

Evaluation of skis of alpine skiing behavior on the snow

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Abstract

- Purpose:** The purpose of this study was to evaluate the behavior of the skis on snow depending on sex, type of ski and the level of training of the technical skier.
- Material:** in the research participated 57 skiers, generally of age 26 ± 8.62 years (34 males and 23 females) at the ski center of Parnassos (Greece). The evaluation of the ski behavior on snow came up via the scores on Test 1 to Test 5 in practice, to the rating scale from 0 to 10 respectively. The participants, after performing daily training with their skis completed the questionnaire. The questionnaire included the following elements: sex, height, weight, the type of skis and the type of TEST as: 1-2) behavior of skis in long and short turning radius, respectively, 3) grip of the ski edges in turn, 4) stability of ski riding, 5) usage of general muscle strength (fatigue).
- Results:** The correlation between the first four tests (Test 1-4) was significant at statistical significance level $p < 0.05$, apart from test 5, which shows reduced physical fitness of the skier. Also the majority of skiers prefer parabolic skis (carving ski), although the racing skis were highly rated.
- Conclusions:** The widespread "carving skis" are skis with medium score in both of all five tests in comparison to the Race ski. Finally, as expected, the highest score was given by the athletes ($r = 0.69-0.99$). It is recommended for further research of the correct selection of the ski in relation to: the physical fitness of the skier, prevention and injuries.
- Keywords:** alpine skiing, ski behavior, evaluation, test.

Introduction

In skiing, the downhill of the skier on the slopes is accomplished by using the skis. A good skier involves good technical training. The technical training in Alpine skiing is the grade of control of the ski from the skier during the course of the descent, and the appropriate use of the baton. Depending on the way of descent, the technique of skiers classify in beginners, medium, advanced and athletes. For this reason in every ski resort there are shaped slopes for all levels of skiers from beginners to elite sportsmen.

Each slope may differ in the difficulty of the descent. The difficulty is usually due to the slope to the horizon, the width and the quality of the snow that exists on the slope. The greater the slope and the smaller width, the more difficult it is considered. The quality of the snow is something which depends on various factors such as the temperature of the atmosphere and the snow, the moisture, the sunshine, the wind etc.

The Ski contests, like the ski equipment, are classified into 3 categories: Nordic ski, Alpine ski and Freestyle ski. The Nordic ski includes jumps from springboard (Jumping ski) and endurance (Cross country ski). The Alpine ski includes speed contests (DH & Super-G) and contests of «slalom» (GS & SL), while the Freestyle ski involves acrobatic contests (Mogul ski, Aerial ski, Cross ski & Half-pipe ski). The sample of this research is all taken from alpine and freestyle categories. The Alpine ski is mainly «carving ski», which is technologically more evolved than the old technologically conventional skiing.

The differences of carving skiing compared to conventional are: the length of the ski is smaller, the side cut is bigger, which works as a regulator of the shape

and then of the ski behavior on the track, and the radius of the turn. When the side cut is not large and the rate of the radius of the turn exceeds 30 meters then the skis are conventional. The longitudinal stiffness of the ski is reduced so that it makes the skis more flexible in order to be better adapted to the track of the turn. The horizontal stiffness of the ski is increased so that it makes the edges of the skis having better grip during the turn and consequently not becoming side sliding.

In freestyle skis the construction is different than the carving ski. The differences are the followings: they are larger so they have bigger part of contact with the snow, they don't have big side cut, which is something that doesn't suit in short turns.

Literature Review

On the evaluation of the ski behavior on the snow by users of different levels there are not many reports. Specifically, the Daily mail ski and snowboard magazine (DMS & S) has dealt with this subject in the issues of [1, 2, 3, 4, 5, 6, 7]. The rating of the skis was done in the form of a questionnaire by professional athletes and ex-champions while tests were done at a specific slope in Italy. The skis were evaluated in the following 12 criteria (DMS & S ski test): Holding the edges, in short turning radius, in long turning radius, stability at speed development in the straight, high speed, low speed, passing over rough terrain, response of skis to the movements of skier, adaptability to different conditions, performance in slopes with brindle, response of skis in powder, and finally how flexible the skis are in the passages with "bumps". Regarding the kind of the skis, in the issues of [5, 7], worked with the freestyle skis in the issue of [2] with the race skis, in issues of [1, 6] with the carving and in the issue of [3] with the cross skis.

On the evaluation of the ski behavior on the snow by

non-professionals worked on only the magazine [14, 15], where a non-professional skier tested 13 different pairs of skis and a team of experts marked them as follows: the response of skis in the entry of turn, the adaption of skis to changes made by the skier and at various turning radius. In all these researches evaluated the same types of skis of different companies. There is a research that compares different types of skis between them, such as racing and touring skis for men and women [10, 11, 12], while for teens and freestyle skis there are tests in the following magazines: [10, 13].

Purpose. The purpose of this study was to evaluate the behavior and the capabilities of skis on snow regarding: sex, type of ski, the level of the skiers in relation to the parameters - criteria (test).

Cases. The study was structured to answer the following research questions:

- a) Are the carving skis the most popular and the most highly rated skis regarding the 5 criteria mentioned above?
- b) Can the results of the evaluation of the skis contribute to a better selection of skis from elite athletes and even to recreational skiers?
- c) Can the type of ski in relation to his behavior on the snow be rated by non-professional skiers?

Material and Methods

Participants. The 57 tested were aged from 10 to 52 years (26.19 ± 8.62). The average height of males was 1.78 ± 0.08 , while of females was 1.65 ± 0.05 . Also the body weight of males was 73.68 ± 10.44 , while females 57.17 ± 8.76 . Finally, the values of the body mass index (BMI) of males were 23.19 ± 2.40 , while females 20.90 ± 2.92 , where the mark of obesity for both sexes was normal.

Research Design. For the study 57 skiers were selected by random sampling in the ski center of Parnassos (Greece). The results were analyzed in three different categories: 1) sex (23 females and 34 males), 2) depending on the type of skis (all - mountain, carving, cross, freestyle and race ski), 3) according to the level of technical training: (12 athletes, 24 advanced, 11 medium and 10 beginners). The evaluation of the behavior and ability of skis on the snow was done via rating skis with 5 different criteria in the evaluation scale of 0 to 10. The process of each test was as follows: the tested, after performing the daily training with his skis, completed the closed form questionnaire with the following information: personal (sex, height, weight), experience in skiing, type of ski equipment and

type of test. The test represented the following parameters - criteria [9]:

1. Behavior of skis in big turning radius (TEST 1)
2. Behavior of skis in small turning radius (TEST 2)
3. Behavior of skis to the grip of edges in turn (TEST 3)
4. Behavior of skis in stability of riding (TEST 4)
5. Behavior of skis during fatigue of general muscle strength (TEST 5)

The evaluation was to one mark with percent values in accuracy.

Statistical Analysis. The statistical analysis was performed using the statistical program Excel 2007 and SPSS 20.

Results

Evaluation according to sex

Table 1 shows small deviations between males and females, while the females are given a lower score in the first four tests compared with the males. This means that to them the first four tests were difficult. Also in the fifth and final test, which refers to the fatigue of general muscle strength seems that females reported higher score (7.3 points), which means that they spent less muscle energy than males (6.9 degrees). The above phenomenon can be explained due to the power of gravity and inertia, because running the downhill on sloping ground and not on straight ground. The classic example is the results in various Alpine ski races where female athletes were not behind males [8]. The correlation coefficient between the tests was important about males ($r = 0,60-0,85$) except TEST 5 which shows the reduced fitness of the skier, while about females there was correlation in all the tests ($r = 0,36-0,81$) at significance level $p < 0.05$.

Evaluation depending on the type of ski

The tested skiers prefer Carving skis (57.4%) compared to the rest categories (Figure 1), although the Race skis (24.1%) had the highest score in most of the tests (Figure 2), while the other categories share the rest percentage.

As for the results for each type of ski in the five different tests, in the first test (the behavior of skis in the long turning radius) we observe that predominate Race skis (9.1 points) and Freestyle skis (9 points), while Carving skis took low score (6.5 points).

In the second test (the behavior of the ski to short radius turn) we observe that the Freestyle skis are rated in turns with short radius with low score (5 points). The

Table 1. The results of tests in relation to sex.

| SKIERS | MALES (n=34) | | FEMALES (n=23) | | TOTAL (n=57) | | |
|--------|-----------------|-----|-------------------|-----|-----------------|-----|-----|
| | M | SD | M | SD | MIN | MAX | M |
| TEST 1 | 7,6 | 2,1 | 6,9 | 2,0 | 1,0 | 10 | 7,4 |
| TEST 2 | 7,1 | 2,4 | 7,0 | 2,0 | 3,0 | 10 | 7,1 |
| TEST 3 | 7,6 | 2,3 | 7,0 | 2,1 | 2,0 | 10 | 7,4 |
| TEST 4 | 7,8 | 2,1 | 7,3 | 2,1 | 2,0 | 10 | 7,6 |
| TEST 5 | 6,9 | 1,7 | 7,3 | 1,9 | 3,0 | 10 | 7,1 |

Race skis are rated and in the second test with too high score (9.4 points), while the Carving skis in this test are in better position (6.6 points), because their construction helps to do turns with short radius. In the third test (grip of the skis edges in turn) we observe that the order of the score of skis in short turning radius (test 2) and of the grip of the ski edges in turn (test 3) are the same. In the fourth test (stability of skis in riding) dominated again the race skis (9.9 points) while freestyle skis are rated higher than the second and third test. In the fifth test the skis were rated according to the fatigue of general muscle strength that the skier felt in the downhill. In this category the cross skis rated too high (8.7 points) which is explained by their construction (with medium side cut) and they are used in stepped and unstepped tracks respectively (e.g. 50% -50%).

The correlation coefficient (r) between the tests was important to the specific types of skis as: All-mountain (r = 0,91-0,98) and Carving (r = 0,38-0,77), in significance

level $p < 0.05$, while the feature of All-mountain skis was the following, that the four tests in relation with the test 5 had negative sign. This means that it required big fatigue of muscle strength (Test 5) in all four tests, which shows the reduced fitness of the skier.

The Race skis had significant correlation between the first four tests ($r = 0,52-0,78$), while they had any correlation with the test 5, which shows the reduced fitness of the skier. The Freestyle skis had significant correlation between all tests ($r = 0,80-0,99$), except for the first two tests, while Cross skis (Free race) had significant correlation only between TEST 1-3, TEST 1-4 TEST, TEST 2-5 and 3-4 ($r = 0,91-0,98$).

Evaluation according to the level of technical training

Regarding the effects of the level of technical training of skiers through the five different tests, as expected, the athletes dominate (Figure 3). It is remarkable that the beginner skiers had little fatigue of general muscle strength (Test 5) relating to the other categories of the

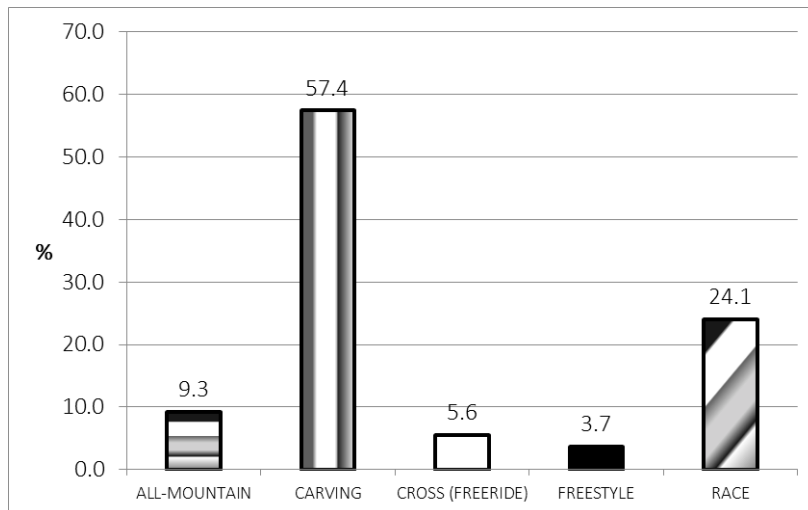


Figure 1. Percentage (%) of selection for the type of skis by the tested.

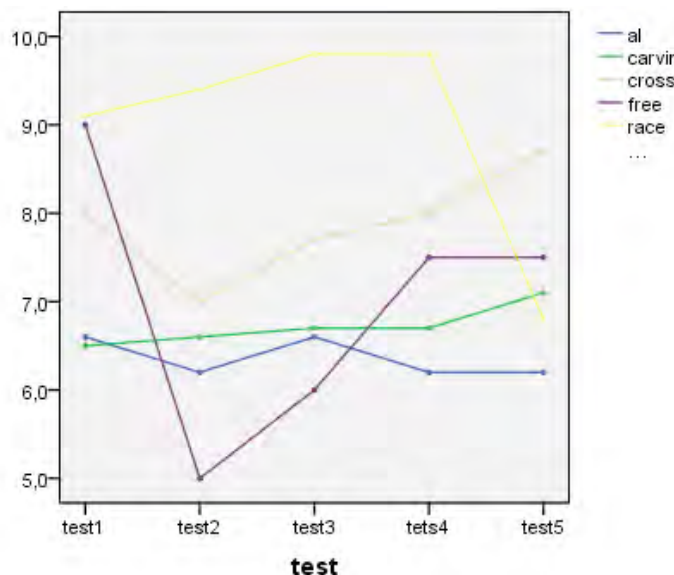


Figure 2. Resulting score of 5 tests - criteria in relation to the type of skiing.

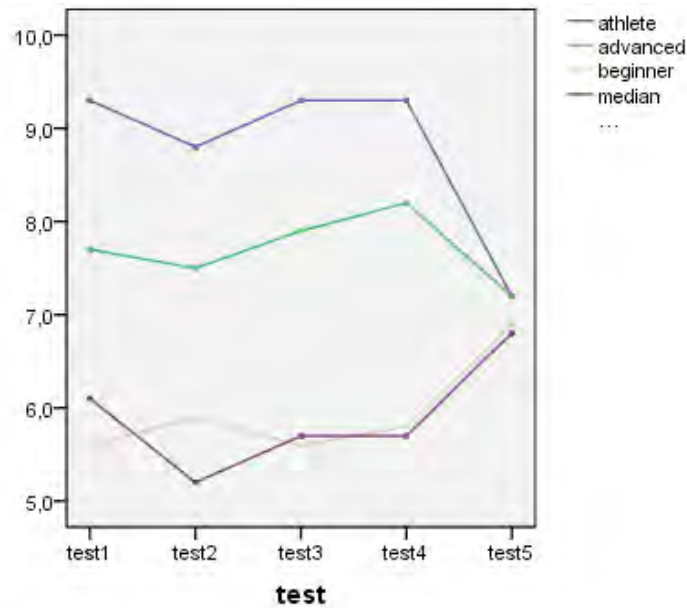


Figure 3. Resulting score of 5 tests - criteria in relation to the plane of the test.

level and to the correlation between the tests. The above fact in this case is explained on the one hand because of the good fitness of the beginner skiers, and on the other hand because of the correct selection of equipment with shorter skis.

The correlation coefficient between the tests was significant about athletes ($r = 0.69-0.99$) except for TEST 5 and between TESTS 1-5, which shows the reduced fitness of the skier. Also about beginners there was correlation at all tests ($r = 0.60-0.89$) except for between TEST 1-5, in statistical significance level $p < 0.05$.

Discussion

From the analysis above and the five tests the following question is raised: why the majority of skiers prefer carving skis while race skis responds better in tests? The above phenomenon may be due to the construction (with a large side cut) and the heavy weight of the ski accessories such as "plate", etc., while it should be noted that the race skis look like racing skis therefore they require better fitness by the skier. Also, the above phenomenon is explained by the vast publicity and Carving skis of that season marketing. The Carving ski is considered unreliable in terms of large radius, because of their construction (with a large side cut), as it is specialized for turns with short radius. Remarkable is that cross skis have stable rating and they are found at the first four tests in the second place, while the race skis were impressive because of the fact that they were top at the first four tests, while in the last one (test 5) high fatigue (tiredness) of muscle strength was necessary (6.8 degrees). This reflects on the reduced fitness of the

skier. The Freestyle skis are rated as unreliable in turns with short radius (5 points), probably because of their construction (with small side cut). The differences in estimate between the all- mountain skis and carving skis were small as in all the above tests. Based on the tests above, it is recommended for beginner skiers, before they buy their new equipment, to test the skis through rentals with shorter skis from the usual options.

Conclusions

Based on these results we can conclude the followings: the skis descent can be classified regarding their behavior on the snow through the method suggested above (the practical part and the questionnaire). The results of the evaluation of the skis can contribute to a better choice of skis from elite athletes even to tourist skiers. The evaluation of the ski behavior on the snow was accomplished with high ratings by the females in all the tests, despite the small muscular strength compared to males ($r = 0.36-0.81$). The widespread and more published «carving skis» are the skis with a medium score to the 5 tests compared to the Race skis, which had a high score ($r = 0.52-0.78$), while they have no correlation with TEST 5 which shows the reduced fitness of the skier. Finally, as expected, the highest rating given by the athletes ($r = 0.69-0.99$) at statistical significance level $p < 0.05$. For further research the correct selection of the skis in relation to the fitness of the skier, prevention and injuries are recommended.

Conflict of interests

The author declares that there is no conflict of interests.

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