

CASE STUDY: USE OF KETOGENIC DIET IN A PROFESSIONAL BOXER GIRL

De Rosa Antonia*^{1,2}, Ciaravolo Vincenzo^{1,3}

¹Post Graduate University Course in “Diete e Terapie Nutrizionali Chetogeniche: Integratori e Nutraceutici (NutriKeto)” - Dipartimento di Farmacia, University of Salerno, Via Giovanni Paolo II – Fisciano (SA), Italy

²Catholic University Sacro Cuore, Largo Gemelli, 1, Rome, Italy

³University of Napoli “Federico II”, Naples, Italy

Email address: antoniaderosa@live.it; nutriketo@unisa.it

Abstract

This case study shows the direct effects of a ketogenic diet on sport and in particular on a combat sport, like boxing. My purpose is to present the case of a professional boxer girl who fought for a competitive preparation for the European Championship of Boxing, and followed a ketogenic diet rich in polyunsaturated fatty acids. The ketogenic diet worked well for the athlete who showed a significant loss of fat mass and also decreased body weight, reaching the 48 kg of female boxer category. This case may prove that ketogenic diet could also be applied to sports which include weight category.

Keywords: *ketogenic diet, boxing, fat mass, lean mass.*

Introduction

Ketogenic diet is a high-fat intake diet (75% of daily calories, generally), with adequate protein content and low levels of carbohydrates (<20 g/day or 5% of total daily energy intake) (1).

Ketogenic diet, has a very low carbohydrate intake for the needs of the individual; therefore, the body uses alternative metabolic pathways, such as gluconeogenesis, which occurs in the hepatic parenchyma, to synthesize carbohydrates from proteins and /or lipids.

The minimum daily intake of low glycemic index simple carbohydrates instead performs several metabolic actions such as: avoiding the decrease of basal metabolism, allowing the retention of sodium and potassium and glucose-dependent cells, such as red blood cells, to always have a source of energy, improving the performances of the organism, causing a loss of appetite, preventing the accumulation of ketone bodies. The consequence of a reduced intake of carbohydrates, especially the high glycemic index ones, is that the blood concentration of insulin is significantly reduced. The low concentration of insulin determines greater glucagon production with feed-back mechanisms, which are the real responsible for the lipolysis that occurs in the adipose tissue and which determines the rapid weight loss (2-4).

In hepatocytes, moreover, under the stimulus of glucagon, ketogenesis occurs starting from the catabolism of triglycerides, which first undergoes a beta oxidation in Acetyl CoA and then in ketone bodies. The ketone bodies therefore enter into circulation generating a ketonemia state and this determines a control of hunger at a hypothalamic level, therefore this provokes a loss of appetite.

The ketone bodies are subsequently integrated in Acetyl CoA in the hepatic parenchyma. The obtained Acetyl CoA is then moved into the Krebs Cycle thus supplying energy to the cells. This second oxidation is made possible by the presence of insulin and glucose obtained from the gluconeogenesis which occurs starting from the exogenous supplementation of high biological value proteins and from the supply of small amounts of carbohydrates with the diet.

Furthermore, the catabolism products of ketone bodies guarantee energy needs.

Also important in the ketogenic diet is the preservation of lean mass, which is guaranteed by the supply of high biological value proteins that compensates for the mobilization of endogenous proteins.

The purpose of this diet is to obtain energy from fats and proteins, through the process of lipolysis (which ensures a rapid weight loss) and of production of ketones (acting on hypothalamus, determine a decrease in appetite) and at the same time ensuring brain function with the minimum amount of carbohydrates intake.

Boxing is a combat sport, which requires a lot of energy, focus and concentration. This sport consists in the confrontation, within a square space called "ring", between two athletes who face off by hitting themselves with their fists (protected by special gloves), in order to weaken and land the opponent. Each boxing match has a duration of 3 shots which last 3 minutes each, and include 1 minute of rest between them.

Boxing can be defined as a sport with mixed activity: massive anaerobic and aerobic activity, in which an aerobic effort is required, interspersed with lightning and repeated anaerobic efforts (alactacid and lactic acids). However, from the analysis of an encounter, from the energy point of view, it requires a commitment of 11 minutes (in which also the minutes of recovery must be counted). Every sporting efforts, which lasts for over 90/120 seconds, then over 2 minutes, commits the aerobic energy profile as a reference energy. Moreover, despite the highly intense efforts, the single powerful blows or the explosive combinations, are at the expense of the anaerobic systems (alactacid and lactic acid) and the aerobic system is charge of the disposal and the reconversion of the lactate through the cycle of Cori.

Therefore, boxing is a sport with mixed activities: massive anaerobic and aerobic ones.

In this sport it is well know that the ratio of carbohydrates is necessary for the energy supply. Recently, there have been some emerging scientific studies which affirm that it is possible to practice sports in the absence of carbohydrate intake, then,

a ketogenic diet could also be effective for anaerobic sports, like running, body building (5-8).

Case presentation

The aim is to show the case of a professional girl boxer who in February 2018, for a competitive preparation for the European Championship of Boxing, underwent a ketogenic diet rich in polyunsaturated fatty acids.

The athlete was a 17 years old girl, weighted 55 kg, and was 157 cm tall. She practiced boxing at a competitive level and she trained 3 hours a day of which 90 minutes in the morning and 90 minutes in the afternoon. In January 2018, she showed these values at the physical examination:

Weight: 55 kg
Circumferences:
Abdomen: 60 cm
Hips: 82 cm
Left Arm: 19 cm
Right proximal thigh: 43 cm
Left proximal thigh: 44 cm
Right median thigh: 38cm
Left median thigh: 39cm
Right calf: 30 cm
Left calf: 30 cm

Plicometry:
Left bicipital plica: 12 mm
Left tricipital plica: 24 mm
Sovrailiac plica: 8 mm
Subscapular plica: 10 mm

BIA:
F.M. 14,9 kg (27,1%)
F.F.M. 40,1 kg (72,9%)
Body total Water 27 l (49,1%)
BMR 1250 Kcal.
Results in agreement to Durnin-Womersley Formula.

Diet profile

She followed a 1400 kcal diet (composed of: 20% proteins, 55% carbohydrates and 25% lipids), but she had difficulty following it due to continuous hunger

and therefore she lost weight with extreme difficulty, despite the intense training that she performed daily.

In February she showed these values at the physical examination:

Weight: 53 kg
Circumferences:
Abdomen: 56 cm
Hips: 79 cm
Left Arm: 18 cm
Right proximal thigh: 42 cm
Left proximal thigh: 41 cm
Right median thigh: 36 cm
Left median thigh: 37 cm
Right calf: 29 cm
Left calf: 29 cm

Plicometry:
Left bicipital plica: 16 mm
Left tricipital plica: 23 mm
Sovrailiac plica: 8 mm
Subscapular plica: 7 mm

Results calculated in according to Dumin-Womersley Formula:
F.M. 14,4 kg (27,1%)
F.F.M. 38,6 kg (72,9%)

The target weight was 48 kg, to be reached by April 17th, competition day. She then underwent a ketogenic diet:

Caloric intake: 1000 kcal.
Protein intake: 1,2 g/kg
Carbohydrate intake: 5%
Lipid intake: 68%
Fiber: 22 gr
Supplements: 4g of creatine after breakfast + 4 g post workout, 1 cp. multivitamin after breakfast, 450 mg magnesium and 450 mg potassium, 1 sachet at breakfast and 1 sachet post workout, 20gtte/week of vitamin D, 3 cp/day of omega 3 after the main meals.
Furthermore, it was recommended to add salt to the food to avoid dizziness and headaches and it

was also recommended to drink at least 2l of water daily.

Results

In April, at the clinical examination, it was observed these results:

Weight: 48 kg

Circumferences:

Abdomen: 53 cm

Hips: 75 cm

Left Arm: 16 cm

Right proximal thigh: 38cm

Left proximal thigh: 38 cm

Right median thigh: 35 cm

Left median thigh: 35 cm

Right calf: 28 cm

Left calf: 28 cm

Plicometry:

Left bicipital plica: 14 mm

Left tricipital plica: 18 mm

Sovrailiac plica: 7 mm

Subscapular plica: 7 mm

BIA:

F.M. 12 kg (25%)

F.F.M. 36 kg (75%)

Body Total Water: 27 l (56,3%)

BMR: 1124 Kcal

Results according to Durnin-Womersley Formula.

The athlete therefore lost 5 kg in 5 weeks with an average of 1 kg per week, reaching target weight. This demonstrates that the ketogenic diet guarantees a weight loss in a short time, and does not affect athletic performances. The values of BIA also show a decrease in basal metabolism, which is likely a consequence of the loss of 2,6 kg of lean mass from the beginning of ketogenic diet, maybe due to the protein intake that was a bit low, although it was a ketogenic diet that preserves muscle mass.

Fat mass, instead was decreased by 2,1% with a loss of 2,4 kg since the beginning of ketogenic diet. The athlete reported no sensation of hunger, but reported mild asthenia, although she continued to

train 2 times per day without any struggle. She also referred constipation, linked to the diet. Finally the day of the competition the girl acceded to the final combat.

Conclusions:

The Ketogenic diet approach can be followed by active athletes for various reasons including weight loss within the weight category of its own discipline. Considering the evidence presented by this reported case, it can be concluded that the ketogenic diet leads to a decrease in fat mass. Furthermore, this study shows that ketogenic diet could be indicated for power sports, because it preserves muscle mass, however the protein intake should be adequate to guarantee this and to prevent the possible appearance of complications related to this, which is the asthenia that can affect the physical performance of the athlete. Furthermore, an adequate protein intake should also ensure that there are no decreases in basal metabolism, as observed in the case under consideration. Finally, more specific studies are needed since those carried out in this sector are still scarce.

Acknowledgments:

I thank Chiara Di Capua, Margherita Dal Moro and Rosario Marotta that helped me in this case study.

References

1. Lindner, P. G., & Blackburn, G. L. (1976). Multidisciplinary approach to obesity utilizing fasting modified by protein-sparing therapy. *Obesity/Bariatric Med*, 5, 198-216.
2. Marineau, J. M. (2004). Mise au point sur le protocole du jeune protéiné. *J Med Esth et Chir Derm*, 31, 149-55.
3. Anderson, J. W., Konz, E. C., Frederich, R. C., & Wood, C. L. (2001). Long-term weight-loss maintenance: a meta-analysis of US studies. *The American journal of clinical nutrition*, 74(5), 579-584.
4. Finnish Diabetes Association. (2001). Development programme for the prevention and care of diabetes in Finland 2000-

2010. Finnish Diabetes Association–Diabetes Centre, Tampere.
5. Paoli, A., Bianco, A., & Grimaldi, K. A. (2015). The ketogenic diet and sport: a possible marriage? *Exercise and sport sciences reviews*, 43(3), 153-162.
 6. Zajac, A., Poprzecki, S., Maszczyk, A., Czuba, M., Michalczyk, M., & Zydek, G. (2014). The effects of a ketogenic diet on exercise metabolism and physical performance in off-road cyclists. *Nutrients*, 6(7), 2493-2508.
 7. Wroble, K. A., Trott, M. N., Schweitzer, G. G., Rahman, R. S., Kelly, P. V., & Weiss, E. P. (2018). Low-carbohydrate, ketogenic diet impairs anaerobic exercise performance in exercise-trained women and men: a randomized-sequence crossover trial. *The Journal of sports medicine and physical fitness*, 59(4), 600-607.
 8. Sawyer, J. C., Wood, R. J., Davidson, P. W., Collins, S. M., Matthews, T. D., Gregory, S. M., & Paolone, V. J. (2013). Effects of a short-term carbohydrate-restricted diet on strength and power performance. *The Journal of Strength & Conditioning Research*, 27(8), 2255-2262.