

Effect of L-carnitine supplementation on anthropometric measurements in overweight women who practice CrossFit**Efecto de L-carnitina en las medidas antropométricas en mujeres con sobrepeso que practican CrossFit**

HERNÁNDEZ-CORONA, Diana M.†*, GONZÁLEZ-HEREDIA, Tonatiuh, MÉNDEZ-DEL VILLAR, Miriam and MERAZ-MEDINA, Tzintli

Universidad de Guadalajara-Centro Universitario de Tonalá, Centro de Investigación Multidisciplinario en Salud. Universidad de Guadalajara- Centro Universitario del Sur.

ID 1st Autor: *Diana M., Hernández-Corona* / **ORC ID:** 0000-0002-8631-9201, **Researcher ID Thomson:** R-5148-2019, **CVU CONACYT ID:** 386383

ID 1st Co-author: *Tonatiuh, González-Heredia* / **ORC ID:** 0000-0003-4089-5462, **CVU CONACYT ID:** 386340

ID 2nd Co-author: *Miriam, Méndez-Del Villar* / **ORC ID:** 0000-0002-9249-7709, **Researcher ID Thomson:** ABF-1251-2021, **CVU CONACYT ID:** 514060

ID 3rd Co-author: *Tzintli, Meraz-Medina* / **ORC ID:** 0000-0002-2062-8618, **CVU CONACYT ID:** 131300

DOI: 10.35429/JP.2021.14.5.1.10

Received July 10, 2021; Accepted December 30, 2021

Abstract

Objective: The aim of the study was to evaluate the effect of 1.5 grams of L-Carnitine on anthropometric measurements in overweight adult women who practice Cross-fit exercise routine, as an adjuvant non-pharmacotherapy for weight loss.

Methods: A randomized, double-blind, placebo-controlled clinical trial was carried out in women age 18 to 40 who practice Cross-fit. Anthropometric measurements, weight, percentage of fat mass and muscle mass were taken in all patients; brachial and waist circumference were measured. The body mass index was calculated according to the World Health Organization. All the measurements were taken at the beginning and end of the clinical trial. The study and evaluations were carried out in a private Cross-Fit gym, in El Salto, Jalisco, México.

Contribution: Hernández Corona, Diana Mercedes: design, implementation of the study, field work, statistical analysis and write of the paper. González Heredia, Tonatiuh: field work, statistical analysis, writing under discussion, conclusion, methodology. Méndez del Villar, Miriam: protocol drafting, field work, results, conclusions. Meraz Medina Tzintli: protocol drafting, field work, drafting methodology.

Carnitine, Overweight, CrossFit**Resumen**

Objetivo: El objetivo del estudio fue evaluar el efecto de 1,5 gramos de L-Carnitina en las mediciones antropométricas en mujeres con sobrepeso que practican Crossfit para ejercitarse de manera rutinaria, como adyuvante no farmacoterapéutico para la pérdida de peso.

Métodos: Se llevó a cabo un estudio clínico aleatorizado, doble ciego, controlado con placebo en mujeres de 18 a 40 años que practican Cross-fit. A todas las pacientes se les tomaron medidas antropométricas, peso, porcentaje de masa grasa y masa muscular; otras medidas fueron tomadas como la circunferencia braquial, la circunferencia del brazo contraído y la circunferencia de la cintura. El estudio y las evaluaciones se llevaron a cabo en Hard Crossfit, en El Salto, Jalisco, México.

Contribución: Hernández Corona, Diana Mercedes: diseño, implementación del estudio, trabajo de campo, análisis estadístico y redacción del artículo. González Heredia, Tonatiuh: trabajo de campo, análisis estadístico, redacción en discusión, conclusión, metodología. Méndez del Villar, Miriam: Redacción de protocolo, trabajo de campo, resultados, conclusiones. Meraz Medina Tzintli: Redacción de protocolo, trabajo de campo, redacción de metodología.

Carnitina; Sobrepeso; CrossFit

Citation: HERNÁNDEZ-CORONA, Diana M., GONZÁLEZ-HEREDIA, Tonatiuh, MÉNDEZ-DEL VILLAR, Miriam and MERAZ-MEDINA, Tzintli. Effect of L-carnitine supplementation on anthropometric measurements in overweight women who practice CrossFit. *Journal of Physiotherapy and Medical Technology*. 2021. 5-14:1-10.

* Author Correspondence (E-mail: diana.hcorona@academicos.udg.mx).

† Researcher contributing as first author.

Introduction

Being overweight is a major risk factor for the development of various chronic degenerative diseases. A balanced diet and exercise are the cornerstones in the treatment of overweight and obesity,² and within this category, CrossFit has proven to be effective in terms of weight control and weight reduction, given that it is a sport characterised by a physical conditioning system based on functional movements, creativity and a variety of high-intensity, short-duration exercises. However, there is evidence that the use of supplements could provide additional benefits in weight control and weight reduction. Among these supplements is Levocarnitine (L-Carnitine), which is an amino acid derivative and an essential cofactor for fatty acid metabolism, which facilitates the entry of long-chain fatty acids into the mitochondria, thereby releasing substrates for oxidation and subsequent energy production.

Oral L-Carnitine supplementation reduces body weight, waist circumference, hip circumference and insulin resistance in women with polycystic ovary syndrome (PCOS). L-Carnitine supplementation may improve aerobic capacity and exercise tolerance during high-intensity constant work rate exercise testing in patients with mitochondrial myopathy. There is evidence that L-carnitine leads to significant weight loss and a decrease in body mass index (BMI).

Due to the above, the present study proposes to evaluate the effect of L-carnitine as an adjuvant in weight loss in overweight women who practice CrossFit.

Aim of the study

The aim of the study was to evaluate the effect of L-Carnitine on anthropometric measurements in overweight women practising CrossFit as an adjuvant therapy for weight loss.

Materials and methods*Type of study*

A double-blind, randomised, placebo-controlled clinical trial was conducted.

Selection criteria

Women aged 18-40 years who met the following selection criteria were included: diagnosed as overweight according to the World Health Organization definition of BMI 25-29.9 kg/m², practiced CrossFit regularly, had a stable weight for at least 90 days prior to the start of the study and signed the informed consent form.

Patients were excluded if they had smoking, comorbidities such as diabetes mellitus, hypertension, metabolic syndrome, liver disease, kidney disease, human immunodeficiency virus, thyroid disease, known allergy to L-carnitine, pregnancy or were breastfeeding, had undergone any type of weight control treatment six months prior to study entry, and had used any medication and/or supplement known to have an effect on metabolism.

The following criteria were considered grounds for elimination: patients who had less than 80% adherence to the L-Carnitine intervention or CrossFit, who did not follow nutritional recommendations, and who had serious adverse events that resulted in withdrawal from the study. All selected volunteers attended CrossFit on a regular basis, where they were invited to participate in the study. All participants were evaluated by the researchers, a complete medical history and anthropometric measurements were taken.

Study site

The study was conducted in a private gym, Hard CrossFit, under the supervision of the researcher in terms of monitoring anthropometric measurements and patient well-being.

Sample size and randomisation

The sample size was calculated using a formula for clinical trials,⁸ with a confidence level of 95% and a power of 80%. The standard deviation for fat percentage was 2%,⁵ with an expected difference between groups of at least 2.3%, resulting in a total of 10 women per group. For the other components such as BMI and body weight, the sample size calculation was equal or smaller.

Randomisation of the patients was performed by a person outside the research team, so that neither the researcher nor the patient was aware of the assigned treatment to ensure blinding; randomisation was performed using a random number table to assign all patients into two groups in a 1:1 ratio.

Pharmacological intervention

After randomisation, two study groups were formed, each consisting of 10 participants. The first group received L-Carnitine 1.5 g (contained in 5 ml of oral suspension) and diluted in 250 ml of plain water, while the other (control) group took an approved placebo (5 ml of rehydration serum) diluted in 250 ml of plain water, before the start of each CrossFit session, for a period of 8 weeks.

The CrossFit session and intervention period took place Monday through Friday from 8:00 to 9:00 a.m. for all participants; Saturday and Sunday were set as rest days. All patients received nutritional recommendations not to make major dietary modifications and to assess the effect of L-carnitine on CrossFit practice; they were also instructed not to modify their exercise habits. CrossFit sessions were based on the CrossFit Training Level 1 training guide and WODZILLA: The Ultimate WOD compilation to be standardised routines.

Anthropometry, tolerance and adverse effects were assessed at baseline and at the end of the intervention.

Anthropometric assessments

Women were assessed at baseline and at the end of the study from 8:00 a.m. to 10:00 a.m. while fasting. Body weight, fat mass and muscle mass percentages were assessed using the HBR-514C OMRON HEALTHCARE, INC.® (Illinois, USA) tetra-polar scale. Arm circumference, contracted arm circumference and waist circumference were measured with a Lufkin® w606 metal tape measure, manufactured in the USA. Arm circumference was measured with the biceps contracted and flexed at right angles; the measurement was taken at the midpoint between the acromion and the olecranon.

For the circumference of the relaxed arm, the measurement was taken with the arm relaxed at the side of the body, with the palm of the hand facing medially towards the thigh, the tape measure was placed around the arm at the midpoint between the acromion and olecranon, and waist circumference was measured at the midpoint between the highest point of the iliac crest and the lowest rib at the mid-axillary line. BMI was calculated according to the World Health Organisation definition, with the following formula: weight (kg) / height (m²). Figure 1 shows the enrolment process.

Statistical analysis

The Statistical Package for the Social Sciences version 21.0 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. Quantitative variables are presented as mean \pm standard deviation (SD) and while qualitative variables as frequencies and percentages. Values are presented according to the international system of units. Non-parametric statistical tests were used given the non-normal distribution of the data. The Wilcoxon rank test was applied for intra-group differences, while inter-group differences were assessed with the Mann-Whitney U-test. Fisher's exact X2 test was used to assess differences in qualitative variables. Data were considered statistically significant with a P-value of ≤ 0.05 .

Ethical statements

The study was conducted in a private gym where crossfit classes are offered. Data collection and anthropometric measurements were performed under the supervision of the investigator, with the aim of guaranteeing the safety and well-being of the participants in accordance with the General Health Law Regulation on Health Research of the United Mexican States.

The study was approved by the institutional research ethics committee (IRB / 448/2017 on 19 October 2017) and registered in the Clinical Trial (NCT03436277).

Results

A total of 19 overweight women were evaluated (L-Carnitine group n=9 and placebo group n=10), with a mean age of 27.5 ± 5.8 years in the placebo group and 32 ± 3.3 years in the L-Carnitine group ($P=0.073$).

No statistically significant differences in anthropometric measurements were observed between each group before the intervention (Table 1). One volunteer in the L-Carnitine group decided to drop out of the study and therefore withdrew her informed consent.

After the 8-week intervention, statistically significant differences were found in the placebo group in body weight (74.7 ± 11.6 versus 73.6 ± 11.7 kg, $P= 0.040$), BMI (27.8 ± 1.7 versus 27.4 ± 1.9 kg/m², $P= 0.041$), waist circumference (86 ± 6.4 versus 82.3 ± 7.4 cm, $P= 0.005$), body fat percentage (29.8 ± 3.5 versus 27.1 ± 2.4 , $P= 0.003$) and muscle mass (36.2 ± 3.4 versus 38.7 ± 2.3 , $P = 0.003$) (Table 2).

The L-Carnitine group demonstrated significant differences in waist circumference (89.4 ± 6.1 versus 87.1 ± 6.3 cm, $P = 0.018$), body fat percentage (31.5 ± 2.9 versus 29.1 ± 2.7 , $P = 0.008$) and muscle mass (34.7 ± 3.5 versus 37.1 ± 3.3 , $P = 0.008$) (Table 2).

Adherence to treatment was greater than 80% in all participants. Study flow diagram: Figure 1 shows the enrolment process.

Deviations: No deviations were found during the study, everything proceeded according to protocol.

Adverse events: One case of insomnia was reported in one of the patients in the placebo group, which was not considered statistically significant ($P= 1.000$)

Annexes

	Placebo n = 10	L- carnitine n = 10	P
Age	27.5±5.8	32±3.3	0.07
Weight (kg)	74.7±11.6	74±6.6	0.65
Height (m)	1.6±0.1	1.6±0	0.70
BMI (kg/m ²)	27.8±1.7	28.6±1.5	0.52
Arm relaxed (cm)	30.4±2.1	31.5±2.2	0.30
Arm contracted (cm)	31.2±2.1	31.7±2.3	0.70
Waist (cm)	86±6.4	89.9±6.1	0.17
Hip (cm)	107.3±8.8	107.1±4.2	0.94
Body fat (%)	29.8±3.5	31.5±2.9	0.27
Muscle mass (%)	36.2±3.4	34.7±3.5	0.34

BMI: Body Mass Index

Table 1 Baseline clinical characteristics of the study groups

Source: Own elaboration

	Placebo		L-carnitine	
	Basal (n = 10)	Final (n = 10)	Basal (n = 10)	Final (n = 9)
Weight (kg)	74.7±11.6	73.6±11.7*	74±6.6	74.1±7.3
BMI (kg/m ²)	27.8±1.7	27.4±1.9*	28.6±1.5	28.3±1.5
Arm relaxed (cm)	30.4±2.1	29±2**	31.5±2.2	30.5±2.5
Arm contracted (cm)	31.2±2.1	30.6±2.7	31.7±2.3	31.4±1.8
Waist (cm)	86±6.4	82.3±7.4*	89.4±6.1	87.1±6.3*
Hip (cm)	107.3±8.8	105.4±8.1	107.1±4.2	106±3.9
Body fat (%)	29.8±3.5	27.1±2.4**	31.5±2.9	29.1±2.7**
Muscle mass (%)	36.2±3.4	38.7±2.3**	34.7±3.5	37.1±3.3**

* $p < 0.05$, ** $p < 0.01$ between baseline-final measurement of both groups.

BMI: Body Mass Index

Table 2 Baseline-final measurement of both groups

Source: Own elaboration

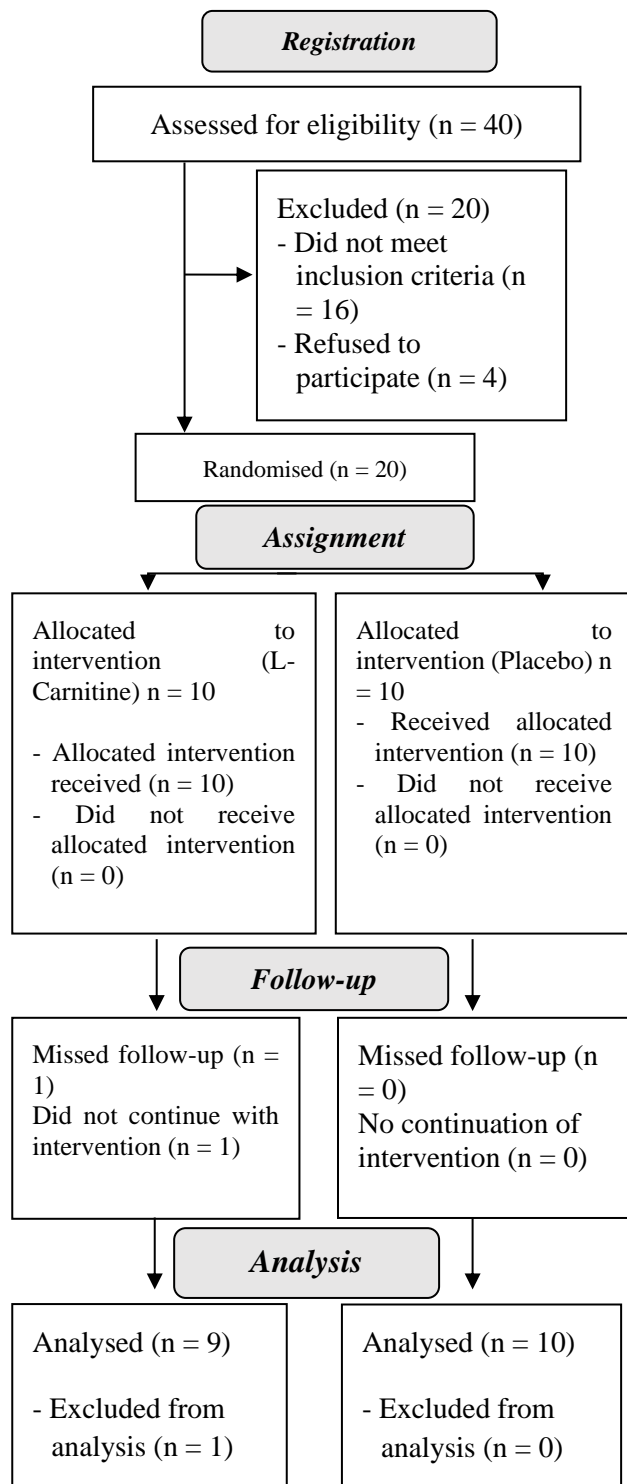


Figure 1 Patient selection flowchart

Source: Own elaboration

Acknowledgements

We thank Assen Ognianov Iantchoulev, Executive Editor of Scientific Communications, for editorial assistance in English.

Conclusions

We can conclude that the administration of 1.5 grams of L-Carnitine to overweight adult women practising Cross-fit as an exercise routine over a period of 8 weeks contributed to a decrease in waist circumference and body fat percentage.

References

- I. Harvie, M. N., Pegington, M., Mattson, M. P., Frystyk, J., Dillon, B., Evans, G., Howell, A. (2010). The effects of intermittent or continuous energy restriction on weight loss and metabolic disease risk markers: a randomized trial in young overweight women. *International Journal of Obesity*, 35(5), 714–727. doi:10.1038/ijo.2010.171
- II. Abbenhardt, C., McTiernan, A., Alfano, C. M., Wener, M. H., Campbell, K. L., Duggan, C., ... Ulrich, C. M. (2013). Effects of individual and combined dietary weight loss and exercise interventions in postmenopausal women on adiponectin and leptin levels. *Journal of Internal Medicine*, 274(2), 163–175. doi:10.1111/joim.12062.
- III. Claudino, J. G., Gabbett, T. J., Bourgeois, F., Souza, H. de S., Miranda, R. C., Mezêncio, B., ... Serrão, J. C. (2018). CrossFit Overview: Systematic Review and Meta-analysis. *Sports Medicine - Open*, 4(1). doi:10.1186/s40798-018-0124-5
- IV. Leelarungrayub, J., Pinkaew, D., Klaphajone, J., Eungpinichpong, W., & Bloomer, R. J. (2017). Effects of L-carnitine supplementation on metabolic utilization of oxygen and lipid profile among trained and untrained humans. *Asian Journal of Sports Medicine*, 8(1). doi:10.5812/asjsm.38707
- V. Samimi, M., Jamilian, M., Ebrahimi, F. A., Rahimi, M., Tajbakhsh, B., & Asemi, Z. (2016). Oral carnitine supplementation reduces body weight and insulin resistance in women with polycystic ovary syndrome: a randomized, double-blind, placebo-controlled trial. *Clinical Endocrinology*, 84(6), 851–857. doi:10.1111/cen.13003.
- VI. Gimenes, A. C., Bravo, D. M., Napolis, L. M., Mello, M. T., Oliveira, A. S. B., Neder, J. A., & Nery, L. E. (2015). Effect of L-carnitine on exercise performance in patients with mitochondrial myopathy. *Brazilian Journal of Medical and Biological Research*, 48(4), 354–362. doi:10.1590/1414-431x20143467

- VII. Pooyandjoo, M., Nouhi, M., Shab-Bidar, S., Djafarian, K., & Olyaeemanesh, A. (2016). The effect of (L-)carnitine on weight loss in adults: a systematic review and meta-analysis of randomized controlled trials. *Obesity Reviews*, 17(10), 970–976. doi:10.1111/obr.12436
- VIII. Jeyaseelan, L., & Rao, P. S. (1989). Methods of determining sample sizes in clinical trials. *Indian pediatrics*, 26(2), 115–121.
- IX. Chavarria, V., Vian, J., Pereira, C., Data-Franco, J., Fernandes, B. S., Berk, M., & Dodd, S. (2017). The Placebo and Nocebo Phenomena: Their Clinical Management and Impact on Treatment Outcomes. *Clinical Therapeutics*, 39(3), 477–486. doi:10.1016/j.clinthera.2017.01.0
- X. Schubert, M. M., & Palumbo, E. A. (2018). Energy balance dynamics during short-term High-Intensity Functional Training. *Applied Physiology, Nutrition, and Metabolism*. doi:10.1139/apnm-2018-0311
- XI. Swift, D. L., Johannsen, N. M., Lavie, C. J., Earnest, C. P., & Church, T. S. (2014). The Role of Exercise and Physical Activity in Weight Loss and Maintenance. *Progress in Cardiovascular Diseases*, 56(4), 441–447. doi:10.1016/j.pcad.2013.09.012
- XII. Washburn, R. A., Szabo, A. N., Lambourne, K., Willis, E. A., Ptomey, L. T., Honas, J. J., ... Donnelly, J. E. (2014). Does the Method of Weight Loss Effect Long-Term Changes in Weight, Body Composition or Chronic Disease Risk Factors in Overweight or Obese Adults? A Systematic Review. *PLoS ONE*, 9(10), e109849. doi:10.1371/journal.pone.0109849
- XIII. Barzegar, A., Alipour, B., Panahi, F., & Karamzad, N. (2013). Effect Of L-Carnitine Supplementation On Serum Adipokines (Leptin And Visfatin) Levels In Obese Type II Diabetes Mellitus Women With Hypocaloric Diet. 10.17795 / jhealthscope-14615
- XIV. Villani, R. G., Gannon, J., Self, M., & Rich, P. A. (2000). L-Carnitine Supplementation Combined with Aerobic Training Does Not Promote Weight Loss in Moderately Obese Women. *International Journal of Sport Nutrition and Exercise Metabolism*, 10(2), 199–207. doi:10.1123/ijsnem.10.2.199
- XV. Sardeli, A., Komatsu, T., Mori, M., Gáspari, A., & Chacon-Mikahil, M. (2018). Resistance Training Prevents Muscle Loss Induced by Caloric Restriction in Obese Elderly Individuals: A Systematic Review and Meta-Analysis. *Nutrients*, 10(4), 423. doi:10.3390/nu10040423.