OSJ | OPEN SCIENCE JOURNAL

RESEARCH ARTICLE

# Analysis of the Metabolic and Hormonal Effects of Krav Maga Physical Training

Joao Batista de Andrade Neto[1,2*], Antonio Coppi Navarro[3], Francisco Navarro[3], Natalino Salgado Filho[3]

[1]University of Sao Paulo, Brazil
[2]Military school of Brasilia, Brazil
[3]Federal University of Maranhao, Brazil

*Corresponding author: Joao Batista de Andrade Neto: andradeneto@usp.br

OPEN ACCESS

Citation: Andrade Neto J.B., Navarro A.C. Navarro F. Filho N. S. (2022) Analysis of the Metabolic and Hormonal Effects of Krav Maga Physical Training. Open Science Journal 7(2)

Received: 9th January 2022

Accepted: 23rd February 2021

Published: 26th April 2022



Funding: The author(s) received no specific funding for this work

Competing Interests: The authors have declared that no competing interests exists.

## Abstract:

Aim: The aim of this study is to evaluate the metabolic and hormonal aspects during 16 weeks of Krav Maga training.
Methods: 30 males, aged between 20 and 58 years, average weight of 173,74 ± 25,88 lbs., and with no medical restrictions, willingly participated in a Krav Maga training program for a period of 16 weeks. They were evaluated for metabolic and hormonal aspects in three different weeks (1, 8 and 16) pre- and post-training. Blood samples were collected and analyzed for pre- and post-training glucose, fasting glucose, total cholesterol, HDL, LDL, VLDL, triglycerides, basal lactate, and cortisol levels. Data were statistically analyzed using the software IBM-SPSS Statistics version 28 (IBM Corporation, NY, USA) and $P < 0.05$ was considered significant.
Results: The research didn't find a significant difference for cortisol levels ($P=0.065$) but found for fasting blood glucose ($P=0.004$), lactate ($P=0.007$), pre-training glucose ($P<0.001$), and post-training glucose ($P<0.001$).
Conclusion: Krav Maga training for 16 weeks is able to change fasting blood glucose, Lactate, pre-, and post training glucose.

Keywords: Krav Maga; Physical Training; Metabolism; Hormone.

## Introduction

Krav Maga is a fighting modality created from other preexisting fight modalities and developed by the Jewish people in the 19th century, to guarantee their survival and independence. It presents psychomotor concepts and situational awareness that involve traumatic blows, pressure to overthrow or dominate the opponent, twists, and immobilizations, aiming to neutralize the attack and the aggressor [1].

Due its application, Krav Maga is considered one of the most popular methods of self-defense in the world and it is estimated that it is currently practiced in more than 120 countries [2,3].

Despite having become a social phenomenon of great popularity and complexity, research related to Krav Maga is still scarce, but it deserves greater attention because of its characteristics as fast and complex movements using of the whole body and its effects on metabolic and physiologic processes (e.g., hemodynamics and hormonal processes) [4].

Physical exercise improves health and quality of life, and its benefits are widely known. For this reason, the possible physiological changes in the most diverse metabolic and hormonal variables that involve its practice must be discussed. Thus, a better understanding of the practitioner's metabolic state in relation to the various sports disciplines may contribute to improving the quality of training.

This study aims to investigate the physiological effects of the application of a specific physical training program for Krav Maga, in a period of 16 weeks, on the metabolic and hormonal variables.

## Methods

### *Ethical issues*

The research was submitted to the Research Ethics Committee of the Federal University of Maranhão – UFMA (Brazilian acronym) under protocol n$^{o}$ 2.533.453, and registration n$^{o}$ CAAE: 82959617.1.0000.5087.

### *Participants*

30 volunteers, all male, aged between 20 and 58 years, average weight of 173,74 ± 25,88 lbs., and with no medical restrictions, participated in a Krav Maga training program for a period of 16 weeks.

They all agreed to keep their regular routine, diet, and participate effectively in all training sessions and not participate in any other type of physical training program during the experiment.

### *Research design*

This is a longitudinal prospective cohort study[5]. All procedures were performed at the Profit Academia in the city of Teresina PI, Brazil, from April to August 2019.

Blood samples for hormonal and metabolic analysis were collected in the weeks 1, 8 and 16 (W1, W8 and W16). Hormonal assessment aimed at cortisol serum changes as a result of the krav maga practice, metabolic assessment consisted of

cholesterol, triglycerides, fasting glucose, HDL, LDL, VLDL, pre-training glucose and post-training glucose levels (mg/dL), and lactate.

### *Metabolic assessments*

10 ml of serum (blood) were collected and analyzed by the MedImagem Laboratory of Teresina. The sample were used for Lipid Profile (total cholesterol, HDL cholesterol, LDL, VLDL, triglycerides) using the Friedwald Equation and Colorimetry method. The lactate analyzes were measured by the dry chemical method.

Three different collections were performed during the experiment (W1, W8 and W16), and in two moments of the training session, the first always before the beginning training session, and the second at up to 5 minutes maximum after the end of the training session, on the same days. All collections were performed by venipuncture, with disposable materials. Blood Glucose Collection to identify glycemic behavior, before, during and after training, was performed using the On Call Plus brand portable glucometer (Acon Laboratories Inc), made in a single device. It has been calibrated before use to ensure its accuracy. Blood was obtained through capillary puncture randomly between the fingers using a G-Tech Lancet (Accumed Produtos Médico-hospitalares LTDA), and disposable lancets, with the first drop of blood being discarded and the second drop immediately placed on the strip analysis.

### *Hormonal assessments*

Blood sample to measure basal cortisol was collected and analyzed by Chemiluminescence. It was carried out at the same time of collection for metabolic analysis, using 10 ml of serum (blood), always fasting, from 6 to 9 o'clock.

### *Training protocol*

The volunteers participated in a Krav Maga training program for yellow belts in an indoor gym with controlled temperatures between 64.4 and 68 °F and a tatami mat-covered floor. The protocol lasted 16 weeks without interruption, with three sessions per week.

In the week that preceded the beginning of the protocol, the participants were submitted to the Yo-Yo test, to estimate the VO2Max and the Anaerobic Threshold (LAn) that were used to determine the intensities of the training session.

From W1, the duration of training sessions started at 40 minutes and increased by 10 minutes per session until reaching a maximum of 90 minutes at the end of the W2. The training intensity started at 10% below the threshold anaerobic activity of the volunteers and progressively increased with the course of the protocol, being stipulated the limit in 50% above the LAn.

Warm-ups were performed before the exercises in all training sessions. The main exercises involved joint mobility, stretching and strength work, in addition to specific Krav Maga techniques. Volunteers had regular breaks for hydration ad libitum.

All training sessions were supervised by the researchers and followed the program developed by Pro Krav Maga Brazil - Personal Safety Advisory - PKM and approved by the Academic College of Wingate - Israel in 2016 [6].

### *Statistical analysis*

Exploratory data analysis included descriptive statistics, mean, median, standard deviation, minimum and maximum values for numerical variables and number and proportion for categorical variables. To analyze the behavior of continuous variables, descriptive statistics, histogram and boxplot plots and the specific test for the theoretical assumption of normality Shapiro-Wilk were considered[7,8].

Comparative analysis of the effects of Krav Maga physical training over time (W1, W8, and W16) was performed using the Friedman test (numerical variables) and the Cochran Q test (categorical variables), and in case of rejection of the null hypothesis, multiple comparisons were performed (pairwise method) with significance values adjusted by Bonferroni correction, to see where the effect of differences was (SIEGEL & CASTELLAN, 2006; COCHRAN, 1950; DICKHAUS, 2014; IBM SPSS Statistics Algorithms, 2020). Statistical analysis was performed using the IBM-SPSS Statistics software version 28 (IBM Corporation, NY, USA). All P values $< 0.05$ were considered significant.

## Results

There were significant differences for fasting blood glucose, lactate, and pre and post training glucose. Multiple comparisons (pairwise method) using Bonferroni Correction were made to find the effect of the differences. The results are detailed in the tables 1 and 2.

For the fasting blood glucose variable, the difference was significant between the W8 and W16, that is, there was a significant increase in fasting glucose values between these two moments.

For the lactate variable, the difference was significant (descending values) between the W1 and W8.

For the pre-training glucose variable, there was a statistically significant difference between the three assessment moments. For post-training glucose, it was observed that the significant difference was between the W1 and W8, as well as between the W1 and W16; on the other hand, between the W8 and W16, the difference is not considered significant.

## Discussion

There are no scientific publications relating Krav Maga to metabolic and hormonal parameters, consequently, the results will be discussed with other types of fights with movements similar to Krav Maga, such as Jiu Jitsu, Boxing, Wrestling and Judo.

Only fasting blood glucose, lactate, pre-, and post training blood glucose showed statistically significant difference. The other metabolic factors and hormonal factor have not changed over the 16 weeks of training.

There is a wide variety of performance and training intensity response markers. Oliveira et al observed differences in the total cholesterol and triglycerides of experienced Judo fighters in a competitive period, when compared to sedentary youngsters, and concluded that training can influence these variables[9].

In the review study by Zanella et al.[10] the beneficial effects of regular exercise were pointed out in the increase of high-density lipoprotein (HDL) concentrations, decrease in VLDL, and change in the composition of circulating LDL.In addition, Prado and Henrique [11] concluded that moderate aerobic exercise generates beneficial changes in the chemical composition of cholesterol fractions and subfractions, with a decrease in LDL and an increase in HDL in practitioners of this modality compared to individuals who train at higher intensities.

Our study didn't show change for lipoprotein profile. The protocol of 16 weeks wasn't able to change the lipoprotein profile stimulating the functioning of the enzymatic processes involved in the lipid metabolism.

Coswiga et al. [12] quantified biochemical, hormonal, and hematological parameters of beginner and experienced athletes in the practice of Brazilian Jiu-Jitsu. The results showed that there was no difference in glucose, lactate, cholesterol, or cortisol levels.

Our results have shown a significant difference in fasting blood glucose and pre- and post-training blood glucose. Probably the training protocol for 90 minutes reported here was sufficient to decrease insulin and increase glucagon, releasing glucose into the bloodstream, as observed in our results for post-training glycemia.

There is usually a linear relationship between the intensity of effort produced and the concentration of blood lactate.[13] Krav Maga was previously defined as one of the fighting modalities characterized by intermittent efforts, that is, during a training the individual performs high intensity efforts, interspersed with small periods of breaks, and/or efforts of lower intensities. Pereira et al.[14], with the aim of observing the lactate production capacity, found high lactate concentrations in Jiu Jitsu fighters after the fights. The results, however, pointed to a great inter-individual variability, which is similar to what was found here, where a variation in lactate with time was not observed. It was also observed by Franchini et al.[15] with Judo elite athletes, that the pre- and post-fight concentrations presented different values.

Cortisol has a catabolic action preventing the re-esterification of fatty acids and inducing lipolysis.[16] We did not observe variations in cortisol levels. Fabre17, when investigating the effects of the metabolic and inflammatory response in judo athletes, found that changes in the immunometabolic profile are subject to the type of exercise, as well as its intensity and duration.

It would be interesting in the future to analyze a longer training and measure the same metabolic variables, along with glucagon and other hormones involved in anabolic and catabolic processes, and further research should be carried out to clarify and strengthen scientific knowledge about this fighting modality.

## Conclusion

The Krav Maga training protocol for 16 weeks was able to change fasting blood glucose, Lactate, pre- and post-workout glucose, however, did not change cortisol levels.

## Acknowledgment

We thank all those who took part in this study: athletes, professionals and reviewers.

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Table 1.
Comparative analysis of the metabolic and hormonal data throughout the study.

| Variable | W1 | W8 | W16 | P value |
|---|---|---|---|---|
| Total cholesterol (mg/dL) | 195.00 (103.00 – 260.00) | 188.75 (105.00 – 255.00) | 179.50 (104.00 – 252.00) | 0.795 |
| Triglycerides (mg/dL) | 89.00 (43.00 – 433.00) | 80.00 (41.00 – 399.00) | 80.00 (41.00 – 399.00) | 0.273 |
| Fasting glucose (mg/dL) | 82.00 (70.00 – 109.00) | 79.00 (66.00 – 102.00) | 83.50 (68.00 – 112.00) | 0.004 |
| HDL (mg/dL) | 47.00 (32.00 – 68.00) | 47.00 (33.00 – 63.00) | 50.00 (33.00 – 63.00) | 0.991 |
| LDL* (mg/dL) | 121.00 (37.00 – 189.00) | 119.00 (54.00 – 181.00) | 125.00 (69.00 – 185.00) | 0.201 |
| VLDL* (mg/dL) | 17.20 (8.60 – 79.20) | 19.10 (8.20 – 64.10) | 17.20 (7.20 – 48.60) | 0.289 |
| Lactate (mmol/L) | 16.95 (9.70 – 72.10) | 14.80 (8.30 -55.30) | 15.80 (9.80 – 34.90) | 0.007 |
| Cortisol (mcg/dL) | 11.00 (3.30 – 20.70) | 12.00 (4.60 – 22.30) | 11.30 (6.60 – 22.50) | 0.065 |
| Pre-training glucose (mg/dL) | 85.00 (72.00 – 109.00) | 89.00 (76.00 – 112.00) | 95.50 (75.00 – 151.00) | $< 0.001$ |
| Post-training glucose (mg/dL) | 72.00 (65.00 – 92.00) | 78.00 (69.00 – 89.00) | 79.00 (65.00 – 119.00) | $< 0.001$ |

Friedman test. * Available in 29 cases.

Table 2
Analysis of multiple comparisons (pairwise method), with significant values adjusted by Bonferroni correction for metabolic variable between the three assessments.

| Variable | P value |
|---|---|
| Fasting glucose | |
| W1 x W8 | 0.526 |
| W1 x W16 | 0.158 |
| W8 x W16 | 0.003 |
| Lactate | |
| W1 x W8 | 0.006 |
| W1 x W16 | 0.158 |
| W8 x W16 | 0.736 |
| Pre-training glucose | |
| W1 x W8 | 0.011 |
| W1 x W16 | 0.000 |
| W8 x W16 | 0.035 |
| Post-training glucose | |
| W1 x W8 | 0.024 |
| W1 x W16 | 0.000 |
| W8 x W16 | 0.413 |