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Original article

Influence of energy drinks on obesity: a preliminary experimental study

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Summary. We performed an experimental research in Sprague-Dawley rats in order to evaluate the effects of different caffeinated beverages on obesity. Animals were divided in 4 groups and received beverages containing different concentration of caffeine: a commercial Energy Drink, a commercial Cola Soda, regular coffee and water. After 15 days we found that Energy Drink and Cola Soda induced body weight gain, on contrary sweetened coffee and water did not influence weight. Besides, an increased reactivity and motility was observed in the Energy Drink supplemented animals. Laboratory tests excluded obesity-correlated dysmetabolism. We supposed a central nervous action of some components of Energy Drink other than caffeine, even if their finest mechanisms are unknown. At long term, degeneration from a condition of body weight gain to obesity cannot be excluded.

Key words: obesity, energy drinks, caffeine

Introduction

In recent years the consumption of energy drinks (e.g. Red Bull®, Monster®, etc.) has increased constantly among young individuals (1-3) (Fig. 1).

The amount of caffeine varies widely in EDs and it is estimated between 80 to 114 mg/can (3).

Besides caffeine (with 80-160 mg/can), EDs contain several other psychoactive substances as taurin, ginseng, gluconolactone and guaranà, the concentration of which is often disparate and not well indicated (4).

The consumption of EDs among young persons is growing persistently and it has been recently linked with cardiac arrhythmia and young unexpected death (3, 5, 6) EDs are consumed by young because they enhance focus, attention and reactivity (7, 8). EDs do not show a great degree of toxicity when consumed

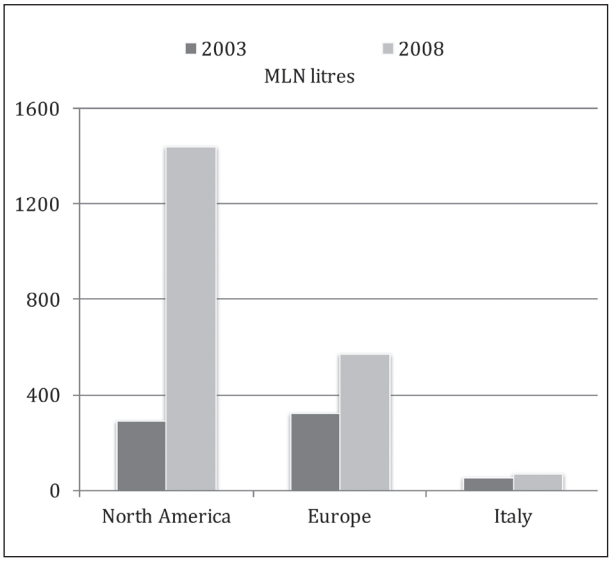

Figure 1.

by healthy subjects in moderate doses, however when consumed in high doses or together with alcoholic beverages, they may cause arrhythmia (3, 5, 6).

It is renowned that the reaction of individuals to caffeine consumption is variable. Caffeine, in fact, stimulates both the central and the peripheric nervous systems affecting the cardiocirculatory and breathing systems (8-11). Recently a paper from showed that caffeine can improve blood lipid and antioxidant levels, and effectively reduce rat serum leptin levels, inhibit the absorption of fatty acids, and markedly reduce the expression levels of the IL-6 and TNF-αgene (12). Some effects of EDs are not known. The present study was design to evaluate the effects of different caffeinated beverages in an animal model.

Methods

We analyze the effect of EDs on body weight gain (BWG) and obesity comparing with different caffeinated beverages.

Forty Sprague-Dawley rats, weighting 150-170 g., were randomly divided into 4 groups. In addition to standard laboratory diet they were fed with different sweetened beverages containing caffeine and caffeine-like substances.

Group A: control group. Group B: a Commercial "Energy Drink" (ED) (80mg/500ml of caffeine and 110 Kcal for week). Group C: a commercial "Cola Soda" (34mg/ 500ml of caffeine plus 92 Kcal for week). Group D: commercial sweetened coffee (250 mg/500ml of caffeine plus 42 Kcal for week. The follow-up lasted 15 days.

The BWG of the animals was calculated every 5 days, and their behavior was daily observed. Changes in behavior were classified on the base of two parameters, strictly correlated each-other: "reactivity", that included energy, vivacity till to an over aggressive answer to nociceptive stimuli, and "motility" manifesting with an increased and quicker running and climbing up inside the cage. The following score was adopted:

Grade O: no change detectable; Grade 1: increased motility, and moderate reactivity; Grade 2:

Increased motility and reactivity with difficulty in manipulating the animals.

Normal laboratory diet consumption was measured every day in all the groups.

After 14 days animals were euthanized. Liver function, renal function, lipid, glucose and methaemoglobin were assessed. Liver and pancreas were macroscopically and histologically evaluated; thickness of white fatty of the subcutaneous space and inside the renal fascia was measured.

All animals received care in compliance with the European Convention on Animal Care. The same trained operator provided animal care in order to reduce stress. The Research Animal Care and Use Committee of our University approved the study.

Statistical analysis. SPSS software, version 14.0.1 (SPSS Inc., Chicago, Ill, USA), was used for statistical analysis. Comparison of data between groups was performed by ANOVA. The t-test was used to compare data within animals of the same group. $P<0.05$ was considered statistically significant. All data are expressed as mean +SD.

Results

Animals treated with EDs **(**Group B) and Soda Cola (Group C) consumed the daily total amount of the supplemented beverages during the follow-up period. Animals treated with sweetened coffee (Group D) consumed the daily total amount of beverages during the first 6 days (mean 6 + 1 day) then tend to reduce intake at 70% of administered beverage.

At the end of the study, BWG was observed in Group B (+10%: $p<0.01$), and in Group C (+5%; $p<0.05$), while smaller changes were reported in Control Group (+2.50 %; p=n.s.) and in Group D (+2.72% p=n.s.). WE also reported an increase consumption of the normal laboratory diet in Group B and C, respectively + 15%, and +10%.

Behavioral changes were observed in Group B (EDs), and were scored as grade 1 in 2 animals, and grade 2 in 8 animals.

The fasting blood glucose test controls, and the other final metabolic parameters were in a normal

range. Measures of the white fatty in the different groups did not demonstrate significant changes.

Histology did not show signs of organ damage;

in particular liver histology excluded signs of steatosis, typically found in obesity (13).

Discussion

The main finding of the present preliminary study is that animals supplemented with EDs and Soda Cola developed body gain weight as compared to animals treated with sweetened coffee and control group. Increase of body weight has been recently associated to sweeetened beverages (14, 15).

We found that BWG was progressive, overcoming the small amount of carbohydrate calories added to the beverages, and can be correlated to an augmented appetite as shown by the increased consumption of the normal laboratory diet. This anabolic action of EDs and of Soda Cola can be referred to a digestive effect, direct or mediated, rather than to a simple caloric supplementation. We hypothesize a central neurologic stimulation, considering that caffeine and caffeine-like substances pass the blood-brain barrier (16-18). The disproportion between BWG and the greater caloric assumption can be explained considering the calories consumption, induced by the increased motility (19).

However the sole caffeine content in the EDs does not explain this effect, as demonstrated by the difference in BWG between group B and D that assumed sweetened coffee. The more vigorous action of EDs seems to be related to its composition that included several different substances, even if all the proper mechanisms of each component are not yet completely known (20-22). It well correlates with its neuro-motorial positive effect, which compensates a more caloric intake, directing the anabolic process to a prevalent muscular mass hypertrophy, assuring a metabolic compensation and avoiding an excessive fat accumulation through greater energy dissipation. The present mid-term study was tailored on the live expectancy of the animals; however we cannot exclude, at long-term, a possible degeneration from BWG to a real obesity.

The protocol allowed us to distinguish between a simple and physiological BWG and obesity. We also observed an ergogenic and positive metabolic of a prolonged EDs consumption, distinguishing it from adverse effects, especially cardiac or neurological, often due to its acute overconsumption (1, 5, 23,24, 25). These data suggest more extended pharmacological researches on the different active components of EDs.

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