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Body Segment Parameters During GS Turn in Recreational Skiers

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A B S T R A C T

Study aim was to analyze the kinematic parameters of the body of the examinees, without competitive experience in skiing, in order to determine the competitive efficiency. The participants in this research were 23 male students from the Faculty of physical education and sport, aged 22±6 months, who attended the classes in the subject alpine skiing. Examinees were divided into two categories, according to duration of the course run, in order to determine whether there is the differences in body segment parameters during giant slalom turn. Using Independent Samples t-test we see that the examinees differ on a statistically significant level in variables duration of the turn p=0.000, duration of the course run p=0.000 and inclination of the body p=0.030, and that the differences are in favor of faster examinees. The analysis of the results in this research has shown that there is a relation between the measured body segment parameters and duration of the course run, or that the technique of skiing has a direct impact on the competition in alpine skiing.

Key words: *kinematic parameters, center of gravity, students, competition*

Introduction

In competitive skiing, in addition to choosing the tactics of skiing, there are other factors (specific motor knowledge of alpine skiing technique, the ability to maintain certain lines of skiing, weather conditions, psychological and physical preparation, start number...) that affect the final result. Z. Hraski and M. Hraski (2009) state that for every skier main goal is to perform turns, from start to finish, with as much as possible efficiency because the slightest error in the technique of skiing can affect the loss of speed and therefore the result. By rules (FIS, 2011), performance is defined as the shortest time from start line to finish line, losing the speed therefore is not an option.

According to the authors (Franjko, Maleš, & Kecerin, 2006), success in the Alpine disciplines depends primarily on the level of the adopted ski specific motor knowledge which require exceptional skiers agility, coordination, strength and endurance. Mujanović, Atiković, Nožinović Mujanović and Nurković (2014) state that the technique of skiing is undoubtedly an important factor for rational performance of movement that can be easily determined by careful observation of skiers by the examiner because exact knowledge of movement execution and highly differentiated tactile and kinesthetic sensations and anticipation of external circumstances are the factors that enable a skier to apply the optimal technique in unpredictable conditions. It is obvious that the evaluation of the efficiency of the ski turn execution and the final results of the race can be made with an adequate assessment of the parameters of the body during the execution of turns.

Since the competition in alpine skiing is increasingly interesting for recreational. In this study we will analyze the kinematic parameters of the body of the examinees, without competitive experience in skiing, in order to determine the competitive efficiency.

Methods

Participants

The participants in this research were 23 male students from the Faculty of physical education and sport, aged 22±6 months, who attended the classes in the subject alpine skiing. The teaching process of the subject alpine skiing that takes place in the winter semester of the third and fourth year of university studies contains exercises in the form of a field course for 30 hours during the semester and lectures for 30 hours during the semester. The first course of elements of basic ski technique lasted 7 days. The second course of elements of advanced ski technique took place a year after the first course, and also lasted 7 days, after which the examinees access the competition. Ski lessons were executed by 3 teachers following the identical program. None of the examinees had prior experience with skiing and giant slalom (GS) competition. All students from the sample were without expressed morphological, motor and psychological aberration and they were able to regularly attend lectures and courses on third and fourth year of the university study. The Ethical Committee of Tuzla University approved the study and the procedures conformed to the principles of human experimentation outlined in the Declaration of Helsinki. All participants were informed of the procedures and potential risks, and gave their written consent to participate in testing.

Variables

Measuring instruments of this study were the body segment

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parameters during the giant-slalom (GS) turn. The examinees were evaluated in: CoGH–height of center of gravity of the body–epresented by the distance between the center of gravity of the body and the snow surface perpendicular to the fall line, TT–duration of the turn–represented by the time elapsed between the moment when the skier pass the imaginary vertical line positioned 2.5 m laterally, before and after the turn pole, T–duration of the course run-represented by the time elapsed between the moment when the skier start and finish the course run, IB–inclination of the body-represented by the angle determined by line that goes from the CoG to the center of outside ski and the line perpendicular to the fall line and HA–hip angulation-represented by the angle determined between the torso and the upper leg.

Procedure

Testing was conducted on the slope marked by safety fence, with start at an altitude of 490 m and the finish line at an altitude of 325 m, on an incline between 20° and 21°. The giant slalom course was with a gate set-up of 13 gates, with distance between the gates of 15 meters as a constant value and a horizontal offset of 7 meters between first and second, fifth and sixth and eighth and ninth gate and 8 meters between the remaining gates. A slope meets all the needs of measurement and we approached a noninvasive method for diagnosis (Mejovšek, Hraski & Medved, 1997). The area was adequate with all the criteria and conditions for carrying out skiing, and suitable for the equipment setup. The cameras had enough light as to further increase the video quality. Start time was at 19:00. Two video cameras recorded the passing of the second gate and all parameters are registered when a skier was in the frontal plane with a gate observed from a position down by the fall line. The reason for the testing of this phase of turn, is because at this stage skiers finishing inclination of the body and trying to maintain a dynamic balance with hip angulation.

The acquisition of the video required for kinematic analysis was performed with two digital cameras (Casio EX-F1) with a frequency of 200 frames per second. The cameras were placed at an angle of 90 degrees relative to the plane of recording and were at a distance of 10 m (Figure 1). Before the recording, there was a preparation that includes calibration of space, with calibration frame (200x200 cm) with the purpose that allows precise calibration of space in the analysis (Huremović, Biberović & Pojskić, 2009). An advanced video analysis program Contemplas was used in order to acquire kinematic parameters (Joerg, Ruediger & Peter, 2007).

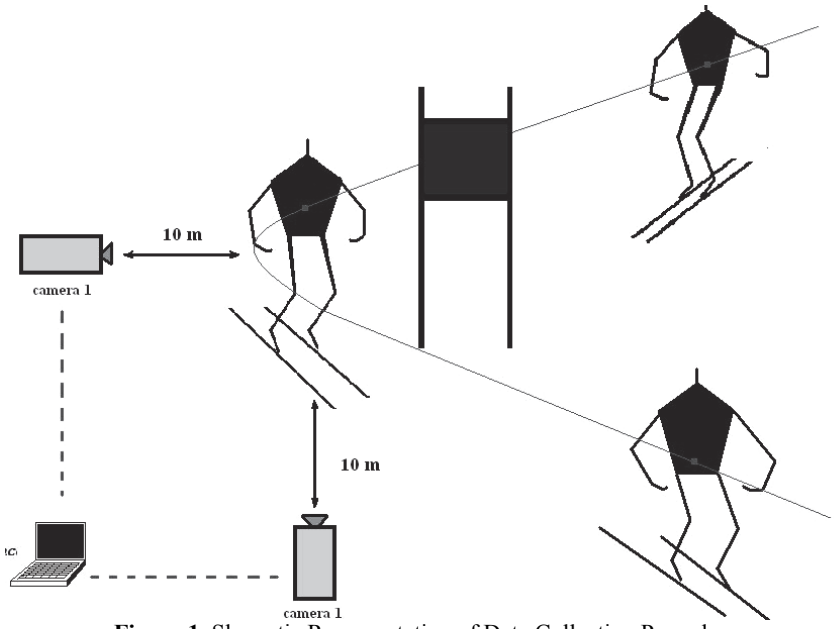

Figure 1. Shematic Representation of Data Collection Procedures

The data for giant slalom competition was collected during the race was performed. For evaluation we used results in 1/100 s, which the examinees achieved in modified giant slalom race. Time is measured by TAG Heuer wireless race timing system equipped with start gate, photocell and chronoprinter timer with timing calculation (speed) to the 1/100.000 of a second (Heuer, 2016).

Data analysis

Data obtained in this study were analyzed using a software system for data. We used standard statistical procedures to determine the basic descriptive parameters of variables. Descriptive statistics (M–arithmetic mean, SD–standard deviation, Min–minimum value and Max–maximum value) were alculated for each variable. Hypothesis that a variable is normally distributed were checked for normality using KS–Kolmogorov Smirnov test. In order to determine whether there are differences between the groups, based on the time of skiing, we used Independent Samples t-test.

Results

Reviewing the results of the descriptive statistics (Table 1) it is noted that the height of center of gravity (CoGH) varies from 0.70-0.90 m, duration of the turn (TT) varies from 2.32-3.60 s, duration of the course run (T) varies from 27.26-39.90 s, inclination of the body (IB) varies from 31.90º-46.16º and hip angulation (HA) varies from 171.79º-178.74º. According to the KS test results (below 1.00), we can see that there are no statistically significant differences (p) between the obtained distribution of results from a normal distribution of results.

Table 1. Descriptive Parameters

	N	Min	Max	M	SD	KS	p
CoGH	23	0.70	0.90	0.7648	0.05712	0.164	0.113
TT	23	2.32	3.60	2.9252	0.26082	0.133	0.200
T	23	27.26	39.90	32.9370	3.95526	0.115	0.200
IB	23	31.90	46.16	39.0739	4.54978	0.138	0.200
HA	23	171.79	178.74	174.6526	2.04456	0.103	0.200

Legend: N-number of examinees; M–arithmetic mean; SD–standard deviation; Min–minimum value; Max–maximum value; KS–Kolmogorov-Smirnov test; p–level of statistical significance for KS-test

According to duration of the course run (T) that we got for each skier (Table 1), based on the value of the M (32.9370), examinees were divided into two categories in order to determine whether there is the differences in body segment parameters during GS turn. This variable we named GROUP and the first category (1) consists of faster examinees (score lower than 32.9370) while the second category (2) consists of slower examinees (score higher than 32.9370).

Table 2. The Results of Independent Samples t-test

	GROUP	N	M	SD	Std. Error M	p
CoGH	1	12	0.7633	0.06597	0.01904	0.902
	2	11	0.7664	0.04884	0.01473	
TT	1	12	2.7458	0.15383	0.04441	0.000**
	2	11	3.1209	0.20710	0.06244	
T	1	12	29.7108	1.66994	0.48207	0.000**
	2	11	36.4564	2.28804	0.68987	
IB	1	12	41.0075	4.66709	1.34727	0.030*
	2	11	36.9645	3.49291	1.05315	
HA	1	12	174.1258	1.79710	0.51878	0.204
	2	11	175.2273	2.22435	0.67067	

Legend: GROUP 1 faster examinees; GROUP 2 slower examinees; N-number of examinees for each group; M–arithmetic mean; SD–standard deviation; Std. Error M-standard error of mean; p-level of statistical significance **p<0.01; * p<0.05

If we look at the results of the mean (M) in t-test (Table 2) in used variables, we see that the differences are in favor of first group (1), of faster examinees. Results of the Independent Samples t-test (Table 2) have shown that the examinees differ on a statistically significant level in variables TT p= 0.000, T p= .000 and IB p= 0.030.

Discussion

Comparing the results of this research with the research Z. Hraski and M. Hraski (2009) which was carried out on the Croatian National Children Team, entering category for FIS races, we can see that M for duration of the turn (TT) was 1.7296 s which is faster compared to examinees in this study, where M for inclination of the body (IB) was 47.8014º which is the greater angle compared to examinees in this study and where M for hip angulation (HA=was 158.1739º which is the smaller angle compared to examinees in this study.

Gurshman (2005) says that the IB in simple terms is a movement of the entire body forward and inward in the direction of the center of the future turn. He also says that while inclining, racer keeps his hips and shoulders level and hips stay almost square to the skis in the beginning of the turn and progressively "open up" into the fall line helping to maintain an edge grip and a racer who can carve turns most cleanly while holding the tightest line throughout the course will have the most overall speed. On the other hand angulation is the result of lateral movements of the parts of the body relative to one another and is achieved by abduction/adduction movements of the femurs and lateral flexion (NZSIA, 2013). If hip angulation is done properly, body mass above the pelvis moves laterally, towards the outside of the turn, shifting more weight to the outside ski (Schnellmann, 2015). Angulation serves for maintaining an edge grip when forces build up in a second part of a turn and allows the skier to adjust the edge angle without necessarily affecting the degree of inclination, as Gurshman (2005) says in reality just compliments inclination.

Based on the above it can be said that the examinees who had a faster overall time in this study, based on the ski specific motor knowledge, achieve better time of turns and larger angles of IB necessary for execution of turns and maintaining balance, that is according to mentioned explanation of IB essential for a better result in the ski competition. Also since the HA does not have statistical significance, and it is said that in reality just compliments inclination, it can be said that the speed of skiing is conditioned by higher angles of IB and consequently better maintaining edge grip throughout the course, while probably HA depends directly on the IB with a goal to shifting more weight to the outside ski, in the second part of the turn, which is necessary to maintain balance through the course. The analysis of the results in this research has shown that there is a relation between the measured body segment parameters and duration of the course run, or that the technique of skiing has a direct impact on the competition in alpine skiing. This is also a good indicator of the technical efficiency of subjects during the performance of turns, which may in the future be the parameters for determining the effectiveness of a technique of skiing, but the question is whether examiners and how accurately can notice the details of characters, without the use of certain technologies.

This study has certain shortcomings, which are reflected in the small number of kinematic parameters. So it is necessary to include other parameters that are considered to have an impact on the technique of skiing and consequently on the result in competition in order to bring even more complete and better conclusions and thus facilitate the adoption of ski knowledge and results in ski competitions.

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