Effects of acute L-carnitine intake on metabolic and blood lactate levels of elite badminton players

Hüseyin Eroğlu [1], Ömer Şenel [2*] and Nevin A. Güzel [2]

1. Atatürk University,School of Physical Education and Sport, 25240,Erzurum, Turkey.
2. Gazi University, School of Physical Education and Sport,06500,Teknikokullar,Ankara, Turkey

* Corresponding Author

Correspondence to: Prof. Dr. Ömer Şenel, Gazi University, School of Physical Education and Sport, 06500, Teknikokullar, Ankara/Turkey
E MAIL: osenel@gazi.edu.tr

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Abstract

OBJECTIVES: Purpose of this study is to research the effects of acute L-Carnitine intake on badminton players' metabolic and blood lactate values.
DESIGN: A total of 16 Turkish national badminton players (8 male, 8 female) were voluntarily participated into study.
$MaxVO_2$, MET, energy consumption, HR (heart rate), V_E (minute ventilation), R (respiratory exchange ratio), AT (anaerobic threshold), oxygen pulse and blood lactate (LA) of subjects were measured by Sensormedics VmaxST and Accutrend Lactate Analyzer. The participants were subjected to the test protocol twice before and after 2g of L-Carnitine intake. The data were evaluated by the use of SPSS 13.0 for Windows.
RESULTS: No significant differences were found between 1st. (without L-Carnitine intake) and 2nd. (with L-Carnitine intake) measurements of female participants as regards to all measured parameters. There was a significant difference in EMHR (exercise maximum heart rate) of males between two measurements ($p<0.05$). However the differences in other parameters were not significant. AT values of female subjects were not significant difference ($p>0.05$). Respiratory exchange ratio of males was significantly different at anaerobic threshold ($p<0.05$).
CONCLUSION: Results of this study show that L-carnitine intake one hour prior to the exercise has no effect on the metabolic and blood lactate values of badminton players.

ORIGINAL ARTICLE

INTRODUCTION

One of the factors which effects the genetic features and therefore performance of the athletes are the ergogenic aids [15].The word "ergogene" was derived from Greek words "ergon" (work) and "genon" (production) and describes the use of substances, methods and materials apart from training and genetic factors to increase the performance. The ergogenes which effect the sportive performance are separated in five categories namely mechanical, psychological, nutritional, physiological and pharmacological ergogenes [11,12].

Carnitine is one of the allowable ergogenes by both the International Olympics Committee and national committees since it is produced in the body and its excessive external intake does not cause significant side effects [3,10,14,19,39]. L-carnitine is a natural compound widely distributed in the body [34,36] and plays an important physiological role, particularly in beta oxidation, because it facilitates long-chain fatty acide transport across the inner mitochondrial membrane [34]. Carnitine also called as vitamin BT is an important factor which plays role in the transportation of long chained fatty acids in to the mitochondria and their oxidation [6,30]. It is this feature that caused intensive arguments on whether the amount of carnitine produced by the body is enough for a strenuous exercise. The resting level of carnitine in plasma ranged 41–64 µmol/l, 70–80% of which remains in free form [1, 9,13, 24]. It was found that there were no significant changes in these ratios during low intensity exercises while both the plasma and muscle carnitine levels showed a significant decrease during high intensity or strenuous exercise. That was why it was proposed that the carnitine levels should be kept high during exercise with external supplementation [8,18, 20,24,31].

Although there are quite a number of studies upon the effect of carnitine on plasma and muscle, the studies related to its effect on sportive performance are highly limited with highly different results. Slipandi [32], Vecchiet [37] and Karahan [22] determined that 2g of carnitine intake 60 minutes prior to the exercise resulted a decrease in blood lactate and significant increase in power generation and performance. Gorostiaga [16] and Wyss [40] claimed that carnitine intake before the exercise or 1–3 week carnitine loading resulted a significant decrease in the respiratory exchange ratio. Oyono *et.al* [27], Colombani *et.al* [7], Trappe *et.al* [35] and Greig *et.al* [17] on the other hand claimed in their studies they carried out with different kind of exercise claimed that supplementation of carnitine before the exercise had no effect upon the athletic performance.

This study is related to the determination of the effect of acute L-carnitine intake upon the metabolic and blood lactate levels of the elite badminton players.

MATERIAL AND METHOD

This study was carried out on eight elite female badminton players with an average age, height and body weight of 20.38 ± 2.50 years,164.00 ± 5.04 cm and 58.13 ± 5.49 kg and eight elite male badminton players with an average age, height and body weight of 25.38 ± 3.20 years, 180.25 ± 5.42 cm and 72.38 ± 8.86 kg Turkish national team.

Sensormedics VmaxST Oxycon Mobile Telemetric System (Gas Analyzer) [5,28,29] was used to measure maxVO2, MET, energy consumption, heart rate, ventilation per minute (V_E), respiratory exchange ratio, anaerobic threshold and oxygen pulse of subjects. The participants were informed about the test protocol, the position of the treadmill, test completion criteria and Sensormedics VmaxST Oxycon Mobile System. Astrand protocol was used to determine the max VO2 values.The speed of the treadmill was kept constant at 9.7 km/ h and the incline was adjusted at 0 degrees initially and was increased by 2% every two minutes and the participants were asked to run on it till the exhaustion [21].

The participants were subjected to the test protocol twice before and after 2g of oral carnitine intake. They were asked to refrain from making excessive activity and alcohol and caffeine consumption 24 hours before the measurements. The participants were given 4 days of resting period between two measurements.

The resting and post exercise blood lactic acid values were measured by Acuttrend lactate analyzer.

The anaerobic threshold of subjects was determinated by V-slope method (the point where there was a non linear increase in ventilation per minute) [12].

The data were evaluated by the use of SPSS 13.0 for Windows. The difference between the first and the second measurements was evaluated by the "Paired t" test between the dependent groups.The significance levels were taken as 0.01 and 0.05.

RESULTS

The average age, body weight, height and the experience of the male badminton players were 25.38 ± 3.20 years, 72.38 ± 8.36 kg, 180.25 ± 5.42 cm and 7.38 ± 3.34 years respectively. These values were 20.38 ± 2.50 years, 58.13 + 5.49 kg, 164.00 ± 5.04 cm and 5.63 ± 1.92 years for the females (Table 1).

As seen in Table 2 there was no significant change between the first (without carnitine intake) and second measurement (with carnitine intake) parameters of the female participants (p>0.05).

Table 3 shows that there was a significant change between the first and second measurement hearth rate of the male subjects (p<0.05), the change in other values was insignificant (p>0.05).

Table 4 reveals that there was not a statistically significant difference in the anaerobic threshold levels of female participants with and without carnitine intake (p>0.05)

Table 1: Physical characteristics of the participants.

Variables	Male (n=8)				Female (n=8)			
	Min	Max	X	SD	Min	Max	X	SD
Age (years)	20.00	30.00	25.38	3.20	16.00	24.00	20.38	2.50
Body weight (kg)	62.00	89.00	72.38	8.86	54.00	70.00	58.13	5.49
Height (cm)	174.00	190.00	180.25	5.42	156.00	170.00	164.00	5.04
Experience (years)	3.00	12.00	7.38	3.34	2.00	8.00	5.63	1.92

Table 2: Comparison of 1st. Measurement (without L-carnitine intake) and 2nd. Measurement (with L-carnitine intake) of the female participants (N=8).

Variables	Measurements	X	SD	X_1-X_2	SD	t
$MaxVO_2$ (ml/kg/min)	1st.	49.94	7.31	1.20	8.14	.418
	2nd.	48.74	6.16			
MET	1st.	14.25	2.11	.33	2.33	.400
	2nd.	13.92	1.76			
$MaxVO_2$ (lt/min)	1st.	2.90	.52	.05	.46	.307
	2nd.	2.85	.45			
Max Energy Consumption (kcal)	1st.	13.76	2.28	.18	1.78	.281
	2nd.	13.59	1.97			
$SubMaxVO_2$ (ml/kg/min)	1st.	16.73	2.18	–.01	2.58	–.005
	2nd.	16.73	1.40			
SubMax Energy Consumption (kcal)	1st.	4.64	.84	–.10	.71	–.381
	2nd.	4.74	.57			
Max LA (mmol/L)	1st.	11.58	2.77	–2.10	3.41	–1.744
	2nd.	13.68	3.55			
Oxygen Pulse (ml)	1st.	5.53	1.03	–.03	.73	–.097
	2nd.	5.56	.67			
EHR (beat/min)	1st.	176.34	7.67	3.74	4.90	2.157
	2nd.	172.60	9.16			
RVO_2 (ml/kg/min)	1st.	9.61	3.44	–1.57	3.40	–1.311
	2nd.	11.19	4.08			
EMHR (beat/min)	1st.	196.69	4.89	.81	3.84	.594
	2nd.	195.88	5.05			

$MaxVO_2$: Maximum oxygen consumption; MET: metabolic equivalent; $SubMaxVO_2$: Submaximal oxygen consumption; Max LA: maximum lactic acid; EHR: Average heart beat rate during exercise; RVO_2: Amount of oxygen used during recovery; EMHR: maximum heart rate during exercise; 1st. Measurement: Measurement made after the exercise without L –carnitine intake, 2nd. Measurement: Measurement made after the exercise with L –carnitine intake.

Table 3: Comparison of 1st. Measurement and 2nd. Measurement of the male participants (N=8).

Variables	Measurements	X	SD	X_1-X_2	SD	t
$MaxVO_2$ (ml/kg/min)	1st.	60.33	16.30	–1.52	10.87	–.394
	2nd.	61.85	14.14			
MET	1st.	17.24	4.66	–.43	3.11	–.395
	2nd.	17.67	4.04			
$MaxVO_2$ (lt/min)	1st.	4.27	.76	–.11	.75	–.423
	2nd.	4.38	.58			
Max Energy Consumption (kcal)	1st.	20.80	3.62	–.70	3.10	–.636
	2nd.	21.50	3.16			
$SubMaxVO_2$ (ml/kg/min)	1st.	18.51	1.75	–.31	2.82	–.312
	2nd.	18.82	2.00			
SubMax energy consumption (kcal)	1st.	6.55	.56	.02	.70	.066
	2nd.	6.53	.79			
Max LA (mmol/L)	1st.	10.75	2.56	–2.58	5.42	–1.343
	2nd.	13.33	4.49			
Oxygen Pulse (ml)	1st.	8.14	1.00	.07	1.24	.151
	2nd.	8.08	1.11			
EHR (beat/min)	1st.	163.27	10.97	–3.97	5.08	–2.209
	2nd.	167.24	7.04			
RVO_2 (ml/kg/min)	1st.	10.92	5.31	–.03	3.96	–.018
	2nd.	10.95	2.69			
EMHR (beat /min)	1st.	186.67	9.72	–5.94	6.02	–2.795*
	2nd.	192.61	6.17			

*$p<0.05$

Table 4: Comparison of the anaerobic threshold levels of the female subjects.

Variables	Measurements	X	SD	X_1–X_2	SD	t
HR (beat/min)	1st.	172.38	15.18	9.38	31.00	.855
	2nd.	163.00	29.50			
V_E (lt/min)	1st.	93.06	8.55	2.12	6.96	.860
	2nd.	90.95	9.04			
R	1st.	1.04	.62	–.38	.84	–1.283
	2nd.	1.42	.47			
VO_2 (lt/min)	1st.	1.61	.39	–.02	.39	–.164
	2nd.	1.64	.20			

HR: Heart rate ; V_E: Ventilation Per Minute ; R: Respiratory Exchange Ratio; VO_2: Amount of Oxygen Consumed 1st. Measurement: Measurement taken without carnitine intake ; 2nd. measurement: measurement taken with carnitine supplementation.

Table 5: Comparison of the anaerobic threshold levels of the male subjects.

Variables	Measure-ments	X	SD	X_1–X_2	SD	t
HR (beat/min)	1st.	158.86	14.36	2.63	13.90	.534
	2nd.	156.25	10.15			
V_E (lt/min)	1st.	127.77	16.71	–3.43	14.88	–.652
	2nd.	131.20	11.32			
R	1st.	1.04	.30	–.60	.60	–2.821*
	2nd.	1.64	.54			
VO_2(lt/min)	1st.	2.29	.45	–.10	.43	–.648
	2nd.	2.39	.42			

*p<0.05

According to Table 6 there is a significant difference in the respiratory exchange ratio (R) values of the male participants (R) ($p<0.05$). The difference in other values is not significant ($p>0.05$) (Table 5).

DISCUSSION

The physical characteristics of elite badminton players (8 male and 8 femele) who participated in this study were given in Table 1.

The comparison of the 1st (without carnitine intake) and the 2nd (with carnitine intake) measurements of MaxVO_2 (Maximum Oxygen Capacity), MET (metabolic equivalent), Maximum Energy consumption, SubMaxVO_2 (Submaximal oxygen consumption), SubMax Energy Consumption, Max LA (maximum lactic acid), EHR (exercise hearth rate), oxygen pulse, RVO_2 (Amount of oxygen used during recovery), EMHR (Exercise maximum heart rate) of females showed no statistically significant difference ($p>0.05$) (Table 3). The comparison of the same variables of the males showed that while there was no statistically significant changes in MaxVO_2, MET, Max Energy Consumption, SubMaxVO_2, SubMax Energy Consumption, Max LA, EHR, RVO_2 oxygen pulse values ($p>0.05$) the difference in EMHR values was significant ($p<0.05$) (Table 5).

There was no statistically significant difference in the anaerobic threshold values of the females determined according to slope method ($p>0.05$) (Table 4).However the difference in R values of the males was statistically significant ($p<0.05$) (Table 5).

Colombani *et.al* in their study [7] they carried out on 7 male athletes found that 2 g acute L-carnitine supplementation had no appreciable effect on long distance running performance (20 km marathon) and did not cause any significant change R value, metabolic plasma concentrations of hormones and had no effect on post race submaximal aerobic-anaerobic threshold performance and lactate values. It was observed that the administration of acute carnitine had no appreciable effect on long distance running and recovery performance and had no ergonogenic stimulus.

Nuesch e.t al [26] determined that the 1g pre-exercise supplementation of l-carnitine had no effect on maximal exercises performance. Brass *et.al* [4] in their study they carried out on 14 healthy males reported that the intravenous administration of 1 dose of L-carnitine prior the exercise (92.5 mol/kg or 18.5 mol/kg) had no effect on R, VO_2, and lactate values. Natali et. Al [25] carried out a study on 12 active males and the administration of 3g L-carnitine 40 minutes before the exercise had no significance effect on VO_2 and VCO_2 values but there was an increase in the oxidation of fatty acids during the recovery after the exercise.

Trappe *et.al* [35] in their study they carried out on 20 male swimmers the oral administration of 2g L-carnitine for seven days had no effect on the sportive performance and blood lactate values. Similarly Wyss et. al [40] reported in their study on seven healthy males that the supplementation of 3g L-carnitine resulted in no significant effect on V_E, MaxVO_2, VO_2, VCO_2, R, HR, blood pressure, blood lactate values and non-esterified fatty acids.

Oyono-Enguelle *et.al* [27] claimed that the oral administration of 2g L-carnitine in non trained males for 28 days had no effect on VO_2, VCO_2, R and lactate concentration in constant load exercise. Barnett *et.al* [2] also reported in their study they carried out on 8 healthy males that 14 day oral administration of 4g L-carnitine caused no appreciable change in lactate accumulation and muscle carnitine content throughout the exercise

Soop *et.al* [33] also reported that the oral administration of 5g L-carnitine resulted in no change in VO_2 values of low trained males in constant load exercise.

In the Decombaz *et.al* [8] carried out on nine healthy males, it was observed that the oral administration 3g of L-carnitine for seven days resulted no change in the hearth beat rate, lactate concentration and respiratory coefficient. Similarly Vukovich *et.al* [38] reported that the administration of 6 g of L-carnitine for 7 to 14 days resulted in no change in the respiratory coefficient and VO_2 values of 8 healthy males.

In many studies especially high dose prolonged administration of L-carnitine resulted in a moderate improvement in the exercise performance and MaxVO_2 values of unprofessional and non elite sportspeople. However there are also studies reporting that carnitine supplementation caused no change in MaxVO_2 and lactate accumulation in high intensity exercise [23].

The literature cited above is in good accordance with the findings of this study that L-carnitine intake do not have any positive effect on the sportive performance. The literature also contradicts with the thesis that carnitine intake has a positive effect upon respiratory exchange ratio (R) and maximum oxygen consumption. This may be due to individual differences. The contradictory results may also be due to the use of different methodology.

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