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8. Investigation and Analysis on Current Sport Life of College Students in Jiangsu Province in China / Qiao Ren-Bo (Jiangsu University, China) ........................................ 60

9. The Data Analysis about Constitution of the Old and Middle-aged Women in Jiangxi Province, China / 2 Jiangxi Management Center of Fitness Qigong, Nanchang, China) .................... 67

10. Effects of Single and Multiple-Set Strength Training Programmes with Different Recovery Period in Male Students at College Level / Pintu Modak (Birla Institute of Technology & Science, India) ........................................ 74

11. Research Trend Analysis on Therapeutic Recreation in South Korea / Ajo, Ki-Jung (University of Suwon, S. Korea) ........................................ 79

12. Validity and Reliability of Rockport Fitness Walking Test in Malaysian University Students / Yoe Nga Pien', Mohd. Asnim Musa', Chen Chee Keong' 'Sports Science Unit, and 'Department of Anatomy, Universiti Sains Malaysia, Kubang Kerian, Kelantan, Malaysia) ........................................ 85

13. A Research on General University's Physical Education in China / Sun Lan (Zhejiang Gongshang University, China) ........................................ 93

14. A Research on the Relationship between a Team Structure and Team Effectiveness / Xiaojun Chen (Zhejiang Gong Shang University, China) ........................................ 98

Pan-Asian Society of Sports & Physical Education
(Corporate Juridical Person) The Society of South & North Sports & P.E.
Table of Contents

8. Investigation and Analysis on Current Sport Life of Regular College Students in Jiangsu Province in China
   / Qiao Ren-Bo (Jiangsu University, China) ................................................. 60

9. The Data Analysis about Constitution of the Old and Middle-aged Women in Nanchang City
   / Cheng Qi-lian¹ Du Shao-wu¹ Huang Wen-ying¹ Ji Na-wei² Zhou Mei-fang¹ Li Wei-yan¹ Gao Sheng¹(1. Jiangxi Normal Univ., China; 2. Jiangxi Management Center of Fitness Qigong, Nanchang, China) ................................ 67

10. Effects of Single and Multiple-Set Strength Training Programme with Different Recovery Period in Male Students at College Level
    / Pintu Modak (Birla Institute of Technology & Science, India) ....................... 74

11. Research Trend Analysis on Therapeutic Recreation in South Korea
    / Jo, Ki-Jung (University of Suwon, S. Korea) ........................................... 79

12. Validity and Reliability of Rockport Fitness Walking Test in Malaysian University Students
    / Yeo Nga Piing¹, Mohd. Asnizam Asari², Chen Chee Keong¹(1. Sports Science Unit, and 2. Department of Anatomy, Universiti Sains Malaysia, Kubang Kerian, Kelantan, Malaysia) .................................................. 85

13. A Research on General University’s Physical Education in China
    / Sun Lan (Zhe Jiang Gongshang University, China) .................................... 93

14. A Research on the Relationship between a Team Structure and Team Effectiveness
    / Xiao Yu-Chun (Zhejiang Gong Shang University, China) .......................... 98
# Table of Contents

1. A Study of Recreation Sports Attitudes  
   / Cheng, San-Chuan (Ming Chuan University, Taipei) .............................. 1

2. Discussion on Sports Administrative Organizational Design and Change of China  
   / Zhang Xian-Jun (Qufu Normal University, China) ............................... 11

3. The Relationship between Leadership and Organizational Culture: Football Compared with Other Sports in Sepahan Club  
   / Rasool Nazari (Islamic Azad University Naein Branch, Iran) Mohammad Ehsani (Tarbiat Modares University, Iran) ................................. 17

4. The Comparison of Aerobic Capacity and Anaerobic Power of Elite Soccer Players in Different Playing Positions  
   / Habibi Abdolhamid¹, Dehnam Asghar², Fatemi Rooholah¹ (Ahwaz Shahid Chamran University, Iran) ......................................................... 24

5. Taipei City Elementary Students Physical Self-Concept, Exercise Involvement and Health-Related Fitness Study  
   / Liu, Su-I (Taipei Physical Education College) ....................................... 32

6. Survey of Business Excellence of Tehran Football Clubs in Premier League of Iran from Administrators’ and Employees’ Perspective (Based on EFQM Model)  
   / Mohammad Ehsani (Tarbiat Modares University, Iran) Seong Cheol Lee (University of Suwon, S. Korea) ......................................................... 42

7. The Effect of L- Carnitine Acute Supplementation on Blood Lactic Acid Level and Covered Distance on the Treadmill  
   / Abdolhamid Habibi¹ Saeed Shakeryan² Meisam Ebrahimi³ (Shahid Chamran University of Ahwaz, Iran) ......................................................... 51
The Effect of L- Carnitine Acute Supplementation on Blood Lactic Acid Level and Covered Distance on the Treadmill

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(Shahid Chamran University of Ahwaz, Iran)

Abstract
The present study aims to examine the effects of taking L-Carnitin supplement on blood activity Lactic Acid level and covered distance on the treadmill following an exhaustive aerobic activity in athlete students. In order to carry out the experiment, 12 male physical education students with an age average of 23.58 ±2.19 year, weight average of 70.75± 1.81 kg, height average of 176.5±4.92 Cm and Body Mass Index average of 22.76± 1.19 participated in the study. The experiment was conducted in a one-blind cross- over clinical way. The participants were randomly divided into two different groups: namely, supplement and placebo. The supplement group received 2 gram L-Carnitine dissolved in 200 milliliter water with 6 drops of lemon juice, but the other group received just 200 milliliter water mixed with lemon juice, 90 minutes before carrying out the Astrand protocol. After a 72 hour wash-span, the two groups were replaced. Blood samples were taken from the participants' fingertips, 90 minutes before the activity and immediately after the activity. Dependent T-test was used to examine the changes and to analyze the data. The results indicated that blood lactate concentration in the L-Carnitine supplement group decreased 36% in contrast to the Placebo group. Also, in the group who received L-Carnitine supplement the covered increased 10% in contrast to the second group who received no supplement. Both these changes were statistically significant (p<0.05). The results also showed that taking two gram Dose of oral L-Carnitine, 90 minutes before the sport, can improve the athlete's record through hindering the rise in blood Lactic Acid level during the sport. 

Key words: L-carnitine, lactic acid, exhaustive aerobic exercise

Introduction
Supplementary diets which improve athletic performance are familiar to most athletes (Karlic & et al 2004). Companies which produce such materials claim that their products improve athletes' performance or accelerate the process of returning to the primary state after exercising. Most of these claims are based on the hypotheses related to the ways in which the supplementary diets can affect metabolism during exercising (Cerretelli, 1990). Considering the recent improvement in sports science, different indices are employed for promoting athlete's performance. One of the valid indices which are used in intense short-term exercises is aerobic threshold. The amount of lactate in blood is a very important factor in exercises and matches (Coen & et al 2001).

From the beginning of the twentieth century, Lactic acid as the final product of glycolysis, has been considered as the essential cause of muscular exhaustion in the lack
of oxygen (Gladden LB. 2004 & Sahlin K. 1990). The lactic acid produced in the
muscles will be analyzed to lactate salt and \( H^+ \) ion. Lactate will be used in chemical
circles for further metabolism and energy production and the \( H^+ \) ion makes the muscles
acidic and consequently leads to exhaustion. The reduction of pH which is the result of
and increase in Lactate salt, leads to a reduction in the release of calcium ion and the
possibility of its combination with Troponin (Hultman E. et al 1992). Consequently, the
increase of Lactate in the muscles and in the blood leads to a disorder in the function of
muscular system and a limitation in athlete's physiologic capacities which restricts the
possibility of generating more energy through aerobic and anaerobic mechanisms.

Basically, trainers and athletes use supplements or especial exercising methods with
the aim of increasing the anaerobic threshold, decreasing the accumulation of lactate, and
improving persistence (Dutkot Mj. Et al 1995). One of these supplements is L-Carnitine.
(Monedero J. 2000)

L-carnitine (3-Hydroxy-4-N-3 Metil Amino Boutanvat) with the molecular weight of
161 gr/µ was first taken from the extract of meat and has an important role in
transmitting fatty acids to mitokondri (Rebouche Cj. 1991). Actually, lack of L-carnitine
leads to a disorder in the metabolism of fats (Heinonen 1996, Brass EP. 2004, Zeyner
A.1999). On the other hand, physical exercising causes a decrease in the level of
L-carnitine in the muscles (Zeyner A.1999). The main functions of L-carnitine which
have been studied in the most researches include transmitting the fatty acids to
mitokondri membrane, protecting the mixture of cellular membrane, estabilizing the
proportion of Coenzyme to Acetyl Coenzyme in Mitokondri and reducing the

Several studies have been conducted on the effect of using L-carnitine as a
supplement on some other variants such as the anaerobic threshold, the ratio of the
transmission of respiratory gases, and the density of Lactate. Some of these studies have
reported a decrease in the density of Lactate and no change has been observed in others
cross-over study to investigate the effect of using L-carnitine supplementation on ten
active men. In this study, the examinees performed two series of intense physical
exercises on a ergo meter bicycle within three days. An hour before starting the exercise,
each examinee received 2 grams L-carnitine supplement or placebo. The results revealed
that after receiving L-carnitine supplement, the proportion of the lactate and the
Pyruvate of the blood to placebo decreased and consequently an increase was observed
in the level of acetyl carnitine the blood.

In a two-blind cross-over study, investigated the effect of using 2 grams of
L-carnitine 120 minutes before exercising on the physical performance and metabolism
of well-trained athletes. The blood samples were taken an hour before the exercise
immediately after the exercise, an hour after the exercise and in the next morning. No
significant differences were observed between the placebo and the supplement groups in
factor like Glucose, Pyruvate, Lactate and free fatty acids (Colombani P. 1996).

Considering these studies, the purpose of the present study is examining the effect of
L-carnitine acute supplementation on blood lactic acid level and the covered distance on
the treadmill after an exhaustive aerobic exercise in athlete students. The study was to
answer this question: Does using two grams L-carnitine supplementation 90 minutes
error was determined $\alpha = 0.05$.

**Results**

Table 1: Examinees' general characteristics

<table>
<thead>
<tr>
<th>Variant</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td>70.75</td>
<td>1.81</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>176.50</td>
<td>4.92</td>
</tr>
<tr>
<td>Age (year)</td>
<td>23.58</td>
<td>2.19</td>
</tr>
<tr>
<td>BMI</td>
<td>22.76</td>
<td>1.19</td>
</tr>
</tbody>
</table>

Table 2: Descriptive data related to the level of the blood lactate concentration (mmol/liter blood)

<table>
<thead>
<tr>
<th>Lactate concentration</th>
<th>Before the exercise</th>
<th>After the exercise</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Supplement (gr)</td>
<td>1.58</td>
<td>0.43</td>
<td>6.39</td>
</tr>
<tr>
<td>Placebo (gr)</td>
<td>1.7</td>
<td>0.45</td>
<td>9.13</td>
</tr>
</tbody>
</table>

As it can be seen in this table the amount of blood lactate concentration in supplement group decreased about 36 percent in contrast to the placebo group.

![Blood Lactate Concentration Chart](image_url)

Figure 1. The chart related to the amount of the blood Lactate concentration in both groups before and after the treatment.

As it is obvious in figure 1, the amount of the blood lactate concentration in L-carnitine
supplement group is less than the placebo group.

Table 3. The results of the dependent T-test related to the amount of the blood Lactate concentration.

<table>
<thead>
<tr>
<th></th>
<th>Dependent Differences</th>
<th>t</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>SD Error</td>
<td>Min</td>
</tr>
<tr>
<td>Different mean</td>
<td>-2.61</td>
<td>0.96</td>
<td>0.27</td>
<td>-3.22</td>
</tr>
<tr>
<td>Supplement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Placebo</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As it is showed in table 3, at the alpha level of %5 the L-Carnitine acute supplement has a significant effect on the amount of the blood Lactate concentration in the supplement group (p=0.001).

Table 4. Descriptive data related to the covered distance in an exhaustive aerobic activity.

<table>
<thead>
<tr>
<th>Covered distance (meter)</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplement group</td>
<td>3213.33</td>
<td>883.37</td>
</tr>
<tr>
<td>Placebo group</td>
<td>2898.92</td>
<td>876.85</td>
</tr>
</tbody>
</table>

According to table 4, in supplement group the covered distance has increased about %10 in contrast to the Placebo group.
Figure 2. The chart related to the covered distance in the supplement and placebo groups.

Based on figure 2, in supplement group the covered distance is evidently more than the placebo group. Table 5, Shows the descriptive data of the two groups related to the covered distance in an exhaustive aerobic activity.

Table 5, Dependent t-test for covered distance. (meter)

<table>
<thead>
<tr>
<th>Dependent Differences</th>
<th>Mean</th>
<th>SD</th>
<th>SD Error</th>
<th>Limited</th>
<th>t</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td></td>
<td>Min</td>
<td>Max</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Different mean</td>
<td>3.14</td>
<td>209.52</td>
<td>60.48</td>
<td>181.28</td>
<td>447.54</td>
<td>5.19</td>
<td>11</td>
</tr>
<tr>
<td>Supplement placebo</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Based on the results presented in table 5, receiving L-Carnitine in supplement group has effected the covered distance in a meaningful way (p=0.001)

**Discussion**

In this study before and after an exhaustive aerobic activity the effects of receiving 2 grams L-Carnitine and its placebo (in one doze) on the changes in the level of blood Lactic acid and the covered distance on the treadmill were investigated. In the present study, continuing the physical activity up to exhaustion increased the amount of the Lactic acid in the blood. This increase and its gradual reduction after the activity can be justified based on the fact that while exercising, the muscles need more oxygen and consequently lack of oxygen occurs in the body. Therefore, further oxidation of the
NADH which is the product of NAD+ during Glucose will be deranged. In this condition, NADH will oxidize through joining the reduction of Pyruvate to Lactate. The produced NAD+ paves the way for Glycolytic process development, consequently, in anaerobic condition, Pyruvate changes into Lactic acid instead of entering the PDH complex and changing into acetyl-CoA (acetyl Coenzyme).

That is, the concentration of the lactic acid increases in the blood and in the muscles. In the rest time after exercise, the produced lactic acid gradually enters the liver through Lactic Acid circle and changes into Glucose (Harvey RA 2005).

The results revealed that during the exhaustive aerobic activity, the lactate concentration in supplement group had a 36% decrease in contrast to the placebo group. The results of this study were in accordance with the studies conducted by Vecchi et al. (1990), Siliprandi et al. (1990) and Brass et al. (1994). In all these studies, acute supplementation had been applied. In some other researches conducted on the effect of the long-term L-carnitine supplementation on the level of the blood lactic acid, Vukovich et al. (1994) and Bakoura et al. (2003) reported a meaningful decrease in the level of the blood lactate.

On the contrary, in the studies conducted by, Dekemysz et al. (1993), Vouk et al. (2002), and Kines et al. (2003), the long-term L-Carnitine supplementation did not have any effect on the level of the blood lactate. Exact comparison of the studies with long-term supplementation and acute supplementation is a very complicated issue because of the differences in the number of the examinees, their readiness, the dosage of the applied supplement, the intensity of the exercise, and kind of the supplement. May be a main reason of the differences in Lactate levels is the differences in applied protocols.

The secondary function of L-carnitine is its effect on the proportion of Acetyl-CoA to free CoA. Acetylc Coenzym is a 2-Carbon Compound and Coenzyme is one of the derivatives of vitamin B. The L-Carnitine supplement reacts with some of the additional Acetyl Coenzyme through producing Acetyl-carnitine and consequently leads to a decrease in the proportion of Acetyl-CoA to free CoA. These additional Acetyl-CoA accumulate during intense exercise.

The decrease in the proportion of Acetyl-CoA to free CoA activates the Pyruvate dehydrogenize enzyme As a result of the activation of this enzyme, more Pyruvate will change into Acetyl coenzyme instead of changing into lactate. Concentration of less Lactate means postponing the exhaustion. Moreover, during the reaction of L-carnitine with acetyl CoA, some free CoA is produced. The free CoA is necessary for the functioning of Krebs cycle (Karlic et al. 2004).

Considering the effect of L-carnitine acute supplementation on the converted distance, the results showed a 10% increase in the supplement group in contrast to the placebo group. The results of the present study were in accordance with the findings of Vikchit et al. (1990) and Siliprandi et al. (1990). The reason for this accordance was the fact that supplementation was acute and the supplement was received two hours prior to the exercise.

Moreover, the examinees were active people. In these studies, the examinees were no trained people and they participated in maximum exercising. So, they could not have a good performance in the protocol. On the other hand, as regular exercise is accompanied with accommodative mechanisms like increasing L-carnitine receptors in cellular
membrane of muscles in order to absorb it, increasing mitokondri and enzymes of mitokondri and instant blood tissues; so there is this possibility that in Masen's and Vaise's studies, the density and the absorption of L-Carnitine in the examinees' muscles had not been as much as it had been necessary (Hiatt W.R. 1989, Sahlin K. 1990, Vukovich MD. 1994, Karlic 2004, Stephens B. 2007).

Generally speaking, the findings of the present study revealed that L-carnitine acute supplementation increases the distance covered by athlete students. Actually this happens as a result of a decrease in blood lactate concentration.

References


