STRENGTH TRAINING BENEFIT ON BODY COMPOSITION AND FITNESS STATE

Cristian Negrea¹, Claudiu Avram², Elena Sirbu², Adrian Nagel², Martin Domokos²

REZUMAT

Obiectiv: Studiul de faţă îşi propune să demonstrhez beneficiul antrenamentului de forţă în regim de rezistenţă asupra masei musculare scheletale (MMS), consumului maximal de oxigen (VO2peak) şi forţei musculare la schi. Material şi metode: Au fost luaţi în studiu 11 studenţi cu specializarea schi din cadrul Facultăţii de Educaţie Fizică şi Sport, Universitatea de Vest, Timişoara. Toţi subiecţii au urmat un stagiu de pregătire pentru schiori de 4 săptămâni la o altitudine de (1400 metri), antrenamentul fiind compus din coborâre pe schiuri (4 ore pe zi) şi un program de forţă în regim de rezistenţă. Evaluarea iniţială şi la finalul studiului a constat în analiza compoziţiei corporale, testare cardiopulmonară la efort şi măsurarea forţei izometrice segmentare. Rezultate: După 4 săptămâni de antrenament am observat o creştere semnificativă a VO2peak (de la 40,64±6,2 la 42,73±5,6 [ml/kg/min], p=0,003); MMS (de la 38,46±6,5 la 39,02±6,7 [kg], p=0,03) şi a forţei musculare a abductorilor (de la 40,11±6,6 la 46,18±6,2 [kg], p=0,02) şi adductorilor coapsei (de la 37,36±8,7 la 43,51±6,8, [kg], p=0,01). La sfârşitul studiului am corelat parametri investigaţi cu VO2peak şi am identificat o corelaţie semnificativă statistic în ceea ce priveşte extensorii genunchiului şi ai coapsei (r²=0,42, p=0,02 şi r²=0,48, p=0,01). Concluzii: Antrenamentul de forţă în regim de rezistenţă medie determină o creştere a MMS, VO2peak şi a forţei musculare la schi. De asemenea forţa musculară la nivelul extensorilor genunchiului şi ai coapsei poate fi un bun predictor pentru VO2peak în cazul schiorilor amatori. Cuvinte cheie: consum maxim de oxigen, fitness, forţă musculară, masă musculară.

ABSTRACT

Objective: The study is aiming to demonstrate the increase of skeletal muscle mass (SMM), peak oxygen uptake (VO2peak) and muscle strength in one month strength stamina training of skiers. Material and methods: Eleven students who chose to specialize in ski from the Department of Physical Education and Sports, University of West Timisoara were randomly included in our study. They participated in a 4 weeks training ski camp at medium altitude (1400 meters) consisted in downhill skiing (4 hours daily) along with a strength stamina training programme (3 times per week of hill running and 3 to 5 sets of push-ups, sit-ups and pull-ups per session). The evaluation performed at baseline and at 4 weeks follow-up consisted in body composition analysis, cardiopulmonary exercise testing and isometric strength measurement. Results: After 4 weeks of training we noticed an extremely significant increase in VO2peak (from 40.64±6.2 to 42.73±5.6 [ml/kg/min], p=0.003); SMM (from 38.46±6.5 to 39.02±6.7 [kg], p=0.03) and muscle strength for hip abductors (from 40.11±6.6 to 46.18±6.2 [kg], p=0.02) and adductors (from 37.36±8.7 to 43.51±6.8, [kg], p=0.01). At the end of the study we try to see which of the investigated parameters correlates with VO2peak and find a good correlation only for knee and hip extensors muscle strength ($r^2=0.42, p=0.02$ and $r^2=0.48, p=0.01$). Conclusions: Physical strength stamina training at medium altitude increase skeletal muscle mass, VO2peak and muscle strength in non professional alpine skiers. Knee and hip extensors muscle strength may be a good predictor for VO2 peak in this subject. Key words: peak oxygen uptake, aerobic fitness, muscle strength, muscle mass.

INTRODUCTION

Increasing muscular performance (a combination of muscular strength, endurance and stamina) is an important target for all nonprofessional and professional skiers.¹² Particularly skiers must have very good strength and stamina in knee and hip extensors muscles.³

The present study is aiming to demonstrate the increase of skeletal muscle mass (SMM), peak oxygen uptake (VO2peak) and muscle strength in one month strength stamina training of downhill skiers.
MATERIAL AND METHODS

Eleven students who chose to specialize in ski from the Department of Physical Education and Sports, University of West Timisoara (age: 23±4 years, height: 177±8.2 cm and weight 82.3±12.5 kg) were randomly included in our study. The subjects participated in a 4 weeks training ski camp at medium altitude (1400 meters) consisted in downhill skiing (4 hours daily) along with a strength stamina training programme.

The evaluation performed at baseline and at 4 weeks follow-up consisted in cardiopulmonary exercise testing (CPX), body composition analysis and dynamic strength measurement.

CPX test is a global physical performance assessment of a subject through reaching his cardio, ventilatory or muscular limitation. By using gas exchange analysis, CPX testing allows us to study simultaneously the cellular, cardiovascular, and ventilatory responses to exercise. For testing we used a breath by breath ergospirometer device (Cortex Metalyzer 3B, Germany). The system recorded the oxygen uptake and carbon dioxide production during a maximal incremental bicycle ergometer test (Lode Corival, Netherlands) within an interval of 8 to 12 minutes. The electrocardiogram (ECG) and HR were continuously recorded throughout and 5 minutes after the test, using a 12 lead stress electrocardiographic device (GE Medical System, Germany). Criteria for achieving a maximal effort test was a plateau in VO2 or heart rate and/or plateau in ventilation together with a subjective judgment that the subject could not continue even after verbal encouragement. (Fig. 1)

Body composition analysis was performed using a multifrequency bioimpedance body composition analyzer (InBody720, South Korea) in order to measure the total skeletal muscle mass of subjects. Using a diverse range of frequency from 1kHz to 1MHz, the InBody720 measures accurately the balance between body water, protein, body fat, mineral and muscle mass.

A digital hand-held dynamometer (Chatillon K-FCE, USA) was used in order to measure the muscle strength in knee and hip muscle groups.

EXERCISE TRAINING

All skiers involved in the study participated in a 4 weeks training ski camp on a medium altitude ski resort (1400 meters). They had a daily training programme consisted in 2 sessions, 4 hours/session of downhill skiing and an hill training session consisted in running for 20 to 40 minutes. For adjusting and monitoring properly the training intensity and duration of the programme we monitored, recorded, and computer analyzed the exercise training using a Polar RS800 heart rate monitor and professional training software (Polar ProTrainer5 v.5.1, USA).

The subjects also performed 3 times per week (with 48 hours brake between sessions) a strength training programme consisted in 3 sets of push-ups, sit-ups and pull-ups per session. We started by establishing the maximum weight of which the subject can perform 10 repetitions (10-RM). Then they were required to perform 3 sets of 10 repetitions as follow:

• Set one with 50% of the 10-RM
• Set two with 75% of the 10-RM
• Set three with the full 10-RM

When the subject was able to perform 13 repetitions on the final set, it no longer represents the 10-RM and a heavier load was used.

RESULTS

Using the paired t test to compare the two groups at the end of the study, we noticed after 4 weeks of training an extremely significant increase in VO2peak (from 40.64±6.2 to 42.73±5.6 [ml/kg/min], p=0.003), SMM (from 38.46±6.5 to 39.02±6.7 [kg], p=0.03) and muscle strength for hip abductors (from 40.11±8.6 to 46.18±6.2 [kg], p=0.02) and adductors (from 37.36±8.7 to 43.51±6.8, [kg], p=0.01). Knee and hip extensors muscle strength also improved but didn’t achieve the statistical significance threshold (p<0.05). (Table 1, Figs. 1-4)

<table>
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<tr>
<th>Parameters</th>
<th>Baseline</th>
<th>4 weeks</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knee extension strength (kg)</td>
<td>41.65± 8.9</td>
<td>43.52 ± 9.3</td>
<td>ns</td>
</tr>
<tr>
<td>Hip extension strength (kg)</td>
<td>42.2 ± 10.1</td>
<td>44.75 ± 8.1</td>
<td>ns</td>
</tr>
<tr>
<td>Hip abduction strength (kg)</td>
<td>40.11 ± 8.6</td>
<td>46.18 ± 6.2</td>
<td>0.02</td>
</tr>
<tr>
<td>SMM (kg)</td>
<td>38.46 ± 6.5</td>
<td>39.02 ± 6.7</td>
<td>0.03</td>
</tr>
<tr>
<td>VO2peak (ml/kg/min)</td>
<td>40.64± 6.2</td>
<td>42.73 ± 5.6</td>
<td>0.003</td>
</tr>
</tbody>
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Values are presented as mean ± standard deviation. SMM: skeletal muscle mass; VO2peak: peak oxygen uptake
CONCLUSIONS

Physical strength stamina training at medium altitude increase SMM, VO2peak and muscle strength in non professional alpine skiers. Significant increase of abductors and adductors muscle strength is probably due to much more use of this muscle groups in skiing (to change the direction of movement and side walking, together with resistance applied by ski equipment) comparing with daily physical activities and training. Increasing the training period to seven weeks or more would conduct to a better increase of strength in knee and hip extensors muscles in the majority of subjects. Knee and hip extensors muscle strength may be also good predictors for VO2peak in skiers.
REFERENCES