Nations Cup athletes spent in average 21.925, s = 0.169 s on the 4th interval, and 11.737, s = 0.166 s on the last interval; an average time on these intervals during other three competitive events was 17.622, s = 0.140 s and 15.888, s = 0.200, correspondingly (no significant difference was found between average interval times during World Championship, its qualification run, and World Cup event). The average total run time at Nations Cup did not differ significantly from the run time during other events (53.272, s =0.348 s, and 53.008, s = 0.373 s, correspondingly). This led to a significant difference in interval time rate to the total run time at Nations Cup and three other competitive events (Table 1).

Correlation analysis of data from Nations Cup 2007 did not give significant correlation coefficients for any interval times, except for the last interval. Since percent ratio of interval times to the total run time at Nations Cup significantly differed from the corresponding values at other events, only data

Table 1

Interval time percent ratio at men's luge competitive events in Lake Placid

Competitive event	Average ratio of interval times to the total run times, %				
	Start interval	2nd interval	3rd interval	4th interval	5th interval
Nations Cup 2007 (NC)	3.31 ±0.06	20.43 ±0.13	13.07 ±0.07	41.16* ±0.12	22.03* ±0.20
World Cup 2007 (WCup)	3.32 ±0.05	20.42 ±0.10	13.04 ±0.05	33.34 ±0.07	29.89 ±0.16
Qualification 2009	3.37 ±0.06	20.51 ±0.14	13.02 ±0.09	33.04 ±0.13	30.06 ±0.33
World Championship 2009 (WCh)	3.30 ±0.05	20.40 ±0.12	13.00 ±0.06	33.20 ±0.11	30.00 ±0.22
WCup and WCh	3.32 ±0.05	20.41 ±0.11	13.03 ±0.06	33.28 ±0.11	29.96 ±0.21
All events except NC	3.33 ±0.05	20.43 ±0.12	13.03 ±0.06	33.24 ±0.14	29.97 ±0.23
Top-10 athletes of WCup and WCh	3.30 ±0.04	20.43 ±0.10	13.06 ±0.05	33.32 ±0.09	29.88 ±0.18
11-25 place at WCup and WCh	3.33 ±0.05	20.40 ±0.11	13.02 ±0.06	33.25 ±0.12	30.01 ±0.20

* significantly different from other luge competitive events

from the last three competitive events were included in the total analysis; this gave 117 data pairs from 37 different athletes. Results of the analysis are presented in Table 2 and Figure 1(a).

Analysis of data from luge events in Whistler gave interval time distribution over the total run time shown in Figure 1(b). Correlation coefficients between interval times and remaining times overall are higher than those shown at Lake Placid track. Data from Whistler track consist of 75 data pairs containing information from 39 athletes; 27 of these athletes also participated in competitive events included into Lake Placid track analysis.

Skeleton

Examination of skeleton competitive events at Lake Placid track in 2005 – 2009 revealed that during these years interval time measurements were performed at different locations along the track. Since interval time measurements appeared to be different, 15 studied skeleton competitive events were divided

Table 2

Correlation analysis of men's luge competitive events in Lake Placid

Competitive event	Correlation coefficients between interval times and remaining run times			
	Start interval	2nd interval	3rd interval	4th interval
Nations Cup 2007 (NC)	n/s	n/s	n/s	0.69
World Cup 2007 (WCup)	0.26	0.25	0.34	0.59
Qualification 2009	n/s	n/s	n/s	0.43
World Championship 2009 (WCh)	0.30	0.34	0.57	0.55
WCup and WCh	0.24	0.35	0.45	0.42
All events except NC	0.18	0.29	0.44	0.37
Top-10 athletes of WCup and WCh	n/s	0.28	0.47	0.50
11-25 place at WCup and WCh	n/s	n/s	0.28	0.23

Kendall-tau rank correlation coefficients describing strength of association between interval times and remaining run times during luge competitive events at Lake Placid track. Remaining run times are used instead of total run times in order to obtain independent variables for correlation analysis. n/s – non significant (P<0.05) correlation coefficients are achieved.

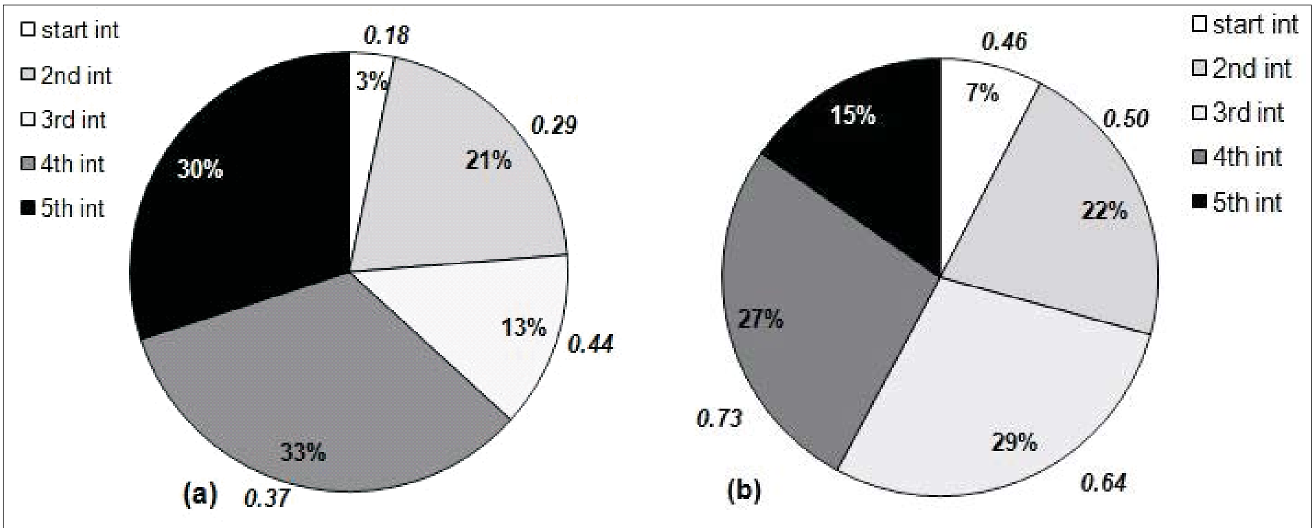

Fig. 1. Interval time percent ratios to the total run time with correlation coefficients between interval times and remaining run time shown besides the corresponding segments: during three season 2007/08 and 2008/09 luge competitive events at Lake Placid track *(a)*; during season 2008/09 luge competitive events at Whistler track *(b)*.

into three groups, according to location of measuring photoelectric cells; grouping of skeleton competitive events is presented in Table 3.

Table 3

Grouping of skeleton competitive events at Lake Placid track according to interval time locations

Group I	Group II	Group III
World Championship 2009	America's Cup 2008/09 #8	Intercontinental Cup 2008/09 #4
	America's Cup 2008/09 #7	America's Cup 2008/09 #6
	World Cup 2007/08 #3	America's Cup 2008/09 #5
	World Cup 2006/07 #3	America's Cup 2007/08 #6
	World Cup 2005/06 #2	America's Cup 2007/08 #5
	World Cup 2005/04 #7	Intercontinental Cup 2007/08 #6

Location of time-measuring points corresponding to different groups is schematically shown at Figure 2. Two events (America's Cups 2006/07 #3 and #4) were excluded from the total data analysis, because during these events percent ratio of interval time to the total run time at the interval between 4th and 5th photoelectric cells pairs significantly differed from the corresponding values during group I and II events (23.14, s = 0.22%, during two excluded events versus 15.13, s = 0.13% during other group I and II events); during group III events interval time was measured directly between points 4 and 7, excluding points 5 and 6 (Figure 2). Average total run time did not significantly differ between competitions, and its average value for 13 competitions was 56.83, s = 1.49 s.

Total analysis of all 13 competitive events gave information about track intervals between measuring points 1 and 2 (start interval), 2 and 3, 3 and 4, and 4 and 7; interval time rates to the total run time did not differ significantly between events, results of the analysis are presented in Figure 3a.

During group I and III events additional time measurements were performed between points 2 and 3 (point 2a and 2b, Figure 2), however interval time from point 2b to point 3 for all cases was 0.10 or 0.11 s, and did not provide significant information for correlation analysis, therefore groups I and III were combined for analysis and interval from point 2a to point 3 was considered as a whole. Results of group I and III analysis are presented at Figure 3b.

Analysis of group I and II competitions gave a closer insight to the part of the track between points 4 and 7: analysis of both groups presented information upon the interval between points 4 and 5, whilst individual analysis of group II allowed to split the final part of the track on additional intervals – from points 5 to 6, and 6 to7. Results of analysis are shown at Figure 3b; summary of correlation analysis of skeleton competitive events in Lake Placid is presented in Table 4. Figure 3c shows results of correlation analysis of skeleton World Cup event at Whistler track, segments represent percent ratio of interval times to the total run time; significant correlation coefficients are indicated beside the corresponding segments.

Table 4

Correlation analysis of men's skeleton competitions at Lake Placid track

Competitive event	Correlation coefficients between interval times and remaining run times						
	Start interval	Point 2 to 3		Point 3 to 4	Point 4 to 7		
		2 to 2a	2a to 3		4 to 5	5 to 6	6 to 7
Groups I, II and III	0.09	0.49		0.72	–		
Groups I and II	0.21	0.56		0.73	0.82	–	
Groups I and III	n/s	0.17	0.48	0.68	–		
Group I	n/s	n/s	0.54	0.71	0.73	–	
Group II	0.25	0.59		0.76	0.85	0.89	–
Group III	n/s	0.21	0.56	0.69	–		
World Cups (WCup)	n/s	0.31		0.61	0.74	0.80	–
WCup and World Championship (WCh)	n/s	n/s		0.58	0.71	–	
Top-10 athletes of WCup and WCh	n/s	0.28		0.62	0.73	–	
11-25 place at WCup and WCh	n/s	0.26		0.51	0.67	–	

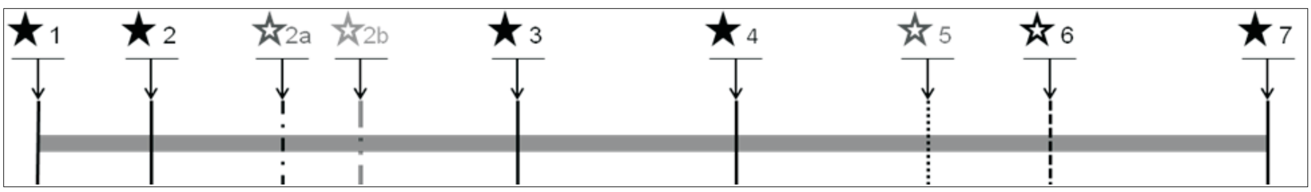

Fig. 2. Distribution of time-measuring photoelectric cells at Lake Placid track for skeleton events. Cells 1, 2, 3, 4 and 7 are used for measurements in all competition groups; cell 2a is used in groups I and III; cell 2b – in group III; cell 5 – in groups I and II, cell 6 – in group II. Starting interval is from measuring cell 1 till 2. Proportions of time intervals are not kept.

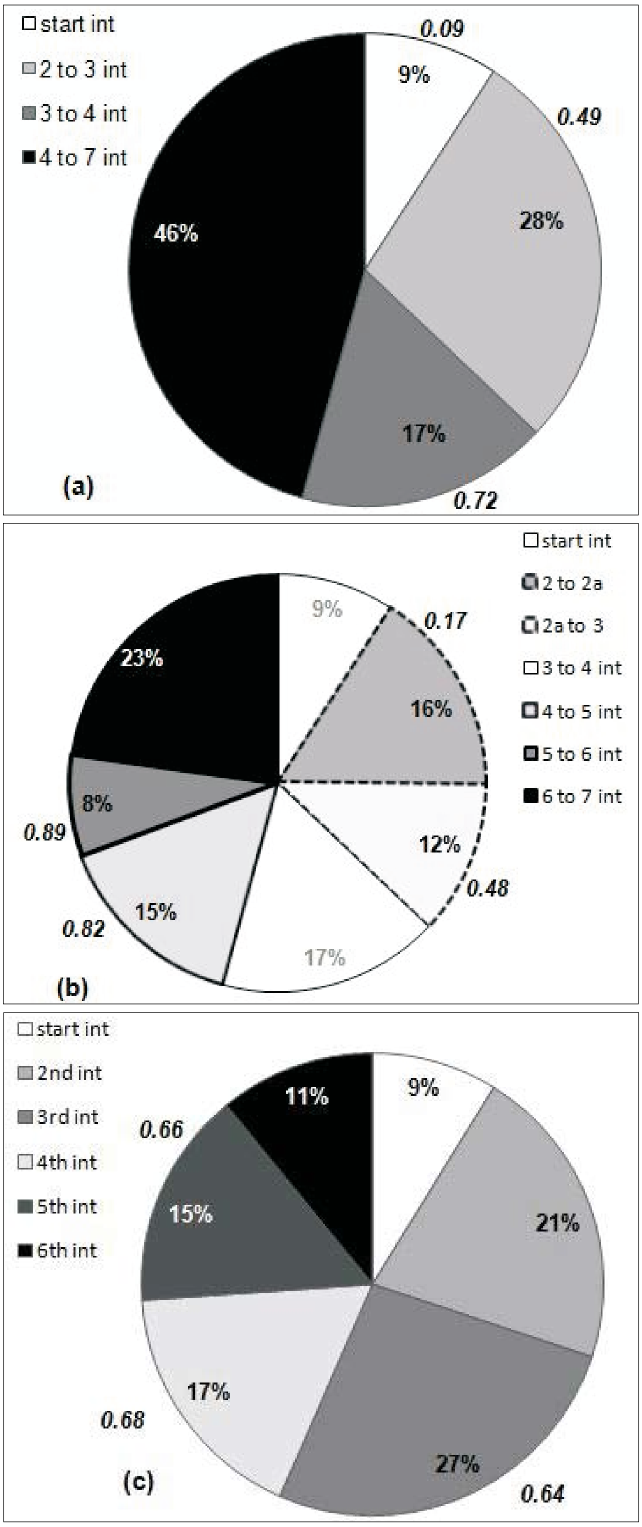

Fig. 3. Interval time percent ratios to the total run time for skeleton events; correlation coefficients between interval times and the remaining run time are shown beside the corresponding segment, non-significant coefficients are not indicated. Data from 13 skeleton competitive events at Lake Placid track *(a)*; additional data from analysis of competition groups I and III, I and II, and II *(b)*; skeleton World Cup 2008/09 at Whistler track *(c)*.

Discussion

The study has shown that at the well-known Lake Placid track influence of interval times on the outcome of the run differs between skeleton and luge athletes. Time spent at the starting portion of the track (50 m long for skeleton and 36 m long for luge according to New York State Olympic Regional Development Authority (ORDA) information) had shown a very weak correlation with the remaining time on the track both for skeleton athletes (correlation coefficient 0.09 for all competitions, and 0.21 for competitions of group I and II) and luge athletes (correlation coefficient 0.18 in total analysis, and 0.24 for major competitions). It is interesting to note that correlation between starting interval time and the remaining time is higher for the sport of luge, despite that in luge athletes spend just around 3% of their time at the initial portion of the track, whilst in skeleton athletes spend around 9% of their time at this interval (the length of the starting portion of Lake Placid track makes about 2.7% of the total length of the luge track and about 3.7% of the skeleton track, Figure 4). It is also notable that in overall analysis (3 competitive events in luge and 13 in skeleton) correlation between start time and the remaining time is lower than in major competition analysis (Table 2 and Table 4).

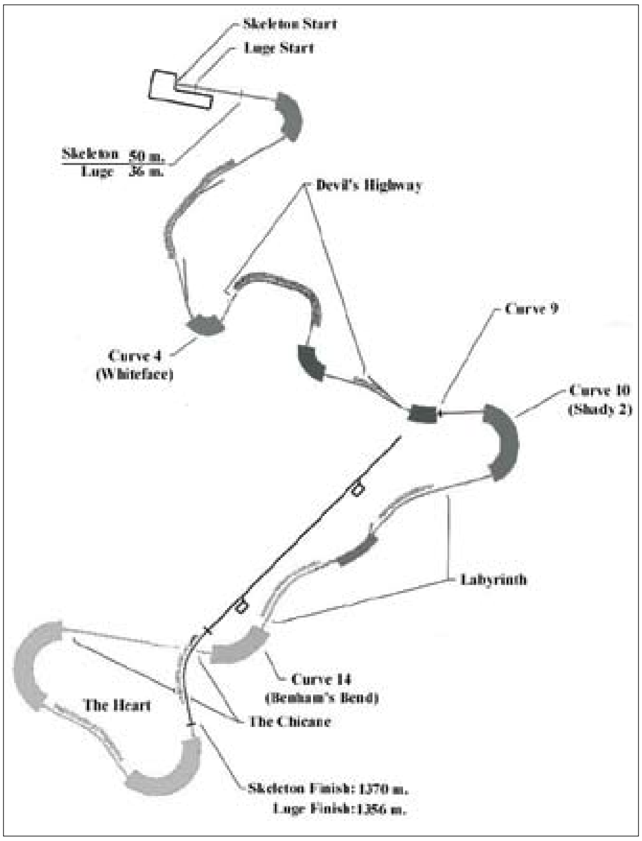

Fig. 4. Lake Placid combined bob-skeleton-luge track map (courtesy of New York State Olympic Regional Development Authority (ORDA)).

Generally correlation analysis of competitive events at Lake Placid track has shown lower influence of interval times on the remaining times at luge events than at skeleton events. Correlation coefficients for luge events do not exceed 0.44, demonstrating a weak correlation between interval and remaining time (gradation to weak, moderate and strong correlation according to general statistics literature, e.g. Abdi (2007), however it should be kept in mind that studies of correlation in sliding sports are limited, and further information is needed to apply appropriate gradation in these sports). Individual analysis of competitive events in luge demonstrated the highest correlation coefficient value of 0.69 for the 4th interval of the track. In overall analysis of skeleton events correlation coefficient reached 0.89 (0.84 in individual analysis), thus showing a high influence of interval time on the remaining time. In skeleton correlation demonstrated tendency to grow from initial parts of the track to final parts, however this was not the case for the sport of luge.

The second part of the track that makes 20.43, s = 0.12% of the total track time in luge and around 21% of the track length (the 3rd measuring point is located at the exit of curve 4) in overall analysis of luge competitions shows 0.29 correlation coefficient with the remaining time (0.35 for major competition analysis). In skeleton this interval makes about 28% of the total track time, and correlation coefficient for 13 competitions is 0.49 (Figure 3a). Analysis of group I and III competitions gives more detailed information about this interval; photoelectric cell 2a (Figure 2) divides the interval in two parts, the first part makes 16% of the track time and shows correlation coefficient of 0.17, the second part is just 12% of the total time, but its correlation coefficient is 0.48. It is remarkable that coefficient 0.17 is comparable to the coefficient of start interval, despite that start interval is significantly shorter than 2 – 2a interval of the track.

The next Lake Placid track interval lasts till the exit of curve 9; "Devil's Highway", an array of curves requiring high steering abilities from athletes, makes the major part of this interval. It shows the highest correlation with the remaining time in the sport of luge (0.44, Figure 1a), taking only 13% of the total lugers' time. For skeleton this interval correlates with the remaining time with coefficient 0.72; its contribution to the total skeleton run time is about 17%.

The 4th part of the track takes around 33% of lugers' time, but its correlation coefficient is relatively low (0.37 in overall analysis); this coefficient is slightly lower than the 3rd interval coefficient for slower lugers (taking 11 to 25 places at major competitions), but increases slightly for top-10 athletes. Additional time measurements in skeleton allowed more detailed analysis of Lake Placid track at the interval between exit of curve 9 and curve 15. Skeleton athletes spend about 15% of their time to slide down from exit of curve 9 to exit of curve 12 (which makes around 18% of the skeleton track length), and correlation coefficient for this part of the track is slightly higher than for the previous interval (0.82 for group I and II competitions). Despite that the next interval of the track is short, it correlation coefficient with the remaining run time is even higher (0.89, analysis of group II competitions).

It is notable that both in skeleton and the sport of luge shorter interval times correlate with the remaining run time as strong as longer interval times and even stronger. This is true also for athletes' performance at Whistler track; however, for the sport of luge this track is divided into more even intervals (Fig. 1b). Correlation coefficient of interval times for luge events demonstrated tendency to increase from starting to final parts of Whistler track, whilst for skeleton coefficients remain almost unchanged (Fig. 3b).

Correlation coefficients achieved in the present study significantly differ from those shown in previous works. Zanoletti et al.(2006) had shown that overall correlation coefficient between start interval time and total run time in 24 competitive events at different track is 0.48 for male skeleton athletes and 0.63 for female skeleton athletes ($P<0.05$). Brüggemann et al. (1997) demonstrated 0.7 correlation coefficient between starting interval and the remaining run time at male luge competition during 1994 Winter Olympic Games in Lillehammer (for top-15 results this coefficient was only 0.3). In this study all correlation coefficients between interval times and remaining time were relatively high (above 0.7 – 0.8), but for top-15 results the coefficients were lower that in overall analysis.

In present work correlation coefficient did not decrease for fastest 10 luge results, moreover, these coefficients even slightly increased for fastest 10 results if compared to overall analysis. Decrease of correlation coefficient relatively to overall analysis, however, was demonstrated for group of 10 fastest results at major skeleton competitive events.

Conclusion

Present study demonstrated that at Lake Placid track, which is well-known to athletes due to its long traditions of hosting important competitive events, results of luge runs correlate with 3rd and 4th interval times (from exit of curve 4 to curve 15) more than with other interval times. This correlation is higher for 10 fastest athletes than for athletes with rankings from 11th to 25th place. The same tendency of correlation is demonstrated at skeleton events; correlation coefficients that are demonstrated in skeleton are stronger than those observed in luge.

Importance of start interval shall not be neglected; taking into account very short time that athletes spend to cross the starting interval at Lake Placid track, this part of the track influences more luge athletes than athletes of skeleton. Correlation between starting interval and the remaining run time in luge is remarkably higher at the new sliding track in Whistler that is built to host Winter Olympic Games in 2010.

At Whistler track the strongest correlation with the remaining run time for luge events is on the interval at the second half of the track; for skeleton it is on the interval including curves 9 and 10. Influence of the starting interval to the outcome of skeleton race at Whistler track could not be estimated at the time this study was performed due to a very limited number of competitions performed at the new track.

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TRASOS ATSKIRO RUOŽO ĮVEIKIMO TRUKMĖS ĮTAKA BENDRAM MARŠRUTO ĮVEIKIMO LAIKUI SKELETONO IR ROGUČIŲ SPORTE

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SANTRAUKA

Sportininkų pasirodymas leidimosi rogutėmis sporto varžybose priklauso nuo trasos specifikos ir kitų veiksnių, įskaitant aplinkos sąlygas ir įrangos pasirinkimą. Šio tyrimo metu buvo analizuojama trasos atskiro ruožo įveikimo trukmės įtaka viso maršruto įveikimo rezultatui vyrų vienetų rogučių ir skeletono rungtyse. Tyrimui pasirinkta Leik Plasido (Lake Placid) leidimosi trasa visiškai atitinka elitinių varžybų trasoms keliamus reikalavimus, turi ilgametes tarptautinių varžybų rengimo tradicijas. Siekiant apibrėžti, kurie trasos ruožai turi didelę įtaką viso nuotolio įveikimo laikui, buvo atlikta tarpusavio sąsajų analizė. Nustatytas ruožų įveikimo trukmės santykis su visu nuotolio įveikimo laiku. Siekiant atrasti nepriklausomus kintamuosius tyrimui, apskaičiuotas atskirų ruožų ir viso maršruto įveikimo trukmės tarpusavio santykis. Tarpusavio sąsajų analizės iš Leik Plasido trasos rezultatai palyginti su varžybų rezultatais iš Vistlerio (Whistler) trasos. Ši trasa, priešingai nei Leik Plasido, buvo neseniai atidaryta ir joje vyko tik kelerios varžybos, todėl ji sportininkams nepažįstama.

Tyrimo rezultatai parodė, kad Leik Plasido trasos startinis ruožas daro didesnę įtaką čiuožimo rogutėmis nei skeletonu rezultatui. Apskritai, atskirų Leik Plasido trasos ruožų įveikimo trukmės įtaka yra silpnesnė rogutininkams nei skeletonininkams. Tačiau Vistlerio trasoje koreliacijos koeficientai tarp ruožų įveikimo trukmės ir viso maršruto įveikimo trukmės buvo tokio paties lygio tiek skeletonininkų, tiek rogutininkų. Paaiškėjo, kad per trumpesnį laiką sportininkų įveikiami ruožai turi didesnę įtaką rezultatui nei ruožai, kuriuos įveikti užtrunka ilgiau.

Ruožų įveikimo trukmė atskleidė stipresnę sąsają tarp trasos įveikimo trukmės ir 10 geriausių čiuožimo rogutėmis rezultatų, lyginant su 11–25 vietų rezultatais. Panaši ir skeletono sporto šakos rezultatų sąsajų tendencija: pirmojo dešimtuko sportininkų grupės koreliacijos koeficientai buvo šiek tiek aukštesni už 11–20 vietų reitingo sportininkų.

Padaryta išvada, kad rogutininkų varžybinio maršruto įveikimo trukmė Leik Plasido trasoje priklauso nuo startinio ruožo įveikimo trukmės, o trečiojo ruožo įveikimo trukmė svarbesnė už kitų ruožų įveikimo trukmę. Skeletonininkams 12–15 ruožų vingiai turi ypatingą svarbą. Kadangi Vistlerio trasoje vyko tik dvejos čiuožimo rogutėmis ir vienos skeletono varžybos, apie šią trasą galima daryti tik preliminarias išvadas. Per skeletono varžybas sportininkams didžiausią įtaką darė 9 ir 10 trasos vingiai, tačiau negalima daryti jokių išvadų apie startinio ruožo ir viso maršruto įveikimo laiko tarpusavio santykį. Tarp Vistlerio trasos rogutininkų startinio ruožo įveikimo trukmės ir viso marš-

ruto įveikimo laiko nustatytas koreliacijos koeficientas – 0,46.

Raktažodžiai: skeletonas, rogutės, ruožų įveikimo trukmė, koreliacijos koeficientas.

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Gauta 2010 02 09
Patvirtinta 2010 09 06