

Physical exercises and fat burners – the easy road to severe consequences?

Nadezhda Shuvalova¹, Gerold Drandrov^{1*}, Svetlana Lezhenina², Antonina Karpunina², Yuvenali Igonin²

¹Chuvash I. Yakovlev State Pedagogical University, 428000, Cheboksary, Russia

²I.N. Ulianov State University, 428015, Cheboksary, Russia

Abstract. The aim of the study is to identify the features of the regular aerobic exercise effect, dietary diet with the intake of dietary supplements with plant components, intended for weight loss, on the reduction of body weight, fat mass, and glycemic profile of overweight women. The article presents the results of two groups of women (22 people in each) in a three-month physical fitness program to reduce excess weight, including regular exercise and adherence to dietary nutrition. Women of the first group additionally took an active substance for weight loss, containing a mixture of carnitine, chromium, arginine and guarana, green tea, citrus fruits and willow extract, women of the second group without placebo. It was found that participation in the program led to approximately the same reduction in body weight, BMI, total body fat, visceral fat and waist circumference in women of both groups. The use of a dietary supplement (fat burner) had a negative effect on glucose metabolism and insulin resistance. We attribute this result to the presence of caffeine and an especially inappropriate combination of substances in the mixture. The negative influence of a fat burner on carbohydrate metabolism revealed by us in the process of physical culture and health-improving fitness must be taken into account when organizing sports nutrition with the use of biologically active additives.

1 Introduction

The leading world challenges that determine the strategic directions of physical culture and sports development include the increased requirements for an increase in the duration of socially and economically active life, taking into account the aging of the population and low involvement in physical culture and sports of middle and older age groups. In this regard, the importance of organizing a healthy lifestyle increases. The basis of it is regular physical activity and physical culture and sports.

Overweight people are a special category of the population. In the Russian Federation, as in other developed countries, in the diet of the population, there is a predominance of simple carbohydrates, combined with a deficiency of indigestible polysaccharides (fiber). With an excess of carbohydrates, their unused portion is converted into glycogen in the liver, and after replenishing the glycogen stores, all the rest of the glucose is converted into fat. Thus, all this contributes to the appearance of excess weight through an increase in fat mass and the development of obesity.

It is known that overweight and physical inactivity are common risk factors for many chronic non-communicable diseases. They include oncological and cardiovascular diseases for modern humans [1, 2, 3, 4, 15, 16, 17]. Therefore, increasing physical activity and adhering to a dietary regimen are the most effective methods of treating obesity and getting rid of excess weight. The ideal option is to use these factors together in a coordinated manner in weight loss programs.

Nevertheless, the practice of using such programs shows that their impact is often not effective enough and is perceived by the participants of these programs as not fast enough.

This situation is used for their own purposes by various pharmaceutical companies for the manufacture of biologically active food supplements, offering as a way to resolve it a huge selection of products to facilitate the process of losing weight. These drugs, the so-called fat burners, are very popular, and their range is becoming more and more diverse every year.

Usually, fat burners are a mixture of substances that can reduce body weight in three ways:

- 1) by general stimulation of metabolism;
- 2) suppressing appetite;
- 3) reducing the absorption of fats from the intestines.

A review of literature data indicates that the problem of the efficacy and safe use of dietary supplements with a mixture of plant extracts (fat burners) intended for weight loss has been the subject of a small number of experimental researches.

* Corresponding author: gerold49@mail.ru

In particular, Hasani-Ranjbar et al. [5] found that supplements using caffeine, ephedrine, or extracts from *Cissus quadrangularis*, *Garcinia atroviridis*, *Bofutsushosan* and ginger as active ingredients were effective in weight loss and did not have any adverse health effects. However, at the same time, the authors draw attention to the need to monitor possible side effects when combining active substances in these drugs.

The effect of the combined use of moderate-intensity physical activity, dietary diet and dietary supplements with components of plant origin (fat burner) on anthropometry and biochemical parameters of carbohydrate metabolism has been little studied.

Therefore, the aim of our randomized, double-blind research was to determine the effect of regular aerobic exercise, dietary intake in combination with the intake of a dietary supplement with plant-based ingredients intended for weight loss, on the reduction of body weight and fat mass, on the glycemic profile of overweight persons.

2 Materials and methods

To achieve the goal of the research, we organized and carried out experimental work with the participation of two groups of women. The inclusion criteria for women in the research were body mass index (BMI) more than 25 kg/m², no thyroid disease, no diabetes mellitus, hypertension and hyperlipidemia.

The average age of women who took part in the work was 50.12 ± 13.51 years, the average BMI was 32.70 ± 5.79 kg/m². No woman did regular exercise prior to the study.

The women studied were randomly divided into experimental and control groups of 22 people each.

Women in both groups completed a standard overweight program for 90 days. It included regular exercise and adherence to dietary guidelines. Three days a week, women walked for 45 minutes on an ergometer treadmill (exercise intensity was set at 50-60% of maximum heart rate reserve). The daily energy restriction on the restorative diet was approximately 2000 kJ for each person.

The experimental group of women, in contrast to the women of the control group, additionally took four capsules of the active substance for weight loss, containing a mixture of carnitine, chromium, arginine and guarana, green tea, citrus fruits and willow extract (see Table 1). The second group - the control group received a placebo.

Table 1. Content of active substances in one capsule

Active substance	Amount of substance
Guarana extract (10% caffeine)	800 mg
Citrus Aurantium Extract (8% Synephrine)	120 mg
Willow Bark Extract (15% Salicin)	60 mg
Green Tea Extract (50% Polyphenols)	60 mg
L-citrulline malate	360 mg
L-carnitine tartrate	800 mg
Arginine	500 mg
Omega-3 fatty acids	100 µg

Before and after the completion of the experimental work, venous blood was taken from the women under study to determine the parameters of glycemia, uric acid, liver enzymes, C-reactive protein, homocysteine, total cholesterol, HDL cholesterol, LDL cholesterol, insulin, proinsulin, glycated hemoglobin, and to calculate the homeostatic model of insulin resistance.

Body composition was assessed by the bioelectrical impedance method (Tanita BC 418-MA). The indices of body mass index (BMI), fat mass and visceral fat mass were determined. The indicators of body weight and waist circumference were determined by anthropometric methods.

Due to the small sample of the studied data, nonparametric methods were used for statistical processing. To compare the differences between input and output values, we used the scoring test and Mann-Whitney analysis to compare input values and differences between groups.

3 Results and discussion

At the beginning of the weight loss program, no statistically significant differences were found between the anthropometry indicators in women of both groups ($P > 0.05$).

The implementation of the program led to a statistically significant decrease in these indicators in women of both groups in comparison with the initial data. In particular, body weight indices in all women who took part in the study decreased by an average of 4.37 ± 2.50 kg, BMI - by 1.66 ± 0.94 kg/m², fat mass - by 4.33 ± 2, 31 kg, indicators), visceral fat mass - by 2.43 ± 1.57 kg and waist circumference by 4.27 ± 4.06 cm.

It draws attention to the fact that a decrease in body weight values by 4.37 kg occurred in women of both groups, mainly due to a decrease in fat mass by 4.33 kg. The average body mass without fat did not change.

Comparative analysis of anthropometric indicators observed in women of both groups after completing the weight loss program did not reveal statistically significant differences. It can be concluded that the use of the weight loss program led to the same positive effect in women of both groups, regardless of whether the fat burner was used or not.

There were no statistically significant differences between the baseline values of biochemical parameters observed in women of both groups.

Of the observed biochemical parameters during the experiment, statistically significant changes were observed only in the glycemic value (-0.44 ± 0.52 mmol / l), which we estimate as clinically insignificant. Changes in all other monitored blood biochemical parameters were statistically insignificant.

In particular, fasting insulin values in women in the experimental group increased by 1.38 ± 3.46 mIU / L, while in women in the other group they decreased by 1.65 ± 2.49 mIU / L). A similar picture was observed with respect to other biochemical parameters. In women in the experimental group, the indicators of C-peptide (by 0.05 ± 0.17 nmol), proinsulin (by 0.28 ± 1.21 pmol, FB) and insulin resistance index (by 0.20 ± 0.79 conventional units) increased. In women of the control group, these indicators, on the contrary, decreased: C-peptide - by 0.09 ± 0.14 nmol / l), proinsulin - by 1.26 ± 1.40 pmol / l; FB) and insulin resistance index - by 0.71 ± 0.69 conventional units).

Taking into account the results of biochemical parameters comparative analysis it can be assumed that the use of a food additive had a negative effect on carbohydrate metabolism and worsened insulin resistance.

Although none of the women were under the supervision of a diabetologist prior to the research, one woman in the experimental group and four women in the control group had an insulin resistance index above the upper limit of normal.

After the end of the experiment, four women in the control group showed an improvement in the insulin resistance index, only in one of the studied women there was a shift in the value of the insulin resistance index from the range of normal values to the range of pathological values.

The food supplement we used in our research contains a wide variety of substances that are relatively well documented in the literature. Only with respect to the willow bark extract, in which the active substance is salicin, we did not find any evidence in the literature of its effect on weight loss (a derivative of salicylic acid, salicin, is used as a relatively ineffective substance with analgesic, antipyretic and anti-inflammatory effects).

Conventionally, all fat burners on the modern sports nutrition market can be classified into groups (table 2).

Table 2. Classification of fat burners, taking into account the mechanism of action

Pharmacological group name	Mechanism of pharmacological action
Thermogenics	Increased body temperature, increased metabolism
Lipotropics	Release fatty acids from fat stores, thereby accelerating weight loss
Nutrient blockers	Waging a war on fats and / or carbohydrates that come with food
Appetite blocker	Reduce appetite, help to eat little and not suffer from it. While losing weight, you do not have to suffer looking at the windows of grocery stores
Cortisol blockers	Reduce the release of cortisol, due to which the breakdown of glucose is more active – the waist becomes slimmer before our eyes
Stimulant of thyroid hormone production	Maintains a healthy concentration of T3, a hormone deficient in obesity.

If nutritional supplements contain sufficient amounts of active substances (but often the amount of individual substances in the mixture is below the limit of effectiveness), then even randomized, double-blind trials support their stimulating effects on weight loss and possibly additional health benefits.

For example, in the case of caffeine, which was included in our formulation, we find a number of studies demonstrating its beneficial effects on weight loss by enhancing thermogenesis, fat oxidation and suppression of leptin [1,5]. Most studies agree that drinking coffee and tea has a protective effect on the onset and progression of type 2 diabetes mellitus [6, 7].

Nevertheless, there are literature data that demonstrate a negative effect of caffeine on the maintenance of glycemic homeostasis [9]. These studies build on previous findings that caffeine can worsen insulin resistance by stimulating the production of catecholamines. They increase plasma glucose and free fatty acid levels [10, 11]. For example, the results of a randomized, double-blind study that examined the effect of weekly doses of caffeine (200 mg twice daily) in healthy people showed impairment of peripheral tissue insulin sensitivity [8]. In people with impaired glucose tolerance, postprandial postprandial glucose uptake has been repeatedly demonstrated in combination with caffeine intake compared to placebo [12, 13]. However, it should be noted that the aforementioned work evaluates the effect of the administration of much higher doses of caffeine than was applied in the preparation we used.

Another substance that was most widely represented in our product was carnitine. As with caffeine, research on the effects of carnitine on carbohydrate and lipid metabolism is inconsistent. A recent research [14] showed an improvement in the insulin resistance index in patients with impaired glucose tolerance following a 10-day low-energy diet in combination with a daily dose of 4 g carnitine and did not confirm this effect with a dose of 3 g carnitine per day. The dosage we used was only 800 mg of carnitine per day. Due to the fact that we used commercially available nutritional supplements at the manufacturer's recommended dosage. The other nutrients were also lower than most metabolic studies. We did not find studies in the literature evaluating the combined effect of all substances present in our preparation.

The above results from our study prove that the use of this dietary supplement not only does not increase the effectiveness of a weight loss program but it can also impair carbohydrate metabolism. This conclusion is important mainly because obesity is almost always sooner or later complicated by certain metabolic diseases; in particular, the link between obesity and type 2 diabetes has been proven. Another problem may be that individual food additives contain mixtures of substances, the interaction of which at the given concentrations is not controlled; therefore, their side effects can be unpredictable.

4 Conclusions

Fitness instructors and trainers need to be extremely careful when choosing sports nutrition. In pursuit of a beautiful figure, you can significantly worsen your health. Before taking this or that drug for faster weight loss, you should think about its undesirable consequences. This is only part of a study that has shown a negative effect of a fat burner on carbohydrate metabolism. In the future, the authors plan to continue researching this problem. Moreover, it should be noted that this problem is not only medical and pedagogical, but also commercial in nature. In pursuit of quick profits, pharmaceutical companies can go to any lengths to make a profit.

A randomized double-blind study, which included the appointment of physical exercise and adherence to the principles of dietary nutrition in combination with a dietary supplement (fat burner), did not reveal a significant effect of the drug on changes in fat mass and other anthropometric parameters (weight, BMI, visceral fat and waist circumference).

The dietary supplement, which contained a blend of carnitine, chromium, arginine and guarana, green tea, citrus and willow extract, had a negative effect on glucose metabolism and insulin resistance. We attribute this result to the presence of caffeine and an especially inappropriate combination of substances in the mixture. This fact should not be underestimated also because some of our probands already had insulin resistance in accordance with the insulin resistance index. We urge caution when using nutritional supplements containing plant extracts, the interaction of which can be unpredictable.

References

1. S.V. Shterman, M.Yu. Sidorenko, V.S. Shterman, Yu.I. Sidorenko, *Food industry*, **6**, 66-72 (2018)
2. E.V. Manuilenko, AV. Izvarina, *Current problems in the field of physical culture and sports*, 217-220 (2018)
3. N.M. Popova, R.R. Badakhshina, A.K. Kuz'minykh, *Capital of Science*, **4(21)**, 157-163 (2020)
4. S. Hasani-Ranjbar, N. Nayebi, B. Larijani et al. *World J Gastroenterol*, **15**, 307303085 (2009)
5. M.S. Westerterp-Plantenga, M.P. Lejeune, E.M. Kovacs, *Obesity Research*, **3**, 1195-1204 (2005)
6. K. Kempf, C.H. Herder, I. Erlund, et al. *Am J Clin Nutr*, **91**, 950-957 (2010)
7. G.D. Pimentel, J.C. Zemdegs, J.A. Theodoro, et al. *Diabetology & Metabolic Syndrome*. 1-6 (2009)
8. T. MacKenzie, R. Comi, P. Sluss, et al. *Metabolism*. **56(12)**, 1694–1698 (2007)
9. L.L. Moisey, S. Kacker, A.C. Bickerton, et al. *Am J Clin Nutr*, **87**, 1254-1261 (2008)
10. G.B. Keijzers, B.E. De Galan, C.J. Tack, et al. *Diabetes Care*. **25**, 364-369 (2002)
11. F.S. Thong, T.E. Graham, *J Appl Physiol*, **92**, 2347-2352 (2002)
12. J.D. Lane, M.N. Feinglos, R.S. Surwit. *Diabetes Care*. **31**, 221-222 (2007)
13. J.D. Lane, A.L. Hwang, M.N. Feinglos, et al. *Endocr Pract*, **13**, 239-243 (2007)
14. A. Molfino, A. Cascino, C. Conte, C. Ramaccini, et al. *Journal of parenteral and enteral nutrition*. **34**, 295–299 (2010)
15. J.A. Kanis, *On Behalf of the WHO Scientific Group. Assessment of Osteoporosis at the Primary Health-Care Level. Technical Report* (WHO Collaborating Centre, University of Sheffield, UK, 2008)
16. S.M. Hosking, A.G. Dobbins, J.A. Pasco, Sh.L. Brennan, *BMC Research Notes*, **8** (2015)
17. A.S. Kuznetsov, Z.M. Kuznetsova, *Russian Journal of Physical Education and Sport*, **14(4)**, 5-7 (2019)