Effects of Three Weeks of Altitude Training on Aerobic Capacity of Elite Marathoners*

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Introduction

The environmental properties of altitude give negative effects on the endurance capacity of athletes. At altitude, the decrease of air pressure makes partial pressure of oxygen to drop, and it will induce a reduced rate of oxygen consumption of organic tissues\cite{4}. As a result of the effects of altitude, maximal oxygen uptake capacity of athletes is decreased\cite{4,10,20}. It is possible that the adaptation process on those negative effects of altitude could bring a certain improvements on the endurance capacity with training at altitude. Because of some effects of environmental negative characters, altitude training is commonly used by athletes to improve performance at sea level, and the improved performance has maintained after return to sea level\cite{9,9}. With this assumption, the training at altitude is used wide to improve the athletes' performance especially on the long distance runners. But, the former studies could not reach an agreement about the effect of the training at altitude. Some researchers\cite{8,18} reported an improvement on cardio-pulmonary function after training at altitude, but the other groups\cite{2,3,19}, reported no significant change with similar treatments. Possible factors affecting those disagreements are known as the altitude of training camp, the length of training, the contents of training program, and other conditions. So, we need more studies to show clear guides on the training at altitude. The purpose of this presenting study was analyzing the effects of training at altitude on marathon national team runners trained on an altitude training camp at 1,895m high from the sea level located in Kunming, China.

Methods

Subjects

Subjects of this study were eight male and female marathon runners training for Hiro-shima

<table>
<thead>
<tr>
<th>Group</th>
<th>Age (yr)</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
<th>Body fat (%)</th>
<th>Careers (yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>23.59</td>
<td>169.18</td>
<td>59.40</td>
<td>11.80</td>
<td>7.65</td>
</tr>
<tr>
<td></td>
<td>2.50</td>
<td>2.67</td>
<td>2.08</td>
<td>1.55</td>
<td>0.50</td>
</tr>
<tr>
<td>Female</td>
<td>20.00</td>
<td>161.05</td>
<td>49.00</td>
<td>13.55</td>
<td>7.00</td>
</tr>
<tr>
<td></td>
<td>0.25</td>
<td>1.55</td>
<td>0.50</td>
<td>2.50</td>
<td>0.25</td>
</tr>
</tbody>
</table>

Values are mean and SD

Asian Games. Characteristics of subjects are showed in Table 1.

Procedures

This study was composed with four tests as follows: 1st test was performed in Seoul before starting the training at altitude, 2nd test was performed in Kunming after 1 week of the training at altitude (After an initial treadmill test at sea level in Seoul, subjects travelled to Kunming and spent 3 weeks of training at 1895 m above sea level), 3rd test was performed in Seoul after 1 week from the end of altitude training, and 4th test was performed after 1 more week passed from the 3rd test. Those tests were composed with performing maximal exercise test on the treadmill to analyze the rate of oxygen uptake, heart rate, blood lactate concentration etc., and the measurement of RBC numbers, Hb concentration, Hct as variants of blood cells in rest. During these sojourns, although maximal treadmill test was performed, results of oxygen uptake at altitude treadmill test were omitted because gas analyzer had some problems.

In maximal treadmill test, after walking of 2 min(speed 80 m/min, 5-6% uphill slope) and jogging of 2 min(speed 130m/min, same slope), the subjects ran until exhaustion through the increase of 20 m/min in every 2 minutes. During maximal treadmill test, oxygen uptake and heart rate were measured continuously by Ergo-Oxyscreen. A fingertip blood sample for the analysis of blood lactate was taken at the end of the each stage, and blood lactate was measured by the YSI lactate ana-