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# Effect of Morphological Characteristics and Motor Abilities on the Execution of Technical Elements in Alpine Skiing

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**A B S T R A C T**

*Testing was conducted on a sample of 35 subjects, students of the Faculty of Sport and Physical Education in Niksic, who attend regular classes of the Based skiing. There were two systems implied during the testing and those are a predicator system of variables and a criterion system of variables. The predictor system of variables consists of 9 morphological measurements (body weight, chest circumference, thigh volume, body height, the length of the lower leg, arm length, knee diameter, shoulder width and pelvic width) and 8 motor skills (hand tapping, foot tapping, bend-twist-touch, balance with closed eyes, balance with open eyes, agility in the air, side steps, backwards polygon). The criterion system of variables consists of 4 situational motor task (oblique descent, turn towards the slope, V shift, basic meandering). Based on the obtained results, basic descriptive statistic indicators have been calculated: range-Range, minimum-Min, the maximum-Max, arithmetic average-Mean, standard error of arithmetic mean-Std.Error Mean, standard deviation-SD. According the results of regression analysis it could be concluded that the system of 17 predictor variables (9 morphological and 8 motor skills) have achieved a statistically significant impact on the efficiency of the performance of ski technique-two out of four situational motor tasks (criterion system) and those are: V-turn and basic meandering. On the other hand, the system of 17 predictor variables has not achieved statistically significant effect on the efficiency of execution of technical elements of ski techniques on two situational motor task, and those are: oblique descent and turn towards the slope.*

***Key words:*** *skiing, morphological characteristics, motor abilities*

## Introduction

The Alpine skiing is a very popular sports-recreational skiing on the mountains' slopes covered with snow. It belongs to the group of cyclic and acyclic movements performed by skiers who ski down the snowy mountains' slopes. (Bilić, Mijanović, & Bozić, 2007,). Skiing is one of the activities that take place during the special conditions in the outdoor environment, where success in the Alpine disciplines depends primarily on the level of adopted specific motor skills, but also on the skiers'' level of motor and functional abilities (Franko, 2007).

Skiing, as a sport, presents great physical and mental efforts for skiers, demanding from them exceptional agility, coordination, strength and endurance, because nowadays, in competitive skiing who is the winner has been decided by only hundredths of seconds (Cigrovski and Matkovic, 2003). Also, skiing, as the sport of reflexes and balance, demands constant skiers' activity and compatibility of apparatus for movement due to continuous weather changes (Hadžić, 2008).

The aim of this study is to determine whether there is a statistically significant correlation between some anthropological characteristics with the adoption process of a ski technique. In other words, what impact morphological characteristics, motor abilities and functional abilities have on the successful adoption of the ski elements: oblique descent, V shift, basic meandering and parallel meandering.

## Methods

The study has transversal character where bibliographic speculative, empirical and statistical methods were applied and applied techniques are testing and observation. Measuring morphological characteristics, as well as the assessment of motor abilities, was based on the principle of assigned tasks executed by a team of the postgraduate students from the Faculty of Sport and Physical Education. Measurements related to motor skills and morphological characteristics were conducted in the afternoon hours in the sports hall. Assessment of the Alpine skiing technical elements performance quality was performed by observation and scaling. Checking was carried out on the slopes where the students previously had training in duration of 8 days (evaluation has been conducted on the 9$^{th}$ day). Four techniques were evaluated (oblique descent, V-turn, turn towards the slope and the basic meandering with the speed control). The subjects in this study were the second year students, age 19-21 years, male and female, who attend the course the Fundamentals of skiing at the Faculty of Sport and Physical Education in Niksic. There were 35 students in total and all of them attended regularly skiing practice. The sample of the measuring instruments for the morphological characteristics assessment consist of: body mass - AMAST, average thorax – circumference -AOKG, thigh volume - AONDK, body height - AVAST, the length of the lower leg - ADUPK, arm length - ADRUK, knee diameter - ADKL, shoulder width - ASIRA, pelvis width – ASIKA. The sample of the measuring instruments for the motor abilities assessment consist of: hand tapping - MTAPR, foot tapping - MTAPN, bend, twist touch - MPZD, balance with closed eyes - MRZO, balance with open eyes - MROO, agility in the air - MOKRVAZ, side steps - MKORSTR, backwards polygon – MPLN. The sample of the measuring instruments for the acquisition of skiing technique

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assessment consist of: oblique descent – SMKS, turn towards a slope - SMZP, V turn - SMKZ, basic meandering with the speed control – SMOV. The basic descriptive statistical parameters were calculates for each obtained variable: range (Range), minimum (Min) and the maximum score (Max), mean (Mean), a standard error of the arithmetic mean (Std.Error Mean), a standard deviation (Std. Deviation ). The distribution of data was analyzed through the following: a standardized coefficient of skewness (Skewness) and standardized coefficient of elongation or ellipticity (Kurtosis). The Kolmogorov - Smirnov (max D ip) method was applied for the data distribution. The multiple regression analysis shall be implied in order to determine the influence of the predicator system of variables on the criterion system of variables.

## Results

**Table 1.** The basic descriptive parameters of motor skills

| | Valid N | Range | Min | Max | Mean | Std.Error Mean | Std. Deviation | Skewness | Kurtos. | max D | p |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MTAPR | 35 | 12 | 34 | 46 | 39.37 | 0.48 | 2.85 | 0.20 | -0.35 | 0.11 | p > .20 |
| MTAPN | 35 | 9 | 20 | 29 | 23.46 | 0.31 | 1.85 | 1.16 | 1.86 | 0.23 | p < .10 |
| MPZD | 35 | 7 | 19 | 26 | 22.00 | 0.31 | 1.83 | 0.40 | -0.79 | 0.15 | p > .20 |
| MOKRVAZ | 35 | 2.86 | 3.03 | 5.89 | 3.90 | 0.11 | 0.67 | 1.33 | 1.46 | 0.17 | p > .20 |
| MKORSTR | 35 | 3.12 | 7 | 10.12 | 8.72 | 0.12 | 0.68 | -0.26 | 0.65 | 0.08 | p > .20 |
| MROO | 35 | 39.8 | 2.11 | 41.91 | 10.15 | 1.41 | 8.37 | 1.82 | 4.74 | 0.19 | p < .20 |
| MRZO | 35 | 5.01 | 1.6 | 6.61 | 3.12 | 0.20 | 1.16 | 1.66 | 2.71 | 0.18 | p < .20 |
| MPLN | 35 | 9.88 | 7 | 16.88 | 9.90 | 0.37 | 2.19 | 1.52 | 3.07 | 0.15 | p > .20 |

According the Table 1 there is a statistical difference between the standardized coefficient of elongation or ellipticity (Kurtosis). It shows the standing on two legs longitudinally on the bench with open eyes test and polygon backwards test had the greatest influence on the adoption of certain techniques of the alpine skiing

**Table 2.** The basic descriptive parameters of morphological characteristics

| | Valid N | Range | Min | Max | Mean | Std.Error Mean | Std. Deviation | Skewness | Kurtosis | max D | p |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AMAST | 35 | 41 | 55 | 96 | 78.77 | 1.74 | 10.31 | -0.39 | -0.37 | 0.10 | p > .20 |
| AOGK | 35 | 27 | 82 | 109 | 93.49 | 1.17 | 6.94 | 0.08 | -0.78 | 0.09 | p > .20 |
| AONDK | 35 | 16 | 45 | 61 | 54.03 | 0.61 | 3.59 | -0.19 | 0.24 | 0.10 | p > .20 |
| AVIST | 35 | 39 | 161 | 200 | 181.33 | 1.63 | 9.63 | -0.60 | -0.10 | 0.13 | p > .20 |
| ADUPK | 35 | 39 | 42 | 81 | 56.20 | 1.05 | 6.20 | 1.63 | 7.08 | 0.15 | p > .20 |
| ADRUK | 35 | 43 | 41 | 84 | 74.80 | 1.33 | 7.85 | -2.56 | 9.42 | 0.21 | p < .15 |
| ADKL | 35 | 11 | 6 | 17 | 9.31 | 0.34 | 2.01 | 1.59 | 5.30 | 0.17 | p > .20 |
| ASIRA | 35 | 22 | 29 | 51 | 41.60 | 0.94 | 5.56 | -0.51 | -0.03 | 0.11 | p > .20 |
| ASIKA | 35 | 13 | 26 | 39 | 30.69 | 0.43 | 2.53 | 0.75 | 2.50 | 0.19 | p < .15 |

According the Table 2 there are statistical differences between the standardized coefficient of skewness (Skewness) and standardized coefficient of elongation or ellipticity (Kurtosis). When it comes to the standardized coefficient of skewness, the greatest impact on the adoption of certain techniques of the Alpine skiing had the ADRUK- arm length test, while in the standardized coefficient of elongation or ellipticity the most influence on adoption of specific techniques of the Alpine skiing had the following tests: ADUPK- lower leg length test, ADRUK- arm length and ADKL- knee diameter.

**Table 3**. Regression V-turn

| | B | St. Err.of B | t(17) | p-level |
|---|---|---|---|---|
| Intercpt | 17.19 | 12.95 | 1.33 | 0.20 |
| MTAPR | 0.09 | 0.12 | 0.76 | 0.46 |
| MTAPN | 0.02 | 0.14 | 0.14 | 0.89 |
| MPZD | -0.05 | 0.17 | -0.32 | 0.75 |
| MOKRVAZ | -0.21 | 0.49 | -0.43 | 0.67 |
| MKORSTR | 0.13 | 0.40 | 0.32 | 0.76 |
| MROO | 0.00 | 0.03 | -0.07 | 0.94 |
| MRZO | -0.12 | 0.23 | -0.53 | 0.61 |
| MPLN | 0.11 | 0.11 | 0.97 | 0.34 |
| AMAST | 0.07 | 0.08 | 0.92 | 0.37 |
| AOGK | 0.05 | 0.06 | 0.76 | 0.46 |
| AONDK | -0.32 | 0.13 | -2.55 | 0.02 |
| AVIST | -0.10 | 0.08 | -1.32 | 0.21 |
| ADUPK | 0.04 | 0.08 | 0.49 | 0.63 |
| ADRUK | 0.09 | 0.06 | 1.35 | 0.19 |
| ADKL | 0.12 | 0.12 | 1.03 | 0.32 |
| ASIRA | -0.01 | 0.06 | -0.12 | 0.91 |
| ASIKA | -0.03 | 0.10 | -0.30 | 0.77 |

Using regression analysis, it was found that the predictor set, which consists of 8 (eight) motor and 9 (nine) morphological characteristics applied on the participants who performed the criterion variable V-turns (SMKLZAOK) has no statistically significant effect on the prediction of the criteria outcome ($p<64$). Despite the relatively high value of the determination coefficient and multiple correlation coefficient (0.68 and 0.46), undetermined statistical significance was probably the result of some other anthropological factors that were not covered by this research. One of the reasons could be the insufficient number of respondents. Even though this research represents the representative sample of respondents who are the second year students at the Faculty of Sport and Physical Education of Montenegro, according the achieved results it cannot be concluded the significant changes. Also, it could be reckoned that for the effective execution of the situational motor test V-turn, performed by the respondents, might have been influenced by some other factors like anthropological characteristics. Those are anthropometric, motor and functional variables, cognitive abilities, conative characteristics, ect. Moreover, we should bear in mind the specificity of skiing as a sport discipline that is done in the specific weather and climatic conditions as well as the motivation of participants.

**Table 4**. Regression to oblique descent

| | B | St. Err.of B | t(17) | p-level |
|---|---|---|---|---|
| Intercpt | 6.06 | 13.16 | 0.46 | 0.65 |
| MTAPR | 0.21 | 0.12 | 1.77 | 0.09 |
| MTAPN | -0.08 | 0.14 | -0.60 | 0.56 |
| MPZD | 0.05 | 0.17 | 0.29 | 0.78 |
| MOKRVAZ | 0.10 | 0.50 | 0.20 | 0.84 |
| MKORSTR | 0.29 | 0.41 | 0.71 | 0.48 |
| MROO | 0.05 | 0.03 | 1.44 | 0.17 |
| MRZO | -0.10 | 0.23 | -0.41 | 0.69 |
| MPLN | 0.07 | 0.11 | 0.64 | 0.53 |
| AMAST | 0.00 | 0.08 | -0.03 | 0.97 |
| AOGK | 0.06 | 0.06 | 0.96 | 0.35 |
| AONDK | -0.25 | 0.13 | -1.90 | 0.07 |
| AVIST | -0.06 | 0.08 | -0.72 | 0.48 |
| ADUPK | -0.01 | 0.08 | -0.10 | 0.92 |
| ADRUK | 0.09 | 0.07 | 1.44 | 0.17 |
| ADKL | 0.04 | 0.12 | 0.30 | 0.77 |
| ASIRA | -0.05 | 0.06 | -0.82 | 0.42 |
| ASIKA | -0.01 | 0.10 | -0.10 | 0.92 |

Using regression analysis shown in the Table 4, it was found that the predictor set, which consists of 8 (eight) motor and 9 (nine) morphological characteristics applied on the participants who performed the criterion variable oblique decent (SMKOSSPU) has no statistically significant effect on the prediction of the criteria outcome ($p<38$). Despite the relatively high value of the determination coefficient and multiple correlation coefficient (0.73 and 0.54), undetermined statistical significance was probably the result of some other anthropological factors that were not covered by this research.

**Table 5**. Regression to the base wriggle

| | B | St. Err.of B | t(17) | p-level |
|---|---|---|---|---|
| Intercpt | 2.46 | 11.18 | 0.22 | 0.83 |
| MTAPR | 0.10 | 0.10 | 0.98 | 0.34 |
| MTAPN | 0.08 | 0.12 | 0.69 | 0.50 |
| MPZD | -0.08 | 0.15 | -0.56 | 0.58 |
| MOKRVAZ | 0.05 | 0.42 | 0.11 | 0.91 |
| MKORSTR | 0.05 | 0.35 | 0.13 | 0.90 |
| MROO | 0.00 | 0.03 | 0.02 | 0.98 |
| MRZO | 0.17 | 0.20 | 0.86 | 0.40 |
| MPLN | 0.07 | 0.10 | 0.77 | 0.45 |
| AMAST | 0.00 | 0.07 | 0.02 | 0.98 |
| AOGK | 0.03 | 0.05 | 0.55 | 0.59 |
| AONDK | -0.11 | 0.11 | -1.00 | 0.33 |
| AVIST | -0.05 | 0.07 | -0.78 | 0.45 |
| ADUPK | 0.05 | 0.07 | 0.73 | 0.47 |
| ADRUK | 0.08 | 0.06 | 1.37 | 0.19 |
| ADKL | -0.01 | 0.10 | -0.14 | 0.89 |
| ASIRA | 0.00 | 0.05 | -0.09 | 0.93 |
| ASIKA | -0.01 | 0.09 | -0.16 | 0.87 |

Using regression analysis shown in the Table 5, it was found that the predictor set, which consists of 8 (eight) motor and 9 (nine) morphological characteristics applied on the participants who performed the criterion variable basic meandering (SMOSNVI) has no statistically significant effect on the prediction of the criteria outcome ($p<74$). Despite the relatively

high value of the determination coefficient and multiple correlation coefficient (0.65 and 0.42), undetermined statistical significance was probably the result of some other anthropological factors that were not covered by this research.

**Table 6**. Regression to turn towards the slope

| | B | St. Err.of B | t(17) | p-level |
|---|---|---|---|---|
| Intercpt | -11.66 | 13.54 | -0.86 | 0.40 |
| MTAPR | 0.17 | 0.12 | 1.36 | 0.19 |
| MTAPN | 0.07 | 0.14 | 0.46 | 0.65 |
| MPZD | -0.26 | 0.18 | -1.49 | 0.15 |
| MOKRVAZ | -0.47 | 0.51 | -0.91 | 0.38 |
| MKORSTR | 0.18 | 0.42 | 0.42 | 0.68 |
| MROO | -0.02 | 0.03 | -0.62 | 0.54 |
| MRZO | 0.06 | 0.24 | 0.26 | 0.80 |
| MPLN | 0.08 | 0.12 | 0.73 | 0.48 |
| AMAST | -0.11 | 0.08 | -1.39 | 0.18 |
| AOGK | 0.09 | 0.06 | 1.42 | 0.17 |
| AONDK | 0.01 | 0.13 | 0.09 | 0.93 |
| AVIST | -0.02 | 0.08 | -0.20 | 0.84 |
| ADUPK | 0.08 | 0.09 | 0.96 | 0.35 |
| ADRUK | 0.07 | 0.07 | 1.06 | 0.30 |
| ADKL | 0.04 | 0.12 | 0.30 | 0.77 |
| ASIRA | 0.10 | 0.06 | 1.63 | 0.12 |
| ASIKA | -0.01 | 0.11 | -0.10 | 0.92 |

Using regression analysis shown in the Table 6, it was found that the predictor set, which consists of 8 (eight) motor and 9 (nine) morphological characteristics applied on the participants who performed the criterion variable turn towards the slope (SMZAOPD) has no statistically significant effect on the prediction of the criteria outcome ($p<67$). Despite the relatively high value of the determination coefficient and multiple correlation coefficient (0.67 and 0.44), undetermined statistical significance was probably the result of some other anthropological factors that were not covered by this research.

## Discussion

According to the results obtained in this research which was performed by 35 students, applying eight tests of motor skills and nine tests of morphological characteristics, as well as the system of predictor variables in order to determine their influence individually on each of the 4 applied motor tests for assessment of situational motor abilities, it can be concluded that: the predicator variables did not affect significantly the criterion variables of situational motor abilities. Therefore, implementation of similar studies should be performed on a larger number of participants.

## REFERENCES

Bilic, Ž., Mijanović, M., & Božić, Lj. (2007). *Od prvog koraka do karvinga*. Mostar: Fakultet prirodoslovno – matematičkih i odgojnih znanosti.

Franjko, I. (2007.) *Faktori uspješnosti izvedbe skijaških elemenata*. Magistarski rad. Kineziološki fakultet Sveučilišta u Zagrebu.

Hadžić, R. (2008). *Tehnika i metodika alpskog skijanja*. Rožaje: Autorsko izdanje.

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